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Evaluation of the Brazilian Agrarian Reform Objective: Agricultural Production Yield Change

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Abstract

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MHum, Wright State University, 2008

MA, University of Arizona, 1999

BA, University of Redlands, 1997

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

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Abstract

Brazil has an active agrarian reform policy program, publicly organized by the federal government and publicly administered at the state level by the National Institute for Colonization and Agrarian Reform. The objective of the agrarian reform policy program is to retitle unproductive and underproductive rural lands to increase agricultural production and land use. Previous agrarian reform researchers have examined quantities of land redistributed, rural technology developments, and the impact of social movements on land redistribution. A knowledge gap remains regarding the quantitative correlation of agricultural production yields in rural municipalities before and after policy program participation. The State of Ceará has undertaken continuous land redistribution efforts between 1975 and 2006. For this longitudinal, quantitative study, an agricultural production yield *t*-test analysis was conducted for the Brazilian State of Ceará with the marked time-series data collection for 1990, 1996, 2000, and 2006. The correlated analysis was organized by group: municipalities with a high-rate of agrarian reform participation and municipalities with a no-rate level of agrarian reform participation. By marking the point of program participation at 1996, the time-series *t*-test identified marked agricultural production increases as correlated to agrarian reform policy program participation. The research and evaluation of the agrarian reform policy program used publicly available, secondary data from the Government of Brazil's Brazilian Institute of Geography and Statistics and the National Institute of Colonization and Agrarian Reform. The results can be used to justify agrarian reform programs, to promote further rural infrastructure development, and to support poverty alleviation efforts.

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Chapter 1: Introduction to the Study

Introduction

Inequitable land distribution has been a prevalent problem in Brazil since the arrival of the Portuguese in 1500. In the later part of the military dictatorship, Brazil had a political opening beginning in 1975, allowing for peasants to organize and occupy land. This opening was followed by a new constitution and nascent democratic reforms in 1984. More structured agrarian reform policy efforts were consolidated under the *Gabinete do Ministro Extraordinário de Política Fundiária e do Desenvolvimento Agrária* (Ministry of Agrarian Development [MDA]), a cabinet-level ministry for agricultural development in Brazil (Rodriguez, 2004). The Ministry included the administration of the *Instituto Nacional de Colonização e Reforma Agrária* (National Institute of Colonization and Agrarian Reform [INCRA]), as a federal initiative to drive state-level land redistribution and further agricultural policy (Rodriguez, 2004).

For more than 50 years throughout the Fernando Henrique Cardoso, Lula da Silva, and Dilma Rousseff administrations, agrarian reform efforts in Brazil have included significant land retitlements policies and efforts, and will continue "as a matter of national security" (Lambais, 2008, p. 7). Brazil continues to make land redistribution efforts, as arable land inequality remains with over half of the arable land held by just 2 percent of the population ("Brazilian President Promises," 2011). Enduring land concentration has originated from colonial development and agribusiness booms throughout Brazil's history; however, with continuous focus on agrarian development and land productivity, Brazilian leaders sees land redistribution as "necessary to build a

country with justice, food security, and peace" (President Dilma Rousseff, quoted in "Brazilian President Promises," 2011).

Agrarian reform policy programs maintain the objective of increasing land use, specifically targeting agricultural production yield increases for underproductive or unproductive land on newly redistributed land parcels or for new land uses on existing land parcels (Barbier, 2000). INCRA and the World Bank support land redistribution for the increase of agricultural production for poverty alleviation, food security, and rural development. To review the agrarian reform program and evaluate if there was a correlated change of agricultural production yields to those areas with high or no participation in the agrarian reform program, I conducted a time-series paired-samples *t*-test analysis of four collection periods for selected municipalities in the State of Ceará. In this quantitative, secondary data research study, based in policy feedback theory (PFT), I further contextualized research and analysis of production yields through purposeful sampling and analysis to validate if the agrarian reform policy program increased land productivity. The greater implication of this research study is that in this evaluation of the agrarian reform policy program, I have identified whether the program organization and execution may be a repeatable process for other agriculture based nation states to meet sustainable livelihood goals.

Background of the Problem

Agrarian reform is a politically stimulated policy program that "affects the extent to which agricultural systems are transformed, the degree of productivity increase and the extent of economic growth that will benefit the poor" (Adams, 2004, p. 5). Brazil defines

agrarian reform policy through Federal Decrees 7280 and 7.255, requiring the federal agrarian reform policy program to redistribute unproductive or underproductive land for social benefit and new use (Planalto, n.d.; Rodriguez, 2004). Theorists such as Cline (1969) have postulated that the division of large land parcels would increase agricultural capacity of the rural areas (Adams, 1973). Agrarian reform is financed through an annual federal budget program of US$90 million, with external support of US$20 billion in International Bank for Reconstruction and Development (IBRD) loans from the World Bank. Although the fiscal efforts for agrarian reform are maintained, there is a lack of research on the areas with a high rate of redistributed land through the agrarian reform policy program to demonstrate agricultural production change, new social use of land, or agrarian changes in support of the World Bank's continued grants and IBRD loans as a means to alleviate poverty (Pereira, 2007).

Theorists opposing agrarian reform argue that the policy program results in an agricultural production decrease due to loss of technical production efficiencies when land is redistributed into smaller parcels and to rural workers (Cline, 1969). Researchers supporting agrarian reform have examined quantities of land redistributed (Ondetti, 2007), rural technology developments (Lambais, de Magalhães, & da Silveira, 2014), impact of social movements on land redistribution (de Medeiros, 2007), and quality of life improvements (Sparovek & Maule, 2007) without evaluating if the program objective of increasing agricultural production has been met. To address the program objective, I designed this study as a public policy and administration evaluation to identify if redistribution of land was correlated to the increase of agricultural productivity within the

State of Ceará (see Frechtling, Frierson, Hood, & Hughes, 2002). A problem with the agrarian reform policy program remains in that the lack of evaluation has negatively impacted validation of the program to determine if the program objective has been met and if federal and international support should continue. Thus, I quantitatively investigated lands redistributed though the National Agrarian Reform Program in the State of Ceará, Brazil to compare agricultural production yields in pre- and postagrarian reform periods for purposefully selected policy program participant municipalities in order to identify if the agrarian reform objective was met.

Historical Background: Brazilian Agrarian Reform

Brazil is the fifth largest nation by area in the world and continues to encounter land ownership and labor issues. Efforts to use all potential land dates back to the 1800s when emancipated slaves, working as land laborers, negotiated with large landowners to segment land between coffee crops for subsistence and local market crop production (Welch & Sauer, 2015). A formal shift in recognizing the need for land rights and productivity reform began in 1850 with Law 601, which gave *de jure* status to *de facto* holdings, requiring formal process and payment for the acquisition of land (Albertus, Brambor, & Ceneviva, 2013). The 1934 Constitution identified the need for land to maintain social welfare and rural, agricultural function; however, government and social efforts in the area of land reform and policy changes were not at the forefront until the 1950s.

Land inequality and social justice issues were pushed into the forefront starting in 1949 as the Communist Party founded the newspaper *Nossa Terra,* identifying agrarian

disparity and land rights issues in Brazil (Welch & Sauer, 2015). Additional socially focused efforts included the "Congress for the Salvation of the Northeast" in 1955, which brought federal focus to Northeast region development objectives, although the efforts were met with criticism and skepticism (Welch & Sauer, 2015). In 1963, Congress approved Brazil's first comprehensive rural labor law, the Rural Labor Statute, and the *Confederação Nacional dos Trabalhadores na Agricultura* (National Confederation of Workers in Agriculture [CONTAG]) was established to support legal standards for rural labor (Welch & Sauer, 2015). The legal standards created a secondary effect, eliminating millions of small farms under the standard shift from "social welfare" to "social function," which consolidated landholdings for agribusiness efforts (Welch & Sauer, 2015, p. 7).

The objective of agrarian reform, called for by the *Ligas Camponesas no Nordeste* in 1964, required better distribution of land and improved access to food (Holanda Almeida, Chagas, & Araujo, 2015). The support for Latin American agrarian reform also came during the Alliance for Progress, which promoted efforts to pacify the rural areas and minimize rural, armed rebellion (Martins, 2006). Continuing through 1964, the João Goulart administration focused on agrarian reform as a means of diversifying agribusiness, furthering the rural agricultural industry and capital base (Martins, 2006).

An administrative result of these requests initiatives included Law 4.504, creating the Brazilian Institute of Agrarian Reform (IBRA) in 1964 and the National Institute of Agrarian Development (INDA) in 1970, establishing an executive function and

organizational framework for agrarian reform policy program efforts (Holanda et al., 2015). INCRA was created in 1970 through Decree No. 1.110 to replace IBRA and INDA. Additional legislation to enforce the regulation of land to fulfill social function continued through the 1970s, and the 1985 National Land Reform Law 91766 initiated the formal reordering of the rural territories (Walkowski, Oliveira, Boneli Vieira & Loch, 2014).

The José Sarney administration, the first democratically elected administration after military dictatorship, advocated dramatic changes and the formation of the first National Agrarian Reform Plan (Welch & Sauer, 2015). The policy was originally entitled "Land Statute," and had the quantitative objective of settling 1.4 million families over a 4-year period. As an amendment within the 1988 Constitution, the popular "People's Amendment" was adapted and secured as the agrarian reform policy amendment (Welch & Sauer, 2015). The subsequent shift in the 1990s brought focus to small production, small farms, and rural workers, aligned to the Food and Agricultural Organization (FAO)-derived agrarian definitions; however, the shift in terminology also shifted some focus away from the national effort of agrarian reform and refocused efforts on agriculture production (Welch & Sauer, 2015).

Agribusiness boomed with the 15.8 million hectare expansion of soybean and sugarcane crops, with continuous growth each year between 1990 and 2001, which advanced soybean production to over 25 percent of the agricultural GDP (Miccolis, Andrade, & Pacheco, 2014). The expansion created an additional focus on large agribusiness and market decrease of the traditional export crops of coffee, rubber, and

sugar. Subsistence crops continued to include rice, beans, and yucca, despite administrative programs facilitating agricultural workers' exoduses from the rural lands, such as Vargas' "March to the West" campaign (Miccolis et al., 2014). Large landholdings are the only viable land parcels that can support the export crop efforts; however, the effort to increase productivity of all agricultural land requires redistribution of underproductive or unproductive land for new land uses (Campelo, 2014). The shift to increased agricultural productivity occurred under the Cardoso administration, whose agrarian reform is referred to as the largest agrarian reform in world history (Ondetti, 2007).

Twelve Latin American nations have attempted national land reforms. Early agrarian reform efforts include land acquisition and federal land redistribution like those efforts in Guatemala (1944–1954) before a government change in administration and repeal of policy efforts (Harbour, 2008). Bolivia is one nation with an ongoing effort comparable in length to Brazil's. The greatest limitation to agrarian reform efforts in Latin America derives from political restrictions and changes in federal administration, resulting in restricted agrarian reform policy program efforts or an abandonment of the program, as has been the case in Chile, Colombia, Mexico, Nicaragua, and Venezuela. Brazil has remained the most consistent in its agrarian reform policy program efforts, structuring and publicly administering agrarian reform as a family farm and agricultural policy to assess, acquire, and redistribute land (de Medeiros, 2007).

Since 2003, INCRA has been the organization responsible for the acquisition and titling of land, even though four evolutions of the National Agrarian Reform Program

have occurred since 1997 and include other agrarian reform efforts over the previous decades (Penna & Rosa, 2015; Sparovek & Maule, 2007). The continuous development and support of agrarian reform policy program efforts has made Brazil's agrarian reform efforts the longest lasting and most comprehensive worldwide (Sparovek & Maule, 2007). These varied efforts include three initiatives for public purchase of private land for redistribution under the Land Bank structure, a National Program for Agrarian Credit (PNCF), and continuous efforts under complementary legislation, such as Law 93, which funded the acquisition of land for rural farmers with limited access to land (Pereira, 2007; Pereira & Sauer, 2011; Walkowski et al., 2014). Multiple program efforts regarding plans, reforms, and programs; these programs include: (a) the National Agrarian Reform Plan I and II, (b) Brazilian Negotiated Agrarian Reform (NAR), (c) National Program for Family Agriculture, (d) National Program for Agrarian Credit (PNCF), (e) Cédula da Terra (Land Bank), (f) Agriculture and Rural Policy Commission (CAPR), (g) Structural Adjustment Program (SAPS), (h) Market-Led Agrarian Reform (MLAR), and (i) State-Led Agrarian Reform (SLAR).

Prior to the 1996/1997 World Bank investment, INCRA and FAO supported a technical cooperative project to demonstrate the need for agrarian support of family-based farms in the Brazilian Institute of Geography and Statistics (IBGE) Census of Agriculture data for the 1995/1996 period (Bolliger & Oliveira, 2010). The São Jose Project under the World Bank was ratified in 1996 and implemented in 1997 to support agrarian reform efforts in the Northeast (World Bank, 2003). Agrarian reform most greatly affects the North and Northeast regions of Brazil, as colonization and settlement

projects created a disparate infrastructure in the a harsh, drought stricken climate that must continue to change in order to increase the Human Development Index for rural laborers. Overall, Brazil remains defined as a country with an unequal distribution of land due to a 0.8 Gini coefficient, which is further magnified by the unequitable distribution of land in the Northeast and the limited quantity of arable land for small farm or cooperative use efforts (Binswanger & Deininger, 1997; Finan & Nelson, 2001).

Land reform has targeted only a small segment of the Brazilian environment, with less than one-third of the rural territories affected by land reform, resulting in only 4 percent of municipalities redistributing land (Albertus, Brambor, Ceneviva, 2013). Graeub, Chappell, Wittman, Ledermann, Kerr, and Gemmill-Herren (2015) have noted that the redistribution numbers continue to decrease, and efforts to resettle 100,000 families in 2005 decreased to only 4,842 families resettled in 2012. INCRA continues to encounter budget constraints with a significant external funding dependency on the World Bank. Despite challenges, efforts continue to maximize land use and support social change initiatives, including rural infrastructure and support of market access for sustainable livelihoods (Graeub, Chappell, Wittman, Ledermann, Kerr, & Gemmill-Herren, 2015).

Programs Affecting Agricultural Production

INCRA

INCRA was created in 1970 through Decree No. 1.110, replacing the IBRA and the INDA (Holanda et al., 2015). INCRA was established as a federal-level solution in response to the social need to address inequalities in land distribution and assist in

subsistence agriculture at the state level (Rodriguez, 2004). The INCRA mission is to implement the agrarian reform policy and support the national agrarian plan for contributing to and developing a sustainable rural environment (INCRA, 2011). The future vision of INCRA is to be an international solutions reference for agrarian reform and social inclusion (INCRA, 2011). In practice, agrarian reform under the administration of INCRA includes the democratic redistribution of land structures, production of basic foodstuffs, development of land settlement, combating of hunger and misery, development of basic public services, reduction of rural emigration, promotion of citizenry and social justice, diversification of commerce, and development of democratic power structures (INCRA, n.d.a; INCRA, n.d.b).

Given that INCRA is an established government organization, it administers land reform to promote and enact means to distribute land equitably for rural development and to empower society. INCRA (a) categorizes land as underproductive or unproductive; identifies land for redistribution; (b) programs international funds for purchase of private land holdings with low-rate mortgages for new land owners; (c) identifies individuals, families, and organizations to receive land title through redistribution; and (d) processes all land title proceedings (INCRA, 2015; Kwader, 1999). INCRA functions as the executive agent for the agrarian reform program, integrating federal program design and function at the state level. Land retitlement applications are often contested by large landowners while supported by social movements, a juxtaposition that requires INCRA to remain neutral as public administrators and maintain objectivity in processing land

requests while subjectively understanding the ethical effects of providing land for new agricultural and social functions (Cooper, 2012).

From 1985 to 1997, INCRA-based agrarian reform fell under the National Agrarian Reform Plan (PNRA; Heredia, Medeiros, Palmeira, Cintrão, & Leite, 2013). In 1995, President Fernando Henrique Cardoso decentralized the agrarian reform policy to allow for land retitlement at the state-level program offices under INCRA better to enable sustainable agricultural processes and development in Brazil (Rodriguez, 2004). In 2003, INCRA became the sole government organization responsible for land acquisition and titling (Penna & Rosa, 2015). According to Rodriguez's (2004), INCRA is the key to the agrarian reform policy program as these offices enact national policy at the local and state level to transform the policy into action.

Within the acquisition of land, the Brazilian government identifies the original owner, new owner, land type, land size, and determined productivity of the land (INCRA, 2012b). A repository of the data is maintained in a spreadsheet-based custom system for data review and web posting by INCRA (Government Finance Officers Association, 2006; INCRA, 2012b). The publicly available data are valuable for measures of performance, and for calculation of performance effectiveness per locale and region; the data do not provide information regarding the value of the land during acquisition or transfer, nor do they provide information regarding departmental processing costs for the program.

Through the federal budget process, international support of the World Bank, and deliberate organizational processes, INCRA is the executive organization supporting the

agrarian reform policy to achieve a sustainable, rural environment (INCRA, 2012a). The federal budget process identifies agrarian reform and INCRA as two programmed areas, ensuring continued support and review of the processes (República Federativa do Brasil, 2012). The World Bank continues to provide international loans and access to funding for capital improvement programs (World Bank, n.d.). Although INCRA and the Brazilian government receive external funding, the state bears the burden of processing land titles, management of the INCRA state offices, support of technical associations, and community development, including infrastructure and education (República Federativa do Brasil, 2012). Forty percent of the agrarian reform policy program efforts are executed at the state level, with the federal government wholly supporting the community-associated projects for technology, infrastructure, and education (World Bank, 2003). Families receiving land titles through INCRA processes are defined as *emancipated* upon implementation of rural infrastructure that ensures self-sustainment capability (Lambais et al., 2014). The benefits of the INCRA processes and budget include economic stimulus for familial farms, rural communities, and local markets, the decrease of rural unemployment and urban migration, and increasing longevity of the land and community.

INCRA offices are assigned to the states, and the amount of reporting from each office fluctuates; as such, in this study I focused on the State of Ceará INCRA office, an office with a high level of participation in the community regarding agricultural issues. The INCRA office is active within the State of Ceará due to recurrent drought, the low level of livelihoods due to lower agricultural production rates, divided land holdings, and

low rural employment rates (IBGE, 2007). Agrarian reform policy program support extends from initial agrarian reform research by Cline (1969) to continuous international funding efforts and evaluations of programmatic measures of success (World Bank, 2003). Previous researchers have reviewed policies and the formation of new agrarian reform programs; however, no researcher has correlated the agrarian reform policy program with the productivity and function of land. Although an agrarian reform policy program cannot guarantee equitable distribution of land or an increase in agrarian productivity, a program evaluation correlating agricultural production yields may indicate how Brazil's agrarian reform policy structure can serve as an example of socially responsible agrarian reform policy for furthering modeling (Frechtling et al., 2002).

World Bank

The World Bank (1975) identified a rural development policy need and hypothesized an agrarian reform social change benefit over four decades ago. The World Bank continues to serve as the primary financial institution supporting rural development efforts within Brazil, supported and executed by the Government of Brazil. One major project includes the São Jose Project in 1996, implemented in the State of Ceará in 1997. Because of the ongoing efforts, the World Bank (2003) evaluates agrarian reform program efforts for sustainability and performance, as associated with family settlement on land and repayment capabilities. The financial support empowers land purchase and offsets INCRA's operational costs (Mikesell, 2013). As of 2009, "no other country had contracted with the World Bank's International Reconstruction and Development Bank

(IRDB) to borrow such a high volume of loans to finance programmes of land purchases and sales" (Sauer, 2009, p. 127).

Providing US$20 billion to Brazil, the World Bank IRDB loans support public works projects to develop infrastructure and sustainable communities in the rural areas (World Bank, n.d.). The international financial support is fundamental to INCRA, as the rural microloans enable farmers to pay for the retitled land parcels, which supports the federal-level policy program and the state-led execution of agrarian reform. The international impact of the Brazilian agrarian reform includes support for an expanded agricultural production base, enabling small farms to provide agricultural yields to local markets with medium to large farms supporting external, export-oriented markets (Lambais, 2008). The World Bank investment also provides international oversight and promotes awareness of the INCRA processes to support agrarian reform through stable financing for routine, equitable land redistribution (World Bank, n.d.).

Researchers such as Cline (1969) have postulated that the division of large land parcels would increase agricultural capacity of the rural areas (Adams, 1973). I selected the State of Ceará for this study because of concentrated effort by Brazil and the international community to review and address rural land inequalities and agricultural production capabilities within the Northeast region since the mid-1970s (World Bank, 1975). Since 2000, the World Bank has provided international funding in support of rural development, agrarian reform initiatives, and agricultural community development (World Bank, 2003). Unfortunately, the World Bank (2003) evaluation of the agricultural production yield regression has only been conducted in 2-year increments for

108 surveyed households, and there is not a more comprehensive assessment of the area. In this research study, I correlated lands with high and no rates of redistribution within the State of Ceará, a focus area of Brazilian agrarian reform and World Bank project efforts, which provided a specific regional sampling to test the extent of agricultural productivity changes as a result of the agrarian reform policy program (Rodriguez, 2004).

State-led agrarian reform policy efforts are financed by an annual federal budget program of US$90 million, with external support of $US20 billion in IRDB loans from the World Bank. Although the fiscal efforts for agrarian reform have been maintained, there is a lack of comparative research within rural territories to demonstrate agricultural production change justifying continued support of World Bank grants and IRDB loans (Pereira, 2007). Brazilian federal fiscal planning for agrarian reform allocates funds for PROCERA, a special credit program that enables rural, agricultural workers to finance the purchase of land from INCRA (Lambais, 2008). The greatest fiscal support of the Brazilian mandate, however, remains external to the federal and state budgetary processes. IRDB loans total an estimated US$2.5 million (2011) for public projects at defined rates (World Bank, n.d.). In addition, the international investment in agrarian reform allows for a third-party oversight for land distribution (i.e., title guarantee), stable financing, and support of family farming initiatives, which is viewed by the World Bank as more productive because small farms support more equitable land disbursement, furthering diversification (World Bank, n.d.).

The community Land Reform and Poverty Alleviation Pilot Project, also known as the São Jose Project, in Brazil was funded by the World Bank and implemented in

1997 for a six-year period. It had the following objectives: (a) management of unproductive or underproductive land, (b) community development and engagement for rural development, and (c) infrastructural development for rural territories (World Bank, 2003). The World Bank's budget review included principal performance evaluation of satisfactory outcomes from the pilot project, sustainability projections of continued agrarian reform, and forecast of program impact in converting rural territories (GFOA, n.d.; World Bank, 2003). The World Bank budget review included performance measures for program evaluation consideration to support decision making efforts for the Federal Republic of Brazil and the World Bank (2003; GFOA, n.d.).

The World Bank (2003) documentation identifies the loan as supporting 60 percent of the total project cost, with the Federal Republic of Brazil financing 40 percent of the project and financing 100 percent of community association projects. The components of the programmed efforts targeted the rural, agricultural needs of the Northeast region, including the states of Bahia, Ceará, Maranhão, Pernambuco, and Minas Gerais (GFOA, n.d.; World Bank, 2003). The project was evaluated by the World Bank division as one of the region's most progressive programs and an exemplar of best practices that could be used as a future guide for rural, agricultural development (GFOA, n.d.; World Bank, 2003). The shift to the loan model for rural agricultural development came in the early 1990s, driving new program priorities and causing the World Bank to refocus on land policies as a systemic cause for rural poverty, rural unemployment, and rural emigration (GFOA, n.d.; World Bank, 2003). The new program, evaluated in 2003, identified a fiscal incentive for maintaining the program as the annual gross income

increased 116 percent, reduced labor efforts on other land parcels by 20 percent, and increased agricultural production of the land by 204 percent, demonstrating a sustainable, successful methodology for implementing agrarian reform policy for the benefit of social change (World Bank, 2003).

Social Change Implications of Agrarian Reform

Poverty Alleviation and Sustainable Food Effort

The World Bank has made investments in Brazilian land reform and rural development targeting alleviation of poverty and increased rural land use in the Northeast region through development loans of up to US$200 million (Pereira, 2007; Sauer 2006, 2013; World Bank, 1975, 2003). Although the World Bank has aggressive land reform programs in Brazil, the Philippines, and South Africa, Brazil has received the largest amount of World Bank financing for the purchase and sale of land worldwide (Patel, 2006; Sauer, 2013; World Bank, 2003). The World Bank investments support placement of families, land retitlement, community development, and subsistence farming to ensure satisfactory program evaluations of Bank and borrower performance (Sparovek & Maule, 2007; World Bank, 2003). Sparovek and Maule's (2007) research complements the World Bank's (2003) evaluations of financial support for agrarian reform, as the researchers provided the first evaluation of increasing subsistence farming for increased livelihood and sustainable food endeavors, which they identified as results of the national agrarian reform policy programs.

Bolliger and Oliveira (2010) identified 92 percent of Brazil's 5.2 million farms as family farms, traditionally small and subsistence-focused with less market orientation.

Family farms constitute less than 18 percent of the land in Brazil, producing 9 percent of the GDP and 32 percent of the national agricultural GDP (Berry & Cline, 1979; Miccolis et al., 2014). The family farm value of productivity at a national level can be deceptive, as the criteria for family farms can include farming efforts up to 200 hectares, a land size that is not the traditional focus of INCRA land retitlement and agrarian reform efforts. The transfer of land title for small family farms enables rural development in the areas of credit market access, new income, financial security, and investment assets at a small farm level, traditionally less than 20 hectares (Cotula, Quan, Toulmin, & Quan, 2006; Assunção, 2008; Coudouel & Paternostro, 2005).

The security of land for income and sustainable livelihoods is a critical item for rural agricultural workers, as the 1991 social security reform created a two-part payroll tax increase equivalent to a 55 percent tax increase on the pay for corn production laborers (Edwards, 2000). Rural agricultural laborers constitute one of the most vulnerable social groups in Brazil because of employment fluctuations and potential displacement if labored land is redistributed, or if cost point is insufficient to maintain land laborers (Coudouel & Paternostro, 2005). Individual land title allows for increased familial productivity, commoditization, and access to programs, supplying a socio-economically productive environment to alleviate poverty, increase employment, and increase food security (Cotula, Quan, Toulmin, & Quan, 2006; Rios, Shively, & Masters, 2009).

Agrarian reform policy program objectives seek a shift of land use for sustainable food production, support of domestic markets, and diversification of agricultural

production, which requires greater equality of land ownership (Deininger & Feder, 2001). Indicators of poverty include the cost of food in relation to income, average life expectancy, and human capital investment (Valdes, 2000). As researchers have shown, these indicators of poverty are exacerbated within rural agricultural communities, and additional inadequacies remain in health care, education, technical assistance, infrastructure, and other social services for remote areas benefiting from agrarian reform (Heredia, Medeiros, Palmeira, Cintrão, & Leite, 2006; Korzeniewicz, 2000; Stavenhagen, 2006).

To augment government program support, the *Movimento dos Trabalhadores Rurais Sem Terra* (Landless Workers' Movement [MST]) works with rural laborers petitioning for land title, provides training for the development of new skills, and supports a two-phase settlement process to ensure that rural laborers can transform the unproductive land and are settled on the land for long-term development (Rosset, 2006). In addition, the MST has a two-year school for vocational, agricultural training, which is accredited by the Ministry of Education and recognized by UNICEF in 1995 for supporting 35,000 students and 1,400 teachers (Martins, 2006). The World Bank supports community development programs through fiscal support of INCRA, enabling additional technical assistance training as part of the National Plan (INCRA, 2011; República Federativa do Brasil, 2014). However, current efforts in education and training for the rural labor force are inconsistent throughout Brazil, especially because of the reduction of budgets, variation of education and training providers, regional differences in training, and limited access for training in rural areas (INCRA, 2011).

Rural Development

Agrarian reform policy efforts have influenced Latin American rural development and agricultural credit for small farmers, and provided social benefits for youth, women, and under-represented persons in the rural communities (Schneider, 2010). Using family farming models (1900–1970) as the grounds for research into sustainability, the World Bank (1975) report and associated comprehensive policy program spurred policy program efforts for rural development (Campelo, 2014). The initial research and policy programs focused on alleviating chronic underemployment and the underutilization of farmland, and promoting sustainable labor standards as a means to increase productivity and quality of life (De Schutter, 2012; Rosset, 2006). The agrarian reform efforts thus tackled rural instability issues related to land tenure, public resources, and settlement efforts for agrarian and agricultural infrastructure development (Lopez & Valdes, 2000).

Since the 1990s, agrarian and agricultural policy efforts have remained in development programs and support national security objectives (Schneider, 2010). Land retitlement also enables rural development in the areas of credit market access, new income, financial security, and investment assets (Assunção, 2008; Cotula et al., 2006; Coudouel & Paternostro, 2005). Rural development challenges include infrastructure, technology, and the environment. Previous researchers have claimed that land reform provides minimal benefits for agribusiness (Abbey, Baer, & Filizzola, 2006); however, while agrarian reform can serve as the catalyst in changing unproductive or underproductive land by diversifying crops and increasing production yields, the evaluation of smaller crop efforts or subsistence farming has not been conducted within

this context. Alves, Figueiredo, and Bonjour (2009) conducted an evaluation of Mato Grosso's implementation of the agrarian reform policy program to demonstrate changes within small agribusiness, rural infrastructure, and agricultural production, supporting a state-case model for a longitudinal study of policy implementation.

Rural development, to increase new production of agricultural goods, requires critical infrastructure including roads, electricity, and telecommunications (Binswanger & Deininger, 1997; Lopez & Valdes, 2000). As of the 2003 World Bank assessment, 93 percent of agrarian settlers' dwellings had cement flooring, 67 percent had sanitation, and 84 percent had electricity in communal areas, while only 50 percent of the rural areas in general have access to electricity (Valdes, 2000). To support rural development, the World Bank São Jose Project in the State of Ceará provided US$70 million in agricultural investments for rural producers, US$50 million for infrastructure development and delivery of potable water and sanitation services, and US$23 million for institutional strengthening to support public administration and technical assistance efforts and the deployment of additional sustainable irrigation technologies (World Bank, 2015). Without the continued development of the rural area and its infrastructure, new and increased agricultural production and uses of land for social function will not be viable. Access to the rural land parcels will be minimally successful and crops to market will remain limited without appropriate infrastructure.

Completion of the retitlement process governed by the agrarian reform policy program averages 17 months, and production can require a five-year period for instantiated agricultural production (de Medeiros, 2007). The serial evaluation of the 10-

year census data, intermittent with municipal agricultural production data, is appropriate for a policy program analysis to capture the regression and variation of agricultural crops. The change within performance indicators of crop production and the context of policy program participation and public administration provided the basis for this longitudinal, correlation research study using PFT analysis.

Research Questions

To provide sufficient data for paired-samples *t* testing to identify change in agricultural production before and after agrarian policy program participation, I used secondary data to identify municipalities with high policy program participation and municipalities with no policy program participation, the nominal independent variable. Agricultural production yields, the dependent variable, for each of the sampled municipalities was collected in a ratio scale for four collection periods, two prepolicy collections and two postpolicy collections. The production yields for each municipality consisted of production yields for seven crops. I measured these production yields in the State of Ceará using a method of univariate regression analysis in a quasi-experimental, repeated measures (time-series) design to demonstrate statistical, linear variation. I then analyzed production yields to report changes in agricultural yield for the researched, rural municipalities in the State of Ceará.

Given samples of multiple rural populations (<20,000 persons) from the State of Ceará, Brazil with unequal variances in agricultural production yields, the null hypothesis $\mu 1$ (mean of an agricultural production in an area postpolicy program participation) = $\mu 2$ (mean of an agricultural production in an area prepolicy program participation) was

tested using the *t* statistic using the preprogram and postprogram samples in repeated measures for the municipalities with a high rate of policy program participation (Group 1), and the municipalities with no policy program participation (Group 2).

$$t = \frac{\overline{X_D} - \mu_0}{s_D/\sqrt{n}}$$

$$\alpha = .05$$

The null hypothesis and hypotheses are:

H0: µ1 = µ2. The national agrarian reform policy program executed in Ceará, Brazil provides no mean increase or a negative change in a mean agricultural production yield (µ1, µ2) measured over the time series for all policy program participants (µ1, µ2) of the sampled rural municipalities.

H1: µ1(0.05) > µ2. The national agrarian reform policy program executed in Ceará, Brazil affected a mean agricultural production yield increase by 5 percent greater in program participant municipalities over the time-series period.

H2: µ1(0.02) > µ2. The national agrarian reform policy program executed in Ceará, Brazil affected a mean agricultural production yield increase by 2 percent greater in program participant municipalities over the time-series period, which may include increase of new crop production types.

Purpose of the Study

The purpose of this quantitative correlational study was to investigate the relationship of lands redistributed in the State of Ceará, Brazil in the context of agricultural production yields before and after agrarian reform policy program

participation. The significance of the land redistribution to agricultural production yield is that it may define the level of agrarian reform policy program achievement in meeting the national objective of retitling land to increase rural land use.

Theoretical Framework

The theoretical basis for the research study is PFT, which I used to contextualize research and analysis of paired-samples *t* tests. PFT enabled me to review agrarian reform policy program data with historical awareness in order to develop analytic models to correlate agricultural production yields before and after policy program participation for rural municipalities with a high frequency of land retitlement (Sabatier & Weible, 2014). Additional sampling of no-participation municipalities enabled an analytic review to compare the two groups. PFT is a justifiable theoretical framework given that previous researchers have used combination techniques, using large data sets for statistical analysis to define causal relationships (Sabatier & Weible, 2014). For this longitudinal study, I sought to identify the causal relationship of agricultural production to areas with a high rate or no rate of agrarian reform policy program participation in the rural municipalities of the State of Ceará (Sabatier & Weible, 2014). Mettler and Welch (2001) used a similar two-stage model of correlated data sampling and PFT, as I have done in this study, to identify increased participation in their research.

Cline (1969) provided the first forecast to identify agrarian reform benefits, and showed that new agrarian structures implemented to increase small farms would result in an increase in agricultural production yields. In the first evaluation of these structures in Brazil, researchers identified a marked agricultural production increase of up to 80

percent in the Northeast, dwarfing original estimates of 25 percent (Berry & Cline, 1979). Additional assessments of agricultural production change rates in the context of agrarian policy administration are limited. The Fayaz, Jan, Jan, and Hussain (2006) model for *t*-test sampling of a rural agricultural credit program and agricultural production yields was harnessed to evaluate the Brazilian agrarian reform policy program. I discuss the theories and models for PFT, social conflict, agrarian reform, and public administration in greater detail in Chapter 2.

The primary evaluation methodology included paired-samples *t* testing to examine the correlation of agrarian reform program participation in changing agricultural production yields within the rural municipalities of Ceará. The paired *t* test compared crop production of rural municipalities with a high-participation rate with that of municipalities with a no rate of participation. The comparison data demonstrated comparative values. Further enhancing these methodologies, I conducted the comparison for the selected municipalities using a times-series design. The technique enabled further comparative review of agricultural production over time with a marked program participation point of 1996, a year identified for maximum redistribution of land parcels, agricultural census data, and the fact that it was prior to the execution of the World Bank São Jose Project. The methodologies and models for *t*-test design and construct for the research study are discussed in greater detail in Chapter 3.

Nature of the Study

In this quantitative study, I compared the causality of agrarian reform to agricultural production before and after agrarian policy program participation. To

correlate the causality, I applied a paired-samples *t* test to the hypotheses and null hypothesis. To identify the appropriate land areas for data collection on agricultural production yields, I used a cross-sectional research design for initial identification of municipalities and traditional crops across the rural region. A cross-sectional design provided a means to provide descriptive causation from large secondary data sets, dispersed subject sets, and for multiple variables (see O'Sullivan, Rassel, & Berner, 2008).

The research methodology included analysis of publicly available, secondary data from the Government of Brazil. Secondary data included four collections of agricultural production yield data by rural municipalities (dependent variable) from IBGE and land retitlement data (independent variable) to include parcel location, size, land zoning, and year of title transfer from the INCRA. I analyzed the initial data collected from INCRA to identify two groups for correlation, one set of areas to be defined as having a high rate for policy program participation and one set to be defined as having no-rate of participation. The paired-samples *t* test of the two groups in the rural area (<20,000 persons) was correlated to the agricultural production rates for the identified municipalities.

As a varied number of agricultural production yields are reported for each municipality, the probability of at least three agricultural production yield samples was assumed, requiring at least 17 municipalities for each group for a power of 50 (Table 2). Because of the potential of missing data or attrition of data for one of the four time series, a total of 20 municipalities were collected for each group to ensure at least 60 crop yield

samples for each group for a collection to be representative of each time period. During the data collection period, seven agricultural products were identified and collected for the total of 40 municipalities. The expanse of collected data provided a representative sampling greater than 40 percent of the rural areas in Ceará. I assessed the sampled municipalities by mesoregion to ensure varied locale within the state while maintaining representativeness of high and no-rate municipalities in the same agricultural areas. For two time-series samples in the preagrarian reform policy participation period, the data samples used were for 1990 and 1996. For the two time-series samples in the postagrarian reform policy participation period, the data samples I used were for 2000 and 2006.

Table 1
Research Sample Size: Municipal Agricultural Production (Two Groups)

Analysis:	A priori: Compute required sample size			
Input:	Tail(s)	=	One	
	Effect size *d*	=	0.5	
	α err prob	=	.05	
	Power (1 – β err prob)		=	.80
	Allocation ratio N2/N1		=	1
Output:	Noncentrality parameter δ		=	2.5248762
	Critical *t*		=	1.6602343
	Df		=	100
	Sample size Group 1		=	51
	Sample size Group 2		=	51
	Total sample size		=	102
	Actual power		=	.8058986

Source: G*Power

Through purposeful sampling, I gathered data from the State of Ceará and focused on rural municipalities within the state, municipalities with a high ratio of lands redistributed by the National Agrarian Reform Program, and municipalities with no lands

redistributed by the National Agrarian Reform Program but with the same demographics of the rural, agricultural sector. I defined *rural* as a municipality with a population base of less than 20,000 persons and not located within the capital mesoregion. The predictive variable of agrarian reform program participation allowed me to use two data samples to contextualize if additional factors such as a shift in agricultural production foci and historical trends stimulated a shift prior to policy program participation. I used the correlation to investigate whether the agrarian reform policy program had a causal relation to the national program objective of increasing rural land productivity (Planalto, n.d.).

Operational Definitions and Key Acronyms

CONTAG: *Confederação Nacional dos Trabalhadores na Agricultura* or the National Confederation of Workers in Agriculture is a unifying organization of Brazilian rural labor unions operating since 1963, and is a key proponent for agrarian reform under the rights defined in the Land Statute.

Family farm: In this study, family farm refers to a parcel or unit of land less than 200 hectares that is administered and worked by the family represented on the land title.

Household: In this study, I used the Bolliger and Oliveira (2010) definition of *household* within the agricultural sector. A household has the capacity to own and retain goods or assets and to make lawful decisions regarding economic activities of the unit to include debt, commitments, and contracts.

INCRA: *Instituto Nacional de Colonização e Reforma Agrária* or National Institute of Colonization and Agrarian Reform was created in 1970 to implement agrarian reform policy program efforts at the state level.

Land reform: In this study, land reform is used interchangeably with agrarian reform policy efforts to redistribute land in the late 20th century and early 21st century in Brazil.

MDA: *Gabinete do Ministro Extraordinário de Política Fundiária e do Desenvolvimento Agrária* or Ministry of Agrarian Development is an executive cabinet-level department within the Government of Brazil focused on rural development strategies, including agrarian development.

MST: *Movimento dos Trabalhadores Rurais Sem Terra* or Landless Workers' Movement is an agrarian reform social movement originating in Brazil in 1985. The movement is the largest, worldwide agrarian reform social movement and a strong advocate for ethical, equitable, and prompt public administration of the agrarian reform policy program in Brazil.

PCT: *Cédula da Terra* or Land Bank Program is a market-assisted land program with land titles provided through 20-year credit programs.

PROCERA: Agrarian Reform Special Credit Program is a program supporting family settlement on newly titled lands under agrarian reform with credit for purchase, settlement, and basic infrastructure development.

PRONAF: National Program for Family Agriculture is a program that has provided land donations and housing to families through credit program efforts.

Social function: In this study, social function alludes to the Brazilian Constitution reference to the three basic requirements of land use: (a) land is used in a manner that is "rational and adequate" (Ondetti, 2016, p. 31), (b) labor is just and legal, and (c) land is used as a resource in a way that does not threaten the environment.

Assumptions, Limitations, Scope, and Delimitations

My assumptions regarding the research samples included continuity of access to the secondary data through Brazilian-based repositories, uniform standards of census, land title, and agricultural yield data. Additional uniform standards for reporting agricultural production were used in SPSS, requiring less modification or manipulation of data. Limitations of the data included threat of selection due to variation of farm ownership, maturation of crop and agricultural techniques, and the variety of instruments used to collect census and agricultural yield data over multiple decades (Shadish, Cook, & Campbell, 2002). I delimited the study to data on the State of Ceará, rural municipalities with populations less than 20,000 persons, and principal crops for the State of Ceará, even though these crops may differ from the primary crops supporting the export economy and gross national product.

Assumptions

The agrarian reform process within Brazil is structured and has been ongoing for several decades under the administration of INCRA. The purpose of this quantitative research study was to investigate the relationship of agrarian reform policy program and agricultural production changes in the State of Ceará, Brazil. For the research study, my primary assumption was that the availability of secondary data published by the MDA,

INCRA, and IBGE remained accessible and that the data would be garnered through consistent data gathering techniques for the entire time-series period. I used the secondary data to identify the two groups of municipalities to meet the power sample requirement of 51; exceeding the original objective of 60 samples for each group to be collected, samples represented more than 40 percent of the rural areas in Ceará. Land targeted for agrarian reform contains land categorized by INCRA as unproductive or underproductive; therefore, an area with a high-participation rate in the agrarian reform program should be a catalyst to change the production types and production yield rates for the land. If both high-participation rate municipalities and no-participation rate municipalities have equitable rates of change in agricultural production yields, the agrarian reform policy program cannot be viewed as the change agent. I also assumed that the areas have not undergone a significant rural emigration to decrease population rates below 20,000 persons, changing early time-series data samples from interior urban populace to rural populace status. Lastly, because I utilized publicly available government data, I assumed that I had unlimited access to obtain and document the land titles, populace, and agricultural yields within the municipalities of Ceará. All research data sets were archived components and Internet-accessible through Government of Brazil websites and repositories.

Limitations

The quantitative, time-series *t*-test design had specific limitations that required mitigation. One concern of the design was the threat to validity due to maturation and attrition of agricultural production yields. The objective of the time-series comparison

was to identify general agricultural production changes for specific rural municipalities within the State of Ceará. The time-series sequence allowed me to identify agricultural changes prior to agrarian reform policy program implementation, but these changes were not the intended focus of the research study. I utilized INCRA land retitlement data to scope rural municipalities and level of participation for purposeful sampling of agricultural production data from IBGE. The restricted framework of the study increased objectivity, mitigating bias and prejudice regarding the location and interpretation of data, and encouraging consistency in my presentation of data and analysis.

I conducted the univariate regression analysis in quasi-experimental, repeated measures (time-series) to bound the statistical, linear variation of agricultural production yields in the State of Ceará. I utilized secondary data from formalized census measures, and analyzed them using SPSS—formal research study processes utilized by previous Brazilian agrarian reform researchers—to ensure measurement instrument, empirical, and sampling validity (Frankfort-Nachmias & Nachmias, 2008). Data sets, SPSS syntax, and output files will be retained for at least 5 years following the research study to allow for measure repeatability and confirmation of the data analysis.

Scope and Delimitations

A program evaluation of the agrarian reform policy program serves to determine if the policy objective, land redistribution for the increase of land productivity, was met. Because of the large quantity of land parcels and farming units within Brazil, extending from family farms to international agricultural efforts, I scoped the research study to one locale, the State of Ceará, and purposefully selected municipalities with a rural populace

less than 20,000 persons. The compared samples included municipalities with a high rate of participation in the agrarian reform policy program and municipalities with no rate of participation in the agrarian reform policy program. I identified the high-participation and no-participation municipalities based on INCRA retitling data, census data (to define population of state municipalities), and agricultural crop production data over four collection periods. The state and population used for the research study were selected because they are the focus of continuous outreach by INCRA and the World Bank to develop rural areas and support new agricultural production.

Agrarian reform policies and program efforts have fluctuated over the research time series; however, the objective of increasing land productivity and the resources available for the targeted sample area are equitable. The research focus of Brazilian agrarian reform has included previous evaluations of quantities of land redistributed, rural technology developments, and impact of social movements on land redistribution of which there has been significant research efforts and findings, which I address in the literature review in Chapter 2. In the review I also discuss agrarian reform evaluation, public administration for public reform, and public reform for social change, which enabled me to develop concepts to guide the time-series comparative analysis in the evaluation period. I reviewed the various periods within the primary theoretical framework of PFT, identifying that the response to policy and development created additional support and response for change, which guided the research design and data analysis methodology.

Significance of the Study

Increased agricultural production supports agribusiness and sustainable livelihood for small and medium farms in rural areas. An increase in agricultural production supports rural infrastructure development, agricultural family sustainability, poverty alleviation, and a decrease in rural emigration (Pereira, 2007). A program evaluation of the agrarian reform policy program serves to determine if the policy objective, land redistribution for the increase of land productivity, was met. As the program and supporting advocacy elements have continued to document efforts, publicly available data lent themselves to quantitative review through paired-samples *t*-test purposeful sampling to investigate if the policy program was a solution creating positive change in rural land use. If successful, program support for the federal budget program can be further justified while also supporting international financial support for retitlement and infrastructure development efforts. Program evaluation also has a social change implication because if the quantitative data validate that the program is meeting the program intent, and that the program organization may be a repeatable, then the process can be replicated in other parts of Latin America or other agriculture-based nation states as a means to meet sustainable livelihood goals.

Summary

The policy program efforts of agrarian reform are transformative. The recent decades of agrarian reform have redistributed unequal land parcels categorized as underproductive or unproductive with the objective of increasing land production yields and uses. INCRA remains as the executive authority to categorize land, acquire land, and

redistribute parcels in an effort to increase land use. The World Bank continues rural development loans throughout Brazil with the intent of alleviating poverty and supporting rural development. The two programs support social change efforts to increase sustainability, develop rural markets, and support family farm initiatives. Through the identification of crop production yields over a times-series in both high-program-participation and no-program-participation areas, the agrarian reform program can be evaluated on whether the policy objective of increasing agricultural production yields and land use was met. I used a PFT framework in this quantitative study of secondary data from Brazilian governmental repositories that I used to review the program application and documented change in agricultural production. In sum, in this research study, I quantitatively compared agricultural production changes in multiple sites over four periods to identify if agrarian reform policy program efforts created positive change in land use.

Chapter 2: Literature Review

Introduction

Agrarian reform is a socio-economic-political process that influences the governance of land, requiring retitling of unproductive or underproductive land for social function, increased agricultural productivity, and individual property rights (Binswanger & Deininger, 1997; Machan, 2002). Access to land is a fundamental requirement for agrarian reform policies and for the supported increase of agricultural production. The Brazilian agrarian reform policy program is the focus of this research study, as Sparovek and Maule (2007) identified the program as the "most comprehensive, long standing and diverse" (p. 1) worldwide. In previous studies of Brazilian agrarian reform, researchers reviewed the quantity of land redistributed under agrarian reform programs, technology application, cooperative efforts in redistributed land areas, market implications of redistributed land, and social movement influence on public administration of land reform. Given the lack of quantitative research identifying if agrarian reform policy program efforts have led to increased productivity and land use, in the literature review in this Chapter, I identify the continued need to assess the program impact as a change agent.

Brazil has 415.5 million hectares of arable farmland, yielding 90 million tons of grain per year, while 25 million hectares remain fallow for up to four years, accounting for nearly 60 percent of all land suitable for annual or perennial crops (Sauer, 2006). At the peak of Brazil's agricultural history in 1985, the total amount of productive land had decreased to 375 hectares, as part of 5.8 million farm units (Bolliger & Oliveira, 2010).

The increase of arable land includes an increase in livestock production by 44 million head of cattle (Bolliger & Oliveira, 2010). Borras, Franco, Kay, and Spoor (2014) identified large landholdings as supporting larger market efforts in the crops primarily supported by foreign investment and subsidies including soy, sugar, and grain. The productivity of the land used by large corporations for these agricultural products is estimated by Borras et al. (2014) as 50 percent productivity yield for the land parcel. In my review of the literature, I identified a need for a focused, continuous review to identify family farm efforts increased productivity and social function.

Agrarian reform has been a prominent policy effort included as a presidential focus for the administrations of Cardoso, da Silva, and Rousseff. The amount of land acquired and retitled during the last three administrations demonstrates the government's focus and dedication to resourcing the policy effort. The process of land reform has been contentious since 1934, with reform debate elevated to the political levels of Brazil's President and increasing social movement advocacy for land redistribution. The literature provides minimal quantifiable data regarding agricultural production yield variances and new uses of retitled land.

In this research study, the geographic focus area was the State of Ceará in the Northeast region of Brazil. The federally mandated, internationally supported programs and initiatives within the Northeast region, specifically Ceará, Brazil, had significant secondary data dating back to the 1940s. The time-series design enabled me to capture data for two periods prior to the crux of agrarian reform policy program implementation, and two periods after program implementation. The time series allowed me to collect a

broad range of agricultural production data, capturing agribusiness peaks and periods of diminished crop production due to drought. I evaluated models for agricultural crop comparisons and program intervention using PFT, social conflict theory, and *t*-test research models similar to those utilized by researchers in Pakistan, South Africa, and other states within Brazil. A summary of this chapter is provided in the last section.

Research Strategies

In the literature review, I focused on the research questions to explore the relationship of land redistribution and changes in agricultural production yields within agrarian reform communities in Ceará, Brazil. I identified and gathered existing research and documents on agrarian reform evaluations, public policy administration of agrarian reform programs, and changes in agricultural production due to policy efforts in reform areas. Over the course of the literature review, I sought to identify gaps in these focal areas to provide structure and ensure that my study added to the body of knowledge. In reviewing the historical agrarian reform efforts within Brazil, I included a search of Brazilian legislation, public administration organizations and missions, World Bank case studies and funding documents, Brazilian Institute of Geography and Statistics for census and agricultural production measures, and literature on agrarian reform efforts in Brazil and other agrarian-based communities worldwide. The documents were retrieved through electronic databases that I accessed using the Walden University library, the multiple organizations and entities of the Government of Brazil, the World Bank, and several electronic archived databases. Relevant literature included legal decrees, organizational mandates, fiscal documents, censuses, publications from INCRA, journal

articles, book reviews, general texts, and multiple media sources to provide context and for assessing agrarian reform influence on agricultural production yield changes. The literature I identified and incorporated did not answer the research question, but added a contextual understanding of the data to support my quantitative research and analysis.

In the following sections, I will focus on the topics of agrarian reform programs, land policy, agricultural productivity research, and time-series and *t*-test models for agricultural yield assessments. Databases I used for the research study included Academic Search Complete, Walden University Dissertations & Theses, EBSCO e-books, Inter-University Consortium for Political and Social Research Datasets (ICPSR), National Bureau of Economic Research, NHS Economic Evaluation Database, Political Science Complete, ProQuest Central, SAGE Research Methods Online, Web of Science, and the World Bank Open Knowledge Repository. In addition, I used traditional texts on rural development, rural agricultural journals, and literature on agricultural economics for new assessment techniques. Key terms selected for the research included: *agrarian reform, land reform, agrarian policy, land redistribution, agricultural production, paired samples and agriculture, t test and agriculture, agricultural economics, rural farming,* and *Brazil*. The focus of the literature primarily fell into the categories of agrarian reform programs, agricultural policies, public policy administration, agricultural production, and statistical tests. My primary focus was on literature published between 2011 and 2015. Because of the context of the environmental, social, and political conditions of each decade under review in the time-series design, I incorporated foundational literature

concerning the agrarian reform developments and assessments of the national agrarian reform policy program for each decade.

Land Reform: A General Framework

Agrarian reform efforts are ongoing worldwide, influencing the social–political governance of land and requiring retitling of unproductive or underproductive land for increased agricultural productivity and individual property rights (Binswanger & Deininger, 1997; Machan, 2002). Two-thirds of Latin America has undergone large-scale land reform programs as a means to develop the rural economy (Albertus, 2015). Equitable land distribution creates dispersion of rural, agricultural workers on small land parcels, while large land parcels remain unproductive or underproductive. Through Decrees 7280 and 7.255, the federal government of Brazil requires the acquisition, redistribution, and retitlement of unproductive or underproductive lands to be executed through state-level processes specifically administered by INCRA (Planalto, n.d.; Rodriguez, 2004).

Literature on agrarian reform efforts within Brazil has included data from the Brazilian Institute of Geography and Statistics (IBGE), INCRA, the Movimento dos Trabalhadores Rurais Sem Terra (MST, Landless Workers' Movement), and previous research from Joaquim Guilhoto to identify data regarding land distribution, agricultural production yields, and the modernization of Brazilian agribusiness (Abbey et al., 2006). Land retitlement is a process controlled by INCRA, even when influenced by the demand of social movements. Researchers have primarily focused on the role of social

movements, such as the MST, as the largest advocate for land reform, leading rural workers to occupy land and demand title for the land occupied (Kwader, 1999).

Agricultural production is a rural development and national security objective since the active implementation of the agrarian policy program in 1990 (Schneider, 2010). Rural development challenges include infrastructure, technology, and the environment, supporting or detracting from agricultural production. Previous research identified land reform provided minimal benefit for agribusiness (Abbey et al., 2006). However, as agrarian reform can serve as the catalyst in changing unproductive or underproductive land by diversifying crops and increasing production yields, the evaluation of agrarian reform policy can demonstrate changes in smaller crop efforts or subsistence farming. Alves et al. (2009) conducted an evaluation of Mato Grosso's implementation of the agrarian reform policy program to demonstrate change within small agribusiness, rural infrastructure, and agricultural production, supporting a state-case model for a longitudinal study of policy implementation. As the Northeast is semiarid, plagued by drought, and has traditionally low agricultural yields, the decades of World Bank and federal funding for rural agricultural developments supported a time-series evaluation to demonstrate agricultural production change in correlation to active agrarian reform policy program efforts (Rios et al., 2009). Completion of the retitlement process governed by the agrarian reform policy program averages 17 months, while agricultural production yield change or variation necessitates a time-series evaluation as crop production can require a five-year period for instantiated agricultural production (de Medeiros, 2007). The serial evaluation of 10-year census data and incremental

agricultural production by municipality was appropriate for a policy program analysis to capture the regression and variation of agricultural crops change rates.

Rodriguez (2004) categorized the importance of INCRA as the principal organization under the MDA, implemented at the state level to identify unproductive or underproductive land for redistribution and retitlement. INCRA was promoted in 1995 as a means to provide a local response to the Brazilian populace, a state-level action agent responsible for executing agrarian policy (Rodriguez, 2004). Through Rodriguez's (2004) evaluation, INCRA is the key to the agrarian reform policy program as these offices implement policy at the local and state level to transform the policy into action. Rodriguez's (2004) review of the policy implementation at the state-level identified the full capabilities of policy program as quantified by the amount of land identified and redistributed to illustrate the INCRA's policy implementation process and ability to promote the objective of the agrarian reform policy.

Previous research reviewed policies and formation of new agrarian reform programs; however, no research had correlated the agrarian reform policy program of the executing organization with the quantity of land redistributed to settle landless families for increased agricultural production and new land uses. Previous studies focused primarily on Brazilian agrarian reform in social movement organization mobilization and influence on policy for land redistribution. Although an agrarian reform policy program cannot guarantee complete, equitable distribution of land and an increase in agrarian productivity, an evaluation of agricultural change rates for high participation and no participation in the rural areas targeted by agrarian reform policy programs allows Brazil

to serve as an example for socially responsible agrarian reform policy program efforts (Frechtling et al., 2002).

One previous researcher, Sauer (2009), identified agrarian reform models promoted by the World Bank (1995–2002) and focused on the constitutional requirement of land to maintain a social function. Captured in Sauer's (2009) research is that agrarian reform policy programs were not legitimately implemented until President Fernando Henrique Cardoso's tenure, 1995–2002, which emphasized the social requirement and objective of land redistribution while also collaborating with the World Bank for additional financing of the reform efforts. Understanding the demand for land redistribution publicly administered policy programs enables contextual evaluation of the policy and stated policy program objective (Albertus et al., 2013). The chronology and emphasis of key policies, laws, and public administrative changes emphasize the continued change and interest in Brazilian agrarian reform efforts (Table 3).

Table 2.
Chronology of Land Efforts and Agrarian Reform Policy in Brazil

1822–1850	No laws regulated land access. Land acquisition through squatting.
1850	Law 601 gave *de jure* status, formalizing land transactions.
1934	Constitution identified social, collective interests over property rights.
1946	Constitution identifies the social function subordinate to property rights.
1963	Rural Labor Statute and CONTAG established.
1964	Constitution requires "fair price" bonds for land acquisition.
1964	Land Bill requires social function of land or for land to be expropriated.
1966	Land Act implemented, creating the federal land reform program.
1970	INCRA established by Decree No. 1.110.
1984	Brazil's Landless Workers' Movement (MST) started.
1985	Brazil transitions to democracy.
1985	1st National Agrarian Reform Plan defeated.
1986	Brazilian Rural Society merged with the Union of Rural Democracy (UDR) for the political advocacy and protection of large landholdings.
1986–1992	Intraregional trade grows in agricultural and industrial manufacturing.
1988	Constitution, Article 186 identified land as an element to protect life.
1991	Agrarian Law passed.
1991	Social security reform introduces two-part payroll tax on rural laborers.
1995	Agrarian Reform Social Program established under the MDA.
1995	World Bank releases Brazil Poverty Assessment.
1996	INCRA operationalizes agrarian reform and family farm policies.
1996	Law No. 9.393, heavy taxation on unproductive large landholdings.
1997	São Jose Project, a World Bank-funded effort in Ceará, Brazil begins.
1998	Law No. 93 (Land Bank) "Fund for Land and Agrarian Reform".
2000	MDA established as a federal agency, separate from the Ministry of Agriculture, Livestock, Farming, and Supply.
2000–2004	World Bank second loan for Brazil's Land Credit Program.
2001	Law 10.267 "Georeferencing Law" unified INCRA, the Federal Revenue, and the Brazilian Institute of Environment and Natural Resources for standardized land evaluation.
2002	2nd National Agrarian Reform Plan abolishes the Brazilian Land Bank.
2006	Law 11.326 "Family Farming Law" enacted.
2010	Brazilian Food Security Law enacted.
2014	United Nations Year of Family Farming.

Sources: (Albertus et al., 2013; Caldeira, 2008; Assunção, 2006; Bollinger & Oliveira, 2010; de Janvry, Key, and Sadoulet, 1997; de Medeiros, 2007; Edwards, 2000; Graeub et al., 2015; Lambais et al., 2014; Ondetti, 2016; Penna & Rosa, 2015; Planalto, 1996; Rosalen, 2014; Sauer, 2009; Welch & Sauer, 2015; World Bank, 2003)

Brazil initiated agricultural development programs in 1947 but structured reforms were slow to take hold. During the 1960s, the Alliance for Progress influenced many Latin American governments to instantiate agrarian reform programs in an effort to stabilize rural areas and diminish support for armed rebellion (Martins, 2006). The political and economic shifts in the 1970s and 1980s were a result of agricultural industry development emphasis on technology for greater agricultural outputs which reduced rural employment and lessened support for rural family farming (Binswanger & Deininger, 1997). Brazil transitioned during this period from a military dictatorship to democracy, which was also marked as the pinnacle of nationwide rural poverty as agricultural businesses owned over half of the productive land (Caldeira, 2008). Large landholdings were politically supported by the UDR, a strong political party within the Constituent Assembly (Albertus et al., 2013). The acceptance and aperture for agrarian reform increased throughout the 1980s, becoming a government administered land title transfer program and a supported political reform topic in the 1990s.

The early 1990s included multiple reforms to stabilize inflation, stabilize economic growth, and develop agriculture to maximize the use of arable land (Bolliger & Oliveira, 2010). The decade was also witness to new agribusiness practices creating an agricultural boom while social movements occupied land in an effort to reestablish the small, family farm (Abbey et al., 2006). President Fernando Henrique Cardoso advocated land retitlement by promoting agrarian reform as a federal policy program (Reydon, & Plata, 2000; Sauer, 2009). Land reform programs, varying from Market-Led Agrarian Reform to State-Led Agrarian Reform, are often the primary subject of agrarian

reform research and evaluative changes of the rural economy. Lambais et al. (2014) identified that 13 percent of rural land parcels derived from market-assisted land reform programs between 2000 and 2006. The program efforts are evolutionary, transitioning from the Land Bank into the Second National Agrarian Reform Plan, to support rural agricultural workers' purchase of land and increased agricultural production for sustainability (de Medeiros, 2007). Sparovek and Maule (2007) identified that credit program and advocacy group participation relates to increased standards of rural living, including infrastructure developments of sanitation and electricity to further the quality of life standards. Borras (2006) focused on agrarian reform as a state-building process for establishing land records, taxes, and supporting a rural economy.

Brazil's restriction of land ownership has created land concentration in segments no smaller than four square kilometers (988 acres), creating wage labor dependencies and inefficiencies in agricultural production (Binswanger & Deininger, 1997). The majority of land parcels within Brazil are 10 hectares or less, while 20 percent of Brazilian agricultural lands are unproductive, demonstrating a persistent need to develop small farming within the agricultural infrastructure (Assunção, 2008). The current agrarian reform program reviews correlate quantity of granted land titles, families resettled, and new technologies supporting agricultural production without identifying changes to agricultural production yields (Assunção, 2006).

De Medeiros (2007) investigated the northern region of Brazil, identifying that 40 percent of the families in the rural areas received land titles through the agrarian reform policy program. The Northeast region is unique for this research study as Pereira (2007)

identified a trade union culture underlying land reform supplementing public administration of the policy program in conjunction with external financing from the World Bank. Sparovek and Maule (2007) provided the first evaluation of the Negotiated Agrarian Reform, correlating land reform with subsistence farming and decrease in rural conflict. Sparovek and Maule (2007) identified two benefits of the land reform program in that the program supported new production and supported use of the retitled land holdings. INCRA and the Food and Agriculture Organization (FAO) conducted a Cooperation Project on Brazilian family farming, using 1995–1996 Brazilian Institute of Geography and Statistics for a short-term evaluation of changes in small farming production yields (Bolliger & Oliveira, 2010). Long-term research has not evaluated agricultural production yield changes, but de Medeiros' (2007) research provided the first review of the transformative change timeline for agrarian reform and identified the process as taking 17 months from title transfer to land settlement and production.

The World Bank (1975) identified a rural development policy need and hypothesized a social change benefit to agrarian reform over four decades ago. The World Bank continues to serve as the primary financial institution supporting rural development efforts within Brazil, supported and executed by the Government of Brazil. One major project includes the São Jose Project in 1996, implemented in the State of Ceará in 1997. Because of the ongoing efforts, the World Bank (2003) evaluates agrarian reform program efforts for sustainability and performance as associated with family settlement on land and repayment capabilities. Unfortunately, the World Bank (2003) evaluation of the agricultural production-yield regression has only been captured in two-

year increments for 108 surveyed households and not an assessment of the affected area over the time series. The research study correlated lands with high- and no-participation rates of redistribution within the State of Ceará, a focus area of Brazilian agrarian reform and World Bank project efforts, providing a specific regional sampling to test the extent of change in agricultural productivity as a result of the agrarian reform policy program (Rodriguez, 2004).

Theoretical Framework

The purpose of this theoretical framework section is to provide a general overview of theories and quantitative research methodologies used to evaluate agrarian reform policies. According to the Deininger and Feder (2001), "… many of the land reforms that have been undertaken [worldwide] since the 1960s have not achieved their stated objectives" (p. 34). Theories and evaluative techniques remain short-term, case-focused. The research study reviewed and utilized the literature as the premise for investigation of whether agricultural production yield changes are correlated to Brazil's agrarian reform policy program. The first subsection provides an overview of the theories and estimates, which identify agrarian reform correlation to agricultural productivity and social change. The second subsection provides examples of agrarian reform as a means to increase agricultural efficiency. The third subsection reviews social conflict theory and PFT. The fourth subsection provides an overview of purposeful-sampling strategies used in *t*-test evaluations of agricultural production. The fifth subsection reviews the benefit of time-series or longitudinal studies, juxtaposed to short-term, single-event research to provide a context to agricultural production changes. The

sixth subsection reviews the literature as a means to identify and scope focus areas to evaluate rural production changes and efficiencies. The final subsection reviews production function estimates to provide a known baseline of Cobb–Douglas formulas used to evaluate production function, but can provide a premise for context and modeling for time-series evaluations.

Agrarian Reform: Productivity and Social Change

In 1969, Cline provided the first forecast regarding the benefit of agrarian reform in Brazil, assessing an increase of agricultural production yield by 25 percent in Brazil as a result of land redistribution. Four years later, two researchers identified obstacles to policy implementation. Smith (1973) identified limitations of incremental policy making, restricting the policy implementation capabilities for effective reforms in such developing nations like Brazil. Adams (1973) identified a correlational relationship in one case study between land reform policy program implementation and short-term production increase but identified that long-term policy support was lacking. Both studies identified the potential for remarkable social and economic change if the implementation strategies were sufficiently sustained to achieve long-term agricultural production increases on the redistributed lands. Smith (1973) summarized that developing nations were not likely to have the long-term policy program success in meeting objectives demonstrated through marked social and economic improvement due to scope and intensity required from public administrators, an aspect of political culture lacking in developing countries.

Berry and Cline (1979) provided the first theoretical concept of agrarian reform leading to a change in agricultural production yields, hypothesizing that small farms

would have higher productivity rates than larger farms and would therefore justify the continuation of agrarian reform policy programs. Within the studies conducted by Cline (1969) and Berry and Cline (1979), agricultural production yield data were anticipated to increase by 25 percent with the distribution of land and support of agrarian reform but the research identified an 80 percent increase on the land evaluated within Northeast Brazil for the areas that participated in the reform program. Continued evaluation of the change in agricultural production yields for lands affected by agrarian reform and in the Northeast has been lacking since 1979, even though the sole criterion for evaluating rural land productivity is based on agricultural production yield per hectare (Berry & Cline, 1979).

The agrarian reform objective is to increase rural productivity. Research by Cline (1969) and Berry and Cline (1979) defined the agricultural production rate of small farms as compared with large landholdings in separate regions of Brazil. Large landholdings were identified as having lower maximum production rates due to underproductive or unproductive segments of land (Berry & Cline, 1979). With the defined objective of agrarian reform requiring an increase in rural land use, small farms have a higher rate of agricultural productivity and reduced poverty rates, while large landholdings have lower maximum production rates due to underproductive or unproductive segments of land with a marginalized labor force (Barbier, 2000; Berry & Cline, 1979). These concepts are not unique as Adams (1973), the World Bank (1975), and Berry and Cline (1979) identified the relationship between land reform and short-term production for policy program efforts in 30 countries as a means to increase land use, land productivity, production rate

per hectare, capital, employment, and a new economic environment for nations implementing land redistribution. The literature continues to identify reform efforts and the creation of smaller, more equitable plots of land as increasing agricultural production and efficiency.

Agrarian Reform: Agricultural Efficiency

Berry and Cline (1979) identified large landholdings as "socially inefficient" (p. 58) for land use, agricultural production, and labor. Framing the agrarian reform policy implementation concerns to address the inefficiencies, Berry and Cline (1979) reviewed data to demonstrate agricultural development and an increase of production per area as correlated to the increase of small farms. The Berry and Cline (1979) study also sought to expound upon the World Employment Conference, which identified the reorganization of agrarian structures, often a function of agrarian reform programs, as a key strategy for eradicating poverty.

Cline (1969), Adams (1973), Smith (1973), and Berry and Cline (1979), assess the implementation of policies during the period shortly after the Land Act of 1966, which enacted the Brazilian federal land reform program, highlighted the historical context of land concentration and benefit of increased agricultural production through land redistribution (Assunção, 2006). Large lands create lower maximum production levels due to under- or unproductive segments of lands, enabling agrarian reform policies to combine the underused land with underused labor to increase agricultural production yields, income, and welfare of the rural poor (Berry & Cline, 1979). Deininger and Feder's (2001) research on agricultural efficiencies identified that large landholdings in

Brazil are subject to economy of scale, identifying that only plantation crops are a viable agricultural product and market-value use for large land parcels. If seeking to shift the equality of land use to sustainable food supplies, domestic markets, and international markets, diversification of agricultural production and a greater equality of land ownership is required and is achievable through such policy programs as agrarian reform (Deininger & Feder, 2001).

Theory

To address the creation of greater equality in land distribution, social conflict theory states highly democratic societies should support land reform (Albertus et al., 2013). Social conflict theory examples support the social change implications of land use and redistribution in a time-series, longitudinal study. Borras (2003, 2006) identified that countries with a higher degree of land redistribution have a higher degree of poverty alleviation and overall national development. In addition, an increase of smaller farms and more equitable distribution of land are identified by Berry and Cline (1979) as correlated to agricultural development, greater subsistence, and higher rate of land use. Identified by Deininger and Feder (2001), land productivity is only limited by the supply of labor, allowing for small family farms to be created and maximize land productivity when participating in land redistribution efforts.

PFT is a second concept that enabled a review of agrarian reform policy program data with historical awareness to develop analytic models to correlate agricultural production yields pre- and postpolicy program participation for rural municipalities with a varied frequency of land retitlement (Sabatier & Weible, 2014). PFT is a theoretical

framework used by Sabatier and Weible (2014) to combine statistical analysis techniques for defining causal relationships in large data sets. Mettler and Welch (2001) used a similar multistage model of correlated data sampling to illustrate how PFT supported changes in the application of policy over time. For the research study, the longitudinal, time-series study seeks to identify the causal relationship of agricultural production to areas with a high rate of agrarian reform policy program participation in the rural municipalities in the State of Ceará (Sabatier & Weible, 2014).

Agricultural Production: *t*-Test Evaluation

The use of *t*-test models over a longitudinal period, or time-series study, captures the natural environmental change information as demonstrated by the Howell, Woodford, Weyl and Froneman (2013) research. Howell et al.'s (2013) evaluation model is applicable to agrarian reform policy program implementation as an environmental predictor in land evaluation, primarily to review agricultural changes for high rate of participation municipalities. In defining agrarian reform and land evaluation for participants, Carter and Zegarra (2000) provided an intensive, short-term study to interpret agrarian reform application as correlated to agricultural production yield changes for a limited sample area.

To define these changes, *t*-test evaluations provided regression information that captured multiple decades in the Brazilian agrarian reform research study, providing a longitudinal investigation of change in agricultural production. The Fayaz et al. (2006) paired *t*-test and independent sample *t*-test examined the utilization and effect of agricultural credit policy program in changing agricultural production yields and income

in rural Pakistani municipalities. Furthermore, sampling of the secondary data was sorted by credit program participants and nonparticipants. The Fayaz et al. (2006) sampling technique and *t*-test formulas allow for a comparative analysis of the change results in evaluating the Pakistani credit program causal relationship on agricultural production yield changes and in demonstrating positive policy feedback in the policy program implementation.

To conduct a *t*-test evaluation, the literature supported purposeful sampling for the quantitative research study. Jones and Gibbon (2011) developed a small, purposeful agricultural sampling design to allow for review of agricultural and market changes without repeated observation data from affected households. Howell et al. (2013) demonstrated a means for purposeful sampling of the natural environment to capture diversity and power sampling, mitigating internal threats of instrumentation, maturation, and selection. The INCRA (2008, 2013) publication of agrarian reform program participation supported the choice of municipalities and purposeful sampling of the secondary data repositories. The data collection and purposeful sampling methods of a focused population, large data set furthered the accuracy and reliability of the data for correlation in the research study (O'Sullivan et al., 2008).

Agricultural Production Time-Series Testing

A quantitative, time-series evaluation using secondary data enabled a review of large data sets to demonstrate if agricultural production yields experienced greater change rates due to agrarian reform policy program participation. Magalhães, Souza Filho, Sousa, da Silveira, and Buainain (2011) identified that agrarian reform changes are long-

term investments and should be evaluated over a greater length of time as short-term performance is not an accurate measure of performance. As identified by Gounou, Jiang, and Schulthess (2009), serial agricultural and natural cycles naturally lend themselves and are more accurate with longitudinal, multiple data collections. The research time-series test included two prepolicy program data samples and two postpolicy program implementation samples with a purposeful selection of high and no participation in the agrarian reform policy program. Jaradat (2013) conducted one of the longest time-series analyses to date for agrarian reform in Brazil, a study using secondary data over an eight-year period to assess agricultural program changes on crop systems. Jaradat (2013) argues for long-term evaluation of agricultural practices and production, allowing for stable interpretation of production shifts, changes, and stresses, enabling analytic insight for each period.

The secondary data from the Government of Brazil, the Brazilian Institute for Geography and Statistics (IBGE), and agricultural censuses have been used throughout the literature for time-series testing. Magalhães et al. (2012) used Brazilian data for labor and production statistics to demonstrate agricultural changes over a one-year period. Hidalgo, Naidu, Nichter, and Richardson's (2010) research focused on the municipality-level data, as incorporated in this research study, using land registry data from INCRA to review a small sample of the population to evaluate change over a one-year period. The research study utilized secondary data from the Government of Brazil for purposeful sampling of Cearense municipalities to review a multiple decade time period. INCRA and the Government of Brazil data allowed for purposeful selection of participant and

nonparticipant areas of rural Ceará, Brazil, utilizing some of the same sampling strategies as Fayaz et al. (2006) in selecting three Pakistani municipalities of credit recipients.

The IBGE is the data source for multiple secondary data analyses, including a change analysis conducted by Miccolis et al. (2014) on the variance of sustainable development indicators for changes in the rural family farm and agricultural production due to agrarian reform. Longitudinal studies and reviews of agrarian, agricultural programs utilize government data to define changes in production rates among policy program participants, as evident in the Jones and Gibbon (2011) time-series evaluation of agricultural production yield changes in African cocoa production.

Agrarian Reform: Sample Areas

Sparovek and Maule (2007) provided research on agrarian reform in Brazil, identifying the objectives and target populations of the policy programs. In addition, Sparovek and Maule (2007) provided the first evaluation of agrarian reform as having increased productivity and enabled subsistence farming. Moreover, Sparovek and Maule (2007) provided a review of Cearense institutions, beneficiaries, land price, agricultural systems, payment capacity, and recommendations for improving evaluation and implementation of agrarian reform.

Multiple research efforts have reviewed agricultural production changes in other states within Brazil. Walkowski et al. (2014) use Santa Catarina, Brazil as a case study to evaluate agricultural production changes due to the national agrarian reform policy. Hidalgo et al. (2010) reviewed over 50,000 municipalities in multiple Brazilian states to evaluate how government resources supported or were diverted from the development of

land and infrastructure for the municipality. Similar to the product-effect focus identified by Hidalgo et al. (2010), Magalhães et al. (2012) identified that agricultural production efficiency could be determined based on access to land. The varied assessments of rural production changes and efficiency evaluations provided understanding and strategies for furthering the research of agricultural production change as a result of agrarian reform policy program in select municipalities.

Agricultural Production: Production Function

Agricultural production worldwide has been assessed using Cobb–Douglas estimate formulas for production function. Magalhães et al. (2012) used the Cobb–Douglas production function to estimate production efficiency of Brazilian farming to forecast profitability. Magalhães et al. (2011) utilized the Cobb–Douglas for identifying land function by defining crop, cattle, labor, and integrated land-use practices, but production yields were not identified and land was not included as a determining factor of land use or agricultural productivity. A short-term land reform study in Zimbabwe by Zikhali (2008) evaluated limited production yield changes for policy program participants within a general area using a Cobb–Douglas estimate formula, a formula that can be adapted for time-series application. The data correlated in the research study could be used in future research efforts for defining shifts in land production function.

Section Summary

Land reform is the most significant policy program for lower income rural households as the program enables significant impact if accessing how land allows for new agricultural production (Assunção, 2006). As Graeub et al. (2015) identified, future

research is necessary to identify successful policy program strategies that develop family farming and agricultural productivity. The literature remains focused on agricultural productivity in case studies or short-term evaluations throughout Brazil, while longitudinal studies would provide a means to evaluate efficiencies and changes in crops and agrarian reform program efforts over the time series. Previous research identified land redistribution as an enabler of democratic and policy resource implementation, but the literature is limited and dated in correlating agricultural development with an increase of productive small-farm landholdings (Berry & Cline 1979). A *t*-test time-series evaluation of high-rate and no-rate participants in multiple rural municipalities and mesoregions within the State of Ceará provided new insight as to the foundational change in agricultural production as a result of the Brazilian agrarian reform policy program.

Agrarian Reform and Agricultural Production Research Strategies

Agrarian reform policy efforts have influenced Latin American rural development, agricultural credit for small farmers, and provided social benefit for youth, women, and under-represented persons in rural communities (Schneider, 2010). Although Latin American land reforms have imperfect market and land valuation processes, which can negatively impact agricultural production yields, 12 of 18 Latin American countries have undergone large-scale land expropriations and redistribution (Albertus, 2015; Assunção, 2008). The redistribution of parcels supports the increase of family farming initiatives, leading to household security in employment, income, and food (Lopez & Valdes, 2000). However, poor documentation underestimates the value of family farming (Graeub et al., 2015) while Cotula et al. (2006) further identified that

"official studies on the comparative effectiveness of these programmes and of state-managed land redistribution have produced largely inconclusive evidence" (p. 19) regarding program achievement in increasing agricultural production and land use.

Land is essential for sustainable development and should be distributed through transparent and participatory reform policy programs to encourage increased land use (Coudouel & Paternostro, 2005; Rosset, 2006). Albertus et al. (2013) identified four types of land redistribution: public grant, expropriation, state-led land reform, and federal land reform. Carter and Zegarra (2000) identified four types of agrarian reform: land tenure reform for land registration, land markets for sale of parcels by large landowners, market-assisted land reforms that provide fiscal support for new land owners, and administrative support to increase small land parcel ownership and productivity. Brazil has executed all variations of land redistribution efforts and agrarian reform in a continuous national agrarian reform policy effort. INCRA is the responsible public administrator for implementing agrarian reform policy throughout Brazil (Pereira, 2007).

Agrarian Reform Research

The primary objective of agrarian reform as a policy is to increase agricultural production yield and utilization of rural land parcels (Barbier, 2000). Increased land redistribution can directly support small farm and rural household access to land, credit, and opportunities to stabilize and develop rural land production (Abbey et al., 2006; Barbier, 2000; Schneider, 2010). As agrarian reform is focused on the rural territories, the municipalities most greatly affected have active social movements advocacy and land redistribution support through INCRA; however, the size affected remains small as only

four percent of Brazilian municipalities have undergone agrarian reform (Albertus et al., 2013). The theories identified within the literature therefore are focused on agrarian reform, the public administration of agrarian reform, and social changes derived from agrarian reform.

Brazil is the fifth largest land mass nation worldwide, with the majority of the population urban-based and an unequitable distribution of rural landholdings. The family farming sector is focused on a domestic market, while large land holdings are postured to support plantation crops, such as soy and sugar for export markets (Borras et al., 2014; Graeub et al., 2015). Further development of the family farm for domestic consumption and sustainable land use requires the ability to secure land for production (Miccolis et al., 2014). Land reforms have been ongoing for nearly five decades in Brazil with a stated objective of achieving new land use to increase productivity and alleviate poverty and support agricultural developments (Deininger & Feder; 2001; Rodriguez, 2004). The review of the agrarian reform research illustrates a breadth of policy impact from land occupations and settlements, fiscal drivers of agrarian reform, land rights and benefits of maintaining small farms, and shifts in agricultural production changes resulting from agrarian reform.

Social movements and agrarian reform. "Land occupations are one of the most effective, proven methods of pressuring governments to act" (Rosset, 2006, p. 321) as identified through multiple research efforts on social movements, resource mobilization, land occupations, land redistribution, and agrarian reform policy changes and implementation (Albertus, 2015; Heredia et al., 2013; Kwader, 1999; Rodriguez, 2009;

Sauer, 2006; Welch & Sauer, 2015). Agrarian reform social movement literature within the context of rural Brazil consists primarily of qualitative case studies to identify participation and social change effects. Rodriguez (2009) provided one longitudinal study on Brazilian land reform, assessing the effect of social movements on land redistribution and agrarian reform policy implementation between 1990 and 2004. In addition, Hidalgo et al. (2010) reviewed 50,000 municipalities with land invasions to identify negative income economics and resulting land redistribution in the sampled areas. Research of agricultural labor and social movements often do not review the policy, the land struggle undertaken by the social movements, and do not identify agricultural products in yield variations (Welch & Sauer, 2015).

Land redistribution and social movement support in Brazil is captured within literature reviewing Brazil's MST. The MST mobilizes resources and is the worldwide standard for orchestrating land occupations and driving legal land redistribution for long-term rural development (Caldeira, 2008; Kwader, 1999; Rosset, 2006). Rodriguez (2004) identified the MST as the most prominent landless worker's movement in Brazil, as the social movement crossed into "… the margins of politics …" (p. 1) with the ability to oppose current government legislation and policies, while forming a means to generate agrarian reform and new legislative efforts. Land conflict diverts resources from production and infrastructure development while land reform increases property rights to increase agricultural production and decrease rural conflict (Hidalgo et al., 2010; Pereira, 2007). The literature on social movements identified efforts regarding social conflict and new settlements, comprised primarily of landless agricultural laborers, sharecroppers, and

relatives of the rural laborers (Heredia et al., 2006, p. 282). The efforts of land reform social movements work in conjunction with policy implementation efforts to support land redistribution for increased social function of the land parcel, increased class status of the laborer and landholder, increased agricultural production, and support of rural democratization (Albertus, 2015; Caldeira, 2008).

Agrarian reform land acquisition and community development is a long-term entrepreneurial investment and "should not be assessed on short-term performance" (Magalhães, Souza Filho, Sousa, da Silveira, & Buainain, 2011, p. 10). Long-term evaluation of unproductive or underproductive land, as assessed by INCRA, is the initial step in challenging the current land tenure and provides justification for reform and redistribution (Albertus, 2015). Social movements initiate 90 percent of the redistribution and retitling requests, 10 percent of the requests are government initiated, and these constitute only 13 percent of Brazil's rural landholdings (Lambais et al., 2014; Rodriguez, 2009). The new rural sector developments are part of an apolitical effort of agrarian reform policy and agricultural policy to support state building, land standardization, develop agribusiness, and initiate an agricultural tax base, while the political support for fiscal financing of INCRA remains a political effort of the Worker's Party (PT) and supported by the MST (Borras, 2006; Caldeira, 2008; Pereira, 2007).

Agrarian Reform and Government Support Organizations. The MDA is a cabinet-level organization that establishes agrarian reform efforts to support sustainable agricultural processes and development in Brazil (Rodriguez, 2004). Within the MDA, the INCRA was established as a federal-level solution in response to the social

requirement to address social inequalities in land distribution and assist in subsistence agriculture at the state level (Rodriguez, 2004). State-led efforts, including negotiated agrarian reforms, began with the establishment of the Brazilian Institute of Agrarian Reform in 1964, the predecessor of INCRA (Sparovek & Maule, 2007). The Land Bill of 1966 stated, "land that did not fulfill its social function should be expropriated for the purpose of land reform," which became the mission of INCRA (Caldeira, 2008, p. 137). Within the literature regarding government support processes, Heredia et al. (2013) reviewed the INCRA expropriation rates efforts between 1985 and 1997, while Pereira (2007) reviewed the legislative and judicial processes that supported INCRA's organizational responsibilities in expropriating and retitling land for social change and increase of agricultural productivity.

As Rodriguez (2004) identified agrarian law efforts formalize and provide legitimacy to land claims of the landless and the redistribution efforts of the government. President Cardoso implemented new agrarian reform efforts in 1997, identified as a "reform for agrarian reform," an effort identified as successful because Cardoso settled more families to newly retitled lands than all of his predecessors combined (Ondetti, 2007; Pereira & Sauer, 2011). Cardoso's strategies made agrarian reform more effective, allowing for decreased land occupations due to increased efficiencies in the public administration of the policy program (Caldeira, 2008). The primary focus of settlement and agrarian reform projects remain in the North and Northeast regions to increase the rural agriculture base, increase rural community infrastructure, increase the Human

Development Index for rural laborers, and decrease urbanization (Heredia et al., 2006; Holanda et al., 2015; World Bank, 2003).

Agrarian Reform and the World Bank. The literature focused on increasing land equality, revealing program efforts to reduce agricultural inefficiencies and increase agricultural production as the Brazilian national agrarian reform policy programs are maintained through continuous financial support of the World Bank (Pereira, 2007; Sauer, 2006, 2013; Sparovek & Maule, 2007; World Bank, 1975, 2003). World Bank investments in Brazilian land reform and rural development have been ongoing for five decades with a targeted focus on the Northeast region (Sauer, 2006; World Bank; 1975, 2003). World Bank fiscal efforts support the Brazilian centralized policy program with decentralized land administration to further public and private administration development with development loans in value up to US$200 million focused on alleviating poverty and increasing rural land use (Pereira, 2007; Sauer, 2013; World Bank, 2003). Although the World Bank has aggressive land-reform programs in Brazil, the Philippines, and South Africa, Brazil has received the largest amount of World Bank financing for the purchase and sale of land worldwide (Patel, 2006; Sauer, 2013; World Bank, 2003). The World Bank investments support placement of families, land retitlement, community development, and subsistence farming to ensure program evaluations of World Bank performance as satisfactory and borrower performance as satisfactory (Sparovek & Maule, 2007; World Bank, 2003). World Bank (2003) evaluations are complemented by Sparovek and Maule's (2007) evaluation of agrarian

reform financial support increasing subsistence farming in Brazil, identified as a result of the national agrarian reform policy programs.

Agrarian Reform for Land Rights and Food Rights. Agrarian reform focuses on land rights, including the rights to access and grow resources to support private property rights and individual development (Akram-Lodhi, 2007; Machan, 2002). Over 80 percent of Brazil's rural laborers do not own land, representing the majority of the lowest income division in Brazil (World Bank, 1975; World Bank, n.d.). Within the context of land rights, the agrarian reform objective is to enable a better distribution of land for better access to food and support food sovereignty (Holanda et al., 2015). Food sovereignty requires radical, comprehensive processes to be adapted uniformly "… with equitable access to productive resources, primarily land, water, and forests, as well as the means of production, financing, training, and capacity building for management and interlocution" (Rosset, 2006, p. 301). Rosset (2006) and the FAO focus on the family farm to identify the need for nations to require public administrators to identify food sovereignty as a national requirement (Graeub et al., 2015).

Food sovereignty supports the agrarian reform efforts of the Brazilian government and the World Bank focus in poverty alleviation through increased productivity of the rural agricultural households, by which per capita income, employment, food commoditization, access to crop subsidization, and access to food increases (Barbier, 2000; Grossman, 1994; Pereira, 2007; Rios et al., 2009; World Bank, 2013). The agrarian reform efforts for these benefits as facilitated through INCRA over the last four decades are identified specifically within two research efforts. Rodriguez (2009)

analyzed 28 observations of six-month increments during the 1990–2004 period and Alves et al. (2009) identified the State of Mato Grosso benefit of large landholding redistribution, credit, and investment in technology for increasing agricultural productivity. Technology investment as a benefit of agrarian reform policy research focuses on access to tractors, expansion of irrigation, basic sanitation, and access to education (Alves et al., 2009; Magalhães, da Silveira, Ferreira, Simoes do Carmo & Lambais, 2012; World Bank, 2003). Even though multiple researchers identify agrarian reform and land redistribution efforts as facilitating social justice, contrary research also identifies that only a small percentage of the population are the beneficiaries of the land redistribution, with fewer receiving the infrastructure and social service support necessary to make the new land productive (Ondetti, 2007; Wang & Caldas, 2014).

Agrarian Reform and Land Productivity. The agrarian reform objective is to increase rural productivity, which in turn supports Berry and Cline's (1979) initial research that small farms have a higher rate of agricultural productivity compared with large landholdings. Barbier (2000) identified the correlated increase of policy efforts to increased agricultural production by either revitalizing landholding with new production standards or by enabling new land holdings to generate new production. Based on the theory of "elasticity of substitution" (p. 21), Berry and Cline (1979) identified a means to calculate the replacement need of land and labor to maintain agricultural production in a new size land parcel. Large landholdings have lower maximum production rates due to underproductive or unproductive segments of land (Berry & Cline, 1979). As the most limiting factor of agricultural production is supply of labor, the substitution of labor to

achieve greater gain on small farms was assessed by the Berry and Cline (1979) estimate that Brazilian agricultural output for small farms would increase by 25 percent if supported by agrarian reform policies, which would also require an increase in infrastructure and capital investment even though small farming techniques may allow for a supply cost decrease (Deininger & Feder, 2001). Barbier (2000) identified a per capita corollary increase in agricultural production resulting in long-term poverty alleviation for the rural areas. Correlation analysis of farm productivity and market participation, identifying higher productivity, allows for increased access and participation to agricultural markets (Rios et al., 2009; Sauer, 2006).

Magalhães et al. (2011) identified "applied econometric techniques to explain inefficiency" (p. 11) in agricultural production, presenting ongoing research that identified increased access to land as a means for increasing agricultural production in family farming (Magalhães et al., 2012). Maximum production is feasible when all land is used for agricultural purposes, including increasing land use for purposes such as livestock (Assunção, 2008). Economy of scale identifies that only plantation crops are viable for agricultural production from large landholdings (Deininger & Feder, 2001). Research identified that farms with an income less than $10,000 were focused on diverse crops and livestock, enabling subsistence for familial livelihood and assured employment, while also protecting the familial investment from market fluctuations (Bollinger & Oliveira, 2010). Because of the increased production of livestock for smaller landholdings, the agricultural census and FAO evaluation techniques have begun to include livestock as an agricultural product. The literature further identified agricultural

production inefficiencies in areas where product consumption is high, identified by Barbier (2000) as evidence that policy has not yet increased key agricultural and livestock products for market consumption.

Assessing productivity and impact of reform creates "a baseline [to assist] in the identification of intervention strategies that are adapted to the conditions at hand and respond to the needs of target groups" (Coudouel & Paternostro, 2005, p. 243). The productivity baseline is necessary to provide contextual analysis to production patterns in a time-series study, even though government processes use land unit productivity as the single variable for evaluating productivity (Berry & Cline, 1979). Agrarian reform policy research must focus on the national implications of supporting rural development, development of performance indicators for new land holders, and support of transparent land redistribution processes (Conning, 2003; Conning & Robinson, 2001; Coudouel & Paternostro, 2005). Therefore, the combination of underused or unused land and underused labor to increase income and social welfare enables a change of the rural environment.

Public Administration Research

Land is an economic asset that has come under reformational demand in Brazil over the last four decades focusing on a rural land policy shift to support family farming as an agricultural policy (Albertus et al., 2013; Assunção, 2008; Campelo, 2014). The administration of the reform policy includes response to the United Nations focus in 2014 as the "Year of Family Farming" (Graeub et al., 2015). Public administration of agrarian reform allows INCRA to evaluate land productivity and land value; rural land

productivity remains solely evaluated on agricultural production yields (Berry & Cline, 1979; Courville & Patel, 2006). Research identifies nations with a high degree of land development and redistribution has having higher levels of performance and ability to eradicate poverty (Borras, 2003; Borras, 2006). Agrarian reform in Latin America is distorted due to market imperfections, policy distortions, and division of land value and agricultural production (Assunção, 2008).

One area of productivity that remains elusive in the literature includes the review of smaller farms and levels of productivity as a greater percentage of small farms use agricultural production yields for subsistence and contain less export-based, market products. INCRA data validate land productivity, reviewing nearly 70 million hectares for transference for the benefit of up to 750,000 families (Albertus et al., 2013). Redistribution is estimated as over-predicted due to the restricted implementation in politically contentious environments and limited ability to acquire and redistribute land (Albertus et al., 2013).

Research by Welch and Sauer (2015) identified institutional organizations and policy changes that support political influence in defining property rights, policy implementation, and use of government resources to facilitate an increase in agricultural production and land use (Albertus et al., 2013). Public policy remains biased toward the urban environment and the rural elite; however, public administration and policy focuses on agrarian reform as a means to continue increased return on capital investments and increase agricultural productivity (Binswanger & Deininger, 1997). Agrarian reform policies should be focused on improvements of underused land, underused labor, and

increasing agricultural productivity to increase land value, income, access to credit, and welfare of small farmers (Barbier, 2000; Berry & Cline, 1979). Research identified the impact of public policies on the ability of families to be agriculturally productive; however, the research identified is not evaluative in providing formative or summative evaluation of agrarian reform on agricultural changes.

Literature, FAO documentation, and government data identify the access to land and resources that increased social change and new use of land, identifying land as productive if it meets production and efficiency standards (Caldeira, 2008; FAO, 2010). Agrarian reform programs experience less resistance if the original land owners receive a fair market value, compensating the owner to protect them from negative economic impact, and demonstrated, productive land use to build cooperative, community efforts in the rural territories (Albertus, 2015). New production, ranging from crop yield increase to animal-rearing, enables a transformation of the rural land (Assunção, 2005; Caldeira, 2008). The transformation of the rural environment has led to the World Bank's continued strong fiscal initiatives over the last five decades to increase production, employment, equitable distribution of land, and support the eradication of poverty (Berry & Cline, 1979; World Bank, 1975, 2003). Because of the severity of drought in the Northeast region, agrarian reform and international fiscal programs continue to focus on transformative efforts of the sertão (Campelo, 2014). Administration of the agrarian reform policy program through regulation, public administration, legislation, and efforts for social change demonstrates the impact of policy on a targeted, participatory population (Albertus, 2015).

Public Administration of INCRA. Public administration of agrarian reform is the responsibility of INCRA, serving as a public office for land evaluation, land acquisition, and land redistribution for an integrated policy implementation strategy (Albertus, 2015; Pereira, 2007). INCRA serves as the organization which evaluates land productivity and value, validating over 70 million hectares of land for title transference, including more than 3,500 families in the State of Ceará (Albertus et al., 2013; World Bank, 2003). Original market valuation of land is often based on the production value (Carter & Zegarra, 2000). The land evaluation includes a new standardization process of land surveying and acquisition in compliance with the Technical Standard for Georeferencing of Rural Properties, assuring the transparent accountability and fair market valuation of land by INCRA in redistribution efforts (Oliveira, 2010; Rosalen, 2014). To support the ethical perception of INCRA and the agrarian reform policy program, decision-making processes must be transparent in the mission and execution of the agrarian reform (Cooper, 2012).

Land retitlement applications are often contested by large land owners, while supported by social movements, the juxtaposition of which requires INCRA to remain neutral as a public organization and maintain objectivity in processing land requests and in providing land to new agricultural efforts (Cooper, 2012). INCRA maintains a workforce of six thousand public servants, increasing with federal and international budget support to expand agrarian reform efforts (Penna, 2015; República Federativa do Brasil, Ministério do Planejamento, Orçamento e Gestão, Secretaria de Orçamento Federal, 2012). Within the State of Ceará, new land petitioners are available to negotiate

land purchase, support community investment with the State Technical Unit, receive donations for specific infrastructure developments, and coordinate land loans through the *Banco Nordeste do Brasil* (BNB) (Governo do Estado do Ceará, 2011; World Bank, 2003). Agrarian reform efforts are not dependent on land loans as federal and international funding includes grants. The Brazilian government receives international funding from the World Bank, specifically international development loans for community development efforts and to support INCRA in furthering long-term agrarian reform strategies (República Federativa do Brasil, Ministério do Planejamento, Orçamento e Gestão, Secretaria de Orçamento Federal, 2012). The state bears the burden of processing land titles, the management of the INCRA state offices, support of technical associations, and development of rural infrastructure and education (República Federativa do Brasil, Ministério do Planejamento, Orçamento e Gestão, Secretaria de Orçamento Federal, 2012). The focused development efforts, administered and supported by INCRA through federal and international funds, support the National Plan to further develop the rural area through such efforts as 150 educational courses targeting agricultural production and rural community projects (INCRA, 2011). INCRA and social movement efforts facilitate equitable land expropriation, public resource allocation, and technical assistance with community support to further capacity of settlement and agricultural production, even in budget restricted areas (Penna & Rosa, 2015; Wang & Caldas, 2014).

Agrarian Reform Legislation. Agrarian reform can only be a successful, sustainable program through legislation, substantiating the policy, and execution of the

programs. The MDA is the organization directed to execute agrarian reform, promote sustainable development in the rural agricultural sectors, and identify, recognize, delimit, demark, and retitle land occupied by land settlers (Planalto, n.d.). Patel (2006) identified however, agrarian reform policies are not self-contained, but extend across multiple government departments and private sectors and can only be viable when efforts extend across the term limits of the government administrators (Coudouel & Paternostro, 2005). The last four decades of agrarian reform as a public policy have integrated agricultural policy to focus on increasing agricultural production and family farming initiatives for production and development initiatives, especially in drought-stricken areas (Campelo, 2014). The current policy criteria for defining a family farm includes a municipality-accepted farm, typically 2 to 200 hectares, maximum of two off-farm laborers, income primarily derived from farming on the parcel identified, and the farm must be managed by the family identified on the title (Miccolis et al., 2014). Even though this definition could allow for up to 24 percent of Brazil's land to be identified as a family farm, urban bias identifies agrarian reform as a low political priority due to constituent remote locations, large landowners' political support, and perception of low return on investment (Albertus et al., 2013; Binswanger & Deininger, 1997; Conning & Robinson, 2001). The limitation of off-farm laborers derived from the 1991 social security reform, which raised employer tax contribution and thereby caused an informal, unsecure labor market, which incentivized rural laborers to look to family farming for sustainability and access to small market areas (Edwards, 2000).

Over the last two decades, Brazil has implemented multiple reforms for inflation stabilization, sustained economic growth, and increased market activity, though public investment for agrarian reform and family farming initiatives continues to wane (Bollinger & Oliveira, 2010; Graeub et al., 2015). Complexity in legislative and executive support arises due to the distributed effects of reform. Brazil underwent significant market changes in the 1990s due to intraregional trade expansion of agricultural and industrial goods, which taxed the current arable land under production for external commitment (Bollinger & Oliveira, 2010; de Janvry, Key, & Sadoulet, 1997; De Schutter, 2012). Brazil's economy in the mid-1990s was struck by such inflation that a new currency was instituted in 1994. Pereira (2007) identified distorted reform execution as large landowners lobbied for a higher price evaluation of land, raising the cost and decelerating the land acquisition and redistribution processes. The policy need however should combine access to land with resources and infrastructure for basic development, even though it may have some negative impacts to individuals or specific communities (Governo do Estado do Ceará, 2011; Lambais et al., 2014).

Agrarian reform policy provides legislative legitimacy in combating inequitable land distribution, supporting Albertus et al.'s (2013) social conflict theory application that agrarian reform propagates democratic society. Legislation also formalizes community development, including cadastral records, formation of a new tax base, and instantiation of infrastructure (Borras, 2006). Caldeira (2008) identified that President Cardoso's strategies effectively facilitated policy to increase agrarian reform processes, decrease administrative delay of the policy program, and created focus on policy efforts

for sustainable development, sustainable food, and stabilized rural environments (Cotula et al., 2006). President Cardoso's administration reformed agrarian policies due to the lack of progressive agendas, seizing a political opportunity to address rural violence within the context of land policy (Ondetti, 2007). Financial assistance, federal and international, continues to support the policy program as a nonconfrontational reform in developing the rural agricultural environment (Sauer, 2006).

***Agrarian Reform as a Public Service and Public Good*.** The 1934 Constitution identified that the public need for land is to fulfill a social function, which is a concept perpetuated in each subsequent constitution and supported through the administration of agrarian reform as a policy program (Ondetti, 2016). Social function involves a rational and adequate economic exploitation of the land, activities to comply with labor codes, and agricultural production to support development while preserving the environment (Ondetti, 2016). Agrarian reform efforts also pair reform policy with agricultural policy in an effort to focus on increasing commoditization and rural land productivity (Campelo, 2014; Pereira, 2007). The agrarian reform policy efforts were the most aggressive after the Alliance for Progress, supporting capitalist-oriented land-reform efforts to distribute land for agribusiness and market efforts (Borras, 2006; Martins, 2006).

The development of active markets supports agribusiness efforts, labor absorption, and poverty alleviation as a national policy objective (Edwards, 2000). The modernization of the rural agribusiness market boomed in the 1990s in Brazil, at the same time when social movements aggressively called for land redistribution and President Cardoso supported the public administration of land redistribution for national

development (Abbey et al., 2006; Penna & Sauer, 2015; Pereira & Sauer, 2011; Sauer, 2009). Over a period of less than five years in the 1990s, the Brazilian government acquired, retitled, and redistributed more land than in the previous 30 years and remains the peak period of agrarian reform since instantiation (Coudouel & Paternostro, 2005). The literature identified redistribution as over-predicted due to the restricted implementation by the government, in part due to agricultural development models that support large landholders' ability to drive national and international markets in large-scale agribusiness efforts (Albertus et al., 2013; Welch & Sauer, 2015).

Public administration of the policy efforts includes identifying the government resources and facilitating access to public goods. Ondetti (2016) identified agrarian reform policy as furthering the government resource base through the use of rural land tax base for stimulating agricultural production, including taxing unproductive land at a higher rate to provide an incentive to repurpose land. The increased tax rate and agrarian reform land retitlement increases productivity and stimulates a greater resource base, supporting rural development and poverty alleviation efforts (Deininger & Feder, 2001). Land reforms, to be effective, require sustained effort from the government to ensure rural land transformation, especially in areas affected by drought, which intensifies government dependencies (Cotula et al., 2006; Finan & Nelson, 2001).

Integration of the rural populace facilitates policy implementation, allocation of government resources, and program structure to support development efforts for the long-term benefit and to protect against short-term impediments such as hyperinflation (Albertus, 2015). The administration of the policy program also ensures land acquisition,

title transfer, and the security of land rights, ensuring access to such government resources as technology, markets, capital, and infrastructure (e.g., roads, electricity, water, sewage, education) (Coudouel & Paternostro, 2005). Barbier (2000), Borras (2006), and Sauer (2006) however identified that participation in the agrarian reform policy program did not guarantee access to government resources as research participants identified a lack of technical assistance, diminished supply of drinking water, delays in irrigation projects, and increased difficulties with transportation, schools, basic sanitation, and health. The difficulties encountered correlated to 60 percent of the researched families to abandon the newly titled land within the first four years of settlement (Sauer, 2006). Short-term assessments of agricultural production on new land parcels are insufficient in evaluating effective investment and agricultural development (Coudouel & Paternostro, 2005).

Agricultural production data remain the primary means of evaluating the agrarian reform policy program. The IBGE provides census data, including yearly municipal-level agricultural production data, to measure crop production and value for domestic and international markets; agricultural production data are subject to collection error but are routinely collected within Brazil and includes FAO standards for performing an agricultural census (Graeub et al., 2015; Hidalgo et al., 2010). Census data allow for the basis of short and long-term evaluations. Evaluation influences and facilitates government decision-making processes for funding agrarian reform efforts based on identified efficiencies, responsiveness, risk management, data processing, preservation of

public interest, and structural control facilitated by INCRA (Franklin & Raadschelders, 2004; Frechtling et al., 2002).

Government evaluations further financial decision making, both in national budget considerations and advocacy for international support. International financing and World Bank efforts have routinely intervened in rural, poverty-stricken regions to initiate modernization and agricultural programs, without requiring productivity evaluations (Schneider, 2010). In 2000, the World Bank reviewed the Brazilian financing of agrarian reform and agricultural production, approving a second loan of US$200M for Brazil's market-based land reform and financing the Cédula da Terra efforts, "Land Credit Program for Fighting Rural Poverty" (Sauer, 2006). The international financing supported the continuation of the agrarian reform as the Brazilian MDA and INCRA continued to be affected by cutbacks (Pereira, 2007). A summative evaluation would provide greater insight into agrarian reform program effectiveness, similar to Walkowski et al.'s (2014) short-term review of Santa Catarina's rural agricultural developments in response to agrarian reform implementation (Frechtling et al., 2002).

Social Change and Application Research

The agrarian reform policy as a social change component is reviewed by multiple researchers assessing the rural environment throughout Brazil. Ondetti (2016) identified agrarian reform policy as changing the social function of land. Campelo (2014) argued that agrarian reform should not be limited to parcel redistribution to the landless, but that the policy reform should focus on the increase of supporting family farmers and small-

farm initiatives. One focus identified by Holanda et al. (2015) is the benefit of agrarian reform for land distribution to ensure food access; the research is qualitative in application, not identifying quantitative increases or measures of increased access.

Agrarian reform supports the development of the rural area for the benefit of alleviating poverty and in support of new or increased agricultural production. Large landholdings support market efforts, primarily soy and sugar production (Borras et al., 2014). Local market efforts and subsistence agriculture within the research area include cotton, manioc, cashews, and livestock such as swine and goats (Finan & Nelson, 2001). Agrarian reform enables a redistribution of land to refocus farm size to maximize land production efficiencies, improve livelihood, and further social justice (Berry & Cline, 1979; Feder, 1985; Wang & Caldas, 2014).

Working on the margins of land labor, Borras (2006) identified rural laborers as receiving minimal benefits due to limited access to resources and no property rights. Assunção (2005) identified government resources, credit, and technology assistance as necessary components of agrarian reform policies to increase rural agricultural production; however, evaluation of production changes before and after credit program participation are not identified in the literature. Although the literature identified agricultural production changes in Mato Grosso, advantages of technology in short-term production, and quality of life indicators in the short term after participating in the agrarian reform policy program, additional research is necessary to quantify agricultural production changes and evaluate if these changes support increased social function for land use in the rural area.

Social Change of Land. The objective of agrarian reform is to enhance the social function of land, to enable a social change, and improve the quality of living for smaller farmers (Courville & Patel, 2006; de Medeiros, 2007; Heredia et al., 2006; Ondetti, 2016). Redistribution of land allows for a greater equitable vision of land as an economic asset, increasing land ownership, and potential for increased income and productivity (Assunção, 2008; Heredia et al., 2006; Rosset, 2006). Lopez and Valdes (2000) quantified that increased access to land did not contribute to short-term increases in agricultural output, but the security of land tenure stabilized the household income and access to foodstuffs (Miccolis et al., 2014). Magalhães et al. (2011) identified this increased production shift from market distribution to consumption through applied econometric techniques, which demonstrated a short-term increase of sustainability in access to food because of agrarian reform (Holanda et al., 2015). Borras (2006) and Grossman (1994) associated new land title ownership enabled access to credit and assistance programs, increasing agricultural production return and general family welfare. Land reform-initiated sustainable agrarian development has been critiqued by Ondetti (2016) as less successful in poverty alleviation than the *Programa Bolsa Familia*, a monthly social assistance program that provides immediacy of purchase power or access to food (Rosset, 2006).

Sparovek and Maule (2007) provided the first evaluation of subsistence farming increase from Brazil's agrarian reform programs, identifying increased production efficiencies for beneficiaries and their families, enabling agricultural production to substitute off-farm labor efforts. Brazil has a small rural labor force compared with other

Latin American nations, but the redistribution efforts support efficiencies, dynamism, and development of the rural economy (Borras, 2006; Coudouel & Paternostro, 2005; Courville & Patel, 2006). Efforts of structured agrarian reform are most paramount in the Northeast region, decreasing emigration from the rural area and doubling the number of family farms in such states as Ceará (Barbier, 2000; World Bank, 2003). The transformation of the rural areas within the State of Ceará is due to ongoing agrarian reform efforts, like the São Jose Project and progressive rates of retitlement through INCRA, identifying 1996/1997 as the period of greatest land retitlement throughout Brazil and for the State of Ceará. The São Jose Project served as the agrarian reform policy program instantiation point from which to analyze pre- and postagricultural production of rural municipalities in the State of Ceará for the time-series research study (INCRA, 2008; INCRA, 2013; World Bank, 2003).

Poverty Alleviation and Rural Development. The use of land, within the family-farm framework, was reviewed through the use of secondary data by Bolliger and Oliveira (2010) using the FAO definition of family farming as applied to land-use types versus an evaluation of agricultural production yield. Bolliger and Oliveira (2010) identified 92 percent of Brazil's 5.2 million farms as family farms, traditionally small and subsistence-focused with less market orientation (Berry & Cline, 1979). The transfer of land title, however, enables rural development in the areas of credit market access, new income, financial security, and investment assets (Assunção, 2008; Cotula et al., 2006; Coudouel & Paternostro, 2005). The security of land for income and sustainability is a critical item for rural agricultural workers as the 1991 social security reform involved a

two-part payroll tax increase, equivalent to a 55 percent tax increase on the pay for maize production (Edwards, 2000). Rural agricultural laborers constitute one of the most vulnerable social groups in Brazil due to employment fluctuations and potential displacement if labored land is redistributed or if cost is ineffective to employ laborers (Coudouel & Paternostro, 2005). Individual land title remains a necessity to increase familial productivity, commoditization, and access to programs, supplying a socio-economic productive environment identified for continued fiscal support by the World Bank and INCRA program administration.

Access to land for rural laborers can facilitate poverty alleviation efforts, supporting household food security, access to markets, and increased employment (Cotula et al., 2006; Rios et al., 2009). Indicators of poverty include the cost of food in relation to income, average life expectancy, and human capital investment (Valdes, 2000). As the literature identified, these indicators of poverty are exacerbated within the rural agricultural communities, particularly for women and indigenous peoples. Heredia et al. (2006) further identified program inadequacies in health care, education, technical assistance, infrastructure, and other social services for remote areas benefiting from agrarian reform (Korzeniewicz, 2000; Stavenhagen, 2006). To augment government program support, the MST works with rural laborers petitioning for land title, developing new skills in a two-phase settlement process to ensure rural laborers can transform the unproductive land and settle on the land for long-term development (Rosset, 2006). MST has a two-year school for vocational, agricultural training accredited by the Ministry of Education, recognized in 1995 by UNICEF for supporting 35,000 students and 1,400

teachers (Martins, 2006). The World Bank supports community development programs through fiscal support of INCRA, which provides additional technical assistance training as part of the National Plan (Instituto Nacional de Colonização e Reforma Agrária, 2011; República Federativa do Brasil, 2014). Current efforts in education and training for the rural labor force to reduce poverty is identified in the literature as inconsistent, especially as INCRA (2011) identified the reduction of budgets, regional variations for training, and access limitations as most training is only provided online, a resource not accessible in newly settled remote areas.

Rural Infrastructure. Research and policy efforts on rural development began with reviews of family farming models (1900–1970) as a means of sustainability, furthering the World Bank (1975) report and comprehensive policy program for rural development (Campelo, 2014). The initial research and policy programs focused on alleviating chronic underemployment, underutilization of farm land, and to promote sustainable labor standards to increase productivity and quality of life (De Schutter, 2012; Rosset, 2006). The agrarian reform efforts thus tackled rural instability issues of land tenure, public resources, and settlement as part of agrarian and agricultural infrastructure development efforts (Lopez & Valdes, 2000).

Research by Alves et al. (2009) identified infrastructural and technology challenges that left 25 percent of Mato Grosso small landholdings dependent on manual labor since credit and access to technology were inconsistent. Land-reform credit is limited to US$11,200 per family for investment in land resources and infrastructure with an additional US$6,900 per family subsidy for titling and registration fees, and up to

US$1,300 for installation (Pereira & Sauer, 2011). The agrarian reform credits are critical as nearly two-thirds of recipients of new land titles receive little or no government technical assistance (Pereira & Sauer, 2011). In a more recent study, Ondetti (2016) identified that the majority of agrarian reform retitlement beneficiaries did not receive support services and the rural infrastructure did not develop further as a result of program participation.

Rural development, to increase new production of agricultural goods, requires critical infrastructure including roads, electricity, and telecommunications (Binswanger & Deininger, 1997; Lopez & Valdes, 2000). As of the 2003 World Bank assessment, 93 percent of agrarian settlers' dwellings had cement flooring, 67 percent had sanitation, and 84 percent had electricity in communal areas, while only 50 percent of the rural areas in general have access to electricity (Valdes, 2000). To support the rural development, the World Bank São Jose Project in the State of Ceará provided US$70M in agricultural investments for rural producers, US$50M for infrastructure development and delivery of potable water and sanitation services, US$23M for institutional strengthening to support public administration and technical assistance efforts, and the deployment of additional sustainable irrigation technologies (World Bank, 2015). Without the continued development of the rural area and its infrastructure, new and increased agricultural production and uses of land for social function will not be viable.

Discussion, Analysis, and Conclusion

The national agrarian reform policy program objective is to redistribute underproductive or unproductive land parcels to increase agricultural productivity and

land use, developing a sustainable and economically viable transition of the rural environment (Lambais et al., 2014). These policy efforts are revolutionary in the redistribution of land to secure private property for sustainability and small agricultural efforts, while evolving fiscal and program elements over the last four decades. The primary objective of the policy program requires an achievement of increased agricultural production yields.

The literature reviewed the relationship of land redistribution and changes in agricultural production yields with a focus on agrarian reform, administration of agrarian reform, and the social changes created by agrarian reform. The primary focus area of the research study was the State of Ceará within Brazil, but agricultural production yield change research and models used in other states within Brazil and worldwide are a topic for many researchers and administrators in the literature. The literature identifies a gap in quantitative reviews of agricultural and land use changes over a longitudinal period to demonstrate long-term developments and impact of agrarian reform policy programs in Brazil.

A brief review of the general framework of land reform within Brazil identified the policy program objective to increase agricultural productivity, uses of unproductive or underproductive land for social function, and individual property rights (Binswanger & Deininger, 1997; Machan, 2002). As 12 of 18 Latin American countries have undertaken large-scale land reform policies, the importance of the ministerial-led institute, INCRA, implementing state-level land acquisition, retitlement, and support is critical for the national agrarian reform program (Albertus, 2015; Rodriguez, 2004). Repeated support

of the national agrarian reform programs has been received from the World Bank, serving as a primary financial support of Brazil's objectives. The current agrarian reform program reviews correlate quantity of granted land titles, families resettled, and new technologies supporting agricultural production as measures of success for the program over various short-term periods (Assunção, 2006). One key research finding by de Medeiros (2007) identified the transformative change timeline for agrarian reform from title transfer to land settlement as consuming 17 months while additional research has identified full transformation of the land requires five years.

Two theoretical frameworks were identified in reviewing agrarian reform productivity and social change. First, the theoretical models and concepts of agrarian reform creating enhanced production, especially within Brazil, are the focus of the literature hypothesizing a higher rate of productivity for small farms, supporting agrarian reform with research dating back to 1969. Efficiency theory within the context of agriculture identifies the inefficiencies of large landholdings for land use, agricultural production, and labor. Second, social conflict theory and PFT provided frameworks for longitudinal, large-data research that has social change implications. For evaluation models, the literature provided multiple *t*-test models to extrapolate environmental predictors in evaluation of land over a time series, land utilization, and effect of policy programs, and the benefit of purposeful sampling of large population sets. Fayaz et al. (2006) provided the most applicable model of purposeful sampling within a repeatable study using the *t*-test formula to demonstrate change in agricultural production yields over the defined time series. A time-series methodology allowed for a review of large

data sets, which is beneficial for identifying rates of change in long-term investments for accurate measures of performance (Magalhães et al., 2011). Lambais et al. (2014) provided a current justification for study of the Northeast region, including the State of Ceará, as the leader in Brazil's rural poverty within Brazil. The research study looked to identify if agricultural production changed in correlation and over time due to the implementation of the agrarian reform policy program.

Additional agricultural research strategies included support of family farming initiatives for household security, employment, and food, while also reviewing assessments of land reform effectiveness (Cotula et al., 2006; Graeub et al., 2015; Lopez & Valdes, 2000). Agrarian reform literature identified the benefits of land redistribution, effects of active social movements' advocacy and land redistribution support through INCRA's public administration of agrarian reform, and social changes derived from agrarian reform. While social movements initiate 90 percent of the lands redistributed under formal retitlement requests, the literature is primarily a qualitative assessment of participation and social change effects in the short term (Lambais et al., 2014; Rodriguez, 2009).

Agrarian reform in Brazil is supported by the federal government, executed by INCRA at the state level, and is fiscally solvent because of federal budgetary programming and continuous financial support from the World Bank. Effective executive support from President Cardoso in the 1990s led to a more effective agrarian reform strategy, which decreased land occupations and enabled the largest amount of retitlements in Brazil's history (Caldeira, 2008). The land reform and rural development

loan initiatives from the World Bank have been ongoing for five decades and target the focused area of the research study, the Northeast region (Sauer, 2006; World Bank, 1975, 2003).

Agrarian reform focuses on land rights and access to new resources. With 80 percent of Brazil's rural laborers divorced from land ownership, better distribution of land enables better access to food, income, and livelihood sustainability (Holanda et al., 2015; World Bank, 1975; World Bank, n.d.). As the agrarian reform objective is to increase rural productivity, Berry and Cline's (1979) initial research identified an increase of agricultural productivity as associated to new titling of small landholdings. Maximum production is feasible when all land is used for agricultural purposes, including increasing land use for purposes such as livestock (Assunção, 2008). One area of productivity that remained elusive in the literature included the review of smaller farms and levels of productivity as a greater percentage of small farms use agricultural production yields for subsistence, which supported the targeted small, rural municipalities for the research study of less than 20,000 persons. Land data were available from the Brazilian Institute of Geography and Statistics, as identified through several research studies, while INCRA data validated land productivity and title transference for the benefit of rural, agricultural families (Albertus et al., 2013).

Public administration of agrarian reform is the responsibility of INCRA, serving as a public office for land evaluation, land acquisition, and land redistribution for an integrated policy implementation strategy for over 70 million hectares of land (Albertus, 2015; Albertus et al., 2013; Pereira, 2007; World Bank, 2003). To support the ethical

perception of INCRA and the agrarian reform policy program, decision-making processes must be transparent in the mission and execution of agrarian reform (Cooper, 2012). Agrarian reform can only be a successful, sustainable program through legislation and executive authority to substantiate the policy program. Brazilian agrarian reform legislation efforts focus on inflation stabilization, economic growth, market growth, and increased family-farm initiatives to ensure access to government resources for a change in the rural environment (Bollinger & Oliveira, 2010; Graeub et al., 2015). Agrarian reform land retitlement increases productivity, stimulates a greater resource base, both of which support rural development and poverty alleviation efforts (Deininger & Feder, 2001).

Agrarian reform policy as a social change component is reviewed by many researchers assessing the rural environment throughout Brazil. Ondetti (2016) and Campelo (2014) identified agrarian reform policy as changing the social function of land by increasing support of family farmers and small-farm initiatives. Land redistribution allows for a greater equitable vision of land as an economic asset as land ownership enables the potential for increased income and productivity even though long-term assessments of agricultural production and economic shifts are lacking (Assunção, 2008; Heredia et al., 2006; Rosset, 2006). Land retitlement furthers land rights and enables rural development in the areas of credit market access, new income, financial security, and investment assets (Assunção, 2008; Cotula et al., 2006; Coudouel & Paternostro, 2005). Rural agricultural laborers constitute one of the most vulnerable social groups in Brazil due to employment fluctuations and potential displacement if labored land is

redistributed (Coudouel & Paternostro, 2005). Literature illuminates employment, land utilization, and quality of life in the rural areas, while new resources made available through agrarian reform enable infrastructure and technology changes (Alves et al., 2009). The rural infrastructure developments support public administration growth, technical assistance, and additional efforts to improve the social function of newly distributed land parcels (World Bank, 2015).

The literature provided a review of agrarian reform within Brazil, including previous research in the areas of agrarian reform, policy administration, and social change, while also reviewing theories and models for identifying production yield changes over a time series. One concept that is consistent throughout the literature is that maximum production is feasible when all land is used for agricultural purposes (Assunção, 2005). Through the research study, all four types of land redistribution administrated by INCRA were targeted in purposeful sampled areas for assessing agricultural production changes, as assessed in parallel with areas of no participation in the agrarian reform policy program. The full methodology and details of the research study are included in Chapter 3.

Chapter 3: Research Methods

Introduction

The purpose of this quantitative research study was to investigate whether there is a correlation between the changes of agricultural production yields over a period of time and agrarian reform policy program implementation. In the first two chapters, I identified the significance of agrarian reform, program objectives to increase agricultural production yields and land use, and the social change impact of increasing private property and family farming efforts. Because the objective of the agrarian reform policy program is defined as supporting the redistribution of land for increasing agricultural production and new uses of the land, I determined that a quantitative study was appropriate to demonstrate possible changes in agricultural production of the research area before and after policy program implementation. Given that this defined objective leads to quantifiable measures captured through routine processes by the Government of Brazil, I deemed a quantitative research study appropriate to demonstrate if an increase or change could be identified. A quantitative design allowed for the ordinal coding of land grouping, dependent on if the land in the municipalities participated in the agrarian reform policy program at either high-rate or no-rate participation levels. The agricultural census data provided municipal-level agricultural production measures for *t*-test evaluation, comparison, and regression analysis. This research study included the three fundamental components defined by Creswell (2009) as the philosophical assumptions, the research strategy, and a data collection methodology. The remainder of this chapter is divided accordingly to address design assumptions, strategy, and methodologies for

collection and analysis. In the chapter, I also introduce ethical considerations and data management concerns that could have arisen during the research study.

Research Design

I designed this quantitative study to compare the causality of agrarian reform with agricultural production before and after agrarian policy program participation. I selected the quantitative research design to support a deductive, large-data evaluation effort that is based upon statistical hypotheses to identify changes. Previous research designs for quasi-experimental, time-series, and agricultural production yield changes were harnessed for application to the Brazilian agrarian reform policy program investigation. Howell et al. (2013) conducted a quasi-experimental, time-series test of multiple collection sites, capturing the environmental change information, which I used in reviewing and purposefully selecting agrarian reform policy program implementation locations for data collection. Fayaz et al. (2006) utilized independent and paired sampling *t*-test approaches to analyze program impact in agricultural production yield changes. These previous research designs demonstrated applicability and reliability for purposeful sampling of environmental data, such as agricultural production yields, over a longitudinal period to evaluate a policy program.

My use of paired-samples *t* testing in a cross-sectional, quasi-experimental design had multiple advantages for this research study. A cross-sectional design served as a means to provide descriptive causation from large secondary data sets, dispersed subject sets, and for multiple variables (O'Sullivan et al., 2008). I used publicly available data, primarily from the Government of Brazil data repositories for IBGE and INCRA-

maintained records. The dependent variable I collected consisted of agricultural production yield data by rural municipalities from IBGE data, and the independent variable data included participation grouping from INCRA and IBGE data. Because of the public availability and consistency of the data from previous government reporting agencies conducted by the same government elements over the time series, the repeatability of the measure was confirmed. I measured logical validity using the specific reporting of land parcels retitled through the INCRA processes, and production of agricultural crops as reported through agricultural census data. Alves et al. (2009) and Joaquim Guilhoto's (Abbey et al., 2006) previous use of these data repositories further validated this content and its applicability for agricultural production. Likewise, the use of these data repositories for assessments of the agricultural business demonstrated validity in my choice of these data points for the research construct and criterion. For the research study design, I adapted prior research designs for environmental and agrarian reform production research, while also using data repositories utilized in previous Brazilian agricultural research studies.

Research Methods

Agrarian reform is a socio-economic–political process that supports the legal government retitling of land for increased individual private property to increase agricultural productivity (Machan, 2002). The nature of the research problem, the research study purpose, research study questions, and availability of data drove me to select a quantitative approach. The availability of agricultural production data for use to determine if agricultural production increased in the retitled research areas of rural Ceará

drove the original selection of quantitative design. Through the use of land title records and agricultural census data, I was able to identify participants of the agrarian reform policy program and agricultural production yields for the associated municipalities. The power sample for such a region required a significant collection, supporting my use of secondary data and quantitative methods that correlated samples. The *t*-test sampling for a quasi-experimental time-series design allowed for multiple collections to demonstrate change and regression.

The *t*-test sampling of the quasi-experimental time series had multiple advantages for this research study. First, through the use of *t*-test design selection, the large, secondary data sets enabled a large review of the research area over multiple decades for comparative analysis. The quasi-experimental design also allowed for transformation of the agricultural production yields to present data for deductive evaluation, which, in turn, enabled me to determine if policy efforts were the catalyst for change. The multiple collections over the time-series allows for validation of change, which is essential because land retitlement and transformation processes average five years to complete (de Medeiros, 2007). The longitudinal approach of the quasi-experimental design for *t*-test comparative sampling therefore allowed for evaluation of the agricultural production changes in the environment with a marked point, so that I could further evaluate if agricultural production yields changes were correlated to agrarian reform policy efforts.

Data Collection Methods

This research study had multiple phases. First, I used multiple large data sets to identify two groups, high-rate municipalities that participated in agrarian reform efforts in

the State of Ceará, and municipalities that had no-rate of participation in agrarian reform efforts in the State of Ceará. Within SPSS, I coded these groups by ordinal numbers, 1 and 2, respectively. The paired-sample *t* test compared the two participant groups. I used these groups for comparisons along a time series to investigate agricultural production changes within each of the municipalities. Second, after I selected and coded the two groups of municipalities, I cross-correlated the municipalities to ensure equitable representation of the mesoregions in the State of Ceará. Seven agricultural production yields were collected and analyzed for each municipality over the four periods for the time series. I compared the paired samples using a *t* test to compare the agricultural production yields (dependent variable) by crop for the group-specific municipalities (independent variable).

Data sources for the collection included secondary data sets in government-based repositories. I assessed Agrarian reform participation through land retitlement data collected and maintained by INCRA. Agricultural production crops and municipal-level yield data were collected from IBGE agricultural census data repositories, maintained by IBGE. To analyze the agricultural production yield changes within the context of policy implementation and feedback, I used additional support documents from the Government of Brazil, INCRA, the World Bank, MST, federal budget documents, legislation, policy papers, and other academic studies. The sources identified have been utilized in previous research on Brazilian agrarian reform efforts and are publicly available data that can be collected in a transparent, routine manner.

Rationale for the Quantitative Approach

The quantitative approach for a quasi-experimental design was appropriate for the research study as the approach allowed for an interrupted time-series design to identify a moment in time to mark as the crux of the policy program for a serial observation of the effected environment before and after the policy program (see Simon & Goes, 2013). Quantitative research allowed for data to be value-based within a collection design that is general for larger application (see Frankfort-Nachmias & Nachmias, 2008). The quasi-experimental design supported large population samples and a variation of data that could be purposefully grouped for the research study (Frankfort-Nachmias & Nachmias, 2008). The quasi-experimental design further allowed for the manipulation of variables as needed, while also allowing for the grouping of participant municipalities to identify areas of program implementation, furthering analysis within the context of the agrarian reform policy program (see Simon & Goes, 2013).

The *t*-test approach was for paired samples, and I used *t*-test models previously used by Fayaz et al. (2006) in evaluating the impact of Pakistani credit programs on agricultural production. I purposefully selected the samples based on INCRA land retitlement data and IBGE agricultural census data. The paired sample *t*-test methodology enabled me to compare the two groups of municipalities, the first group defined by a high rate of agrarian reform policy program participation and the second group defined by no rate of agrarian reform policy program participation. The paired-samples *t*-test compared crop production yields for the group-defined municipalities. The

t-test comparisons were plotted and tabulated to present the critical regions and change rates.

The time-series approach allows for a periodic measurement of a group or individual with a defined introduction of a specific change event (Campbell & Stanley, 1963). Measurements across the time series enable deductive identification of a change pattern (Campbell & Stanley, 1963). The research study measurements are captured in a time-series pattern of:

$$O_1\ O_2\ X\ O_3\ O_4$$

The pattern enabled a historical pattern of $O_1\ O_2$ to document historic changes and support PFT assessments for the introduction of the change event and subsequent production for O_3 and O_4 (Campbell & Stanley, 1963). The time series also allowed for the presentation of outlier data, which could not be explained through *t*-test correlation in the quasi-experimental approach (Campbell & Stanley, 1963). The use of the government census data, derived from regularly maintained records, allowed for pattern analysis to determine if the marked change event affected production yields and the changes were graphically depicted to show municipal-crop production time-series collections (Figure 1). Regression analysis of the *t*-tests over the time series of the total paired samples was developed after data collection and analysis, ensuring presentation of appropriate and salient data points.

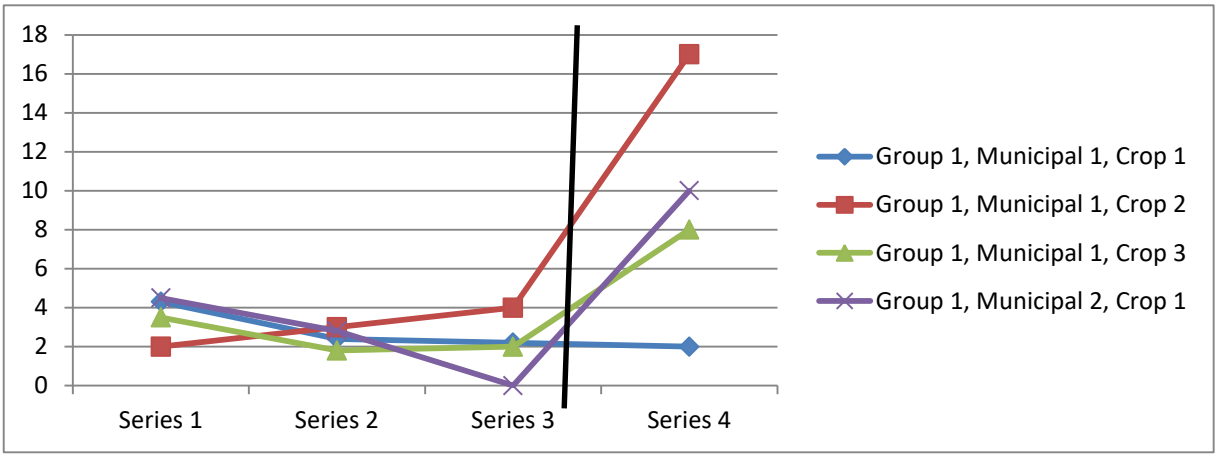

Figure 1. Concept Model: Agricultural production yields, time series with marked agrarian reform policy program.

A qualitative approach was not appropriate for the research study as the policy program objective can be primarily evaluated through ratio data of agricultural production data from IBGE census and ordinal data to classify agrarian reform policy participant groups. Qualitative research of the new or increased uses of land through agrarian reform efforts would be limited to research through an ethnography, case study, or focus group. An ethnographic approach would need to review the phenomenology of land transformation, requiring purposeful selection; the ethnographic approach would be time intensive, necessitate field participation for observation, and could not review multiple municipalities without a dedicated research group for timeliness of data collection. A case study of a single family, group, or small community in the process of transforming retitled land to increase productivity and use is plausible, but would be time and field intensive without identifying if the policy program objectives had been satisfied outside of the timeframe and over a larger research population. A focus group approach would be time intensive and would have been best approached through a field option

around the crux of agrarian reform implementation. Qualitative research methods would be more narrowly scoped due to time, field access, and participants, which drove the quantitative approach to be identified as the most appropriate focus for the research study.

Research Questions

The research questions derived from the ability to address researchability, feasibility, and framework concerns for an impactful study. The first research question sought to identify if there is a significant, positive increase in agricultural production for program participant municipalities within the State of Ceará. Therefore, the corresponding null hypothesis was to identify if the national agrarian reform policy program executed in Ceará, Brazil provided no mean increase or a negative change in a mean agricultural production yield ($\mu1$, $\mu2$) measured over the time series for all policy program participants of the sampled rural municipalities. The second and third research questions sought to identify if there was a significant or minimal change to agricultural production for the program participants within the State of Ceará. The change-related hypotheses presented in Chapter 1 included:

H0: $\mu1 = \mu2$. The national agrarian reform policy program executed in Ceará, Brazil provides no mean increase or a negative change in a mean agricultural production yield ($\mu1$, $\mu2$) measured over the time series for all policy program participants ($\mu1$, $\mu2$) of the sampled rural municipalities.

H1: $\mu 1(0.05) > \mu 2$. The national agrarian reform policy program executed in Ceará, Brazil affected a mean agricultural production yield increase by 5 percent greater in program participant municipalities over the time-series period.

H2: $\mu 1(0.02) > \mu 2$. The national agrarian reform policy program executed in Ceará, Brazil affected a mean agricultural production yield increase by 2 percent greater in program participant municipalities over the time-series period, which may include increase of new crop production types.

The research study remained focused on identifying agricultural production yield changes over the four collection periods. The research study captured and presented the data to demonstrate an impact of the agrarian reform policy program, using data to illustrate if retitled lands increased agricultural productivity in support of rural social change. The research study provided a defined means to collect and analyze secondary data for scientific review through quantitative methods. The use of secondary data further enabled a feasible study with a limited scope targeting a research inquiry of agricultural production and land use changes in the State of Ceará. Lastly, the research study addressed the policy program objective as a basis for ethically and culturally acceptable research of the changed environment.

Role of the Researcher

In a quantitative research study, the researcher is an instrument to review, collect, and validate the appropriate use of data. For the research study, I was responsible for identifying rural municipalities within the State of Ceará, coding municipalities, mapping municipalities, agricultural production data collection, data input, and data review to

enable analysis to respond to the research hypotheses. Given my familiarity with agrarian reform policy efforts in Latin America, the MST, and the State of Ceará, my prior knowledge and experience enabled critical review of the data and rural locations for critical assessment. Because of personal and research connections to the research area, the quantitative research was focused on archived secondary data sets to alleviate ethical concerns of bias and conflict of interest. Areas of ethical concern or personal interpretation due to personal experience were acknowledged to clarify potential bias in the data analysis.

Study Participants and Sampling Strategy

The main focus of the quantitative research study was to investigate if agrarian reform policy program efforts correlated to an increase of agricultural production within the State of Ceará, including new use of lands previously identified as unproductive or underproductive. The study participants were municipalities within the State of Ceará. Municipalities were purposefully selected as rural based on a population of 20,000 persons or less during the 2015 population census and 2016 estimate, while also geographically located in one of the mesoregions in the interior of the state. Municipalities were ordinal-coded as participant (high rate) or nonparticipant (no rate) depending on the level of participation in land retitlement efforts as documented by INCRA (2008, 2013). The selected municipalities were reviewed prior to data collection, ensuring a cross-section of the rural territories and mesoregions were appropriately represented. Municipalities for no-rate participation municipalities were purposefully selected based on mesoregion and similar population of the high-rate participation

municipality selected. After confirming the municipalities for the research study, agricultural production yield data for all crop types were collected for all identified Cearense municipalities in the municipal agricultural production years of 1990, 1996, 2000, and 2006. The intervals allowed for maturation and solidification of land retitlement processes and new agricultural efforts. The crop types were narrowed after identifying crops produced within both high-rate and no-rate municipalities; seven agricultural products were sampled for Ceará, an increase from the originally proposed three sample agricultural products. The sampling strategy allowed for a phased approach to data collection, validating the appropriate participants (municipalities), groups (agrarian reform high-rate participant, agrarian reform no-rate participant), and data (agricultural production yields by crop) during each phase. The rural focus was critical as the agrarian reform policy program implementation effort seeks to be the catalyst of change for these areas.

Sample Size

The research study compared the causality of agrarian reform with agricultural production before and after agrarian policy program participation within the rural areas. As a varied number of agricultural production yields were reported for each municipality, the probability of at least three agricultural production yield samples was assumed, requiring at least 17 municipalities for each group (Table 3). Because of the potential for missing data or attrition of data for one of the four time series, a total of 20 municipalities were identified for collection to ensure at least 60 samples for each group. The extent of collected data provided a representative sampling greater than 40 percent of the rural

areas in Ceará. The municipalities were aligned by mesoregion to ensure that an appropriate cross-section of the State of Ceará was represented.

State-based hectare measurement of agricultural production can be captured by product for 1970, 1975, 1980, 1985, 1996, and 2006, but all municipality-based agricultural production was available in repositories for 1990 onwards (Instituto Brasileiro de Geografia e Estatística, n.d.b). For the two time series sampled in the period prior to agrarian reform policy participation were the data samples from 1990 and 1996, which allowed for time spacing of the sample units. The justification for the time series is based on previous Brazilian agricultural reform research which identified land retitlement processes as requiring 17 months and for new agricultural efforts taking up to five years for crop maturation (de Medeiros, 2007).

Table 3.
Research Power Samples

***t*-Tests–Means difference: Two groups**			
Analysis:	A priori: Compute required sample size		
Input:			
	Effect size *d*	=	0.5
	Power (1 – β err prob)	=	.80
Output:			
	Sample size Group 1	=	51
	Sample size Group 2	=	51
	Total sample size	=	102
	Actual power	=	.8058986

Source: G*Power

The sample size ensured an actual power of .80, sufficiently large for documentation of variation in agricultural production and for a cross-section of the rural areas within the State of Ceará. Moreover, the purposeful *t*-test sampling enabled a correlation to

investigate causality of the agrarian reform policy program and rural land productivity and uses (Planalto, n.d.).

Ethical Protection

No human subjects were interviewed or subjects of the research study. All data were collected from publicly available secondary data repositories, primarily documents and data retrieved from the Government of Brazil, IBGE, and INCRA. Some protective measures were taken in regards to ethical concerns of data collection, analysis, and storage due to personal identifying information available through some of the secondary data sets. Where an individual person, cooperative, or settlement community is identified by name and land parcel(s) in the data, the data were captured and masked, assuming strict privacy controls, even with publicly available data. All data were input into SPSS. After the municipalities were selected, the municipalities were coded alphanumerically to allow for initial data assessments without bias or knowledge of the location. All data collection, analysis, and reporting were done to the highest ethical standards and in compliance of IRB guidelines.

Data Collection and Analysis

Multiple data sources were reviewed for targeted scoping of the research area and for purposeful sampling to compare agricultural regression of multiple areas over the time series. The research study followed statistical assumptions and analyses appropriate for the interpretation of paired sampling *t*-test approaches to analyze program impact on agricultural production yield changes. Data collection was limited purposefully and used to define participant groups as ordinal data within the SPSS and for four periods of the

agricultural census data corresponding to the selected municipalities. The availability of public data through Internet-based repositories and university-provisioned SPSS software meant that no expenses were incurred for data collection. I identified no restrictions for this research study.

The intent of using large data sets within SPSS was to provide correlation and analysis to the agricultural production within the State of Ceará over the four collection periods. The data were carefully captured, marked, and analyzed to expand current knowledge and perceptions about agricultural production in the research study area. Data were organized into two groups, the high agrarian reform participation rate group and no agrarian reform participation rate group within the state. Each agricultural crop was cataloged to assist in documenting changes over the time series, with focus on production yield variations of each crop for the municipality and assigned group under review. Because of the large amount of data collected, correlated, and analyzed, all original files and syntax files were maintained.

Evidence of Quality

The phased research study was designed ensure quality of data collection and analysis. The research study addressed the Campbell and Stanley (1963) requirements for quantitative research quality as the research study design and methodology supported dependability, trustworthiness, transferability, confirmability, credibility, and reflexivity. The use of secondary data sets within previously exercised models furthers the research construct dependability. The use of government data, used in previous research efforts and for government policy decision making, demonstrates the dependability and

trustworthiness of the data to be collected and analyzed. The use of program data and the government census data concerning agricultural production identified the credibility and transferability of the data from government reporting, creating a plausible use of data for the evaluation of the agrarian reform policy program (Lincoln & Guba, 1985). With the use of secondary data and known comparison models, the repeatability enabled confirmability and furthers the credibility for the research design. The data and approach supported reflection of the agrarian reform policy program and reflexive use of the research approach for other Brazilian states and potentially for other evaluations of agrarian reform program efforts worldwide.

The reliability of the quasi-experimental design derived from the same variable measurement at four different periods deductively to identify regression. Because of standard weight and measurements for agricultural crops across the sampled municipalities, in addition to uniformity of census processes and timing, externally collected data consistency increased the reliability of the data sets to be used for the research study. The use of multiple collection points, allowing for sufficient time for retitlement and agricultural production, negates environmental instability and change, supporting a dependable variable assessment. Lastly, the use of secondary data within the research provided a means to authenticate the data, data coherence, findings, and analytic interpretations. Lastly, the quality measures mitigated my bias as a researcher and human error as an instrument of the study. The research study enveloped previous research models and data sources for a new evaluative process of the agrarian reform policy program based on productivity.

Summary

The research quality strategies enabled a research study representing an accurate review of agricultural production yield changes in a specific Brazilian state, while the design will be applicable to other Brazilian settings for future use, and the research findings will be original and repeatable. This chapter reviewed the research study design, methodologies, sampling techniques, and evaluation strategies. The quality of the research study was established through criteria of reliability, credibility, dependability, transferability, and reflexivity. Lastly, the quantitative research methodology allowed for the large data sets to investigate and illuminate correlation of agrarian reform policy program efforts and changes in rural agricultural production yield changes. The research methodology provided a new approach to agrarian reform research, establishing a new template for future research, and a means to undertake agrarian reform objective analysis.

Chapter 4: Presentation and Analysis of Data Results

Introduction

The objective of this chapter is to present the findings of the quantitative study I undertook to investigate if there is a correlation between the changes of agricultural production yields over a period of time and agrarian reform policy program implementation. I used the collected agricultural production yield data to identify whether the agrarian reform policy program implementation within the State of Ceará supported an increase in agricultural production. The study provided a means to review the distribution of agricultural land at a national, regional, and state level over a period of 40 years. My second review of data included the overall agricultural production for the State of Ceará over the 40 years. Lastly, seven agricultural products, including permanent and temporal crops, for 40 municipalities were identified and production yields for four different years were collected for analysis. The 40 municipalities represented two groups within the State of Ceará, municipalities with a high rate of agrarian reform policy program participation and municipalities with no participation in the agrarian reform policy program. The comparison of the paired samples within these municipalities for the State enabled a long-term comparison to identify if the policy program had an impact on the municipalities with a high rate of participation. In this chapter, I will review the data collection and sampling strategy, provide data analysis by hypotheses, and discuss key findings. The overall interpretation of the data within the context of social change will be presented in Chapter 5.

This chapter is organized into two major sections. The first section includes the data collection and sampling strategy. In this section, I provide a review of the land and agricultural production of Brazil, the State of Ceará, and agricultural production at the municipal-level within the State of Ceará. The process I used for selecting municipalities and agricultural crops for collection and analysis is also included in this section. The second section includes data analysis by hypothesis. All data collected originated from publicly available, secondary data repositories maintained by the Government of Brazil.

Data Collection and Sampling Strategy

The quantitative study was approved by Walden University's IRB on July 12, 2016. Walden University's approval number for the study is 07-12-16-0359147. I confirm that I adhered to the research protocol, including the ethical procedures required by Walden University's IRB. I collected all data in July and August 2016 through iterative, purposeful-sampling techniques. Initially, I conducted a national, regional, and state review of land distribution patterns to verify an overall increase of small farms within the State of Ceará during the period under investigation. Land retitlement data from INCRA (2008, 2013) showed all State of Ceará parcels redistributed through the National Agrarian Reform Program. The identified municipalities were grouped into two sets of 20 municipalities, Group 1 having a high rate of participation in the agrarian reform policy program and Group 2 having a zero rate of participation in the agrarian reform policy program. Municipalities proximate to Group 1 municipalities and of the same mesoregion location were then identified for grouping the 20 municipalities into categorical groups, identifying the municipalities' participation in the agrarian reform

policy program. I identified the selection of 20 municipalities for each group in the research proposal, and maintained it throughout data collection.

In the identification of sample sets, the agricultural crops for production yield data required review of permanent and temporary crop yields. I identified seven agricultural crops (cashew, coconut, rice, sugar, beans, yucca, and corn) as the principal crops with the greatest consistency of production in the State of Ceará for both municipality groups. The primary evaluation was of agricultural production changes for Group 1(high rate of participation); however, Group 2 (no rate of participation) was the baseline group I used to correlate patterns and rate of change for the State of Ceará over the time series. Each group contained 20 municipalities with a dependent fixed factor on participation in the agrarian reform policy program and seven agricultural products as independent variables. Analysis was conducted using SPSS and data plot pointing with Microsoft Excel. The agricultural production rates for each agricultural crop were measured in continuous rates based on the IBGE rate of measurement. Using purposeful selection of the Group 1 and Group 2 municipalities and agricultural crops, I identified normally distributed sampling that consisted of a sample size of 40 municipalities, which represents 44 percent of the rural municipalities in the State of Ceará.

National Review

When reviewing the National Agrarian Reform Program efforts, the first data I collected included the distribution of agricultural land by hectare. To identify if the State of Ceará, or the Northeast region, was representative of land redistribution within Brazil, I obtained data collections for Brazil, the Northeast region, and the State of Ceará for

1975, 1985, 1995, and 2006. Because the State of Ceará agrarian reform efforts peaked in 1996 with the World Bank-funded São João Program, identifying land distribution changes for the state, region, and nation over the time period allowed for the data to support PFT analysis.

Figure 2 shows the changes in agricultural land distribution throughout Brazil over the four time periods, 1975, 1985, 1995, and 2006. Overall, small farms of less than 10 hectares remained the most prominent land parcel size throughout Brazil over the four decades. The peak of the small farm throughout the nation was in 1985, with the small farm leveling in 2006 with 2.5 million parcels. A similar change pattern is shown for the agricultural land parcels of 10 to 100 hectares, peaking in distribution in 1985 and leveling in 2006 with two million parcels. The two parcel sizes that have a net gain over the four decades are the agricultural parcels of 10 to 100 hectares and the parcels with more than 1000 hectares.

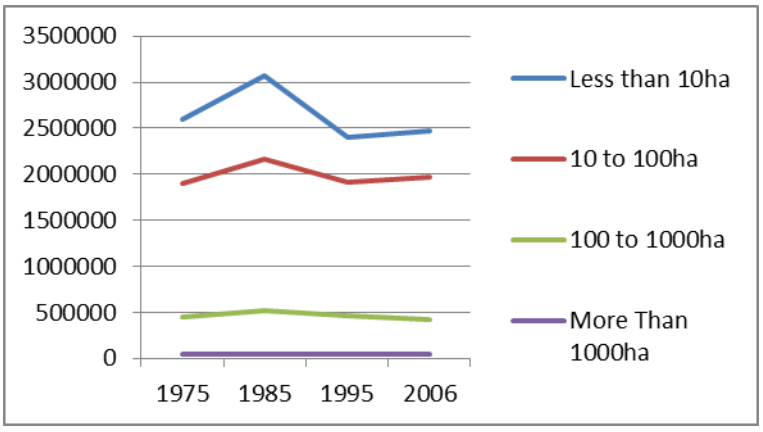

Figure 2. Brazil agricultural land distribution by size.

To provide further context of how the agricultural lands were divided within the Northeast region, the distribution throughout the region (Figure 3) presents the changes

over the four time periods, 1975, 1985, 1995, and 2006. Small farms of less than 10 hectares had a negative gain over the four decades, decreasing from 1.6 million parcels in 1975 to an overall 1.5 million parcels in 2006. Land with a parcel size of 10 to 100 hectares is the only group with a net increase, by 83,832 parcels. Northeast distribution of land has a similar pattern of land parcel size and distribution to the nation; however, the State of Ceará diverges from the land distribution patterns for parcels less than 10 hectares and for parcels between 10 and 100 hectares.

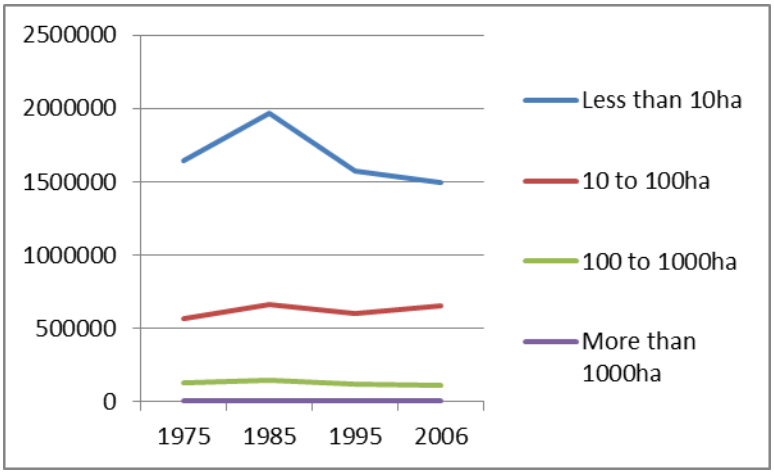

Figure 3. Northeast region agricultural land distribution by size.

To provide a context for the research area, the State of Ceará, a final collection of agricultural land distribution within the State of Ceará over the four time periods, 1975, 1985, 1995, and 2006 demonstrates changes at the state level (Figure 4). The research area for this study, the State of Ceará, had a significant increase in small farms of less than 10 hectares over the four decades with a 30 to 40 percent decrease in agricultural land parcels sized between 10 and 100 hectares, 100 to 1000 hectares, and parcels greater than 1000 hectares. Small farms parcels nearly doubled from 1975 to 2006, increasing from 130,005 parcels to 257,461. The greatest increase occurred between 1975 and

1985, whereas the smallest increase of only 12,000 parcels occurred during the agrarian reform height between 1995 and 2006.

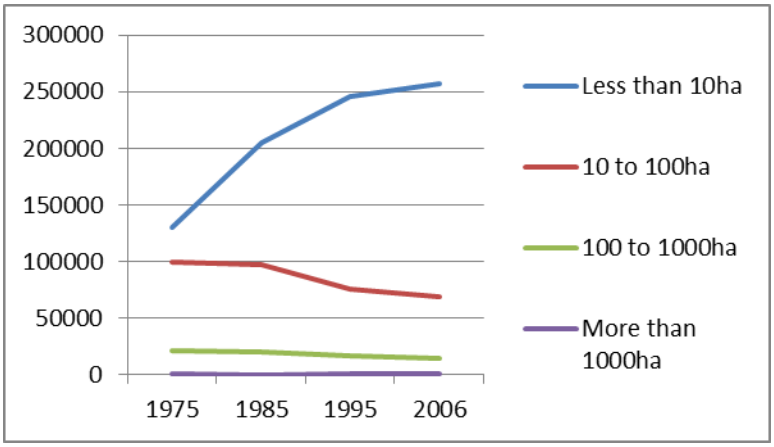

Figure 4. State of Ceará agricultural land distribution by size.

The data in the figures above show a change in the agricultural landscape for the State of Ceará during the period under review. The continued increase of small farm parcels is one factor to be considered when reviewing the agricultural production within the State of Ceará and assessing whether the agrarian reform policy program contributed to the increase of agricultural production and new uses of land.

State Review

I conducted two reviews of data from the State of Ceará. First, population census data I obtained from the IBGE allowed for categorical review of each municipality within Brazil. For this research study, I considered only municipalities with a population less than 20,000 persons and in a mesoregion other than the capital region. Using these parameters, 90 municipalities were identified as rural and potential municipalities for purposeful selection in the research study.

The second data collection at the State of Ceará level derived from INCRA's retitlement data. All parcels redistributed and cataloged by INCRA were reviewed and the total of titles transferred allowed for categorization of municipalities into groups. The group identified as "High Rate" includes municipalities with greater than 60 title transfers; one exception includes Antonina do Norte. The South-Central Cearense region did not have any municipalities with a high rate of agrarian reform participation; to ensure all six mesoregions (South-Central, Jaguaribe, Northeast, North, Sertão, and South) were captured within this study, Antonino do Norte was purposefully selected to be included in the "High Rate" grouping even though the municipality has redistributed only 25 land titles. The inclusion of Antonino do Norte increased the selected municipalities to 20 for each categorical group.

Population data and mesoregion alignment provided the two factors to identify the 20 municipalities with no participation in the agrarian reform policy program. Municipalities with a similar population level to a "High Rate" municipality within the mesoregion were purposefully selected for research and data collection. The correlation allowed for all six regions to be represented with high-rate and no-rate participation with similar population rates, supporting no significant outliers or variation in participants and data samples. The high-rate and no-rate participation are categorical groups for independent variable use within the paired sample *t*-test analysis. The approach also sought to ensure normally distributed data of the dependent variable, agricultural production by crop for the municipality group.

Municipal Review: Agricultural Crops

After selection of the municipalities, agricultural production by municipality was reviewed. As production in each municipality varied, agricultural production yields was reviewed by crop. The agricultural production by municipality, as collected by IBGE for 1990, 1996, 2000, and 2006, included over 60 agricultural crops. Across both permanent and temporal crop production yields, seven crops were identified as having greater than 85 percent production across the selected municipalities for both groups. The seven agricultural products identified for research were cashew, coconut, rice, sugar, beans, yucca, and corn. Five of these crops, rice, sugar, beans, yucca, and corn, are staple crops that have been recorded in Brazil, the Northeast region, and the State of Ceará over the last four decades. Likewise, the seven key crops, including both permanent and temporary crops, were identified for maximum response of all municipalities for the state. Lastly, the frequencies and means of the crops by group were statistically calculated to demonstrate relations. The comparison of the municipalities by mesoregion and through the comparison of the same crop identifies a normal distribution. Cashews and coconuts are regional products with a high production rate within the State of Ceará. Cotton was grown in the majority of Cearense municipalities and decreased or stopped by 1996 and was therefore purposefully excluded due to the decrease across the state.

Data Analysis by Hypotheses

The data collected for the research included four collections for a time-series approach with a defined introduction of a specific change event (Campbell & Stanley, 1963). As the agricultural production by municipality was captured for 1990, 1996,

2000, and 2006, the time-series pattern in correlation to the participation in the agrarian reform policy program is:

O1 O2 X O3 O4

The pattern enabled a pattern of O1 O2 to document agricultural patterns prior to the agrarian reform policy implementation and two subsequent agricultural production collections (Campbell & Stanley, 1963). The data were documented to represent production trends and changes in both groups, municipalities with high-rate and no-rate participation with a *t*-test to compare the changes for each group by crop to enable further change analysis. The analysis is to identify if the national agrarian reform policy program executed in the State of Ceará, Brazil provided an overall mean increase or change in agricultural production yields measured over the time series for the sampled, rural municipalities.

Null Hypothesis: No Change

The null hypothesis for the research is that the national agrarian reform policy program executed in Ceará, Brazil provided no mean increase or a negative change in a mean agricultural production yield measured over the time-series for all policy program participants of the sampled rural municipalities. If the null hypothesis were correct, the increased difference between the 1990 and 2006 production values for all seven agricultural crops for Group 1 (High Rate) would be zero or less than zero. A one-tailed paired-samples *t*-test for Group 1 (High Rate) municipalities for seven agricultural crops revealed that the High Rate municipalities had six agricultural crops with greater production in 2006 compared with 1990. The agricultural production is measured on a

continuous scale with the participation as a categorical grouping. The paired-samples *t*-test for Group 1 (High Rate) revealed significant changes in agricultural production yields, allowing the null hypothesis to be rejected.

Cashews 2006 had greater production (m = 330.0, s = 127.1), than Cashews 1990 (m = 142.5, s = 147.4), t (19) = 5.14, $p \leq .00$.

Coconut 2006 had a greater production (m = 6.5, s = 2.9), than Coconut 1990 (m = 2.2, s = 2.6), t (19) = 5.01, $p \leq .00$.

Rice 2006 had less production (m = 0.3, s = 0.8), than Rice 1990 (m = 153.1, s = 276.7), t (19) = –2.47, $p \leq .01$.

Sugarcane 2006 had a greater production (m = 19.0, s = 19.7), than Sugarcane 1990 (m = 16.0, s = 17.6), t (19) = 0.70, $p \leq .25$.

Beans 2006 had a greater production (m = 480.6, s = 150.9), than Beans 1990 (m = 174.5, s = 163.7), t (19) = 6.68, $p \leq .00$.

Yucca 2006 had a greater production (m = 9.7, s = 2.8), than Yucca 1990 (m = 7.1, s = 4.2), t (19) = 2.44, $p \leq 0.01$.

Corn 2006 had a greater production (m = 360.9, s = 391.3), than Corn 1990 (m = 187.5, s = 187.5), t (19) = 1.90, $p \leq .04$.

Hypothesis 1: Mean Five Percent Increase

The first hypothesis postulated that the national agrarian reform policy program executed in Ceará, Brazil affected a mean agricultural production yield increase by five percent greater in program participant municipalities (Group 1) over the time-series period. The research tested seven agricultural crops (cashew, coconut, rice, sugar, beans,

yucca, and corn) to identify if the municipalities with a high rate of participation (Group 1) in the agrarian reform policy program had a five percent or greater increase in agricultural production, demonstrating a greater increase in production than the municipalities that did not participate (Group 2) in the agrarian reform policy program. The initial correlation identified the rate of change between the agrarian reform policy program implementation in 1990 and 10 years postagrarian reform policy program implementation in 2006 (Table 1). Group 1 had positive rate changes for four agricultural products with an increase greater than five percent. Group 2 had three agricultural products with an increase greater than five percent.

Table 4.
Agricultural Production Rate Change Group 1 and Group 2

Cashew Group 1	Coconut Group 1	Rice Group 1	Sugar Group 1	Beans Group 1	Yucca Group 1	Corn Group 1
+104.9%	+17.6%	–99.8%	+11.7%	+112.8%	–2.5%	–99.4%
Cashew Group 2	Coconut Group 2	Rice Group 2	Sugar Group 2	Beans Group 2	Yucca Group 2	Corn Group 2
+76.2%	+42.9%	–99.6%	–2.4%	+101.6%	–2.6%	–18.3%

The high-participation rate Group 1 is the only segment to have a positive increase in sugar production over the time series at a rate of 11.7 percent. Group 1 and Group 2 both demonstrated positive increases in agricultural production of cashews, coconuts, and beans. These products are temporal crops and traditional staples for the State of Ceará. Cashews demonstrated a significantly greater increase, 37.7 percent greater rate of change, for the high rate of participation Group 1 while the growth pattern for both Group 1 and Group 2 are parallel in agricultural production efforts within the State of Ceará (Figure 5. Cashew production rates in the State of Ceará, 1990–2006).

Coconut product increased for both groups but Group 1 did not increase at the same rate as Group 2. Bean production increased for both Group 1 and Group 2 with an 11.2 percent greater rate of change for Group 1.

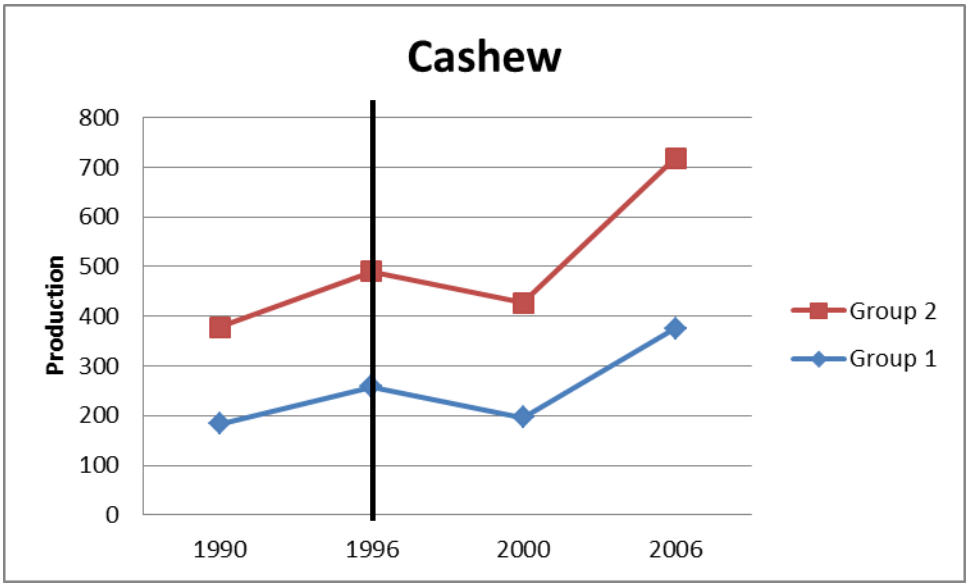

***Figure 5*. Cashew production rates in the State of Ceará, 1990–2006.**

Although the high rate of participation municipalities of Group 1 demonstrate agricultural increases greater than five percent for four agricultural products, three agricultural products demonstrated a negative rate change. Rice, yucca, and corn are the three agricultural products with overall agricultural product decreases between 1990 and 2006. Rice and yucca production trends are parallel and reflective of agricultural production shifts from these crops for both Group 1 and Group 2 between 1990 and 2006. The decrease of these crops is pronounced with the Group 1 decreasing production rates to near zero by 1996, correlating to the implementation of the agrarian reform policy program (Figure 6. Rice production rates in the State of Ceará, 1990–2006). The decrease of corn production between Group 1 and Group 2 is significantly different in

mean rates; however, both groups demonstrate a significant decrease in 2000 and the mean pattern is not reflective of the agrarian reform policy program (Figure 7. Beans Production Rates in the States of Ceará, 1990–2006). Large landholdings remain more efficient in economy of scale of intensive crops for market production, such as rice and corn (Deininger & Feder, 2001).

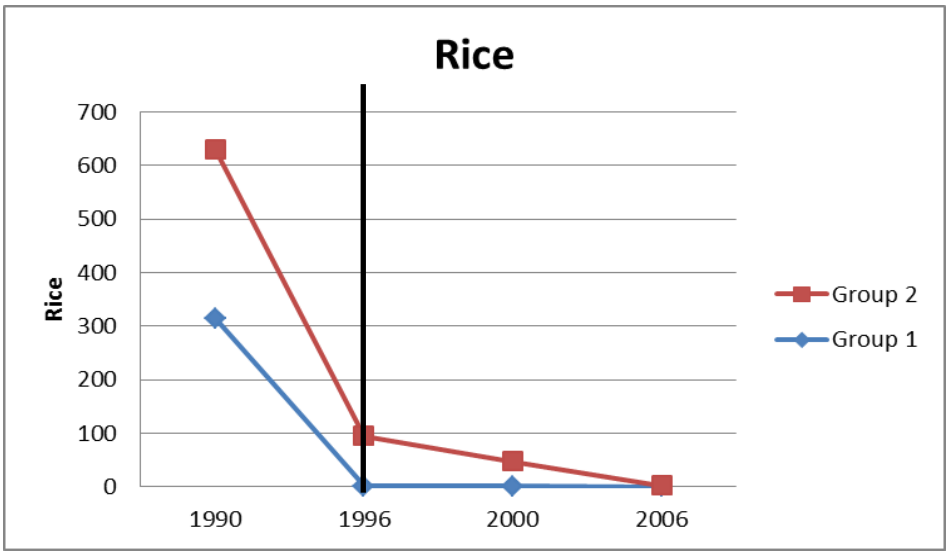

***Figure 6*. Rice production rates in the State of Ceará, 1990–2006.**

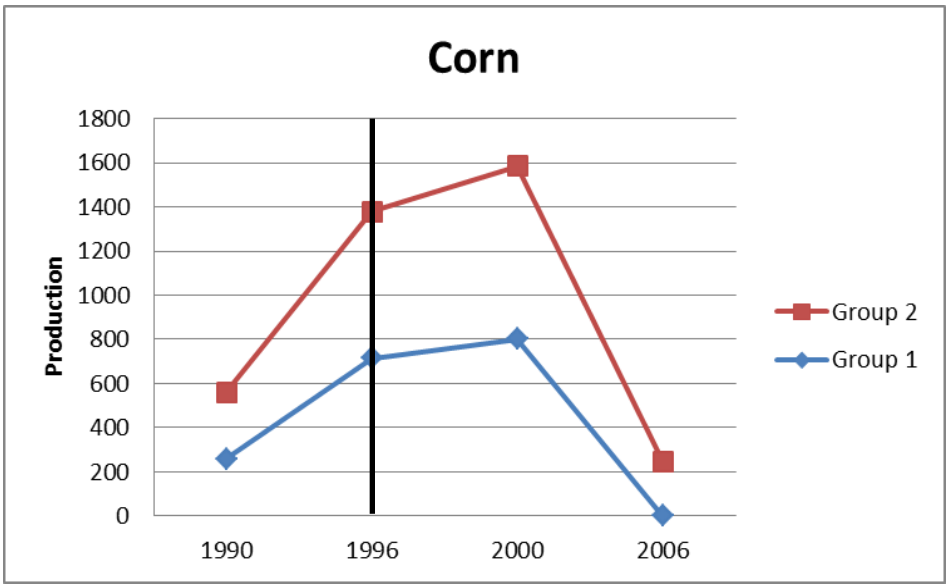

***Figure 7*. Corn production rates in the State of Ceará, 1990–2006.**

Hypothesis 2: Mean Two Percent Increase

The second hypothesis postulated that the national agrarian reform policy program executed in Ceará, Brazil affected a mean agricultural production yield increase by two percent greater in program participant municipalities over the time-series period, which may include increase of new types of crop production. The hypothesis was based on the expectation that agricultural production may not be affected or increase at a rate greater than two percent over the time series. Of the seven agricultural products evaluated, the four agricultural crops with a positive rate change exceeded change rates of two percent and exceeded five percent, as identified in Hypothesis 1. With the decrease of three agricultural crops, a review of new and emerging crops for the High Rate Participant Municipalities of Group 1 was conducted. Two new agricultural products emerged in the Group 1 municipalities over the time series, castor oil plants and tomato. The introduction of these new crops is varied and inconsistent as the new crops are temporal crops and are in limited production for less than 20 percent of the Group 1 municipalities. There is insufficient data to conclude that the agrarian reform policy program supported the introduction of new agricultural products into the municipalities with retitled land.

Summary

This chapter presented the data analysis regarding agricultural production changes for municipalities with a High Rate of Participation (Group 1) in the national agrarian reform policy program within the State of Ceará. Further comparative analysis between the High Rate of Participation (Group 1) and No Rate of Participation (Group 2) in the

national agrarian reform policy program identified the pattern and significance of agricultural production changes for the municipalities that participated in land retitlement. The data analysis revealed that municipalities with a high rate of participation in the agrarian reform policy program demonstrated an overall significant increase in agricultural production yields. In comparison with the natural agricultural production trends for the State of Ceará, two agricultural products demonstrated a greater rate of positive change for the High Rate of Participation (Group 1) municipalities, specifically the two staple crops of cashews and beans. Beginning with an explanation of policy feedback and agricultural production changes along the time series, Chapter 5 discusses the key findings identifying themes that emerged from the data analysis with a theoretical proposition as to any influencing factors impacting agricultural production and resulting data. In addition, the implications for social change and recommendations for action include suggestions for further research to evaluate the agricultural production changes and implications for other areas with agrarian reform program efforts.

Chapter 5: Conclusion and Recommendations

Introduction

Programs regarding agrarian reform seek to address inequitable land distribution and land productivity. Even though Brazil has had the longest and largest agrarian reform program, quantitative evaluations to support the continuation of the country's agrarian reform policy program efforts have remained based in qualitative identification of notional impacts. The original studies of land redistribution and correlated agricultural production within the State of Ceará began with Cline (1969), who linked agricultural production increases with the continuation of the agrarian reform policy program. In this study, I identified participant municipalities and correlated agricultural growth to demonstrate an overall impact of agrarian reform policy program efforts within the State of Ceará. Making this correlation, I found that agrarian reform policy program implementation is linked to a greater increase in agricultural production for the municipalities participating in the agrarian reform program.

Key Findings

The key objective of this research study was to investigate the correlation of the agrarian reform policy program with agricultural production yields within the State of Ceará. The researched hypotheses postulated a relationship of participation in the national agrarian reform policy program, administered by INCRA and rates of changes in agricultural production. The findings from this study showed support for the first hypothesis, and provided key evidence of significant increases in agricultural production yields for municipalities with a high rate of participation in the agrarian reform policy

program, even when production paralleled the pattern for municipalities with no participation in the agrarian reform policy program.

According to my research, the State of Ceará demonstrated the greatest increase of small land parcels over the last four decades, with a marked increase since 1996. The State of Ceará is divided into seven mesoregions, including the metropolitan region surrounding the capital, Fortaleza. The six mesoregions (South-Central, Jaguaribe, Northeast, North, Sertão, and South) I reviewed in this study demonstrated parallel agricultural production shifts for high-rate and no-rate municipalities with a greater increase in temporal crops (cashews, beans) over the time-series. The findings of this research study confirm Cline's (1969) initial assessments of agricultural production increases, although the rate for this extended period was significantly greater for positive-rate-of-change yields. The findings do not show the specific governmental, policy, and environmental impacts on the State of Ceará that caused a more conservative rate of growth or decrease in production. However, the result is evidence-based on a time-series review and demonstrated rates of agricultural production changes in the State of Ceará, correlated to an increase of small land parcels and agrarian reform policy program implementation.

Emerging Themes

PFT enabled me to review of agrarian reform policy program data with historical awareness to develop analytic models to correlate agricultural production yields before and after policy program participation (see Sabatier & Weible, 2014). The land parcel changes correlate to the shift to democracy in 1985, the largest agrarian reform policy

program implementation in the State of Ceará in 1996, and continued review of land redistribution effort under the Brazilian Worker's Party in the early 2000s. The changes in the land redistribution pattern and corresponding changes for key staple crops enable an interpretation of a causal relationship between agrarian reform policy program participation and agricultural production yields, as Cline (1969) discussed in the initial change rate research regarding agrarian reform and agricultural production. I identified an increase of temporal, staple crops for high-rate, rural municipalities. The data imply positive policy feedback in regard to increased productivity for high-rate, rural municipalities at a more aggressive rate than traditional no-rate, rural municipalities.

Social conflict theory posits that the changes of land use justify continued land redistribution even though some traditional crops decrease over the time series. Increase of smaller farms and more equitable distribution of land were correlated by Berry and Cline (1979) to agricultural development, greater subsistence, and higher rate of land use. The decrease of permanent crops, particularly large-scale crops within the State of Ceará, shows a socio-agricultural shift. Because of the arid environment and increase of small farm land holdings, there is a natural conflict in continuing land intensive farming with such agricultural products as rice and corn. In addition, large crop production is traditionally offset or subsidized by the Government of Brazil for individual farms. With a redistribution of these parcels previously identified by INCRA as underproductive, the crop cycle of land intensive agricultural products will decrease or cease due to the production shift.

Implications for Social Change

This research study is timely and pertinent because the political shifts within Brazil are decreasing advocacy for agrarian reform efforts. Ultimately, a policy program can sustain through policy turmoil if a positive change and benefit can be identified as a result of the policy program. As such, the first hypothesis postulated a social change benefit if only a 5 percent increase in agricultural production could be assessed in the rural municipalities with a high rate of policy program participation. I identified increases exceeding 100 percent over the time series, with a greater rate of increase for the rural municipalities with a high rate of participation than those with no rate of participation. This research study shows agricultural production patterns among high-rate and no-rate municipalities, and provides information to contextualize the impact of policy on the rural environment. The increased production of the redistributed land has an immediate impact in that this study validates the policy program objective and shows how increased agricultural production yields are linked to support efforts for small farms within Brazil.

Recommendations

As agrarian reform is a complex, nationally-directed policy with an impact on small farmers, continued evaluation of the program must address sustainability and related issues. To that end:

1. I recommend that this study be replicated in additional states participating in the national agrarian reform policy program in Brazil. Sufficient publicly available secondary data exist to replicate the study for other states.

2. I recommend that a review of livestock changes be assessed using the paired-samples *t* testing of this study to identify if the agrarian reform policy had an effect on livestock. Livestock is a new use of land that can demonstrate positive change and increased production, supporting the FAO definition of agricultural uses of land.
3. I recommend that a qualitative study be undertaken to identify if the increased agricultural production within the rural, high-rate municipalities correlates to increased household and food security.

Limitations

I narrowly focused the scope of this study on quantifiable changes within the State of Ceará in order to identify municipal participation in agrarian reform and rates of change for agricultural products. Data I identified and used for the research study are government collected, publicly accessible, secondary data. My access to the government data for land retitlement, land distribution size, and agricultural production was unimpeded. Some agricultural production data by municipality was archived, therefore restricting access for the agricultural production rate of change review to nearly two decades, unlike the land parcel distribution review of four decades. The qualitative study design initially was threatened by variation of farm ownership, maturation of crop and agricultural techniques, and census collection methods (Shadish et al., 2002). However, the large data sets were easily accessible, allowing me to identify ownership of land parcels for those under review, continued production for specific crops purposefully selected for the research study, and crops with standardized collection processes for the

time-series. The time-series and variety of seven agricultural products enabled a variety and extended scope to overcome maturation and changes to the research environment.

Summary

The primary purpose of this research study was to conduct a quantitative correlational study to investigate the relationship of lands redistributed in the State of Ceará in the context of agricultural production yields before and after participation in the agrarian reform policy program. My intent was to identify land redistribution and correlate agricultural production yields to define the level of agrarian reform policy program achievement in meeting the national objective of retitling land to increase rural land use. Using the initial research of Berry and Cline (1979) and the dependent paired-samples *t*-test process of Fayaz et al. (2006), I built a phased approach to purposeful sampling in order to identify the correlation of change with program participation. My findings from the collection and analysis of publicly available secondary data show a positive change pattern for the small rural farm. In this study, I identified changes in land use, a topic previously undocumented in the literature. In the literature review, I demonstrated that previous studies of the Brazilian agrarian reform focused on amounts of lands redistributed, applied technologies, market implications of redistributed land, and social movement influences on public administration of land reform. There was a lack of quantitative research to identify whether agrarian reform policy program efforts correlated to increased productivity and land use over a time-series. I correlated lands with high- and no-participation rates of redistribution within the State of Ceará, a focus area of Brazilian agrarian reform and World Bank project efforts, to test the extent of

change in agricultural productivity as a result of the agrarian reform policy program (Rodriguez, 2004). Although this study has added meaning to the changes of land distribution and agricultural production rates, my analysis is only suggestive of positive policy program efforts in the State of Ceará. As such, there is an opportunity to continue the research effort into other states within Brazil and to other nations with agrarian reform policy programs.

In sum, agrarian reform is a policy that can be of dual benefit: increased land use and increased access to private property for small farm sustainability. The agrarian reform policy program does not simply identify the categorization, acquisition, and redistribution of land, but also the advantage of increased productivity of the area over a longitudinal period. Agrarian reform policy programs enable long-term agricultural shifts for sustainable change patterns in rural communities. Agrarian reform policy program evaluations support policy program continuation in Brazil for other agriculture-based nation states to meet sustainable livelihood goals.

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