UNIVERSIDADE ESTADUAL DE CAMPINAS
FACULDADE DE ENGENHARIA AGRÍCOLA

MARIA ANGÉLICA PETRINI

THE USE OF ANALYTIC HIERARCHY PROCESS TO PRIORITIZE PUBLIC POLICIES FOR FAMILY FARMING IN AN AREA OF SUGARCANE EXPANSION IN THE MICROREGION OF CERES, GOIÁS

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Thesis presented to the School of Agricultural Engineering of the University of Campinas in partial fulfillment of the requirements for the degree of Doctor in Agricultural Engineering, in Planning and Sustainable Rural Development.

Tese apresentada à Faculdade de Engenharia Agrícola da Universidade Estadual de Campinas como parte dos requisitos exigidos para a obtenção do título de Doutora em Engenharia Agrícola, na área de concentração Planejamento e Desenvolvimento Rural Sustentável.

Advisor/Orientador: Prof. Dr. Jansle Vieira Rocha
Co-advisor/ Coorientador: Profa. Dra. Julieta Teresa Aier de Oliveira

ESTE EXEMPLAR CORRESPONDE À VERSÃO FINAL DA TESE DEFENDIDA PELA ALUNA MARIA ANGÉLICA PETRINI, E ORIENTADA PELO PROF. DR. JANSLE VIEIRA ROCHA.

CAMPINAS
2016

Agência(s) de fomento e nº(s) de processo(s): CAPES

Ficha catalográfica
Universidade Estadual de Campinas
Biblioteca da Área de Engenharia e Arquitetura
Luciana Pietrosanto Milla - CRB 8/8129

P448u

Petrini, Maria Angélica, 1985-
The use of analytic hierarchy process to prioritize public policies for family farming in an area of sugarcane expansion in the microregion of Ceres, Goiás / Maria Angélica Petrini. – Campinas, SP : [s.n.], 2016.

Orientador: Jansle Vieira Rocha.
Coorientador: Julieta Teresa Aier de Oliveira.
Tese (doutorado) – Universidade Estadual de Campinas, Faculdade de Engenharia Agrícola.

1. Agricultura familiar - Políticas públicas - Brasil. 2. Etanol. 3. Tomada de decisão. 4. Cana-de-açucar. I. Rocha, Jansle Vieira,1961-. II. Oliveira, Julieta Teresa Aier de. III. Universidade Estadual de Campinas. Faculdade de Engenharia Agrícola. IV. Título.

Informações para Biblioteca Digital

Título em outro idioma: Uso do método de análise hierárquica para priorizar políticas públicas para agricultura familiar em uma área de expansão de cana-de-açúcar na microrregião de Ceres, Goiás
Palavras-chave em inglês:
Family farming - Public policy - Brazil
Ethanol
Decision-making
Sugarcane
Área de concentração: Planejamento e Desenvolvimento Rural Sustentável
Titulação: Doutora em Engenharia Agrícola
Banca examinadora:
Jansle Vieira Rocha [Orientador]
John Christopher Brown
Adriano Rodrigues de Oliveira
Ricardo Abid Castillo
Marco Tulio Ospina Patino
Data de defesa: 04-11-2016
Programa de Pós-Graduação: Engenharia Agrícola

Este exemplar corresponde à redação final da **Tese de Doutorado** defendida por **Maria Angélica Petrini**, aprovada pela Comissão Julgadora em 04 de novembro de 2016, na Faculdade de Engenharia Agrícola da Universidade Estadual de Campinas.

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A Ata da defesa com as respectivas assinaturas dos membros encontra-se no processo de vida acadêmica da discente.

Acknowledgments

I would like to offer my gratitude to my advisor Prof. Jansle and my co-advisor Profa. Julieta. Many thanks for guiding my steps and sharing their knowledge during this time. A special acknowledgment to Prof. Chris Brown, my advisor at the University of Kansas, who is a role model of Geographer, teacher, and researcher.

I would also like to acknowledge the funding that supported my research and fieldwork: *Programa de Demanda Social* scholarship, *Programa de Doutorado-sanduíche no Exterior* (grant number 004971/2014-00), Feagri/Proap/Capes and Unicamp/Faepex (grant number 519.292 - 0556/14).

I am grateful to all participants in the interviews for making this study possible. Thank you very much.

I would also like to thank my thesis committee members for their contributions to improving this work.

I would also like to thank the faculty and staff of the School of Agricultural Engineering, especially my colleagues from LabGeo.

I am grateful to my friends who have always believed in me. Thanks to Ligia Galarza for receiving me at her home in Lawrence, Kansas. Thanks to Aimet Gutiérrez Estrada for reviewing part of my English writing.

Finally, I offer my sincerest gratitude to my wonderful family, especially my parents Carlos and Maria Elena, and my brother Gabriel, for their constant encouragement and for giving me the opportunity to further my education. I am forever grateful to my best friend and future husband Rafael, for his unconditional love and support during the entire process. He unselfishly gave his time, energy, and insights to help me develop this work. Thanks for being my partner in many challenges and adventures.

Abstract

In Brazil, some see intensive, large-scale production of sugarcane-based ethanol, based on a historical model of capital and land concentration, as a threat to the survival of family farming. Family farmers are increasingly under pressure to sell or rent land to mills where sugarcane monoculture is expanding. The present study is based on research conducted in the municipality of Ipiranga de Goiás, Goiás State, Brazil, where sugarcane plantations compete with corn, pasture and dairy cattle. It has two main objectives: (1) to examine the socioeconomic and environmental impacts of mill-cultivated sugarcane expansion on family farming; (2) to employ the Analytic Hierarchy Process method, with participation of stakeholders at federal, state and municipal levels, to support public policy decision-making addressing family farming, in order to mitigate adverse impacts of the sugarcane production. Using a questionnaire composed of closed- and open-ended questions, we interviewed 28 family farmers, which were divided into two groups: those with and those without land renting contracts with the ethanol and sugar mill. The results show differences between both groups, such as average area size, main source of income, past and current activities, and perceptions about the pros and cons of sugarcane expansion. Land leasing emerged as a short-term solution to the lack of on-farm labor and other economic difficulties small farmers continue to face. There are some farmers, however, who have resisted leasing their land for a number of reasons, including revenue is too low due to the small area in question; they also want to avoid loss of autonomy in production and the deep transformation of their rural way of life and landscape. In relation to the AHP results, the stakeholders prioritize environmental and economic benefits as the most important criteria requiring the attention of policy makers. Also, stakeholders agree that diversification of production is the most appropriate alternative for strengthening family farming. The AHP approach can be the starting point in the formulation of public policies. The approach helps ensure transparency, and it purposefully includes family farmer's points of view. Policies derived from this process, therefore, may have a higher likelihood of being supported and accepted by farmers.

Keywords: family farming; ethanol; public policy; decision-making; AHP.

Resumo

No Brasil, a produção intensiva e em larga escala do etanol derivado da cana-de-açúcar, baseada em um modelo histórico de concentração de terra e capital, muitas vezes é vista como uma ameaça para a sobrevivência da agricultura familiar. Os agricultores familiares convivem com a crescente pressão para vender ou arrendar suas terras para usinas aonde a monocultura da cana-de-açúcar vem se expandindo. O presente estudo baseia-se em uma pesquisa realizada no município de Ipiranga de Goiás, no estado de Goiás, Brasil, local onde os canaviais competem com cultivo de milho, pastagem e pecuária leiteira. Os objetivos principais são: (1) examinar os impactos socioeconômicos e ambientais na agricultura familiar derivados da expansão da cana-de-açúcar cultivada pelas usinas; (2) aplicar o Método de Análise Hierárquica (AHP), com a participação de *stakeholders* nas escalas federal, estadual e municipal, para subsidiar as tomadas de decisão em políticas públicas direcionadas para a agricultura familiar a fim de minimizar os impactos negativos da produção de cana-de-açúcar. Utilizando um questionário composto por questões abertas e fechadas, foram entrevistados 28 agricultores familiares, que foram divididos em dois grupos: aqueles com e aqueles sem contratos de arrendamento de terra com a usina sucroalcooleira. Os resultados mostram diferenças entre os grupos, tais como o tamanho médio do lote, a principal fonte de renda, atividades agrícolas atuais e do passado, e as percepções a respeito das vantagens e desvantagens da expansão da cana-de-açúcar. O arrendamento da terra surge como uma solução a curto-prazo para a escassez de mão de obra familiar na propriedade e outras dificuldades econômicas que os agricultores familiares enfrentam continuadamente. Alguns agricultores, entretanto, têm resistido ao arrendamento da terra por várias razões, como o baixo valor devido à sua pequena área, a perda de autonomia na produção e a profunda transformação do seu modo de vida e da paisagem rural ao seu entorno. Em relação aos resultados do método AHP, os *stakeholders* priorizam os benefícios ambientais e econômicos como os critérios mais importantes que demandam a atenção dos decisores políticos. Além disso, os *stakeholders* concordam que a diversificação da produção é a alternativa mais apropriada para o fortalecimento da agricultura familiar. O método AHP pode ser o ponto de partida para a formulação e direcionamento das políticas públicas, uma vez que ajuda a garantir a transparência no processo de tomada de decisão e, intencionalmente, inclui o ponto de vista dos agricultores familiares. As políticas públicas derivadas desse processo, portanto, apresentam maior probabilidade de serem aceitas pelos agricultores familiares.

Palavras-chave: agricultura familiar; etanol; política pública; tomada de decisão; AHP.

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List of Abbreviations

AGETOP	Goiás State Enterprise for Transport and Public Works
AGRODEFESA	Goiás State Enterprise for Agricultural Defense
AHP	Analytic Hierarchy Process
ANA	National Water Agency
ATER	Technical Assistance and Rural Extension
CANG	National Agricultural Colony of Goiás
CI	Consistency Index
CONAB	National Food Supply Agency
CONSEA	National Food and Nutrition Security Council
COOPERAGRO	Regional Agriculture and Cattle Ranching Cooperative of Rubiataba
CR	Consistency Ratio
DAP	Declaration of Eligibility for Pronaf
EMATER	Goiás State Enterprise for Technical Assistance and Rural Extension
EMBRAPA	Brazilian Agricultural Research Corporation
FNDE	National Fund for Development of Education
GIS	Geographic Information System
IBGE	Brazilian Institute of Geography and Statistics
INCRA	National Institute for Colonization and Agrarian Reform
MAPA	Ministry of Agriculture, Livestock and Food Supply
MDA	Ministry of Agrarian Development
MDS	Ministry of
NGO	Non-Governmental Organization
PAA	Food Acquisition Program
PES	Payment for Environmental Services
PGPAF	Price Guarantee Program for Family Farming
PNAE	National School Feeding Program
PNATER	National Policy for Technical Assistance and Rural Extension for Family Farming and Land Reform
PNPB	National Program for Production of Biodiesel
PROÁLCOOL	National Alcohol Program
PRONAF	National Program for Strengthening Family Farming

PRONATER	National Program of Technical Assistance and Rural Extension for Family Farming and Land Reform
RI	Random Consistency Index
SAF	Family Farming Secretariat
SANEAGO	Goiás State Sanitation Company
SDT	Territorial Development Secretariat
SEAGRO	Goiás State Secretary of Agriculture, Livestock and Irrigation
SECIMA	Goiás State Secretary of Environment, Water Resources, Infrastructure, Cities and Metropolitan Affairs
SEDUC	Goiás State Secretary of Education
UFG	Federal University of Goiás

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1 Introduction

Agriculture in general, and family farming in particular, are among the most essential activities in the world. In addition to producing food, family farming is linked to food and nutrition security, preservation of agro-biodiversity, and sustainable use of natural resources. Furthermore, agriculture is an activity that both supplies and demands energy, consequently markets in both sectors have always adjusted to one another. The recent growth and expansion of energy markets in most developed countries, and in several developing countries, have reshaped the role of agriculture as a provider of feedstock for the production of liquid biofuels for transport - ethanol and biodiesel. Biofuel production remains small in relation to total primary energy demand worldwide. Fossil fuels are still the dominant source of primary energy in the world, with oil, coal and gas together supplying more than 80% of the total. Renewable energy sources represent only 13% of total primary energy supply, with biomass and waste dominating with 10% the renewable sector. Biofuel production, however, is significant, considering current levels of agricultural production (FAO, 2008).

The environmental and socioeconomic impacts of its constant growth, therefore, must be recognized, especially in Brazil, where approximately 40% of the total energy supplied comes from renewable sources, with sugarcane products corresponding to 15.7% of the domestic energy supply in 2014 (EPE, 2015). Brazil, in this context, is at the center of the debate, given that sugar and ethanol production are key components of rural development and energy strategies (MARTINELLI, 2011) and the country is the world's leading producer of other agricultural commodities such as sugar, coffee, soybeans, poultry and beef.

In Brazil, however, family farming has taken a secondary and subordinate role to large-scale agribusiness, which has been favored by agricultural policies designed to modernize and ensure its reproduction (WANDERLEY, 1995). Moreover, infrastructure and rural credit programs have favored cash crop production over food crops (NOVO et al., 2010; CARVALHO and MARIN, 2011). This situation began to change with the creation of Pronaf in 1996 - The National Program for Strengthening Family Farming. This program signaled public concern about family farming for the first time. Until then, policies exclusively supported large-scale agribusiness, which was considered the only viable form of production in the modernization of Brazilian agriculture (SACHS, 2001). Policy makers viewed family farming as an important generator of employment and income. As part of a larger package of rural development initiatives, Pronaf was originally structured into 4 parts: articulation of

public policies for rural areas; installation and improvement of infrastructure and services; financing for family farming production; and family farmer education and training. From the beginning, the government chose the financing element – Pronaf credit – as the main instrument to promote sustainable development of family farming; the high cost and scarcity of credit for farmers was viewed as a major roadblock to family farm development (AQUINO, 2009). Pronaf's rural credit provides loans with low interest rates to cover annual costs or long-term investment in family farming.

Though Pronaf helped make the family farmer a focus of policy, other issues have remained. The Brazilian government still has not developed a census properly characterizing the specific and diversified livelihood strategies of this social group to help track progress in the sector; agricultural censuses still focus only on production data (NEVES, 1995). Family farming and family farmers also remain relatively invisible in studies and discussions about bioenergy and decision-making in development. Family farmers are often viewed instrumentally, as mere producers, rather than as rural actors with their own distinct voices and views about rural development (ROSSI and HINRICHS, 2011).

Brazil is seen as a major world player in the production of biofuels (mainly in the form of sugarcane), backed by strong rhetoric and discourse about the positive role of biofuels in promoting sustainability. Many researchers and policy analysts believe that biofuels could offer an opportunity for agricultural and rural development. Some initiatives have emerged as an attempt to integrate family farming systems into sugarcane ethanol production (WILKINSON and HERRERA, 2010; AGOSTINHO and ORTEGA, 2012; MAROUN and LA ROVERE, 2014). Small-scale production and cooperative efforts could contribute to economic stability and improve livelihoods, if farmers maintain control of their crops and land (DAUVERGNE and NEVILLE, 2010). Others have argued that sugarcane production potentially reduces global greenhouse gas emissions, creates jobs, and increases income. Moreover, the availability of underutilized land, abundant water, and other favorable climatic conditions allow for the growth of both food and fuel crops, without promoting deforestation (WILKINSON and HERRERA, 2010; NOVO et al., 2012).

However, after the initial euphoria defending the so-called “sustainable” ethanol from sugarcane in the international biofuels debate, fundamental questions arose concerning negative environmental, social, and economic impacts of biofuel production. In Brazil, sugarcane ethanol is being intensively produced at a large scale, increasing corporate control of production and distribution, resulting in capital and land concentration in such a way that it is unclear whether the sector can benefit family farmers. In addition, others are concerned that

sugarcane production has led to competition with food production and negative land use change impacts, such as loss of biodiversity and deforestation (DAUVERGNE and NEVILLE, 2010; NOVO et al., 2010; MAROUN and LA ROVERE, 2014).

The increase of federal government support to biofuels in the early 2000's resulted in considerable land use changes in central Brazil, with the expansion of intensive sugarcane-monoculture, which led to pressures on family farmers for selling/renting land to the sugar mills. Renting land is an attractive low-risk option for farmers, compared with other land use options. The sugarcane industry also incentivizes renting via long-term contracts and the opportunity for monthly payments for the land lease. This new scenario could cause significant impacts on family farming production, including a decrease in food production and extinction of local food markets, landscape change, and an overdependence on income from the sugar mills; farmers might even quit agriculture altogether. Moreover, rural extension and technical assistance services could lose their importance in supporting family farmers, who find themselves stripped of their status as food producers, inserted in the middle of a sea of mill-cultivated sugarcane.

The government, therefore, needs to formulate or modify public policies in sugarcane producing regions to support farm livelihoods and income. Research on family farmer interactions with the sugar mills concerning land use, sustainability, and income, among other issues, can help form the basis for policy-making. Many observers are calling for more direct participation by family farmers in development and policy-making processes to achieve agricultural development that truly values family farming. It is believed that better social and environmental outcomes are achieved when local development programs are discussed and negotiated among all stakeholders involved in the process, with the municipality or a group of municipalities as the territorial unit, in which family farmers are key actors (SACHS, 2001). It is often the problem, however, that small farmers lack the power and political channels to participate in political debates and influence public policies in the first place (GUANZIROLI et al., 2013).

In spite of all controversies over biofuels, one fact deserves attention: most of the time, the small-scale farmer's voice is not heard in the studies of policy making and impact assessments. This is a serious issue, because they are the most vulnerable in the countryside. We assume that there are three possible outcomes for family farming in a sugarcane-monoculture context, already reported in some case studies: resisting the pressure from the sugar mills and distilleries, coexisting with the sugarcane through land renting and/or by integrating sugarcane and dairy production, or abandoning agriculture definitively

(MAROUN and LA ROVERE, 2014; SCHLESINGER, 2013 and 2014; NOVO et al., 2012; CARVALHO and MARIN, 2011; EGESKOG et al., 2011; ÁVILA, 2009).

As stressed by Van der Horst and Vermeylen (2011), "policies clearly designed for the purpose of security of energy supply cannot realistically be expected to yield high social or environmental benefits". Accordingly, we hypothesize that the intensive and large-scale production of sugarcane is, in most cases, incompatible with family farmers' livelihoods in a developing country like Brazil, historically characterized by capital and land concentration that keep on benefiting producers tied to agribusiness; and, in this context, a multi-criteria decision-making tool, such as the Analytic Hierarchy Process, can be applied to help family farmers and policy makers define the policy priorities in areas affected by the expansion of sugarcane.

Knowing these priorities is an essential step policy makers must take to arrive at policies that have a high likelihood of being accepted by farmers, implemented, and then assessed for whether they achieved intended social and environmental outcomes. The Analytic Hierarchy Process (hereafter AHP) is a well-established methodology that deals with multi-criteria decision-making and allows for the participation of multiple stakeholders. Using the AHP, policy makers are able to incorporate important human dimensions of decision-making, by quantifying and deriving measurements for subjective as well as group preferences. The AHP works as a link between the field of debates and the field of practical actions by public managers. It is a tool that can help policy makers take people's desires, expectations, and wishes and translate them into beneficial public policies.

Thus, seeking to explore how family farmers have dealt with sugarcane presence close to their rural properties, by listening to what they have to say, this study contributes to our understanding of the future of family farming facing that situation, given that sugarcane will continue to advance over the Cerrado biome (Brazilian savanna). We examine how the expansion of mill-cultivated sugarcane has impacted family farming at production sites, regarding socioeconomic and environmental aspects, in the municipality of Ipiranga de Goiás, Goiás state, Brazil, where sugarcane plantations compete with corn, pasture and dairy cattle from small-scale farmers. We also present an application of the AHP approach to finding common policy priorities among the multi-stakeholders with the purpose of improving family farmers' livelihoods.

1.1 Research questions and objectives

The guiding questions of this research are: What are the prospects for the survival of family farming in the context of competition from sugarcane? In the light of the potential impacts arising from sugarcane expansion, what policies addressing family farming should be given priority?

The specific objectives are:

A. To identify the positive and negative impacts on family farming caused by the expansion of sugarcane and to understand how family farmers have coped with the pressure to rent land to sugar and ethanol mills;

B. To determine objectively, using the AHP approach, what are the policy priorities of multiple stakeholders focusing on family farming;

C. To present the public policies that fit the priorities identified in objective C, from the viewpoint of family farmers.

1.2 Outline of the thesis

Besides this introduction and definition of the research questions, this thesis is organized as follows. The next chapter addresses the literature review about the legal recognition of family farmers as political actors and direct beneficiaries of public policy in Brazil, as well as the Brazilian experience in sugarcane and ethanol production, the concerns that have arisen regarding the recent expansion of sugarcane plantations in areas of family farming, and the wide use of the AHP approach in decision-making process. The third chapter describes the materials and methods used for the selection of the study area and the steps involved in the execution of the AHP methodology with multiple stakeholders. The fourth chapter addresses the results and discussions, divided into three sub-sections. The first sub-section analyzes how the expansion of sugarcane, through land renting contracts between farmers and sugar mills, has impacted family farming in the study area, with respect to socioeconomic and environmental aspects; it addresses objective A. The second sub-section addresses objective B, exploring the priorities of multiple stakeholders that require the attention of policy makers and should be the most important drivers of public policies geared toward family farming. These results allow us to transition to the last sub-section, which addresses objective C, presenting the public policies that could be expanded or implemented

to meet farmers' demand and minimize the impacts generated by sugarcane production. The fifth chapter consists of a general conclusion of this thesis and suggestions for future works.

2 Literature Review

2.1 Family farming in Brazil

Family farming in Brazil is defined by the Law 11,326[1], dated 2006, which establishes the directives for the formulation of a National Policy for Family Farming and Rural Family Ventures. According to the law, the family farmer and the rural family business as the person or entity that undertakes activities in the rural environment and meets simultaneously the following requisites:

- does not exceed the maximum area of landholding for the municipality where the farm is located;
- predominantly uses labor of his/her own family within the economic activities of his/her establishment or venture;
- has a family income predominantly from economic activities tied to the establishment or venture itself;
- manages his/her establishment or venture with his/her family (FAO, 2015).

The limit of landholding is four *módulos fiscais* (literally, tax modules), and this unit of measure attempts to represent the minimum area required for a farm to be economically viable. The size of the tax module varies from five to 110 ha, depending on the municipality, and the size is set by the National Institute for Colonization and Agrarian Reform - Incra. In Goiás, a tax module varies between seven and 80 ha. In Ipiranga de Goiás, our study area, the tax module is 20 ha (LANDAU et al., 2012).

The existence of a legal milestone allowed the Brazilian Institute of Geography and Statistics – IBGE to identify the family farmers in the last Brazilian Agricultural Census, whose data were collected in 2006. This contributed to the backfilling of an important deficiency in official information concerning the public policies for rural development (FAO, 2015). The results of the Agricultural Census showed that there were 5,175,489 rural establishments in the country, of which 4,367,902 (84.4%) were classified as family farmers. Regardless of their numerical significance, these familiar units occupied just 24.3%, around 80 million ha, of the total area of rural establishments. This means that 15.6% of the non-familiar farms occupied 75.7% of the area, indicating a huge concentration of land ownership. The average area size of familiar establishments was 18.37 ha, against 309.18 ha of non-

[1] Available at <http://www.planalto.gov.br/ccivil_03/_ato2004-2006/2006/lei/l11326.htm>.

familiar establishments. Despite the land inequality, family farmers produce 70% of all food products consumed in Brazil daily, account for 33% of the production value and generate 74.7% of the rural work force (IBGE, 2009). Among the Brazilian geographic regions, the Northeast stood out with 50% of rural establishments classified as family farmers, followed by the South with 19.5%, the Southeast with 16%, the North with 9.5% and the Central-West region with 5%. The Goiás state, located in the Central-West region, had, in 2006, 135,683 rural establishments in more than 25 million ha, of which 88,436 (65.2%) were familiar units that occupied 3,329,630 ha, just 13% of the total (IBGE, 2009).

In addition to the deep-rooted land concentration in Brazil, the access to agricultural finance remains also uneven. The family farming sector will receive R$ 30 billion for the 2016-2017 agricultural year (MDA, 2016a), while the agribusiness operating large-scale mono-cultivation will receive R$ 185 billion (MAPA, 2016), over six times more.

It is worth mentioning that the generic concept of family farming does not cover the variations in the profile of farmers across the different agro-climatic zones and regions of the country. Family farmers differ by their history, cultural heritages, professional experiences, and access to markets, natural resources, human and social capital. They are inserted in distinct agrarian landscapes and have different potentialities and constraints, which shape their interests and specific strategies for survival and production. But besides these differences, economic and social similarities justify the use of the family farming category for the purposes of public policy. Family farmers create numerous jobs in the countryside, spend locally, and contribute to other activities such as the street markets, the local retail trade, food supply, and the production of inputs integrated with agro-industrial value chains. They also suffer from disadvantages because of infrastructure deficit, and low access to land due to the highly concentrated land ownership (GROPPO and GUANZIROLI, 2014).

2.2 Public policies and family farming in Brazil

There are several definitions about public policy. Souza (2006) summarized public policy as "the field of knowledge which aims, at the same time, put the government into action and/or analyze this action (independent variable) and, where necessary, propose changes in direction or course of these actions (dependent variable)". The formulation of public policy constitutes the stage in which democratic governments translate their purposes and electoral platforms in programs and actions that will produce results or changes in the real

world. Decision-making involving public policies, in short, entails responding whom gains what, why and what difference it makes.

Souza (2006) lists the main public policy's fundamentals: it makes a distinction between what the government intends to do and what, in fact, does; it involves several actors and decision levels, although it is materialized through the governments, and is not necessarily restricted to formal participants, as informal ones are also important; it is comprehensive and not limited to laws and rules; it is an intentional action, with objectives to be achieved; it is a long-term policy, although it may have impacts in the short-term; after its decision and proposition, it also implies implementation, execution and evaluation.

Public policies are systematized in official documents - laws, programs, finance lines - that guide actions usually involving public resources applications. There may be, however, incompatibility between the statements and the actions taken. Therefore, the "non-action" and omissions should also be considered as forms of political manifestation, as they represent options and guidance of those who hold office (TEIXEIRA, 2002).

Public policies aim to meet the demands, especially those from marginalized sectors of society. These demands are interpreted by those who hold power but influenced by an agenda created by civil society through social mobilization. Other policies aim to promote development, create employment and income generation as a compensatory form of adjustments created by other economic policies with more strategic nature (TEIXEIRA, 2002).

In Brazil, until the early 1980s, public policies were characterized by centralization at the federal level and exclusion of civil society in the processes of formulation, implementation, and control of governmental actions. The new Federal Constitution of 1988 consolidated the process of democratic opening succeeding the military governments and emphasized political and administrative decentralization and the empowerment of broad sectors of civil society. It favored an arrangement of elected representatives and the direct participation of organized society in decision-making processes, through legal and political instruments that allow the citizens to play a direct role in various subjects that concern them (RUA, 2009).

The development of differentiated public policies targeted at small sized rural properties was simultaneous to the emergence of the concept of family farming, and the continuity of the reorganization process of the actors in the rural environment. However, during the 1990s, despite the social advances, the neoliberal public policies dismantled the instruments concentrated on rural development, giving privileges to the market instruments,

and restricting their response to a few of the demands of the organized movements in the countryside (FAO, 2015). Then, the strengthening of family farming is closely associated with the advance of political pressure from rural workers' unions in the 1990s. Disputes over credit, prices, different forms of commercialization, rural social welfare, protection and the fight against deregulation and indiscriminate trade liberalization encouraged the unions to join other movements in national protests, such as the one-day marches - "*Jornadas Nacionais de Luta*". These mobilizations and struggles had a significant political impact (SCHNEIDER et al., 2010). Furthermore, in the same period, there was heated academic debate in Brazil about family farming. Grisa and Schneider (2014a) highlighted four emblematic studies that contributed to the concept of family farming: Veiga (1991), Abramovay (1992), Lamarche (1993), and FAO and INCRA (1994). These studies drew attention to the different strategies of social reproduction, resilience, and innovation capacity of small farmers, instead of their subordination to capitalist relations of production, as well as recommended formulation of agricultural policies designed specifically for family farming. The debate on the family farming as a political and conceptual category was afterward assimilated by scholars and policy makers, giving an extraordinary legitimacy to family farming such that it became a strong reference in opposition to other equally powerful concepts, like agribusiness (SCHNEIDER et al., 2010).

In this context, starting a new path to this social category, the creation of the National Program for Strengthening Family Farming - Pronaf in 1996 responded to this demand and triggered the emergence of other differentiated policies for rural development, as this program recognized the specific characteristics of family farming as a social form of work and production. A few years later, in 1999, the establishment of the Ministry of Agrarian Development - MDA[2], and, in 2001, the creation of Family Farming Secretariat - SAF signified a federal commitment to agrarian development with family farming at its heart. In 2003, the federal government adopted the approach of territorial development in the formulation of some public policies with the objective of reducing regional disparities, promoting a leading role of social actors in the construction and governance of development

[2] During the writing of this thesis, the Brazilian Senate on 31st August 2016 impeached Dilma Rousseff, Brazil's first female president, and removed her from office for the rest of her term. The then vice-president Michel Temer is expected to remain in office until the end of the current term in 2018. While Temer served as the interim president during the impeachment trial, he eliminated nine ministries, including the Ministry of Agrarian Development - MDA, which became the Special Secretariat for Family Farming and Agrarian Development linked to the Civil House. The Ministry of Social Development and Fight Against Hunger - MDS is now the Ministry of Social and Agrarian Development. In this thesis, we maintained the previous denomination of the ministries throughout the text.

processes, and offering innovative solutions for sector policies. For this purpose, the Territorial Development Secretariat - SDT was created under control of the MDA (SCHNEIDER et al., 2010; IPC-IG, 2013; GRISA and SCHNEIDER, 2014a; GRISA and SCHNEIDER, 2014b).

Also in 2003, the Food Acquisition Program - PAA was established as part of the strengthening family agriculture component of the Zero Hunger strategy. When Luis Inácio Lula da Silva became president in 2003, hunger became a major focus of Brazil's federal government. The Zero Hunger strategy was created with the goal of promoting food security, comprising four axes: access to food, strengthening family farmers, income generation, and social mobilization and social accountability (IPC-IG, 2013). The PAA aims to support family farmers' production and their access to market through simplified public procurement procedures, and to distribute food in quantity, quality, and regularity necessary for food-insecure groups. As a coordinated attempt to support the construction of new markets for those farmers while simultaneously fighting poverty and hunger, recent reforms of the National School Feeding Program - PNAE, in 2009, introduced the legal requirement that at least 30 per cent of the products purchased for school meals should be bought from family farmers and/or their organizations. Both PAA and PNAE are currently major sources of structured demand for small farmers producing food crops (IPC-IG, 2013).

The Technical Assistance and Rural Extension - Ater services also experienced important changes. In 2003, the responsibility for Ater, once under control of the Ministry of Agriculture, Livestock and Food Supply - MAPA, was transferred to the MDA. One year later, it was created the National Policy for Technical Assistance and Rural Extension for Family Farming and Land Reform – Pnater, and the National Program of Technical Assistance and Rural Extension for Family Farming and Land Reform – Pronater that adopted the agroecology as a guiding principle for actions (CAPORAL, 2014). In 2010, the Pnater was modified by Law 12,188[3]. It defines Ater as non-formal on-going based education services in rural areas, with the following principles: sustainable rural development, participatory methodology, ecological-based agriculture, gender and race equity, and gratuity, quality and accessibility to technical assistance services (FAO, 2015).

As from 2003, the federal government initiated studies for the substitution of the petroleum-based diesel by a renewable source, inspired by the successful experience with the National Alcohol Program – Proálcool (see Section 2.3). The idea of a new biofuel program

[3] Available at <http://www.planalto.gov.br/ccivil_03/_Ato2007-2010/2010/Lei/L12188.htm>.

was to provide renewable energy and, at the same time, support productive inclusion, mainly that of family farming. Then, the National Program for Production of Biodiesel – PNPB was established in 2005, ensuring a better position in auctions and providing tax benefits for the biodiesel producing plants that purchased raw material from family farmers. The MDA grants the "Social Fuel Seal" to these units that must prove that the raw materials (mainly soybean, cotton, animal fat from cattle and chickens) were obtained from family farmers and must also provide technical assistance to these producers and ensure the participation of family farming representatives in negotiation of contracts and prices (FAO, 2015).

Finally, in 2006, only ten years after Pronaf was established, family farming in Brazil was legally recognized. This made it possible for family farming-related activity to be included in official government statistics, secured the legal grounds for public policies specifically addressing this sector, and recognized family farmers as political actors and direct beneficiaries of public policy. The impacts of these public policies and the changes occurring in rural areas are heterogeneous in a country as large and diverse as Brazil. It is notable, however, the improvements in terms of reducing social inequality and raising the living standards of many millions of small-scale family farmers, who have experienced improvements in access to land and credit since the early nineties (SCHNEIDER et al., 2010).

2.3 The expansion of sugarcane in Brazil and its impacts on family farming

Sugarcane originates from tropical South and Southeast Asia and sugar production was known 5,000 years ago in India. It had a great influence on many tropical islands and colonies in the Caribbean, South America, and the Pacific, driven by the interests of the European colonial powers. In Brazil, the land use change into sugarcane, which was first introduced in the Northeast coast, is part of the history of the country, dating short after Portuguese colonization during the 16th century. For most of the 20th century, sugarcane production was driven by global demand for sugar, was conditioned by the heritage of colonial structures, and was greatly influenced by policy and trade agreements. Since the mid 1970s, however, sugarcane production in Brazil has been largely driven by domestic policies fostering ethanol production to increase energy self-reliance and to reduce the import bill for petroleum. In recent years, ethanol demand became a driving force at the global level, as a possible option in response to climate change and also to concerns over energy security. At this time, the largest area under sugarcane cultivation is in the Central-South region, which has the favorable environmental conditions in terms of temperature, radiation, precipitation,

soil and relief that match the crop physiological needs, besides socio-economical aspects (FISCHER et al., 2008).

Brazil's well known production of liquid biofuels began in 1975 with the creation of the Proálcool, the most extensive and well known program in ethanol being produced commercially as a fuel. It was a way for Brazil to face the collapse of international sugar prices and the first oil crisis in 1973. Thus, the Brazilian government developed Proálcool to reduce the historic high dependence on imports of fossil fuel and also to revitalize the sugarcane industry. The program established a highly regulated market through price control and increased subsidies for alcohol production to replace gasoline. The program also invested in research and development to generate new technologies (NOVO et al., 2010). This favorable legal framework resulted in a huge expansion of ethanol production, which increased more than 50% within five years. In 1979, when international oil prices reached new highs, the Proálcool gained new force, stimulating the use of hydrated ethanol as exclusive fuel in car engines. The end of the expansion phase of the Proálcool began around 1985 due to the decline in oil prices and strengthening of sugar prices. In 1986, the federal government reviewed the incentive policies for ethanol, thus reducing the average sugarcane industry returns and further making it more profitable to produce sugar for export. A move towards deregulation and free-market pricing in the sugar-ethanol sector started in 1991, in the context of a more stable economy, together with the cutting of subsidies, a process completed in 1999. Although the subsidies were eliminated, the government preserved the blending rules with the requirement for the anhydrous ethanol mixture in the gasoline of 20-25%, maintaining a minimum and relatively safe internal market for the biofuel (NOVO et al., 2010; NOGUEIRA and CAPAZ, 2013).

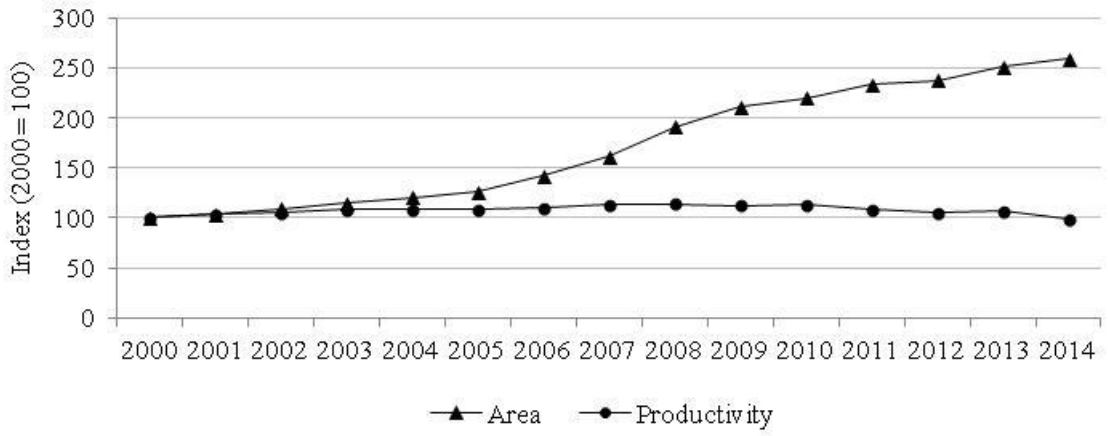
Back in the 1970s, environmental concerns were not an important issue driving the shift to alcohol. Since the beginning of the 21st century, however, the main arguments behind policies supporting biofuels based on agricultural commodities have been the potential to mitigate global climate change through reduction of greenhouse gas emissions, to contribute to energy security and support agricultural producers, and to reduce rural poverty in developing countries, where 75% of the world's poor depend on agriculture for their livelihoods (FAO, 2008). Furthermore, in the case of Brazil, the introduction of flex-fuel technology in 2003 created a domestic demand for a new expansion of the sugarcane industry that re-emerged even stronger, boosted by the growing middle class population with access to durable consumer goods (CASTILLO, 2015). Flex-fuel cars were well accepted by consumers because they offered the options of using gasoline (with 20-25% anhydrous ethanol), hydrated

ethanol (pure) or any blend of both fuels, depending on relative prices and availability along with consumer desire for autonomy and performance (NOGUEIRA and CAPAZ, 2013).

Such circumstances combined triggered a rapid expansion of sugarcane planted area in Brazil from 2003 to 2008, concentrated in the Central-South region (states of São Paulo, Goiás, Minas Gerais, Paraná, Mato Grosso do Sul and Mato Grosso). The expansion process decreased in 2009 after the 2008 financial crisis brought an end to new investments in the sector. Government intervention in gasoline prices, to keep inflation under control, decreased ethanol's competitiveness. Consequently, ethanol demand decreased as consumers switched to putting gasoline in their flex-fuel vehicles (ANGELO, 2012; NOGUEIRA and CAPAZ, 2013). After that decline, the government included in the 2011/2012 Annual Harvest Plan a specific credit line for expansion and renewal of sugarcane fields (MAPA, 2011). In addition, as part of a set of policies for the sugar-energy industry recovery, the government has encouraged the acquisition of new vehicles by reducing the tax on industrialized products, which resulted in a rapid growth of motorization rates (CASTILLO, 2015). At present, flex-fuel cars represent around 90% of new car purchases (ANFAVEA, 2015).

A horizontal expansion of sugarcane production (increase in planted area) rather than a vertical expansion (increase in productivity) (CASTILLO, 2015) met the demand for ethanol in Brazil, as shown in Figure 1. The Index shows the relative evolution of area and productivity considering the year of 2000 as the starting point (2000 = 100).

Figure 1 – Sugarcane cultivated area (ha) and productivity (tons/ha) in Central-South region, 2000-2014



Source: IBGE, 2016

We observe in Figure 1 that sugarcane productivity varies very little, while the cultivated area increased by about 2.5 times in the period. For the 2016/2017 crop season, the sugarcane planted area in the Central-South was 8,089.7 thousand ha, that is 5.2% greater than the previous crop season. The estimated sugarcane production is 637,667.2 thousand tons, an increase of 3.4% compared to the 2015/2016 crop season (CONAB, 2016a).

Such horizontal expansion, together with particular characteristics of sugarcane, entails important consequences to the region around ethanol and sugar mills. This feedstock cannot be stored for a long time, since it begins to degrade and should be processed soon after the harvest. Then, once the mill has been implemented, there will necessarily be cultivation of sugarcane nearby. This constraint results in rigidity in the land use, making the diversification of production more difficult. It follows a deeper regional productive specialisation, in which the economy of municipalities dedicated to sugar and ethanol production becomes more vulnerable by relying largely in a single economic sector (CASTILLO, 2015).

Despite the ups and downs of the sugarcane industry over time, it is undeniable that the rapid horizontal expansion of a large-scale monoculture causes a number of impacts. Leal et al. (2013) estimated the land demand in global terms to produce the amount of 300 billion litres of ethanol forecasted for 2030, considering first- (1G) and second-generation technologies (2G) of sugarcane ethanol in Brazil and corn ethanol in USA. With respect to sugarcane, the estimated demand of land is 29 Mha considering 1G technology and 22 Mha when combining 1G and 2G technologies. Taking into account that the Sugarcane Agroecological Zoning for Brazil indicates 65Mha of land adequate for cultivation of sugarcane, without major impacts on food production and on the environment, those values seem to be feasible (LEAL et al., 2013). However, keeping in mind that the benefits promised by biofuel proponents may differ from what actually happens on the ground, the production of biofuels may generate negative impacts depending on the complexity of the local conditions (RIBEIRO, 2013). Brown et al. (2014) addressed the difficulty of tracking shifts in agricultural area dedicated to food versus fuel production in Brazil. Regional hot spots were identified where major shifts toward or away from staple crop may be occurring, but without empirical studies at finer scales, it is difficult to determine to what degree food production is being replaced by sugar cane.

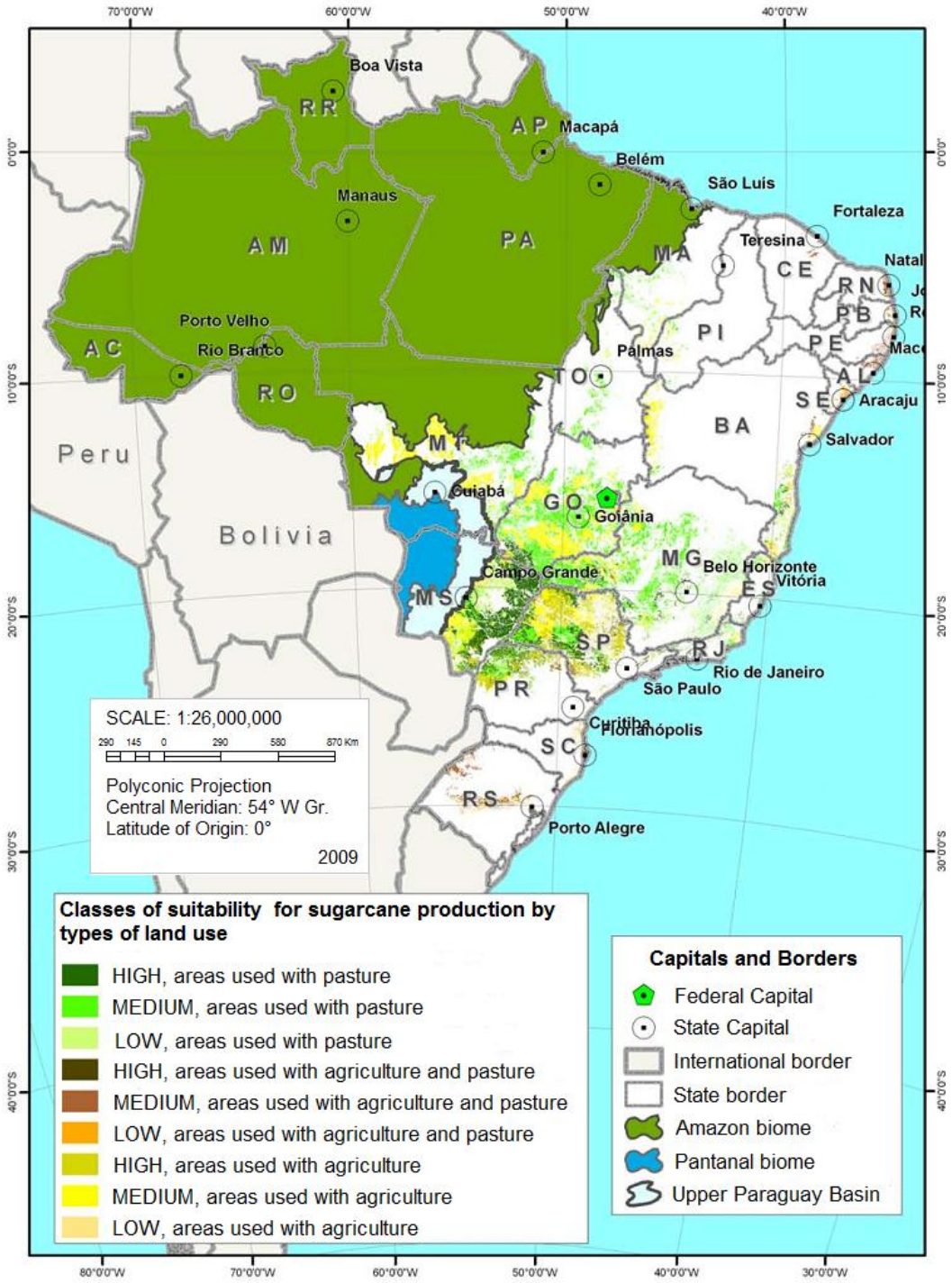
Researchers have prioritized environmental and economic impacts in studies addressing biofuel sustainability in the past few years, while social impacts have not yet received the same attention. Ribeiro (2013) undertook a systematic review of peer-reviewed literature identifying social impacts of ethanol and summarizing them from a lifecycle

perspective. There are a number of positive and negative impacts mainly related to land use change, concerning the feedstock production stage of ethanol: land tenure conflicts; concentration of wealth; reduction of natural heritage and environmental services to local populations due to forest clearing for biofuel production; reduction of jobs due to mechanization in sugarcane plantations, excluding unskilled workers, but with a possible increase in demand for skilled workers; rural-to-urban migration; air pollution and respiratory problems due to harvest burning practices; pollution of waterways by farm wastes and reduction of water availability and quality; increased noise and perceptible odour levels near feedstock production; homogenization of agricultural landscape that reduces natural pest control, increasing the need for pesticides; direct or indirect threats to food security of local people and society; revitalization of rural areas after changes in local rural infrastructure; contribution to the empowerment of women in rural areas. Then, Ribeiro (2013) argues that the levels of social vulnerability close to production sites can increase at the local and regional levels, although indirect consequences may also be felt at wider societal levels, especially concerning the access of poor people to cheap water, consumer goods, and staple food in the near future.

Particularly in Brazil, concerns have arisen with respect to the expansion of sugarcane plantations in traditional areas of family farming. We focus on Goiás state in the present study. It is the third largest sugarcane producer, behind São Paulo and Minas Gerais, but its cultivated area increased 533.8% between 2000 and 2014, while area expanded in São Paulo and Minas Gerais less than Goiás in the period, 124% and 224% respectively (IBGE, 2016). A number of factors help explain the exponential growth of sugarcane area in Goiás, including tax incentives, relatively low land prices, and flat topography suitable for mechanized harvest (CASTILLO, 2009). Goiás is located in the Cerrado biome (Brazilian savanna), considered the area with the greatest availability of suitable land for sugarcane cultivation, according to the Sugarcane Agroecological Zoning (MANZATTO et al., 2009). The Sugarcane Agroecological Zoning was drawn up by Embrapa, the Brazilian Agricultural Research Corporation. It is a study to guide the sustainable expansion of the sugarcane production and the investments on the sugar and ethanol sectors. The following guidelines have been set: exclusion of areas with native vegetation; exclusion of areas for cultivation in the Amazon and Pantanal biomes, and in the Upper Paraguay River Basin; identification of areas with agricultural potential without need of full irrigation; identification of areas with slope below 12% that allow the use of mechanical harvesting; respect for food security; and priorization of degraded areas or pasture. As shown in Figure 2, the majority of suitable areas

for sugarcane expansion in the Goiás state (GO) have medium suitability, and are currently used with pasture and with agriculture. This zoning indicates approximately 12Mha of land adequate for cultivation of sugarcane in Goiás (MANZATTO et al., 2009).

Figure 2 – Suitable areas for sugarcane expansion by classes of suitability and land use, according to the Sugarcane Agroecological Zoning



Source: Manzatto et al. (2009). The map legend was freely translated into English by the thesis' author.

Notwithstanding the long experience in sugarcane cultivation, for both sugar and ethanol production, the land use change driven by sugarcane expansion and its impacts at the level it takes place is still a topic of discussion in Brazil. On one hand, the media, official reports (CONAB, 2013), and studies based on official statistics and remote sensing data (WALTER et al., 2008; SPAROVEK et al., 2009; RUDORFF et al., 2010; ADAMI et al., 2012) have spread the idea that sugarcane cultivation has advanced over pastures and does not represent a threat to food crops, which is mainly supplied by family farmers. Moreover, statistical analysis of socioeconomic indicators, at the municipal level in São Paulo, Alagoas and Goiás states, showed that the municipalities where sugarcane activity is relevant presented, overall, better socioeconomic conditions than the municipalities without sugarcane. In Goiás, where sugarcane production started more recently than other states, the differences between the two groups of municipalities were not so strong (MACHADO et al., 2015). Comparing the sugarcane sector and the agricultural sector in general, at the regional level, the former presented better socioeconomic indicators than the latter, regarding employment, wage and education (MORAES et al., 2015). However, these socioeconomic indicators are only helpful to describe the situation in a certain period; though properly selected, they are insufficient to explain why that situation exists or which processes led to that situation.

On the other hand, Brazilian policy makers believed that ethanol production was not succeeding in reducing poverty and social inequities in Brazil, although it is considered one of the most economically efficient and technologically advanced biofuels (HALL et al., 2009). For instance, recent studies described the changes in family farming activities after the sugarcane expansion in some municipalities of Goiás, such as Itapuranga (CARVALHO and MARIN, 2011), Inhumas, Itaberaí and Jussara (CASTILLO, 2009). In these places, staple food, fruits and milk production decreased; forests were cleared and buildings were demolished. In Goiás, it is common for farmers to take part in the sugar-energy sector by renting their land, as a passive landowner, with the mill being responsible for all steps of production, rather than being a sugarcane supplier. The consequences of this leasing system may be very harmful to the small farmers, especially considering the difficulty in regaining control over their land once it is leased (CASTILLO, 2009). In São Paulo state, many family farmers were attracted by increased land prices and high rents offered by the sugarcane industry; specialized dairy farmers ceased operations, selling or renting their land to the sugarcane sector (NOVO et al., 2010). In Mato Grosso state, the non-governmental organization Fase - Federation of Organs for Social and Educational Assistance - carried out fieldwork in agrarian reform settlements and family farming areas surrounded by sugarcane

monoculture. Their reports presented a number of negative impacts on those marginalized people, such as deforestation of large areas, soil degradation, loss of biodiversity and reduction of clean water availability; land tenure concentration and displacement of local people, making food production and local and regional supply unfeasible; among others (SCHLESINGER, 2013, 2014).

2.4 Applications of the Analytic Hierarchy Process in decision-making

In human decision-making, a variety of subjective and objective criteria are taken into consideration. In fact, making a choice is rarely an objective action, and it usually involves a certain degree of inconsistency. Policy makers are under increased pressure to make decisions in a transparent and responsible way. In this context, the Analytic Hierarchy Process - AHP is an approach that combines both objective and subjective criteria in decision-making, in a manner that is easy for lay people to understand. On one hand, AHP requires the use of computers to perform mathematical calculations. On the other hand, it provides a relatively simple approach for users to express preferences for complex problems (ITAMI et al., 2001). Additionally, Garfi et al. (2011) highlight the multi-faceted aspect of AHP, considering it an appropriate tool for human development projects aiming to improve living standards in developing countries; the AHP is simple, flexible, and transparent to participants, and it focuses on the needs of beneficiaries.

Originally developed by Thomas Saaty in the 1970's, the AHP is one of the most widely used methods of multi-criteria decision-making. It is a useful tool based on mathematical and psychological fundamentals to analyze complex decisions, many times involving multiple stakeholders and multiple alternatives, using a hierarchical structure that facilitates rigorous definition of priorities and preferences in decision-making processes (SAATY, 1991). The AHP can deal with both quantitative and qualitative attributes. It can be applied with a limited number of individuals or groups, as long as they are knowledgeable about the problem at hand, which is different from statistical methods that require ideal sample size for data collection. Furthermore, this approach can also be used in decision-making procedures where perceptions of individuals, groups, or both, are under consideration (DUKE and AULL-HYDE, 2002; KUKRETY et al., 2013).

AHP has found its widest applications in multi-criteria decision-making, in planning and resource allocation, and in conflict resolution (SAATY and VARGAS, 2001). It has been applied in various research topics including public participation in decision-making

processes in public administration, environmental management, sustainability and energy issues, and agricultural policies. No studies were found, however, that used the AHP method oriented towards the needs of family farming in Brazil, including the perception of family farmers. Alphonce (1997) suggested five hierarchies illustrating the variety of multi-factor agricultural decisions in developing countries to which AHP can be applied: (a) determination of farm portions to be allocated to each of the food crops – corn, millet and cassava; (b) resource allocation to agricultural activities; (c) best location for a village store; (d) choice between subsistence and cash crops production; and (e) determination of the crop production technology. Duke and Aull-Hyde (2002) used the AHP to identify public preferences for the environmental, agricultural, growth control, and open space attributes of farmland in Delaware/USA. Oddershede et al. (2007) presented a decision model based on community preferences to determine activities that would best contribute to rural development in Chile. Garfì and Ferrer-Martì (2011) presented a comprehensive list of criteria and evaluation indicators as a guideline in multi-criteria analysis for an effective assessment of water and sanitation projects in developing countries, detailing technical, environmental, social and economic aspects. Xu et al. (2014) applied AHP to understand what Chinese peasants want to achieve by participating in the "Grain for Green" program and what their priorities are with respect to planting selected types of trees. Chávez et al. (2012) used AHP to rank alternative farming activities to tobacco for crop diversification in Argentina. Kurka (2013) employed the AHP method to assess different bioenergy alternatives concerning their regional sustainability in Scotland. Kukrety et al. (2013) incorporated stakeholder perceptions about the most suitable restoration planning and management option in India by using the AHP.

Furthermore, the AHP can be used in conjunction with Geographic Information Systems - GIS, configuring a decision support tool for allocation of land (EASTMAN et al., 1995). Itami et al. (2001) combined the AHP and GIS for assessing biophysical capability for horticultural crops in rural catchments in Australia. Barros et al. (2007) used variables derived from remote sensing data and the AHP method to delimitate favorable areas to the coffee crop agroecosystem in four municipalities of Minas Gerais State, Brazil. Akinci et al. (2013) identified suitable lands for agricultural use in Turkey applying the AHP to determine the weights of the parameters, which were used to create the agricultural land suitability map.

3 Materials and Methods

3.1 Study area

The study area was selected using a GIS, software ArcGis 9.3. Two types of data were used:

- 2006 Agricultural Census data of Goiás state: table 854 (area of rural establishments per land use) and table 1258 (number and area of rural establishments, according to indicators of familiar and non-familiar farming), available at <http://www.sidra.ibge.gov.br/>;
- Vector file of sugarcane areas in Goiás state, 2012/2013 crop season, made available by the Canasat Project (RUDORFF et al., 2010).

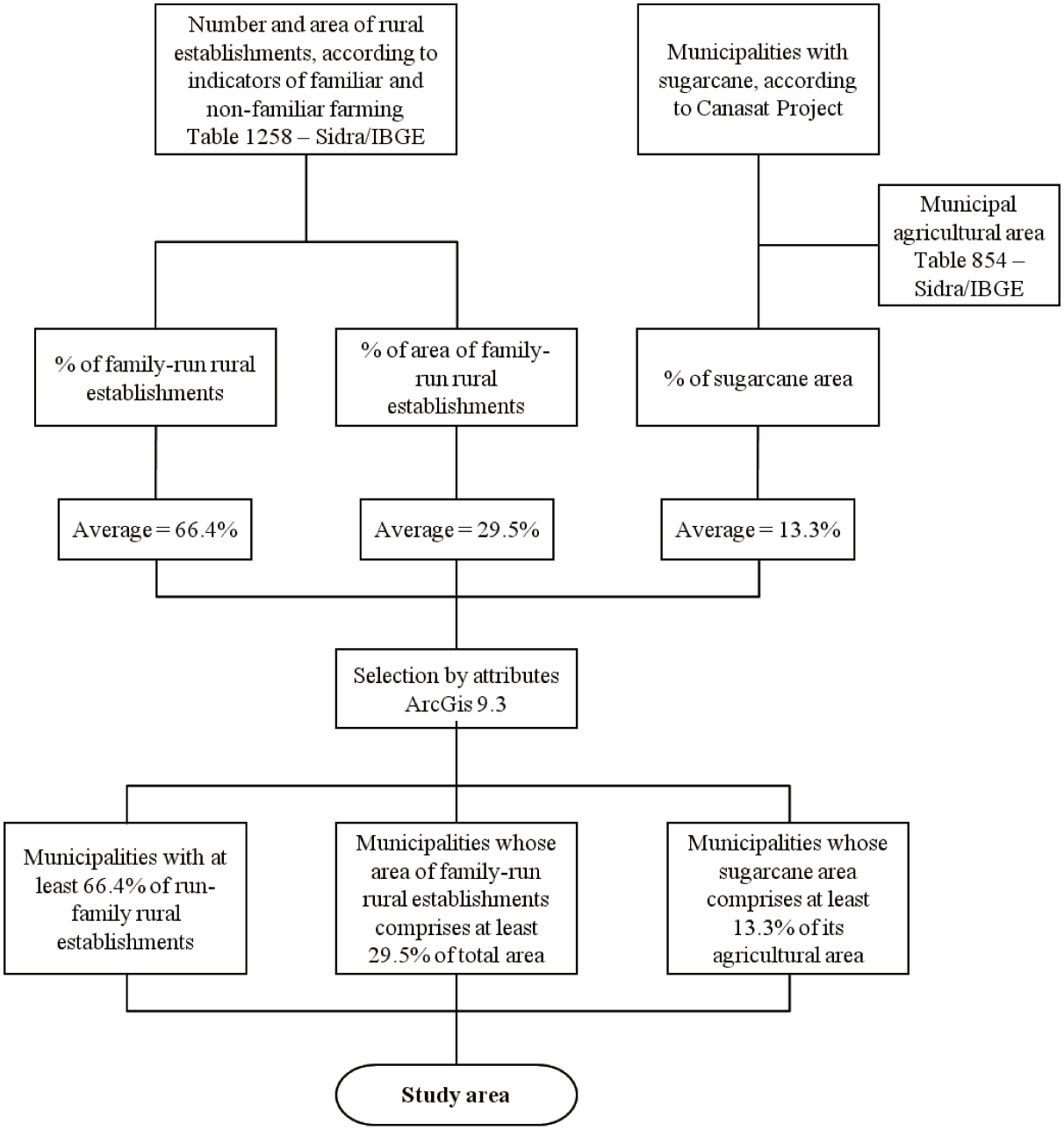
From these data sources, we calculated per municipality:

- Percentage of family-run rural establishments in relation to the total number of rural establishments;
- Percentage of area of family-run rural establishments in relation to the total area of rural establishments;
- Percentage of sugarcane area in relation to the total agricultural area.

Then, we identified the municipalities in the Goiás state that showed numbers above the state average for these three criteria (Figure 3). The preliminarily selected municipalities were: Carmo do Rio Verde, Ipiranga de Goiás, Itapaci, Nova Glória, Santa Isabel (these are located in the microregion[4] of Ceres), Anicuns, Edéia, and Jandaia. Among these eight municipalities, the sugarcane area varies from 19.2% to 38.3% of the total agricultural area, in Edéia and Nova Glória, respectively. In all municipalities, the number of family-run rural establishments accounts for more than 80% of the total, while the area occupied by them ranges from 31.8% to 63.7%, in Anicuns and Edéia, respectively (Table 1).

[4] The Brazilian territorial structure is divided as follows: Federation Unit, Mesoregion, Microregion, and Municipality. A microregion consists of a group of bordering municipalities with specificities regarding the production structure: agriculture and livestock, industry, mineral extraction or fishing. It aims to provide for member municipalities to cooperate on the organization, planning, and execution of public functions of common interest. In practice, the divisions are used primarily for statistical purposes by the IBGE. Source: <http://www.ngb.ibge.gov.br/Default.aspx?pagina=divisao>.

Figure 3 – Flowchart of the study area selection



The municipality chosen to proceed with the case study was Ipiranga de Goiás, due to the significant presence of family farming which is 92.5% of the rural establishments, and the second highest percentage (34.5%) of sugarcane in relation to the agricultural area (Table 1). It is one of the 22 municipalities that compose the microregion of Ceres, located in north-central Goiás where the pioneer mills were established in the state, with subsidies from Proálcool in the 1970s.

Table 1 – Criteria used for the study area selection

Municipality	**Agricultural area (ha)**	**Sugarcane area (ha)**	**% of sugarcane area**	**Total number of rural establishments**	**Number of family-run rural establishments**	**% of family-run rural establishments**	**Total number of rural establishments**	**Area of family-run rural establishments**	**% area of family-run rural establishments**
Anicuns	47,417.7	12,162.4	**25.6**	1,175	1,011	**86.0**	55,201	17,527	**31.8**
Carmo do Rio Verde	24,764.5	7,673.8	**31.0**	540	454	**84.1**	32,183	15,558	**48.3**
Edéia	104,364.6	20,086.1	**19.2**	385	337	**87.5**	51,193	32,626	**63.7**
Ipiranga de Goiás	*16,664.2*	*5,741.1*	***34.5***	*415*	*384*	***92.5***	*18,541*	*11,637*	***62.8***
Itapaci	49,408.7	6,995.4	**14.2**	410	326	**79.5**	60,031	17,939	**29.9**
Jandaia	51,015.8	12,270.3	**24.1**	600	492	**82.0**	67,009	29,016	**43.3**
Nova Glória	37,996.9	14,542.3	**38.3**	461	388	**84.2**	39,337	11,712	**29.8**
Santa Isabel	55,953.3	13,407.5	**24.0**	532	465	**87.4**	65,126	25,456	**39.1**

Source: IBGE/Sidra <http://www.sidra.ibge.gov.br/>; Rudorff et al. (2010)

There are currently 37 existing mills in Goiás state of which six are located in the microregion of Ceres; two mills are under construction; one mill that ceased operating in the microregion of Ceres; and one mill project (Figure 4). In the 2014/2015 crop season, the sugarcane production in the microregion of Ceres was approximately 7 Mt, which is around 10% of the Goiás state production (70.4 Mt). The sugarcane planted area was 105,119 ha, that corresponds to 11.5% of the state planted area (911,847 ha) (IBGE, 2016).

Ipiranga de Goiás was founded in 2001, and its territory was initially part of Ceres, the municipality that gives its name to the microregion. Although its political autonomy is recent, Ipiranga de Goiás' historical legacy goes back to the creation of the first National Agricultural Colony of Goiás - CANG in 1941, which originally distributed lots between 26 and 32 ha in size, aiming to occupy and develop the countryside. During the 1940s and 1950s, the CANG was an important agricultural frontier, notable for its production of rice, corn and beans (CASTILHO, 2012). Because of that, the microregion of Ceres is the area with the highest concentration of family farmers in the state.

In addition, rapid sugarcane expansion has occurred in Ipiranga de Goiás over the past decade that may impact family farming activities. Sugarcane fields are cultivated by the Cooper-Rubi (*Cooperativa Agroindustrial Rubiataba Ltda*.) ethanol and sugar mill located to the west, just outside Ipiranga de Goiás, in the neighbouring municipality of Rubiataba. This mill was founded in 1987, with subsidies from Proálcool. Japungu Group, from Paraíba state, has owned the Cooper-Rubi since 2003. This mill produces all the sugarcane that it processes. In 2013/2014 crop season, the total area harvested was approximately 22,000 ha, yielding around 1.4 Mt of sugarcane and 117 Ml of ethanol. 905 ha are Cooper-Rubi's property; the remaining area comes from land leasing contracts in Rubiataba and eight other neighbouring municipalities, including Ipiranga de Goiás. More than 300 land leasing contracts are signed with small and medium-sized landowners, with an average area of 73 ha per landowner, and no sugarcane is supplied by autonomous producers (Personal communication, October 2013). There are other two mills within a radius of 30 km from Ipiranga de Goiás, however all of the sugarcane activity in the study area is tied to Cooper-Rubi. Figure 5 shows the study area location and the spatial distribution of farmers interviewed, classified into "without" or "with" land leasing contract with Cooper-Rubi ethanol and sugar mill, surrounded by sugarcane fields.

Figure 4 – Location of ethanol and sugar mills in Goiás state, highlighting the microregion of Ceres

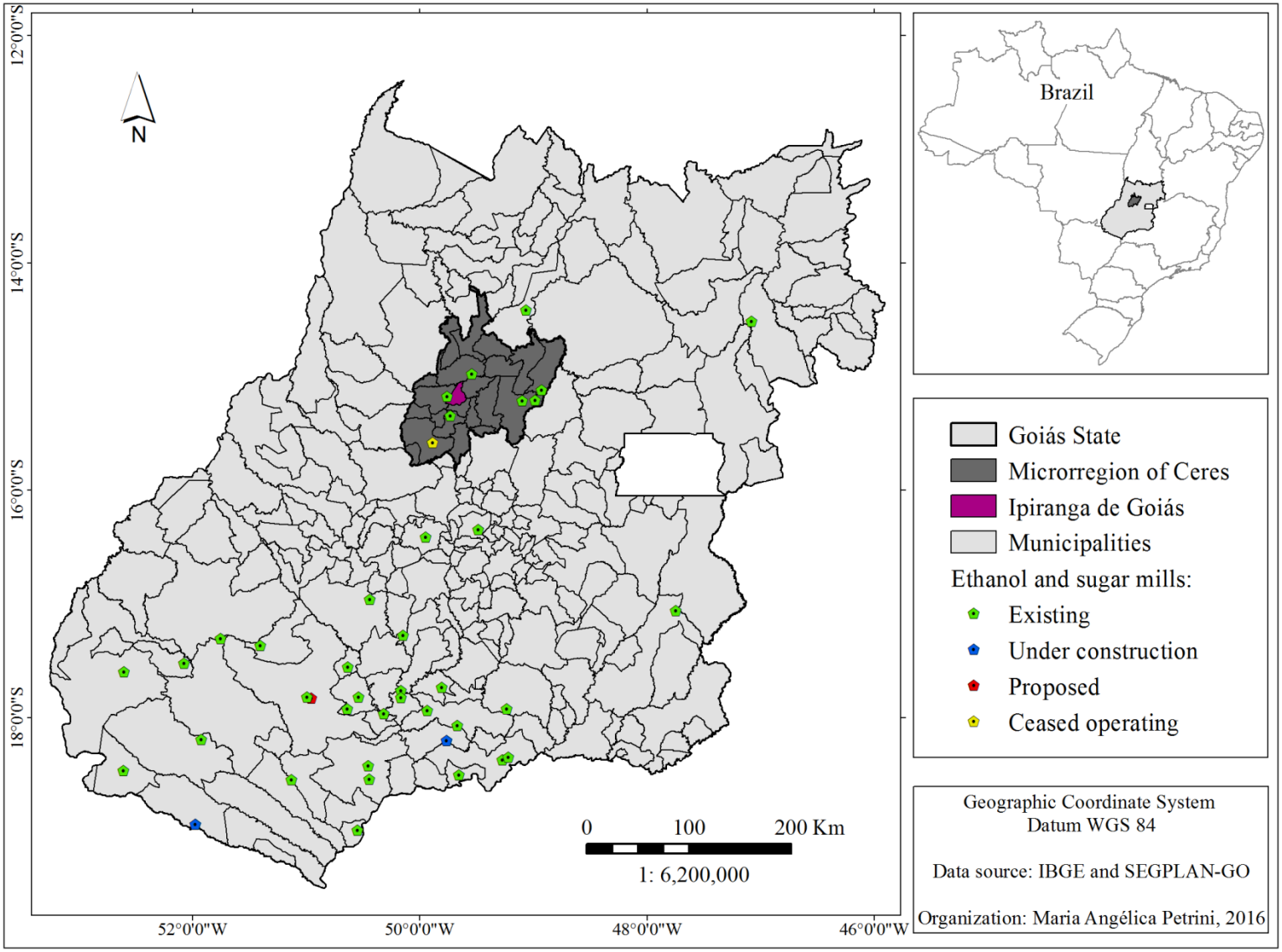
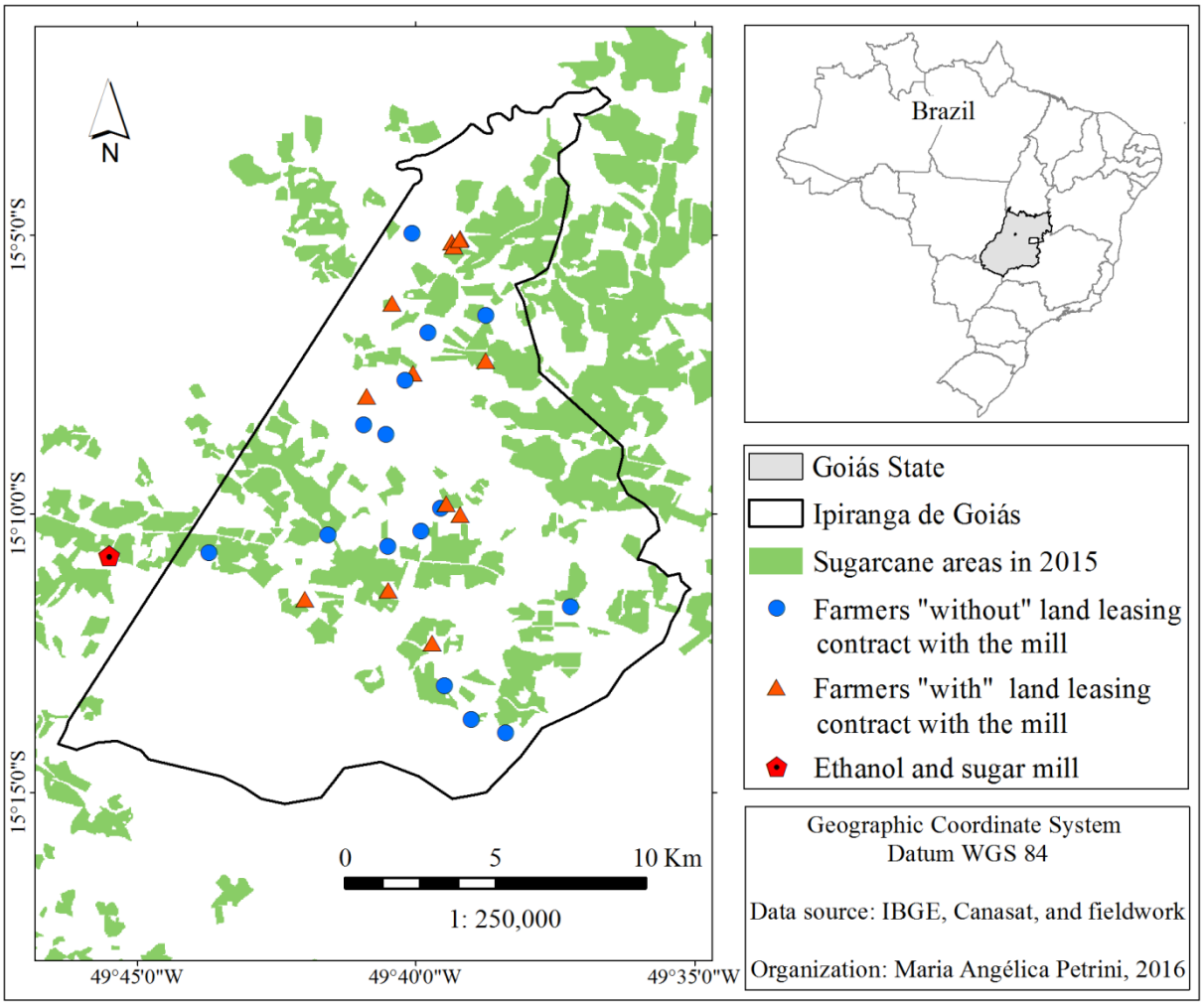


Figure 5 – Study area location, sugarcane areas, and the spatial distribution of farmers interviewed



3.2 Stakeholders and Interviews

Rua (2009) defines stakeholders, in general, as political actors whose interests may be affected, positively or negatively, by the direction taken by a specific public policy. Political actors can be individuals, groups or organizations, with particular characteristics. They can be further distinguished as public actors (politicians and bureaucrats), private actors (companies, businessmen) or workers.

A preliminary fieldwork was carried out in Ipiranga de Goiás in October 2013. We interviewed the Municipal Secretary of Agriculture, a local agent of Emater - the Goiás State Enterprise for Technical Assistance and Rural Extension, 3 family farmers indicated by them, and the Administrative and Financial Manager of the Cooper-Rubi ethanol and sugar mill. The choice of these stakeholders was due to their political, social and economic

relevance in Ipiranga de Goiás. Each interview lasted approximately 2 h and 30 min, at their work offices and at farm homes. We applied a questionnaire with closed-ended questions about social and economic aspects of agriculture in Ipiranga de Goiás, and also open-ended questions focusing on the importance of the sugarcane to the region and positive and negative consequences of the recent sugarcane expansion. Field notes from interviews allowed us to understand how farmers and government have responded to the pressure from sugarcane expansion and to what extent public policies have affected the farmers in the municipality, giving us the basis to create the AHP hierarchy (see Section 3.3). This preliminary fieldwork was fundamental to the engagement of stakeholders in the study and to the design of the AHP hierarchy, considering there are no well-established guidelines for this type of AHP application, similar to that presented by Garfì and Ferrer-Martì (2011) for water and sanitation projects.

The second fieldwork was conducted in June and July, 2014, for the purpose of applying the AHP approach. This step involved six stakeholder groups associated with the research problem, in a total of 33 participants (Table 2): at the federal level, an agent of Conab - National Food Supply Agency; at the state level, an agent of Emater; and at the municipal level, an employee (administrative and financial manager) of the ethanol and sugar mill Cooper-Rubi, the president of the cooperative Cooperagro - Regional Agriculture and Cattle Ranching Cooperative of Rubiataba, the Municipal Secretary of Agriculture, and 28 family farmers. We identified the family farmers interviewed through initial contacts with Emater and Secretary of Agriculture, followed by snowball sampling. Family farmers in most cases involved both the male and female heads of household and children as a group, thus their judgments represent family choices. For the other government officials and industry representatives, the representative from Conab was a woman, and the rest were men.

We interviewed family farmers using a questionnaire comprised of closed- and open-ended questions in order to build a socioeconomic profile of family farmers and gather opinions about the importance of sugarcane to the region and what are the positive and negative consequences of the recent sugarcane expansion (see Appendix 1). Each interview, conducted at farmer homes, lasted approximately 45 minutes. We sought to balance the number of farmers according to their position in relation to the sugarcane industry, i.e. those who have never rented their land to sugarcane producers (15 farmers) and those who rented their land in the past or were renting their land at the time of interview (13 farmers). In addition, a specific AHP questionnaire was also applied to all stakeholders. Details of this step are in the next Section 3.3.

Before proceeding with the interviews, informed consent was obtained from each participant (see Appendix 2), according to procedures approved by the University of Campinas Ethics in Research Committee (see Annex 1).

Table 2 – Stakeholder participants

Stakeholder groups	**Level**	**Explanation**	**Respondents**
Conab (National Food Supply Agency)	Federal	Conab is affiliated with the Ministry of Agriculture, Livestock and Food Supply, responsible for contributing to the regularity of food supply and guaranteeing income to rural producers, participating in the formulation and execution of agricultural and supply policies.	Superintendent for the Support of Family Farming
Emater (Goiás State Enterprise for Technical Assistance and Rural Extension)	State	In general terms, Emater is the State agency for planning, coordinating and executing plans, programs and projects of technical assistance, agricultural extension, research and sustainable rural development, giving priority to family farming in Goiás.	Local agent
Cooper-Rubi (Ethanol and Sugar Mill of Rubiataba)	Municipal	Founded in 1987, with subsidies from Proálcool. This mill has been responsible for the expansion of sugarcane production in Rubiataba and surroundings. Cooper-Rubi produces all the sugarcane that it processes, cultivated in 22,000 ha, of which less than 1,000 are its property; it has land leasing contracts in Rubiataba and 8 other neighboring municipalities, including Ipiranga de Goiás.	Administrative and Financial Manager
Cooperagro (Regional Agriculture and Cattle Ranching Cooperative of Rubiataba)	Municipal	This cooperative was created in 1971. Currently, there are approximately 2,000 rural properties affiliated to Cooperagro, within a radius of 40 km of Rubiataba. There are 85 milk producers from Ipiranga de Goiás.	President
Secretary of Agriculture	Municipal	The Municipal Secretary of Agriculture is a political position, chosen by the mayor and his party, usually for a 4 year-term when municipal elections occur. The current mandate is 2013-2016.	Municipal Secretary
Family farmers	Municipal	According to the law 11,326/2006.	28 family farmers were classified into groups according to their position in relation to the sugarcane industry

3.3 Analytic Hierarchy Process – AHP

According to Saaty (1990), the practical application of the AHP involves three basic steps. The first step is to structure the problem as a hierarchy. From top to bottom, the elements may include the overall goal to be achieved, criteria and sub criteria that contribute to the goal, and alternatives that are to be evaluated with respect to criteria in the level above. Choosing the appropriate criteria and possible sub criteria is the main challenge when working with multi-criteria decision-making; they are specific to each site and context, so the selection of the elements should be discussed by all decision-makers and involved stakeholders, reflecting their concerns and preferences (GARFÌ and FERRER-MARTÌ, 2011).

In the second step, we carry out pairwise comparison judgments among the elements at one level of the hierarchy in terms of the next higher level. Qualitative (verbal) comparisons are converted into quantitative values by using a numerical scale of integers ranging from 1 to 9. This scale was validated for effectiveness, not only in many applications by a number of people, but also through theoretical comparisons with a large number of other scales (SAATY, 1990). The fundamental scale of values to represent the intensities of judgments is shown in Table 3.

Table 3 – The fundamental scale

Intensity of importance	Definition (verbal scale)	Explanation
1	Equal importance	Two activities contribute equally to the objective
3	Moderate importance	Experience and judgment slightly favor one activity over another
5	Strong importance	Experience and judgment strongly favor one activity over another
7	Very strong importance	An activity is favored very strongly over another; its dominance is demonstrated in practice
9	Extreme importance	The evidence favoring one activity over another is of the highest possible order of affirmation
Reciprocals	If activity ***i*** has one of the above numbers assigned to it when compared with activity ***j***, then ***j*** has the reciprocal value when compared with ***i***	

Source: Saaty (1990)

Each one of the comparison matrices assumes the form:

$$A = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \ldots & a_{2n} \\ \vdots & \vdots & \ldots & \vdots \\ a_{n1} & a_{n2} & \cdots & a_{nn} \end{bmatrix}$$

where a_{ij} represents the pairwise comparison rating for attribute i and attribute j. Given the reciprocal property of the matrix, if $a_{ij} = x$, then $a_{ji} = 1/x$ where $x \neq 0$. Only $n(n-1)/2$ actual pairwise comparisons are needed for an $n \times n$ comparison matrix (SAATY, 1991).

The scores obtained from individual preference are used to synthesize local priorities of each element of the hierarchy by using the eigenvalue method. The vector of priorities is the principal eigenvector of the matrix. It gives the relative priority of the element measured in a ratio scale (SAATY, 1990). In addition, the AHP also allows decision makers to maintain control over the inconsistent comparisons that may occur due to inherent human nature (KUKRETY et al., 2013).

The consistency ratio (CR) is calculated based on properties of reciprocal matrices. Saaty (1991) proved that the largest eigenvalue, λ_{max}, of a reciprocal matrix is always greater than or equal to n (number of rows or columns). If there are no inconsistencies in pairwise comparisons, then $\lambda_{max} = n$. The more consistent the comparisons are the closer to n are the λ_{max} values. The quantity $\lambda_{max} - n$ measures the degree of inconsistency within the $n \times n$ matrix. The consistency index (CI), that measures the inconsistencies of pairwise comparisons, is given by equation $CI = (\lambda_{max}-n)/(n-1)$. The CR measures the coherence of the pairwise comparisons. It is defined by CR = CI/RI, where RI is the average consistency index of the randomly generated comparisons (Table 4). Values of $CR \leq 0.1$ are considered as acceptable. Otherwise, higher values of CR mean an undesirable level of inconsistency, and participants should revise their pairwise comparison judgments.

Table 4 – Random Consistency Index

n	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
RI	0.00	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49	1.51	1.48	1.56	1.57	1.59

Source: Saaty (1991)

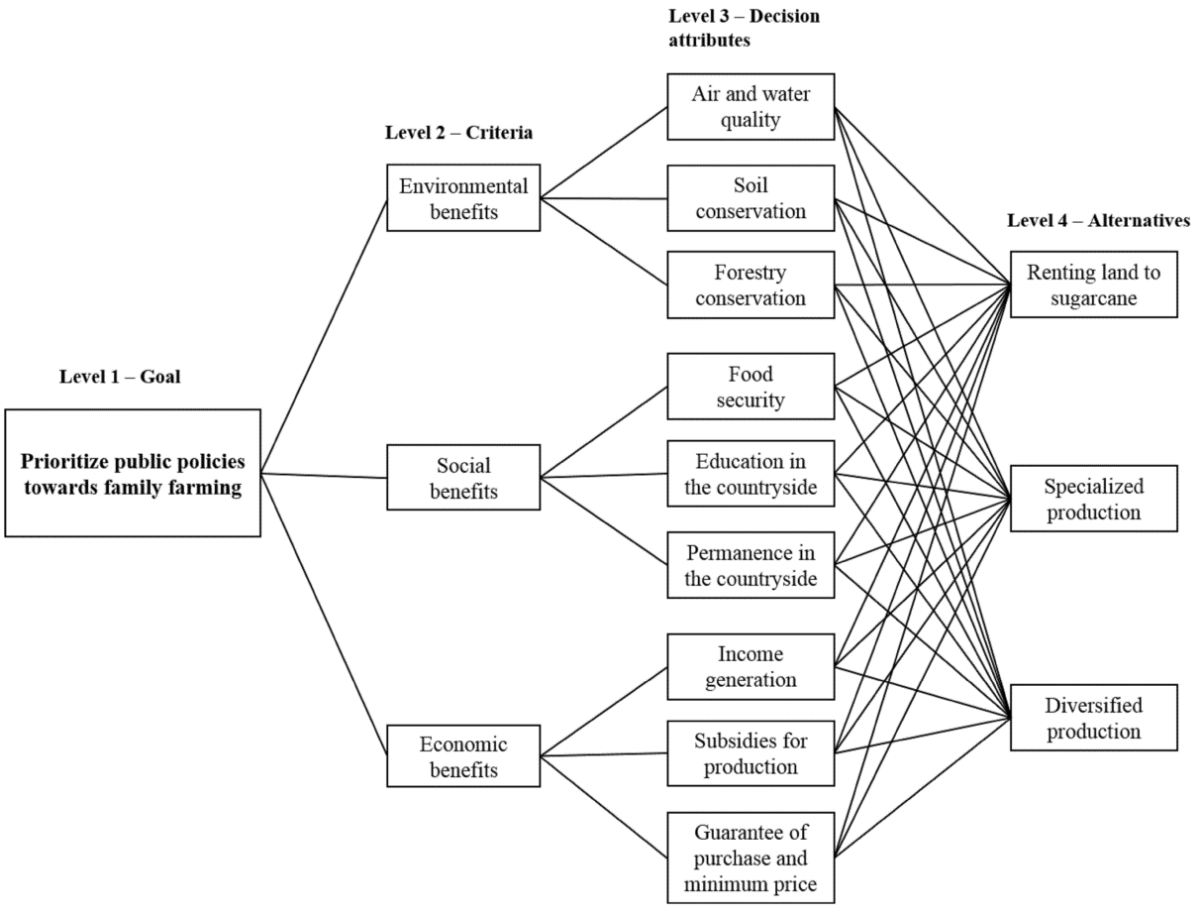
Finally, in the third step, the pairwise comparison judgments are used to develop overall priorities for ranking the alternatives. The overall priority values are calculated from the top of the hierarchy by multiplying the local priority of an element by the priority value of

the level just above it. The sum of the overall priorities at each level is equal to one. As a result, the overall priority value of the elements at a level shows the proportionate contribution to the overall preference of the individual or the stakeholder group (KUKRETY et al., 2013).

3.3.1 AHP hierarchy

The AHP decision hierarchy built for the present study (Figure 6) was based on literature reviews (ELLIS, 1998; ANANDA and HERATH, 2003; SCHNEIDER, 2007; CHÁVEZ et al., 2012; KUKRETY et al., 2013; KURKA, 2013; KURKA and BLACKWOOD, 2013; XU et al., 2014) as well as information gathered during the preliminary fieldwork.

Figure 6 – Four levels of hierarchical structure used in this case study



We have four levels and limited numbers of elements for a number of reasons, based on an understanding of human cognition and past research by other authors. To avoid confusion with a large number of comparisons, which significantly increases uncertainty of the process, it is recommended that the number of elements in a category should not exceed 10 (KUKRETY et al., 2013; DELGADO-GALVÁN et al., 2014). The top level of the hierarchy represents the goal, which defines priorities for public policies addressing family farming. The second level refers to criteria dealing with the environmental, social and economic benefits to be achieved with implementation of public policies. They are the three pillars, environmental, social and economic factors, which sustainable rural development policies should integrate simultaneously. The third level of the hierarchy consists of nine decision attributes: air and water quality, soil conservation and forestry conservation under environmental benefits; food security, education in the countryside and permanence in the countryside under social benefits; income generation, subsidies for production and guarantee of purchase and minimum price under economic benefits. The definition of these decision attributes was directly related to what we learned during the preliminary interviews. Those interviews helped us identify areas of concern that policy makers should address in policies to meet the demands of family farmers.

Regarding the environmental criteria, field notes indicated that there is a need to improve environmental quality in Ipiranga de Goiás. Numerous environmental problems were mentioned as major concerns among family farmers and representatives of government: deforestation, soil erosion, air pollution caused by sugarcane straw burning practices and vinasse stench, decreasing water availability due to irrigated cultivation of sugarcane, and water pollution by pesticides. These concerns are unsurprising, given that there is no environmental agency in the municipality, and, consequently, no environmental monitoring. Considering the criteria under social benefits, the main concerns relate to reduction of food production in the municipality itself and rural out-migration. For that, there are few successful initiatives implemented that could be expanded. One is focused on “Community Farming” (a state/municipal partnership encouraging farmers to cultivate mainly rice and vegetables, sharing harvests among themselves), and another is the “Rural Housing Program” to build or renovate houses in the countryside. In addition, Emater drew attention to the lack of technical courses to improve farmers' professional skills. With respect to economic benefits, the stakeholders interviewed mentioned the lack of economic incentives and mechanisms to encourage family farming production, which leads the farmers to rent their lands to sugarcane

mills because they cannot be competitive, even though most farmers have accessed Pronaf to obtain rural credit. A brief description of each decision attribute is shown in Table 5.

Finally, the fourth and bottom level of the hierarchy consists of the alternatives, in terms of agricultural activities that might be more adequate for the success of the public policies. The alternatives represent options for family farming activities facing the pressure from sugarcane expansion: rent land to sugarcane mills, which is already underway; specialized production, when the family farmer has income from only one type of agricultural activity (e.g. dairy cattle in Ipiranga de Goiás); and diversified production, in which the family farmer grows various products for own consumption and the market.

Table 5 – Description of criteria and decision attributes selected for this case study

Criteria	**Decision attributes**	**Refers to:**
Environmental benefits	Air and water quality	Promotion and/or maintenance of air and water quality levels as well as water resources availability
	Soil conservation	Control and prevention of soil erosion and soil contamination by pesticides
	Forestry conservation	Protection of vegetation, preventing deforestation, visual impacts on landscape and impacts on biodiversity
Social benefits	Food security	Arable land available for food production and conditions of access to good quality and variety of food products
	Education in the countryside	Offering of technical courses that improve the professional qualifications of the family
	Permanence in the countryside	Conditions to maintain living and working in the countryside, avoiding rural out-migration
Economic benefits	Income generation	Income generation in the countryside through direct income transfers
	Subsidies for production	Mechanisms to reduce purchase costs of agricultural inputs
	Guarantee of purchase and minimum price	Mechanisms to guarantee the outflow of agricultural production and the maintenance of the market price of the products

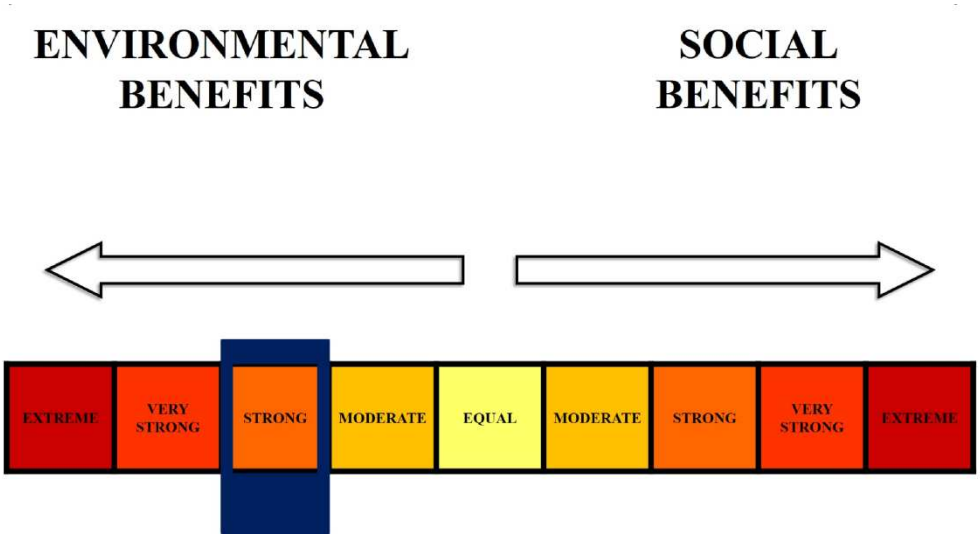
3.3.2 Pairwise comparisons

The AHP pairwise comparison surveys were carried out during fieldwork, June and July, 2014, in Brasília-DF (Conab's office), and in Ipiranga de Goiás and Rubiataba, a neighboring municipality where the ethanol and sugar mill and the cooperative are located.

Representatives of Conab, Emater, Cooper-Rubi, Cooperagro and Secretary of Agriculture were interviewed at their work offices. Family farmers were interviewed at their homes. Each participant was asked to indicate the relative preference of one element over the other, considering the point of view of the public or private enterprise they were representing, while the family farmers were asked to use personal judgment based on their own perceptions and experiences to express their relative preferences. Most individuals took approximately one hour and 30 min to complete the pairwise comparisons process.

Starting with the second level of the hierarchy (Figure 6), we asked: regarding the implementation of public policies toward family farming, which benefit do you think should be given more importance? How much more? In order to facilitate participant judgments, we used cards with pairs of elements and a graded color scale that visually guided the participant during the comparison process. We displayed cards with the first pair of criteria and the participants were instructed to choose one criterion and the intensity of importance of such criterion over the other, moving the marker through the scale, from light yellow (equal importance) to dark red (extreme importance). Figure 7 shows an example of a pairwise comparison between the criteria environmental benefits and social benefits, in which environmental had strong importance over social. Three combinations of pairs of criteria were possible in this level.

Figure 7 – Example of pairwise comparison considering the second level of the hierarchy



Next, considering the third level of the hierarchy, we asked: regarding the environmental benefits that public policies should provide, which is more important? How much more? This question was repeated with the other two criteria – social and economic

benefits – to compare participant decisions regarding the respective attributes. Three combinations of pairs of decision attributes were possible under each criterion, totaling nine comparisons. With respect to the forth level of the hierarchy, we asked: which of these agricultural activity options do you think is most appropriate for achieving air and water quality? How much more? This question was repeated with the other eight decision attributes. For each decision attribute, three combinations of pairs of alternatives were possible, totaling 27 comparisons. Thus, a total of 39 pairwise comparisons were made across all the hierarchy levels, following the same procedure with cards and scale as shown in the example from Figure 7.

All the participants used a verbal scale to make qualitative comparisons, which were converted into quantitative values by using Saaty's fundamental scale (see Table 3). Using a laptop computer during the fieldwork, the judgments obtained from the pairwise comparisons were entered into the AHP Excel Template, developed by Goepel, 2013, in order to find the local priorities. The CR equal or below 0.1 was checked for all judgments. In case of a stakeholder group, such as the family farmers, a consensus decision approach was used. The individual judgments for each group of family farmers were aggregated by calculating the geometric mean (SAATY and VARGAS, 2001; GOEPEL, 2013) of all decision matrices. Furthermore, the AHP Excel Template has an output field showing the consensus index for more than one participant/decision maker. This is calculated based on the row geometric mean method results of all inputs using Shannon alpha and beta entropy (GOEPEL, 2013). Global priorities were calculated in post-fieldwork by inputting data from the AHP Excel Template to the AHP Online System also developed by Goepel <http://bpmsg.com/academic/ahp.php>, a web based AHP solution that can manage complete AHP projects and group sessions. We downloaded the data in csv format (comma separated values) for further processing as well as sensitivity analyses in a Microsoft Excel spreadsheet.

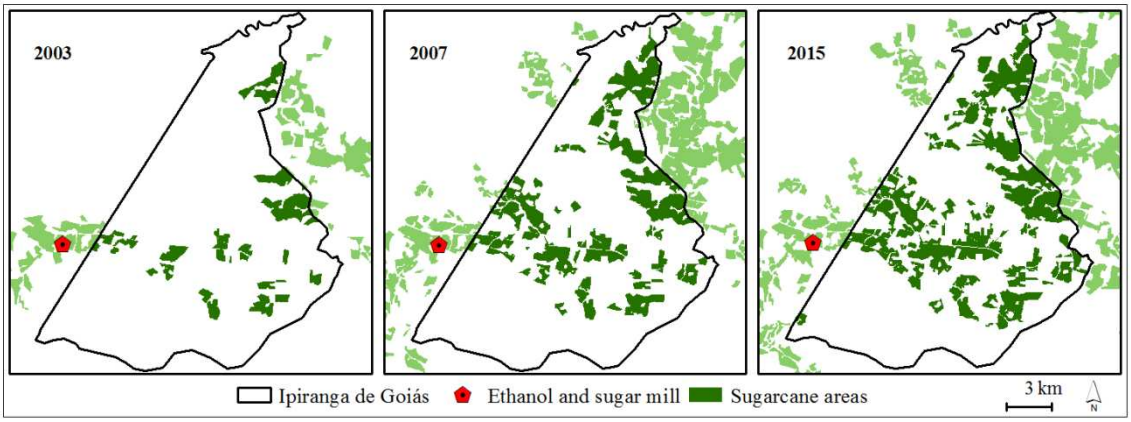
4 Results and Discussions

4.1 Environmental and socioeconomic impacts of mill-cultivated sugarcane on family farming[5]

4.1.1 Sugarcane expansion

In the period between 2001 and 2014, sugarcane area increased 275.8% in Ipiranga de Goiás, from 1,360 ha in 2001 to 5,111 ha in 2014. Such expansion may seem insignificant compared to other locations that presented much larger numbers. The largest properties and the largest sugarcane producers are concentrated in south of Goiás. For example, in 2014, Quirinópolis had the largest sugarcane planted area, with 76,804 ha, with sugarcane growing beginning in 2006, with 5,000 ha (IBGE, 2016). However, we want to emphasize the strong presence of family farming in Ipiranga de Goiás, whose farmers are more vulnerable to the consequences of the land use change. Figure 8 illustrates the horizontal expansion of sugarcane in the municipality, based on crop masks provided by the Canasat Project (RUDORFF et al., 2010). We checked and updated the files for the 2014/2015 crop season, using visual interpretation of Landsat-8 images and Google Earth database.

Figure 8 – Sugarcane area expansion in Ipiranga de Goiás, 2003-2015

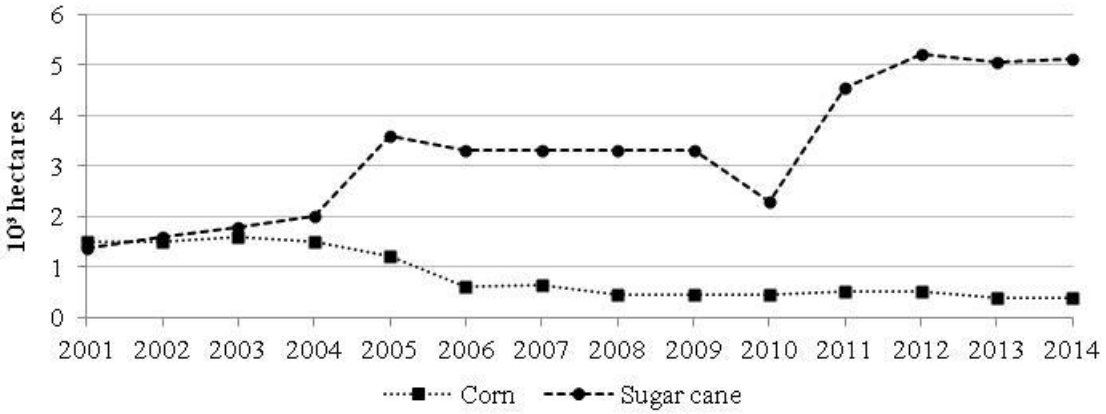


Source: updated from Rudorff et al. (2010)

[5] These results have been submitted as: Petrini, M.A.; Rocha, J.V.; Brown, J.C. Mismatches between mill-cultivated sugarcane and smallholding farming in Brazil: environmental and socioeconomic impacts. **Journal of Rural Studies**, 2016.

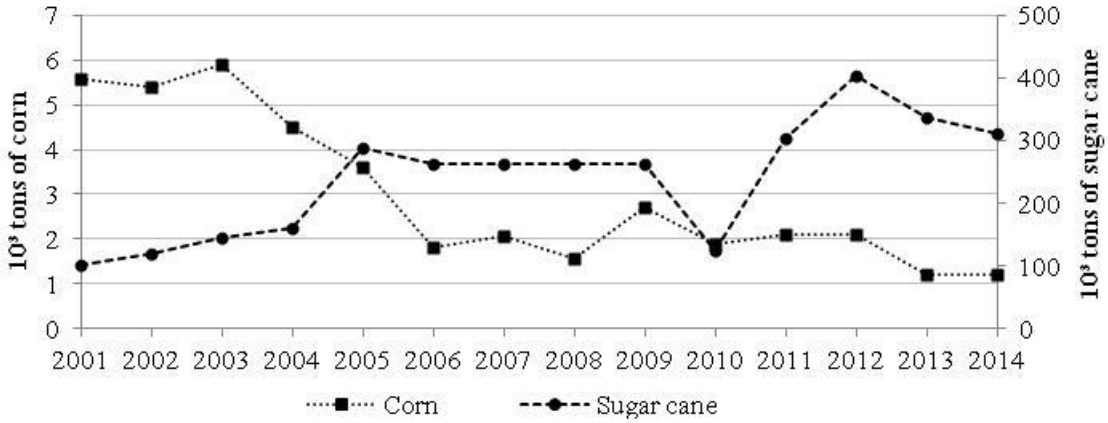
In Ipiranga de Goiás, other agricultural activities that compete with sugarcane for land are annual crops (mainly corn) and dairy cattle. Data from 2006 Agricultural Census show that pasture occupied 34.8% of area of agricultural establishments of family farming, while annual crops accounted to 5.3% of it. Also, family farmers were responsible for 72.3% of milk production that year (IBGE, 2016). We observe in Figure 9 and Figure 10 that the planted area and production of corn started decreasing in 2003, from 1,600 ha and 5,920 thousand tons in 2003 to 400 ha and 1,200 thousand tons in 2014, showing also a decrease in productivity. In turn, sugarcane area and production increased at a higher rate, except in 2010 when sugarcane fields were renovated.

Figure 9 – Corn and sugarcane planted area in Ipiranga de Goiás, 2001-2014



Source: IBGE (2016)

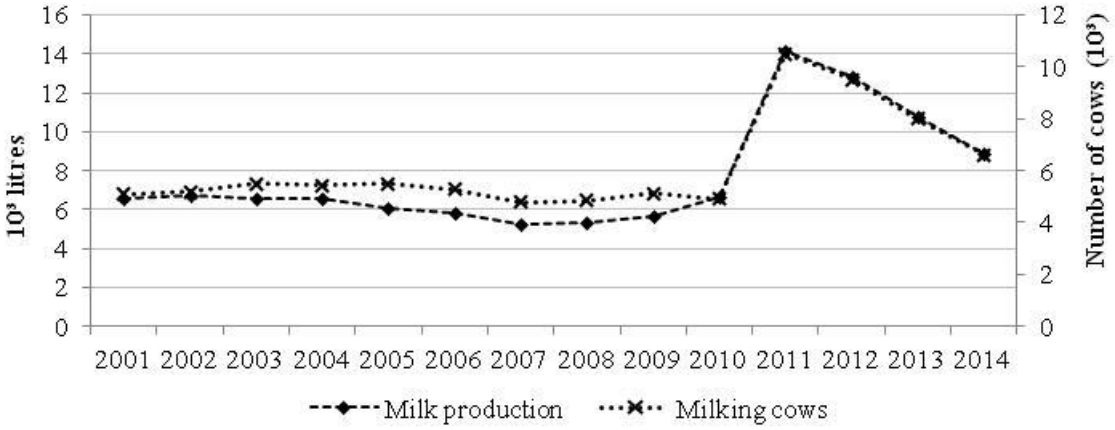
Figure 10 – Corn and sugarcane production in Ipiranga de Goiás, 2001-2014



Source: IBGE (2016)

The dairy sector was somewhat less affected. The herd of milking cows remained nearly the same between 2001 and 2010, while milk production decreased slightly in that period (Figure 11). From 2010, herd and milk production expanded, reaching a peak in 2011, followed by a gradual decrease until 2014, but still remaining around 30% greater than the beginning of the 2000's. For the first time, milk production increased more than the number of milking cows, indicating an increase in productivity. The president of the cooperative Cooperagro also confirmed this upward trend in productivity among the cooperative members (Personal communication, July 2014). As another example, Novo et al. (2012) demonstrated that the presence of sugarcane on the farm can be part of a strategy of intensification and income diversification, strengthening stability and resilience for dairy farmers in São Paulo state.

Figure 11 – Milk production and number of milking cows in Ipiranga de Goiás, 2001-2014



Source: IBGE (2016)

4.1.2 Findings from interviews

Family farmers participants were in most cases both the male and female heads of household; average age was 56 years, having lived their entire life in Ipiranga de Goiás or, in few cases, over 30 years of residence. The average education level in the sample is low: 11% are illiterate and 43% did not finish elementary school; 21% finished high school and 4% finished college. The farmers' socioeconomic profiles and perceptions about the sugarcane industry in the region are presented here according to their position in relation to the sugar mill, classified into two groups: a) "without" group: 15 farmers without land leasing contracts with the mill (farmers who had never rented land to the mill at the time of the interview) and

b) "with" group: 13 farmers with land leasing contracts with the mill (farmers who had a contract with the mill at least once before or at the time of interview).

Table 6 shows the characteristics of each group with respect to lot size and income. In general, the majority of farmers that did not rent their land to the mill ("without" group) own lots with the smallest area, up to 20 ha. The average area size in this group is 22.4 ha. In fact, sugarcane production requires economy of scale, and, because of that, small areas are not profitable either to the farmers or to the mill, especially if neighboring farmers did not rent their land too. On the other hand, the majority of farmers that signed land lease contracts with the mill ("with" group) own the largest areas, with more than 80 ha, a size more adequate for monoculture cultivation. In this group, the average area size is 78.6 ha, that is 3.5 times bigger than the "without" group. This large gap between both groups shows that the lot size is a key element of the land leasing. Regarding monthly income, farmers' profiles are fairly similar. The majority of both "without" and "with" group have a monthly income ranging from one to three minimum wages (one minimum wage was R$ 724 or US$ 329 at the time of interviews), followed by the range from three to five minimum wages. Only farmers from "without" group declared that their monthly income was less than one minimum wage. The primary source of income for farmers from "without" group are, first, retirement pensions, followed closely by dairy cattle and annual crops. In turn, farmers from "with" group have their income coming, first, from land leases and, second, from dairy cattle. We observe that only 23% of farmers rely exclusively on land leases as their source of income, and 46.2% need to complement their income with dairy cattle or other activities, since the amount paid by the mill is not enough for them, and both activities are equally important to their monthly income.

We observe from Table 7 that 80% of the "without" group cultivated annual crops before the sugarcane expansion, such as corn, rice and beans, and the remaining 20% had both annual crops and dairy cattle as farm activities. At present, after the sugarcane expansion, the majority of this group still cultivates annual crops, but to a lesser extent (46.6%), while 26.7% have started working with dairy cattle and other 26.7% continue combining both activities. From the "with" group, 46.2% had annual crops and dairy cattle as farm activities, 38.5% grew only annual crops and 15.4% worked with dairy cattle before the sugarcane expansion. Now, most of them (69.2%) share their land between sugarcane and dairy cattle. Only 7.7% of farmers quit farm production altogether and exclusively rent their land to sugarcane industry. These farmers have more than 80 ha.

Table 6 – Lot size and income characteristics of farmers interviewed

	Farmers *without* land leasing contracts with the mill	**Farmers *with* land leasing contracts with the mill**
Lot size[a] (hectares - ha)	**%**	**%**
Up to 20 ha	66.7	7.7
20 - 40 ha	13.3	30.8
40 - 60 ha	13.3	7.7
60 - 80 ha	6.7	-
80 - 100 ha	-	15.4
More than 100 ha		38.4
Monthly income[b] (minimum wage - MW)		
Up to 1 MW	13.3	-
1 - 3 MW	53.3	46.2
3 - 5 MW	20.0	23.1
More than 5 MW	6.7	7.7
Don't know / Don't answer	6.7	23.1
Main source of income		
Retirement pay[c]	33.3	-
Dairy cattle	26.7	30.8
Annual crops	26.7	-
Dairy cattle + other activities[d]	13.3	-
Land lease to sugarcane	-	23.0
Land lease to sugarcane + dairy cattle	-	15.4
Land lease to sugarcane + other activities[d]	-	30.8

[a] In Brazil, law 11,326/2006 defines the family farmer as the one that, among other criteria, does not exceed the maximum area of landholding of four *módulos fiscais*. The size of one *módulo fiscal* depends on each municipality where the farm is located. In Ipiranga de Goiás, the *módulo fiscal* is 20 ha, so the limit is 80 ha (LANDAU et al., 2012). Therefore, many of "with" group cannot be considered as family farmer from a legal perspective. However, we kept them in our study due to the characteristics of the establishment, depending upon family labor and management, and the context of the region where they are inserted.

[b] At the time of interviews (June and July 2014), the Brazilian minimum wage was R$ 724. It was equivalent to approximately US$ 329.

[c] Farmers receive from the government a retirement payment equal to the minimum wage, after the age of 60, for men, and 55 for women.

[d] Other activities refer to individual cases of coconut and pig farming, and off-farm revenue, such as urban job and retirement pay. Farmers mentioning other activities were unable to identify their major source of income, responding that both activities are equally important to their monthly income.

Table 7 – Farm activities of farmers interviewed before and after sugarcane expansion

	Farmers *without* land leasing contracts with the mill	**Farmers *with* land leasing contracts with the mill**
Before sugarcane expansion	**%**	**%**
Annual crops	80.0	38.5
Dairy cattle	-	15.4
Annual crops + dairy cattle	20.0	46.2
After sugarcane expansion		
Annual crops	46.6	7.7
Dairy cattle	26.7	7.7
Annual crops + dairy cattle	26.7	7.7
Land lease to sugarcane	-	7.7
Land lease to sugarcane + dairy cattle	-	69.2

These land use changes shed some light on food security issues, considering that the access to food is a critical concern at the household level. It refers to the ability of farmers to produce or purchase sufficient food for their needs. From our sample, many smallholders are net purchasers of food: 69.2% of the "with" group and 46.7% of the "without" group reported they did not own sufficient land to produce enough food for their families. 23.1% of farmers from the "with" group and 40% from the "without" group produce their own food, while 7.7% from the "with" group and 13.3% from the "without" group produce as well as purchase food to complement their needs. Since many rural poor people spend a great part of their household incomes on food, there is a risk that a lower supply could threaten household level food security (FAO, 2008).

With respect to the farmers' opinions about sugarcane in Ipiranga de Goiás, we have a pros and cons table (Table 8) containing items spontaneously mentioned by interviewees when asked about the advantages and disadvantages of the sugarcane expansion for family farming and for the municipality in general. We highlight that, among the farmers with land lease contracts, pros were mentioned more than cons, while farmers without land lease contracts mentioned more cons regarding sugarcane expansion. Interviewees viewed job creation as the most important advantage of sugar cane in the region. Many also mentioned that switching to sugarcane from annual crops can be a good move to deal with low crop prices or lack of on-farm labor brought on by the advanced age of many farmers and the fact that many sons/daughters are no longer around to help with daily farm tasks; 6.7% of farmers from "without" group responded in this way, compared with 30.8% of farmers from "with"

group. 15.4% of "with" group also mentioned as an advantage the guaranteed monthly income coming from the ethanol and sugar industry. With respect to drawbacks, environmental impacts were the mentioned most (60% of farmers from "without" and 38.5% of farmers from "with" group). Almost half of "without" farmers (46.7%) complain about the damages in other crops caused by the aerial spraying of pesticides in sugarcane fields, against 15.4% of "with" farmers. For 13.3% of farmers from "without" group and 23.1% of farmers from "with" group, renting land to sugarcane does not financially compensate if the lot size is small. 26.7% from "without" group also mentioned the problem of the taxes derived from the mill's activities which do not return as improvements to Ipiranga de Goiás, since the mill is located in the neighbouring municipality.

Table 8 – Pros and cons of sugarcane mentioned by farmers in the interviews

	Farmers *without* land leasing contracts with the mill	**Farmers *with* land leasing contracts with the mill**
Pros	**%**	**%**
Job creation	53.3	61.5
Renting land is an option to replace annual crops, when it is no longer competitive and/or lacks labor force.	6.7	30.8
Guaranteed monthly income	0.0	15.4
Cons		
Environmental impact (deforestation - "trees cemetery", worse water security and soil quality, loss of biodiversity, air pollution and health problems due to burning harvest practices and pesticides spraying, odor of vinasse)	60.0	38.5
Damage to other crops due to the aerial spraying of pesticides in sugarcane fields	46.7	15.4
Renting land does not financially compensate for farmers with small area of land.	13.3	23.1
Tax does not return to the municipality	26.7	0.0

The family farmers are aware of advantages and disadvantages that the sugarcane industry can bring to their surroundings. Balancing all pros and cons, the decision to rent the land is individual and represents an escape from the inherent economic risk of agriculture, especially in cases where there is lack of, or inefficiencies in, government policies supporting and encouraging food production. Novo et al. (2012) found that the shift to sugarcane is not

merely stimulated by better prices and maximization of profit, but mainly as a result of perceptions of labor constraints and the risks and opportunities offered by diversification. In the municipalities of the São Patrício Valley region, of which Ipiranga de Goiás is part, Ávila (2009) also found similar reasons why farmers decided to rent their land. Ficarelli and Ribeiro (2010) pointed out that landowners give not just an economic value to their land, but there are also cultural and life aspects influencing farmers' decisions. Therefore, the monetary amount to be received from the ethanol and sugar mill is not the single criterion evaluated in the decision to sign a land lease contract. In our study, among the farmers who have resisted ("without" group), 67% already received an offer to lease their land. The reasons for refusal vary from the preference for work with food crops or cattle raising, low revenue that does not offset the loss of autonomy, and they want to avoid the profound transformation of their rural home and landscape. Furthermore, to these farmers, the access to technical assistance and rural extension services has become very inefficient and restricted, since those services lose their meaning in supporting family farmers in an area dominated by mill-cultivated sugarcane monoculture.

There is also evidence in the interviews of concern that contracts can lock farmers into a situation where it is very difficult to return to their normal farming operations and way of life; farmers talk about this process as a “one-way road,” with no turning back. The contracts require the removal of many capital investments – corrals, barns, fences – in addition to places with economic and cultural value such as houses and groves of trees, which can lead to a deep loss of a sense of place. After completing one full sugarcane crop cycle, around six or seven years, such dramatic changes often force the renewal of the lease, leading to families cutting off their ties entirely to the countryside, leading to rural out-migration, loss of autonomy, and worsening of poverty. The small farmers who resist leasing their land end up surrounded by sugarcane fields, suffering the consequences of contamination by pesticides and the soot of burning sugarcane (CASTILLO, 2009; NOVO et al., 2012).

In Brazil, leasing contract terms in general tend to favor landowners over renters. In the sugarcane sector, this relationship seems to be reversed, with mills and distilleries having much better productive and financial conditions at their disposal, which gives them greater bargaining power, creating an asymmetric relationship between the contracting parties (ALMEIDA and BUAINAIN, 2016). Through contractual arrangements, the mill imposes its interests on small producers, such as in the São Patrício Valley region; farmers are given no opportunity for input on the type of contract to be signed, and they are not allowed any participation in the measurement of planted area and quantity of sugarcane produced, causing

dissatisfaction and distrust towards the mill. It is worth mentioning that the land leasing (as both the mills and the farmers refer to the contracts) are most likely partnership agreements disguised as leased contracts (ÁVILA, 2009).

This characterizes what Fernandes et al. (2010) called "bittersweet promises of the sugar industry", when describing territorial disputes between expanding sugar-ethanol production and agrarian reform settlements in Pontal do Paranapanema region of São Paulo state. The mill enticed settled families with a discourse of hope and large amounts of money, but in the end, the mill failed to fulfill its obligations and many settlers who signed contracts have come to regret their decisions.

4.1.3 Concluding remarks

The ideas sustaining the growth in the sugarcane-based ethanol sector sometimes conceal all environmental damages and social problems generated by the advance of sugarcane crops and mills. Moreover, aggregate data and analyses at national or global levels can mask the socio-environmental dynamics in particular places, so this study aimed to give voice to farmers, and determine the prospects for the survival of family farming, in the midst of an area undergoing rapid sugarcane expansion. Considering our earlier hypothesized farmer responses to sugarcane expansion – complete resistance, maintain mixture of farming with sugarcane production, leaving farming entirely – our findings indicate that the outlook for family farmers is not favorable, no matter the response. The research revealed the processes by which this occurs.

The competitiveness demanded by the market imposes a farm size, scale of production and minimum crop yield that lead to land concentration and exclusion of small producers from the sugar-energy sector. As traditional crops (corn, rice and beans) became less profitable in Ipiranga de Goiás, along with other variables such as lack of support for production and lack of on-farm labor, the monthly income offered by the sugarcane and ethanol industry has become very attractive to family farmers. In this context, farmers assumed a form of passive landowner renting their land to agroindustry, because they want, at the same time, to obtain income and maintain the land tenure. In most cases, this alternative emerged as a short-run solution to cope with economic difficulties of the landowners to continue in the countryside. However, as we saw in Ipiranga de Goiás, and from other studies, the land lease contracts make it difficult for farmers to return to their former activities and way of life. Some farmers have resisted leasing their land, for a number of reasons: the small

size of landholding would not generate sufficient revenue; they would lose autonomy in production; they fear the deep transformation of their rural establishment and landscape. They are more critical than farmers with contracts concerning environmental impacts and other negative impacts of the mill-cultivated sugarcane production in the municipality.

Seeking rural development, we need to put considerable effort into understanding better the variety of local impacts arising from large-scale sugarcane production through land leasing. More studies should focus on the experiences and knowledge of family farmers in other areas, concerning the benefits and drawbacks of agriculture as a provider of biofuel feedstock. Research findings may help lead to the formulation of government policies designed to protect family farmers, making it possible for them to choose what to produce, either food or biofuel feedstock, empowering them to maintain their status as agricultural producers.

4.2 Using an analytic hierarchy process approach to prioritize public policies addressing family farming in Brazil[6]

4.2.1 Stakeholders' priorities

Table 9 and Figure 12 present the consolidated priorities for each criterion by stakeholder group and the CR of the comparisons. The acceptable threshold of 0.1 or less was checked, and the results confirm that the judgments made by the participants are quite consistent. Participants in the family farmer groups presented high consensus in their judgments. The consensus index ranges from 0% (no consensus between participants) to 100% (full consensus between participants). Each group of farmers is reported from here as follows: Farmers 1 – 15 farmers who have never rented land to sugarcane producers; Farmers 2 – 3 farmers who rented land to sugarcane producers at least once in the past; Farmers 3 – 10 farmers who were renting land to sugarcane producers at the time of interview. As can be seen, in the AHP application, we divided the group of farmers with land leasing contracts with the mill into two subgroups, in an attempt to capture their different preferences and demands.

Environmental benefits are the most important criteria for the Secretary of Agriculture (63.7%), Cooperative (63.7%), Farmers 1 (44.8%) and Emater (45.5%) groups.

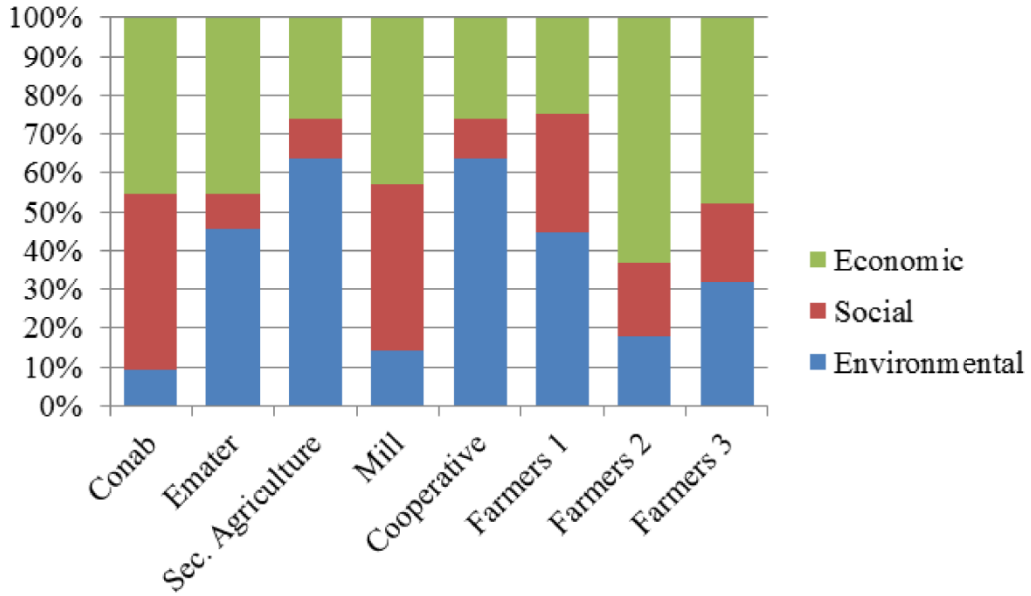
[6] These results has been published as: Petrini, M.A.; Rocha, J.V.; Brown, J.C.; Bispo, R.C. Using an analytic hierarchy process approach to prioritize public policies addressing family farming in Brazil. **Land Use Policy**, 51: 85-94, 2016.

The Farmers 2 and 3 groups preferred economic benefits (63% and 48%, respectively) over environmental and social. When farmers were asked about the advantages and disadvantages of the presence of sugarcane in the region, only 38% from Farmers 2 and 3 mentioned environmental impacts among others disadvantages, while 60% from Farmers 1 perceived environmental impacts, and these differences were reflected on the AHP ranking of criteria.

Table 9 – Global priorities for criteria

Stakeholders	Environmental benefits	Social benefits	Economic benefits	CR	Group consensus
Conab	0.091	0.455	0.455	0.00	-
Emater	0.455	0.091	0.455	0.00	-
Sec. agriculture	0.637	0.105	0.258	0.04	-
Mill	0.143	0.429	0.429	0.00	-
Cooperative	0.637	0.105	0.258	0.04	-
Farmers 1	0.448	0.303	0.248	0.00	74.5%
Farmers 2	0.177	0.193	0.630	0.01	81.2%
Farmers 3	0.320	0.201	0.480	0.00	76.0%

Figure 12 – Global priorities for criteria



The ethanol and sugar mill group prioritized both economic and social benefits (42.9%) concerning public policies addressing family farming. The mill group did not recognize the need for environmental policies as did others stakeholders. During interviews,

the stakeholders (Farmers, Emater, Secretary of Agriculture, and Cooperative) complained about environmental problems caused by the mill's activities. The impacts cited were: deforestation, use of pesticides, reduction of headwaters, decline in soil quality and water availability, air pollution due to straw burning, stench of vinasse, and loss of biodiversity. The Conab group also prioritized both economic and social benefits (45.5%). This is in accordance with its mission; the agency is responsible for managing agricultural and supply policies, to ensure basic needs of the population, preserving and encouraging market mechanisms.

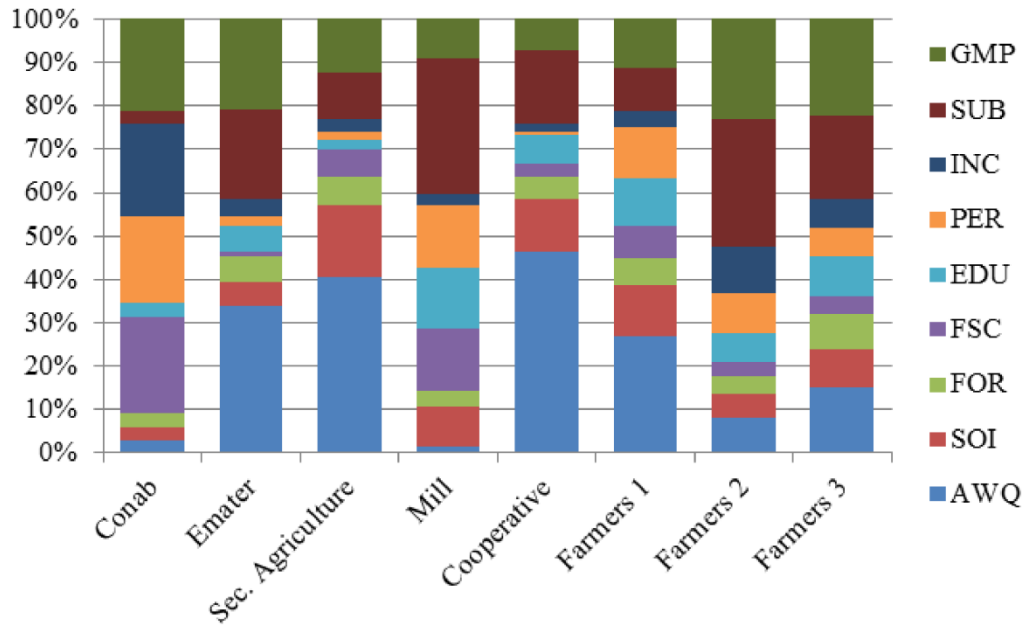
Table 10 and Figure 13 show the global priorities for decision attributes according to each stakeholder group. "Air and water quality" had the highest weights among the attributes, and it is the most important attribute for 4 different stakeholder groups: Emater (34%), Secretary of Agriculture (40.6%), Cooperative (46.5%) and Farmers 1 (27%). In turn, Farmers 2 gave preferences for "subsidies for production" (29.4%) and "guarantee of purchase and minimum price" (23.2%). Farmers 3 expressed preferences in reverse, i.e. ranking "guarantee of purchase and minimum price" (22.4%) first and "subsidies for production" (18.9%) second, but both under the economic criterion. These farmers said that renting their land to the mill to grow sugarcane is not the best option, because they lose autonomy over their own land. At the same time, however, they recognize that at least part of their monthly income is guaranteed when they rent it for sugarcane production. They would prefer to work in the field, raising food crops or dairy cattle, if they could afford to or if some policy guaranteed the value of their own production. For the ethanol and sugar mill group, attributes under economic and social benefits are most important, emphasizing "subsidies for production" (31.5%). Only Conab prioritized a decision attribute under social benefits ("food security" with 22.1%) concerning public policies toward family farming. However, the importance among "income generation" (21.2%), "guarantee of purchase and minimum price" (21.2%) and "permanence in the countryside" (19.8%) is fairly similar.

Table 10 – Global priorities for decision attributes

Stakeholders	AWQ	SOI	FOR	FSC	EDU	PER	INC	SUB	GMP	CR	Group consensus
Conab	0.030	0.030	0.030	0.221	0.035	0.198	0.212	0.030	0.212	0.00	-
Emater	0.340	0.054	0.061	0.010	0.058	0.023	0.041	0.207	0.207	0.00	-
Sec. agriculture	0.406	0.165	0.067	0.063	0.021	0.021	0.029	0.105	0.124	0.01	-
Mill	0.015	0.091	0.037	0.143	0.143	0.143	0.025	0.315	0.089	0.03	-
Cooperative	0.465	0.120	0.052	0.029	0.068	0.008	0.019	0.168	0.072	0.02	-
Farmers 1	0.270	0.116	0.062	0.076	0.111	0.116	0.036	0.100	0.113	0.00	77.7%
Farmers 2	0.080	0.055	0.042	0.032	0.068	0.093	0.104	0.294	0.232	0.00	74.0%
Farmers 3	0.152	0.086	0.082	0.042	0.091	0.067	0.067	0.189	0.224	0.00	73.6%

AWQ - air and water quality; SOI - soil conservation; FOR - forestry conservation; FSC - food security; EDU - education in the countryside; PER - permanence in the countryside; INC - income generation; SUB - subsidies for production; GMP - guarantee of purchase and minimum price.

Figure 13 – Global priorities for decision attributes



AWQ - air and water quality; SOI - soil conservation; FOR - forestry conservation; FSC - food security; EDU - education in the countryside; PER - permanence in the countryside; INC - income generation; SUB - subsidies for production; GMP - guarantee of purchase and minimum price.

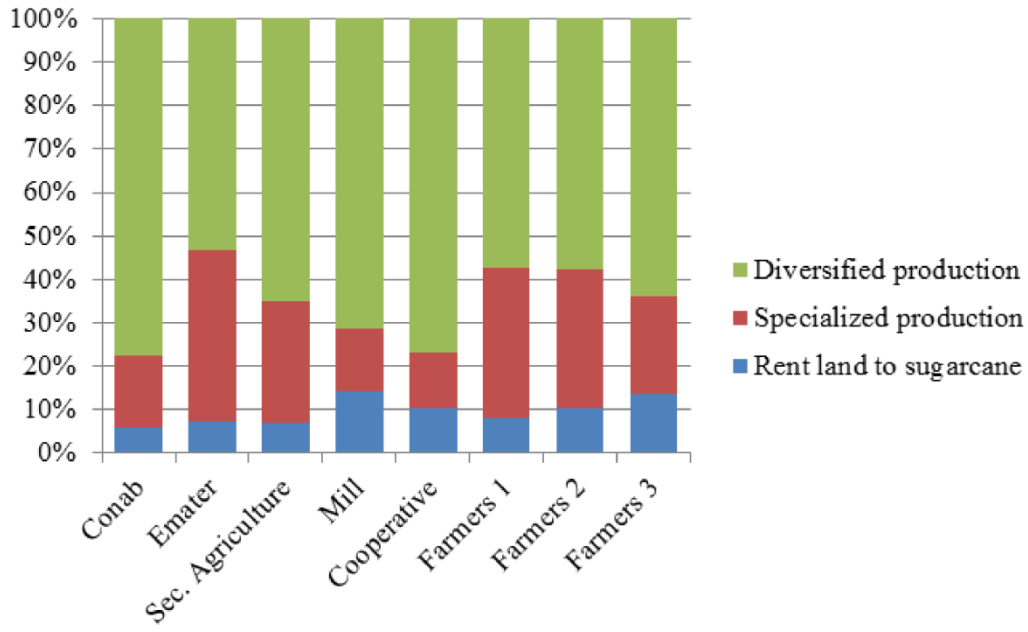
The alternatives were ranked as shown in Table 11 and Figure 14. The results point out that “diversified production” notably outperformed the other two alternatives, followed by “specialized production” and “rent land to sugarcane” as the last choice, a

preference shared even by the mill group. The results are consistent with what is found in the literature on rural livelihoods. The capability to diversify income sources improves livelihood security, hence the elimination of constraints and expansion of opportunities for diversification are desirable policy objectives (ELLIS, 1998). Support for diversification makes sense because it is seen as an inherent characteristic of family farmers, who have historically had multiple occupations and multiple forms of income, while specialization of production, created and stimulated by agricultural modernization, makes the farmers dependent, vulnerable and subordinate (SCHNEIDER, 2007).

Table 11 – Consolidated weights of alternatives

Stakeholders	Rent land to sugarcane	Specialized production	Diversified production	Group consensus
Conab	0.058	0.165	0.776	-
Emater	0.075	0.392	0.533	-
Sec. Agriculture	0.071	0.278	0.651	-
Mill	0.143	0.143	0.714	-
Cooperative	0.104	0.127	0.769	-
Farmers 1	0.081	0.345	0.574	91.9%
Farmers 2	0.102	0.321	0.577	96.6%
Farmers 3	0.135	0.226	0.639	91.4%

Figure 14 – Consolidated weights of alternatives



Among all stakeholder groups, those related to the governmental sphere gave the lowest weights to the alternative "rent land to sugarcane": Conab (5.8%), Emater (7.5%) and Municipal Secretary of Agriculture (7.1%). Participants in this group believe that family farmers should focus their land resource on production on food, not sugarcane. Interview data reveal that successful government programs, such as the Food Acquisition Program – PAA coordinated by Conab, are nowhere to be found in Ipiranga de Goiás municipality, although 82% of all farmers expressed interest in obtaining access to this type of public policy program.

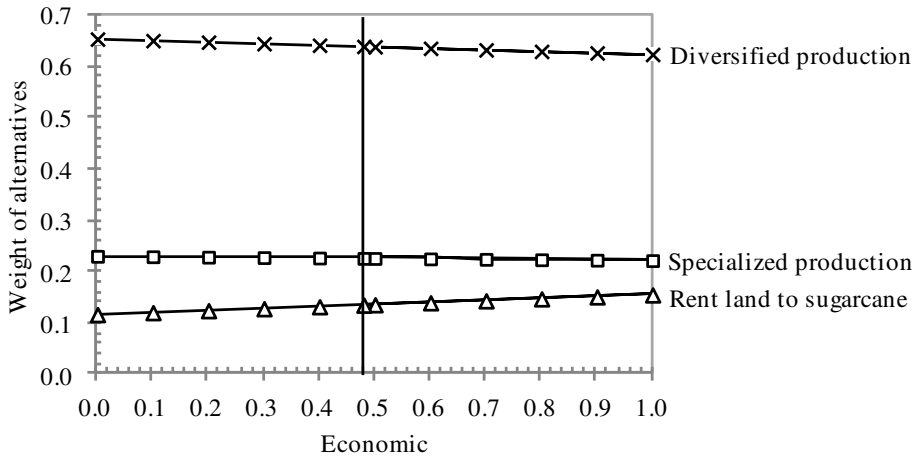
4.2.2 Sensitivity Analysis

Analyses were conducted to verify the robustness of results. It is important to determine whether they are affected or not by hypothetical changes in the weights of criteria and decision attributes. If we found that a small change in weights affected results, then they would have little utility for the formation of relevant policies (XU et al., 2014). Sensitivity analysis takes into account three variables: the local weight of the criteria (economic, social, and environmental) or decision attributes; the weight each alternative received in relation to the criteria or attribute considered; and the global priority of the alternatives, or the final ranking of the alternatives considering all the criteria and decision attributes. In this study, 12 graphs were generated to analyze the sensitivity of each criteria and decision attribute of the AHP hierarchy, for each one of the eight stakeholder groups, totaling 96 graphs. In general, results were insensitive to any variation in the weights of the criteria or attributes. All the graphs can be found in the Appendix 3. We present here two examples of sensitivity analysis graphs, one that shows insensitivity and another that shows sensitivity.

First, we take the Farmers 3 group (farmers who were renting land to sugarcane producers at the time of interview) and the economic criterion as an example. Figure 15 shows how alternatives were prioritized relative to each other with respect to the economic criterion. The vertical line in the graphs marks the local priority given to the economic criterion from the Farmers 3 interviews. The weight is 0.480. The global priorities of alternatives can be read on the y-axis at the point that they intersect the vertical line marking the priority given to the economic criterion (0.639 for diversified production; 0.226 for specialized production; and 0.135 for rent land to sugarcane). We can see that diversified production is the most desirable alternative and that it remains that way regardless of the weight given to the economic criterion, given that no line representing the alternatives

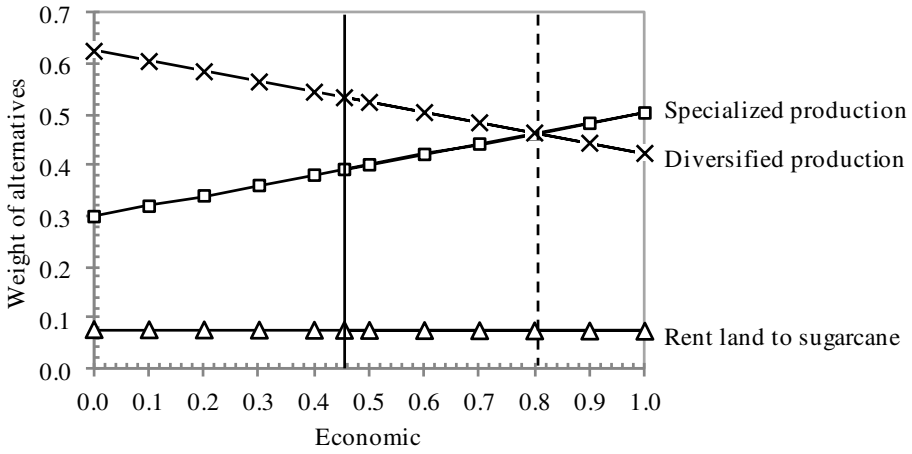
intersects with another. In other words, the final ranking of alternatives is *insensitive* to any changes in the weight respondents gave to the economic criterion. Moreover, we notice that the preference gap between diversified production and other two alternatives is significant, whereas the distance between specialized production and rent land to sugarcane is not large.

Figure 15 – Sensitivity analysis of the economic criterion of the Farmers 3 group



The majority of results showed a pattern similar to that shown in Figure 15, for all stakeholders. The only exception was considering the Emater group. Its results were *sensitive* to changes in weights given to the environmental and economic criteria, and to the following attributes: air and water quality, food security, education, permanence in the countryside, income generation, subsidies for production and guarantee of purchase and minimum price. Figure 16 illustrates the sensitive result of the economic criterion from the Emater group. The weight given to the economic criterion from Emater respondent was 0.455, indicated by the intersection of the vertical line with the x-axis. The global priority of each alternative is indicated by the intersection of the alternative line with the vertical line marking the economic criterion weight (0.533 for diversified production; 0.392 for specialized production; and 0.075 for rent land to sugarcane). The dashed line shows where the weight for the economic criterion would have to be to begin to have a switch in the final priority ranking of the alternatives. In short, the sensitivity analysis allows for identifying unstable results. Instability is more of a concern the closer any alternative line intersection is to the vertical line marking the weight on the x-axis. In this example, the priority for diversified production tends to decrease and specialized production tends to increase when economic weight increases, up to 0.8 (dashed line), at which point the alternative of specialized production would become the top option for any public policy aimed toward addressing economic benefits.

Figure 16 – Sensitivity analysis of the economic criterion of Emater



As mentioned, the "diversified production" alternative, which received the greatest global priority from all the stakeholders, was insensitive to any hypothetical change in weights. An exception is found in some of the results from Emater, where a change in weights of some criteria and attributes would make the "specialized production" alternative a more important policy direction. In no way, however, would changes in the weights of criteria and attributes result in the "rent land to sugarcane" alternative being any more than last in stakeholder preferences. In practical terms, this means that policy makers can feel assured that no hypothetical changes in weights of the criteria and attributes would lead to any different results.

4.2.3 Concluding remarks

Though there were differences among stakeholder groups regarding the priorities of criteria and decision attributes, we discovered that environmental and economic benefits should be the most important drivers of public policies in Ipiranga de Goiás municipality. Furthermore, all stakeholders agreed on the priority of “diversified production” as the most appropriate choice to promote public policies addressing family farming. These findings are corroborated by previous studies about the importance of diversification to raise the living standards of rural households.

This study is a first attempt to use the AHP for prioritizing public policies geared toward family farming in Brazil. The methodology is effective and can be applied in a number of different areas of application. In addition, the method is easy and simple to apply, and consistency tests can identify inconsistent judgments, leading to reliable results. Having

support material during the pairwise comparisons (the cards, the visual scale, etc.) proved useful in making the paired comparisons easier to understand among participants, especially the farmers.

Care should be taken, however, when building the hierarchical model, since the formulation of hierarchies and selection of criteria involve a certain level of subjectivity. It is possible for policy makers to derive different hierarchies for similar decision problems and consequently arrive at different solutions. Moreover, we should note that it is a mistake to consider this hierarchy as a model that fits all contexts and empirical situations. Decision makers interested in using this tool must first determine the characteristics and dynamics of family farming in a certain locale or region, and only after that adapt or build an appropriate hierarchy.

The AHP approach can be the starting point in the formulation of public policies, ensuring transparency and including family farmer viewpoints in the decision-making process, since they are the ones who will benefit from the implementation and consequences of the decisions made.

4.3 Public Policies in Ipiranga de Goiás, GO, Brazil

After the critiques of agricultural modernization ("Green Revolution") gained strength in the 1980s, the understanding of rural development has changed. One of the reasons for this is that rural development initiatives now seek to give local rural actors voice and an active role in the design, planning, implementation and evaluation of policies (SCHNEIDER et al., 2010). In this context, we used the AHP approach for prioritizing public policies geared toward family farming, in an effort to include family farmer viewpoints in the decision-making process. Family farmers in Ipiranga de Goiás are in the midst of an area undergoing sugarcane expansion. Considering the social problems and environmental damages arising from large-scale sugarcane production through land leasing, it is imperative to listen to what are their demands and policy priorities. As seen in the previous section, the results showed that environmental and economic benefits should be the most important drivers of public policies in Ipiranga de Goiás, focusing on air and water quality, and subsidies for production and guarantee of purchase and minimum price. Furthermore, the alternative of “diversified production” was considered the most appropriate choice to promote public policies addressing family farming. These findings are corroborated by previous studies about the importance of diversification to raise the living standards of rural households (PETRINI et al., 2016). Based

on that results, we present below the public policies already in place in the municipality (Pronaf, PNAE, and Community Farming) that could be expanded, and other policies that could be implemented (PAA and PES) to meet farmers' demand and minimize the impacts generated by sugarcane production. We complement the discussion with data from interviews made during the second fieldwork in Ipiranga de Goiás in June and July 2014.

4.3.1 National Program for Strengthening Family Farming - Pronaf

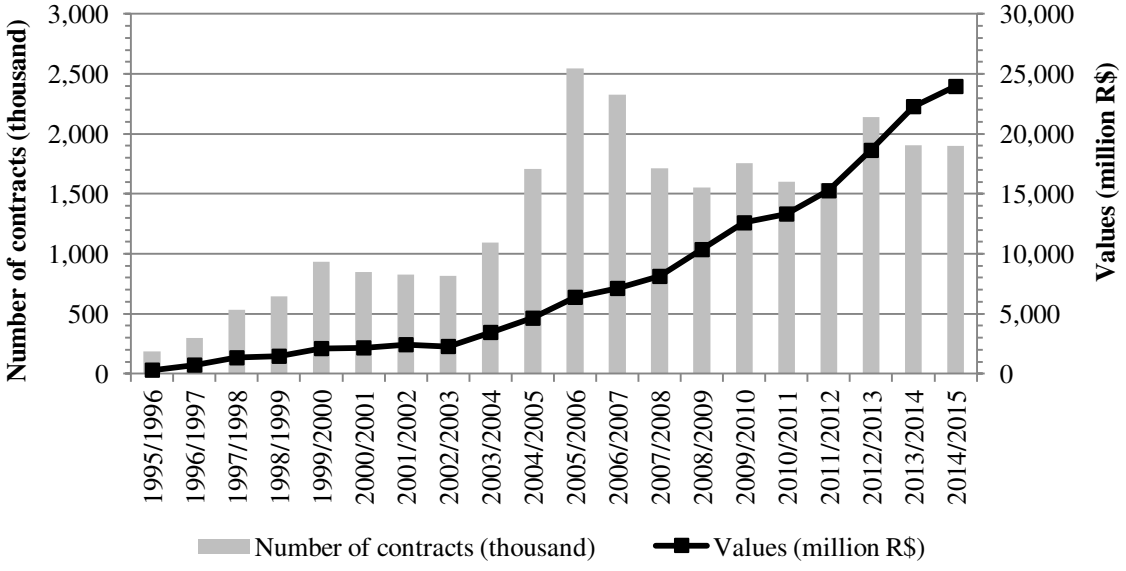
Pronaf is the cornerstone for shaping the trajectory of family farming and the broad set of new rural development policies and initiatives in Brazil (SCHNEIDER et al., 2010). Until 1999 the program was operated under the responsibility of the MAPA, being now coordinated by the MDA and executed in collaboration with local governments, financial agents, associations and cooperatives of rural producers, rural extension services. In general, Pronaf's credit is classified into two broad modalities: (1) operating credit, that consists in short-term loans aimed to cover the operating costs of both agricultural and livestock activities, processing and industrialization of rural products and acquisition of animals for subsistence purposes; and (2) investment credit, that finances investments in infrastructure addressing the processing and commercialization of the agricultural and livestock production, forestry production, handcraft products and exploration of rural tourism, including also the implementation, recovering or modernization of agroindustrial units of family farmers. Additionally to the conventional operating and investment modalities, Pronaf has others special-purpose credit lines, such as Pronaf Women, Pronaf Rural Youth, Pronaf Semi-arid, Pronaf Agroecology, Pronaf Forestry, Pronaf Eco, these four last aimed to promote more sustainable environmental practices (RUIZ-CÁRDENAS, 2013). The annual interest rates charged on all loans provided by Pronaf are subsidized and varies between 0.5% and 5.5%. The support to family farm agriculture is complemented with the provision of technical assistance and rural extension services (SANTANA and NASCIMENTO, 2012).

All farmers wishing to be a beneficiary of Pronaf must first have a declaration of eligibility, called DAP - *Declaração de Aptidão ao Pronaf*. The DAP is the government's registration and targeting mechanism for all family farmers in the country. Without it, a family farmer and his/her associative forms - cooperatives, associations of producers - will not be eligible to access any public policies addressed to this category of rural producers. Information submitted through DAP applications allows the government to compile data on

income, labor, land and management for all registered family farmers (NEHRING and MACKAY, 2013). The DAP initially gave access to Pronaf, and has since started allowing access to other relevant public policies targeted at family farming (FAO, 2015). Many of the poorest and often landless farmers have yet to be registered with DAP and are consequently excluded from these public programs.

Since it was created, Pronaf has grown in terms of both number and total amount of the loans granted, increasing substantially after 2003. The number of contracts expanded from 184 thousand in 1995/96 agricultural year to 2.5 million in 2005/06 and 1.9 million contracts in 2014/15. The total amount of credit provided by Pronaf increased from R$ 300 million in the first year to approximately R$ 23 billion in 2014/15 agricultural year (Figure 17). One important characteristic of the Pronaf is its flexibility to operate across the country and adapt to local needs because the program is not limited to specifics culture or economic activities, but it is focused on family farmers who can use the resources in their establishments as they see fit (FAO, 2015).

Figure 17 – Number and total values of rural credit contracts made by Pronaf

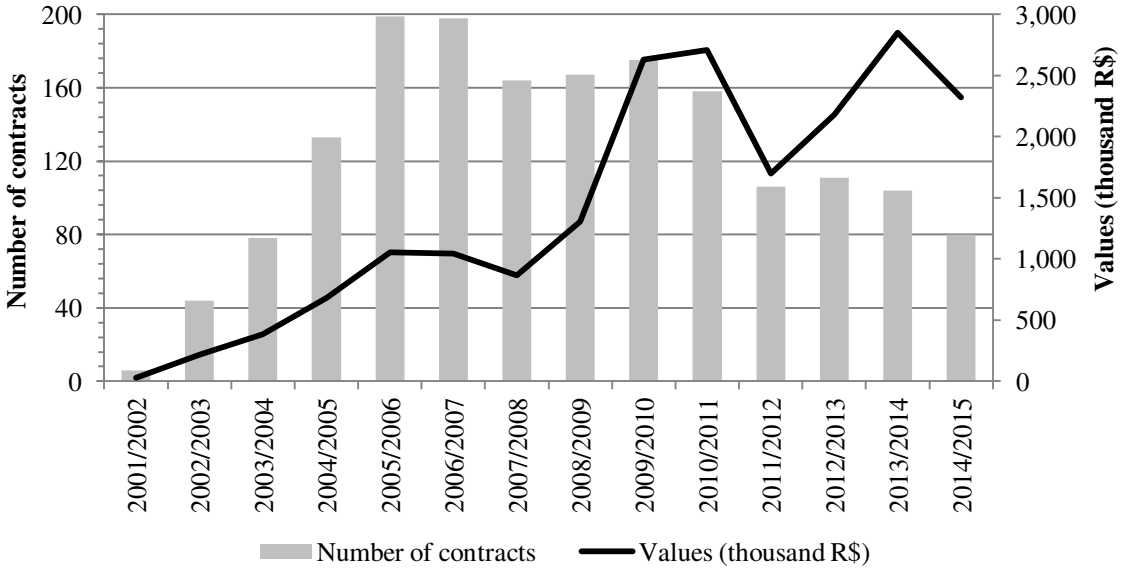


Source: MDA (2016b)

In Ipiranga de Goiás, Pronaf is the main policy accessed by family farmers. Data from interviews with 28 family farmers show that most farmers (23 or 82%) have accessed Pronaf to obtain rural credit. There are currently 353 family farmers in the municipality, of which 322 (91%) have the DAP (MDA, 2016b). The number of contracts made by Pronaf

increased from six in 2001/02 agricultural year to about 200 in 2005/06 and 2006/07 and decreased continuously from that peak to 80 contracts in 2014/15 agricultural year. In turn, the total amount of Pronaf's rural credit expanded from R$ 26,240 in 2001/2002 to the peak of R$ 2,850,754 in 2013/14, except the declines in 2011/12, 2012/13 and 2014/15 agricultural years (Figure 18). According to the Brazilian Central Bank's reports, from January/2012 to June/2016, the vast majority of the Pronaf's operations in Ipiranga de Goiás were allocated for livestock activities (Table 12). Although dairy cattle is an important activity in Ipiranga de Goiás and surroundings and have resisted in some degree to the sugarcane expansion, this concentration of Pronaf's resources toward livestock sector indicates that this policy has not been able to promote an effective improvement in the pattern of rural development. It seems, on the contrary, that Pronaf stimulates family farmers to maintain the productivist and sectoral biases of agricultural production. Gazolla and Schneider (2013) observed the same in a study analyzing Pronaf's resources application in Rio Grande do Sul state. The authors argue that Pronaf have financed production activities usual for farmers, such as agricultural commodities - soybean and corn, leading to a growing specialization and use of external technologies, whilst the process of economic diversification of productive activities - small livestock, crops, and basic food for household consumption - is an indirect strengthening provided by Pronaf.

Figure 18 – Number and values of rural credit contracts made by Pronaf in Ipiranga de Goiás



Source: MDA (2016b)

Table 12 – Number and total amount of Pronaf's rural credit contracts in Ipiranga de Goiás, by modality and activity, from Jan/2012 to Jun/2016

Activities	Modalities			
	Operating		**Investment**	
	Contracts	Total amount (R$)	Contracts	Total amount (R$)
Agriculture	1	4,981.70	7	287,446.69
Livestock	256	3,893,937.32	148	5,810,488.55

Source: BCB, 2016b.

One important innovation included in Pronaf rural credit is price insurance, known as Price Guarantee Program for Family Farming - PGPAF. From the 2006/2007 crop onwards, when enrolled in Pronaf, family farmers automatically have access to the PGPAF. It works with the granting of a bonus discount on Pronaf contracted credit operations whenever the market price of the financed product is below the current guarantee price. Guaranteed prices are fixed at the beginning of the season, using the average production costs in the region, established by Conab. In case prices received by producers at the moment of a sale are lower than the guarantee price, there is an automatic discount on the Pronaf installment amount, proportional to the fall in the price (FAO, 2015). Currently, the bonuses are limited, per family farmer, to R$ 3,500 for operating loans and to R$ 1,500 for investment loans. For the 2016/2017 crop season, the PGPAF covers 42 agricultural and 3 livestock activities, including rice, bean, corn, soybean, coffee, cotton, cassava, wheat, and milk (BCB, 2016a).

4.3.2 Food Acquisition Program - PAA

The Food Acquisition Program - PAA comprises the following purposes: (1) to encourage family farming, promoting its economic and social inclusion, boosting production with sustainability, food processing and industrialization and generation of income; (2) to encourage the consumption and appreciation of food produced by family farming; (3) to promote access to food in the necessary quantity, quality and regularity for the populations facing food and nutritional insecurity; (4) to promote food supply, that involves government purchases of food, included the school meals; (5) to constitute public stocks of food produced by family farmers; (6) to support the building up of stocks by the cooperatives and other formal organizations for family farming; and (7) to strengthen local and regional markets and

commercialization networks (Law 10,696/2003[7], with wording given by Law 11,512/2011). It was created in 2003, by articulation with the civil society through the National Food and Nutrition Security Council - Consea, within the Zero Hunger Program.

The PAA, therefore, aims at two different audiences: food producers - family farmers as defined by Law 11,326/2006; and food consumers - people and families under social vulnerability, with imminent risk of nutritional and food insecurity. To take part in PAA, it is necessary that the farmer present his valid DAP, assuring exclusive participation of family farming. Funds for PAA are directed from the MDA and the Ministry of Social Development and Fight Against Hunger - MDS, while implementation is a coordinated effort between Conab and local governments (state and municipal).

There are currently six modalities in operation to purchase agricultural produce from family farmers: Direct Purchase with Simultaneous Donation; Direct Purchase; Stock Formation; Incentive for Production and Consumption of Milk - PAA Milk; Seeds Acquisition; and Institutional Purchase (WWP, 2016; Conab, 2010). Table 13 shows, per modality, the purpose, funding sources, executors, forms of access, and limits per farmer and per organizations. The most widely used mechanism is the Direct Purchase with Simultaneous Donation, which, in 2015, comprised 84% of all purchases executed by Conab. The food items procured by Conab are diversified, totaling more than 500 different types since 2003. Many of these products emphasize regional agricultural vocation, culture and eating habits, that is one of the important effects of buying locally. Fruits and horticulture represented 59% of all purchased products in 2015 (Conab, 2016b).

The PAA demonstrated the feasibility of implementing and extending a state-driven structured demand for family farms. In 12 years, its budget increased from R$ 143 million in 2003 to R$ 555 million in 2015, with a peak of R$ 839 million in 2012. The number of family farmers who have benefited from the program increased from 42,000 in 2003 to 95,000 in 2015, but reached 185,000 in 2012 (Figure 19) (SAMBUICHI et al., 2014 and PAAData[8]). The program has purchased more than 3.5 million tons of food. Still, even with its growth, the PAA's funds represents less than 0.0004% of Brazil's gross domestic product, and, with its greatest budget and coverage in 2012, covered about 5% of the four million family farmers, according to the latest agricultural census (IPC-IG, 2013).

[7] Available at <http://www.planalto.gov.br/ccivil_03/Leis/2003/L10.696.htm>.
[8] PAAData is a tool for online PAA data viewing, from 2011 onwards. Available at <aplicacoes.mds.gov.br/sagi/paa/>.

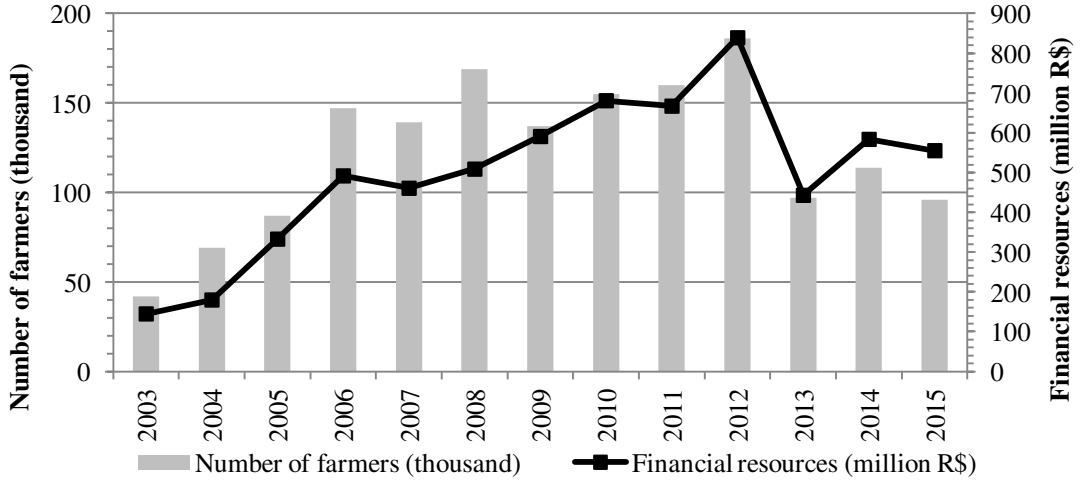
Table 13 – Summary table of the PAA modalities

Modality	Purpose	Funding source	Executor	Participation	Limit per farmer	Limit per organization
Simultaneous Donation	Purchase of various foodstuffs and simultaneous donation to entities	MDS	Federative entities that have joined the program	Individual	R$ 6,500 per year	Not applicable
			Conab	Association or cooperative	R$ 8,000 per year	R$ 2 million per year
Direct Purchase	Purchase of products defined by GGPAA* in order to maintain prices	MDS or MDA	Conab	Association or cooperative	R$ 8,000 per year	R$ 500,000 per year
Stock Formation	Financial support for stockpiling foodstuffs by supplier organizations	MDS or MDA	Conab	Association or cooperative	R$ 8,000 per year	R$ 1,5 million per year, with the first operation limited to R$ 300,000
PAA Milk	Purchase of cow's or goat's milk to be supplied directly to beneficiairies or entities	MDS	State governments in the Northeast and northern of Minas Gerais	Individual	R$ 4,000 per semester	Not applicable
Seeds Acquisition	Purchase of food crop seeds	MDS	Conab	Association or cooperative	R$ 16,000 per year	R$ 6 million per year
Institutional Purchase	Purchasing of foodstuffs by different government agencies by public tender	Purchasing agency's own funds	Purchasing agency	Individual or cooperative	R$ 20,000 per year per purchasing agency	R$ 6 million per year per purchasing agency

Source: WWP (2016)

* GGPAA is the Management Group responsible for guiding and monitoring PAA deployment. It is composed of representatives of the MDS, MDA, MAPA, Ministries of Planning and Budget (MOP), Finance (MF), and Education (MEC).

Figure 19 – Financial resources and number of family farmers participating in the PAA, from January/2003 to September/2015



Source: Sambuichi et al. (2014); PAAData

In relation to regional distribution, data from Conab operations for 2015 show that the Northeast is the region with more resources from the PAA with 32%, followed by Southeast with 27%, South with 19%, North with 12%, and Center-West with 10% of PAA's expenditures. Among all the states of the Center-West region, including the Federal District, Goiás presented the highest expenditure, approximately 42%. In 2015, however, only 13% of all municipalities in Goiás state (32 out of 246) participated in the PAA, reaching 1578 suppliers (CONAB, 2016b). In Ipiranga de Goiás municipality, interview data and online reports (PAAData and *Transparência Pública do* PAA[9]) revealed that the PAA is nowhere to be found there, although 82% of farmers interviewed expressed interest in obtaining access to this type of public policy program. However, only 39% of these farmers are members of an association of producers. In this context, the PAA can also serve as an incentive for producers to engage with or join collective organizations through a series of activities to support and motivate them to improve the quality of their products, increase their scale and have better access to information about the institutional markets. In addition, the program can lead to a more participatory and socially inclusive community (IPC-IG, 2013; NEHRING and MACKAY, 2013).

Since the beginning of the PAA, many researchers have pointed out to significant transformations in the local market where the family farmers were located. It is important to link farmers' productive capacity to local demand, because, for many small farmers, the lack of consistent access to a market is a significant obstacle to guaranteed income and investment for production. With the PAA, family farmers are allowed to sell a larger variety of produce, which results in less volatile income, increased food security through subsistence and more integrated productive methods through crop rotation and intercropping (NEHRING and MACKAY, 2013). Furthermore, an analysis of the PAA evaluations reported in Sambuichi et al. (2014) showed that the most common positive impact was diversification of production, which is also the preference of the family farmers participating in the AHP survey. Thus, the PAA consists in a relevant public policy with a high likelihood of being accepted by family farmers in Ipiranga de Goiás.

4.3.3 National School Feeding Program - PNAE

[9] Available at <http://www.conab.gov.br/detalhe.php?a=1296&t=2>.

Another public policy that is a main source of demand for family farmers is the National School Feeding Program - PNAE. School feeding programs in Brazil date back to the 1940's. Since then, a number of major policy reforms were implemented until the PNAE reached the current coverage of public schools in the basic educational system, which includes day care, kindergarten, elementary school, high school, as well as education for young and mature adults (NEHRING and MACKAY, 2013). The PNAE has been considerably redesigned as part of the comprehensive food and nutrition security approach and has become an example of the integration of education, agriculture, health and social protection to promote access to healthy diets at school, while strengthening family farming (SIDANER et al., 2012).

In 2009, the PNAE was amended by Law 11,947[10] that introduced the legal requirement that at least 30% of the school feeding budget should go to procurement from family farmers or their organizations, with bidding exemption. The linkage between school feeding and family farming is based on guidelines established by law, especially regarding the use of healthy and diversified food, respecting the culture, traditions, and local eating habits; and the support to sustainable development, with incentives for the acquisition of diverse and seasonal foodstuffs produced by local family farms (FNDE, 2016a). Together with the PAA, the PNAE is an important public policy to strengthen the demand for food produced by local farmers, complement the income of family farmers and promote local development.

The PNAE is the responsibility of the National Fund for Development of Education - FNDE, a structure linked to the Ministry of Education. Municipalities and State Secretariats of Education are the executing agencies, being responsible for receiving and supplementing the resources of the federal government for the implementation of the program (SIDANER et al., 2012). It has a budget of over R$ 3 billion per year and feeds more than 40 million students every school day. Given this current budget and the PNAE's 30% rule, more than R$ 1 billion per year should have been used to purchase from family farmers (FNDE, 2016a). This amount is practically twice larger than the PAA's total budget allocated for 2015. However, the maximum amount of purchases from an individual farmer is R$ 20,000, more than double those that operate in the different PAA modalities. This reflects the trade-off between spreading the purchases among a larger number of family farmers and the need to have a minimum scale to supply school's demand for food on a regular basis, particularly in medium-sized and large cities (IPC-IG, 2013).

[10] Available at <http://www.planalto.gov.br/ccivil_03/_ato2007-2010/2009/lei/l11947.htm>.

Many executing agencies have struggled to reach the legal framework of 30%, while others have surpassed it. At the national level, the proportion of municipalities that reach the minimum requirement increased from 30% in 2010 to 45% in 2011 and 2012. The South region presented the highest level of compliance, with 69% of executing agencies meeting the requirement in 2012, followed by the Southeast region with 45%; the Center-West region with 33%; North region with 27%; and Northeast region with 26% of executing agencies that complied with the requirement of spending a minimum of 30% of resources received from FNDE/PNAE on purchases from family farmers (IPC-IG, 2013).

Ipiranga de Goiás municipality demonstrated compliance with the PNAE's legislation from 2012 to 2014. In 2011, there were not made food acquisitions from family farming. Indicators for 2010, the first year of the effective implementation of the Law 11,947/2009, were not available (Table 14) (FNDE, 2016b). From interview data, we know that only one family farmer participated in the PNAE selling homemade milk jam (*doce de leite*).

Table 14 – Financial resources transferred by FNDE to Ipiranga de Goiás municipal administration and amount used to purchase food from family farmers, 2011-2014

Year	Total budget	Acquisition from family farming	%
2011	R$ 18,480.00	R$ 0.00	0
2012	R$ 18,204.00	R$ 6,652.40	36.5
2013	R$ 32,300.00	R$ 11,597.47	35.9
2014	R$ 30,726.00	R$ 9,410.45	30.6

Source: FNDE, 2016b.

4.3.4 Community Farming

The Community Farming Program (*Lavoura Comunitária*) has existed since 1999 and consists in a state/municipal partnership encouraging farmers to cultivate mainly rice and corn, sharing harvests among themselves and charitable organizations, which receive 4% of production. It aims to: (1) reduce food insecurity in rural and peri-urban areas; (2) promote social integration of rural families participating in the program; (3) increase the family income with the surplus of production; (4) provide courses, training and technical assistance to the beneficiaries through Emater, the Goiás state Enterprise for Technical Assistance and Rural Extension. The Goiás state government provides seeds, inputs and technical assistance

through Emater's local offices and the municipal administration is responsible for providing land for cultivation, selecting the family farmers beneficiaries and coordinating the working plan. Family farmers should participate in all activities from soil preparation up to harvest. From its implementation to the 2006/2007 harvest, the Community Farming Program directly benefited 403,893 families and 2,372 charitable organizations, in 236 municipalities in Goiás state (SED, 2016).

In Ipiranga de Goiás, the Community Farming Program is implemented in a partnership with associations of family farmers and there are currently 127 families participating in this program (EMATER, 2016). They produce rice for household consumption and can exchange the rice surplus with other foodstuffs. Consequently, they end up spending less of their household income on food. This is important because, from the interviews, we found out that many smallholders are net purchasers of food, mainly those farmers that lease their land to the ethanol and sugar mill. Furthermore, the Community Farming Program allows for agricultural diversification through public policies that provide subsidies for production that is what this group of family farmers - with land leasing contracts - prioritized in the AHP application.

4.3.5 Payment for Environmental Services - PES

Despite the improvements in terms of public policies that put family farming as a pillar for rural development in Brazil, other policies may adversely affect family farming, such as regulatory environmental policies that establish rules of use of natural resources. The Brazilian Forest Code[11] requires private landowners to protect or restore Areas of Permanent Preservation, such as riparian buffers, natural springs, steep slopes, and hilltops, in part to provide erosion control and reliable water supplies. In addition, each rural property must maintain 80% of its area in the Amazon and 20% in other biomes as a Legal Reserve of native vegetation. However, many small and medium-sized landholdings have not complied with the law and encounter difficulties in the face of a prescriptive and punitive legislation. In this context, payment for environmental services - PES schemes have been suggested as a means to foster legal compliance by landowners. The Forest Code, in its current version, establishes PES as a form of environmental compensation and an instrument for promoting ecosystem conservation and restoration (CHIODI, 2015; RICHARDS et al., 2015).

[11] Law 12,651/2012. Available at <http://www.planalto.gov.br/ccivil_03/_ato2011-2014/2012/lei/L12651.htm>.

PES is a recent policy innovation to deal with the ecosystems degradation worldwide. As environmental services formerly provided free by nature are becoming more and more affected by changes in land use, this growing scarcity makes them potentially subject to trade. Furthermore, continuing degradation regardless of legal requirements has been a main motivation for the adoption of new instruments such as PES (WUNDER, 2005). PES is defined as a voluntary transaction where a well-defined environmental service - or a land use likely to secure that service - is being 'bought' by a (minimum one) environmental service buyer from a (minimum one) environmental service provider, if and only if the environmental service provider secures environmental service provision (conditionality). Four types of environmental service stand out: carbon sequestration and storage; biodiversity protection; watershed protection; and landscape beauty (WUNDER, 2005).

In Brazil, the PES approach has been used since 2006, with examples of the application at a variety of scales, ranging from micro watersheds to entire states. The majority of the local PES programs in Brazil focus on water-related services - for instance, improving water quality, regulating water flows, and reducing sediment loads - and rely on existing municipal agencies or on local non-governmental organizations - NGOs to implement their programs in the field. Extrema and Montes Claros, in Minas Gerais state, were the first municipalities to establish PES programs aimed at protecting watershed services (PAGIOLA et al., 2013). Current large-scale, statewide PES programs are operating in São Paulo, Minas Gerais, Espírito Santo, and Amazonas states, while others are being planned in Paraná, Santa Catarina, and Acre states. There is no federal PES program *per se*, although the Proambiente program executed by the Ministry of Environment has some PES-like features. The National Water Agency - ANA, however, designed the Water Producer Program, a program of technical support to local water users wishing to develop PES programs to protect their water supplies. Also, a draft Law on a national PES policy has been debated in congress (PAGIOLA et al., 2013).

The Water Producer Program focuses on the environmental regeneration of watersheds with the PES for conservation actions regarding water and soil in rural areas that are reflected in the quantity and quality of water. Projects to be developed within the framework of the Water Producer Program must meet the requirements defined by the ANA: use of PES mechanisms; application in rural areas, preferably benefiting smallholder producers; watershed as the planning unit; prioritization of sustainable production practices; and monitoring systems. Other features such as payment amount and mode and timing of payment; conservation actions in each rural property; participation of farmers/service

providers; and the choice of the project name should be designed according to the particularities of each region. With different institutional arrangements, the program supports about 20 projects in progress throughout the country (ANA, 2016).

In Goiás state, the "Water Producer in João Leite Watershed" program is under development. The João Leite watershed supplies the Goiânia metropolitan area, has a high level of anthropic activities, environmental degradation and conflicts over water and land use. The institutional arrangement involves a technical cooperation agreement among the ANA; the Emater; the Goiás State Prosecutor's Office; the Goiás State Sanitation Company - Saneago; the Goiás State Enterprises for Agricultural Defense - Agrodefesa, and Transport and Public Works - Agetop; the Goiás State Secretaries of Environment, Water Resources, Infrastructure, Cities and Metropolitan Affairs - Secima, Agriculture, Livestock and Irrigation - Seagro, Education - Seduc; the University of Goiás - UFG; and municipal authorities of Anápolis, Campo Limpo de Goiás, Goiânia, Goianápolis, Nerópolis, Ouro Verde de Goiás e Terezópolis de Goiás. A pilot-project has been implemented in the municipalities of Nerópolis and Ouro Verde de Goiás. Once the farmer has his/her proposal approved, a contract is concluded with the Saneago. There are currently 51 farmers qualified to participate in this PES program. In the João Leite watershed, the opportunity cost was estimated at R$ 216 per hectare per year (RIBEIRO, 2015).

Considering a PES program well administered and continuously funded, so that environmental services buyers can fully meet their obligations, the family farmers can benefit from PES since it offers an extra source of income in areas with low diversification, with a cash flow potentially more stable than common alternative sources, such as cash crops with fluctuating prices. Furthermore, there are non-monetary side gains that can benefit PES recipients, for instance, PES contracts can help increase the land tenure security, the social capital of participants by improving internal organization, and the visibility of the community in relation to donors and public entities (WUNDER, 2005).

However, in Brazil, PES programs aimed at protecting watershed services have mainly been implemented by environmental public policies under the National Water Resources Policy, thus rural development and improvement of family farmers' livelihoods are important side benefits of PES programs, but not their primary objective. Analyzing PES mechanisms for the conservation of water resources as public policy for family farming in Brazil, Chiodi (2015) found that the implementation of the projects did not take into account the social, economic and cultural dimensions of the family farming. As a result, few significantly positive impacts on these dimensions were observed, and the PES projects

analyzed relegated to the background the prospect of building an agro-environmental policy based on family farming. Therefore, future PES projects considering the perspective of family farmers beneficiaries should allow for their participation in the formulation of rules, aiming at a better understanding of the complex social, economic, cultural and environmental dynamics of family farming, and improving projects implementation.

4.3.5 Concluding remarks

Regarding public policies aimed at rural development in Brazil, the creation of the Pronaf indicated public concern about family farming for the first time and represented the starting point of differentiated policies towards this social category, historically in a situation of economic and social vulnerability. In order to identify the target audience of these policies, the characteristics for the delimitation of what is considered family farms were legally defined. Since then, a set of actions has been implemented in order to improve the family farmers' livelihoods throughout the country. However, many family farmers in Ipiranga de Goiás lack access to public policies that may potentially benefit them, mainly policies related to environmental benefits that are not found there and were prioritized in the AHP application.

The use of the AHP approach allows us to identify public policies that have a higher probability to be better accepted by family farmers in Ipiranga de Goiás. The aforementioned policies can support family farmers to diversify their income sources, which indicate an improvement in the livelihood security and income-increasing capabilities of the rural household. Public policies that broaden the opportunities for diversification are in general preferable; they are related to micro-credit, rural services and infrastructure. The Pronaf is accessed by many farmers in the municipality; however, it has not met the demand for diversification, since the great majority of the Pronaf's resources were allocated for livestock activities. Together with the Pronaf, agriculture taking advantage of new markets is also a desirable policy emphasis towards diversification, such as in the case of the PAA and PNAE. These examples demonstrate that governments can play a central role in structuring acquisition practices and supporting local production due to the volume of the institutional purchases.

5 Conclusions

The controversial debate on biofuel production is far from finished. In the literature, arguments in favor or against it can be found without difficulty, as well as a list of both positive and negative impacts of the biofuels expansion. Sugarcane-derived ethanol production is not good or bad in itself, but rather the outcome (good or bad) is based on how the production is undertaken. Brazil is a country historically characterized by high levels of capital and land ownership concentration and policies that keep on favoring the agribusiness, such as intensive, large-scale sugarcane production. Consequently, some areas where family farming is traditionally strong are potentially impacted by the expansion of sugarcane through land renting contracts between farmers and sugar and ethanol mills, characterized by an asymmetric relationship between the contracting parties, in which the family farmers are the weakest side. This type of productive inclusion in sugar-energy production chain is incompatible with family farmers' livelihood.

In Ipiranga de Goiás, on one hand, family farmers who rented their land to Cooper-Rubi wanted to obtain income while maintaining the land tenure, as a strategy to deal with the lack of support for production and lack of on-farm labor. However, in most cases, this supposed temporary situation turned into a one-way road, making it difficult for family farmers to return to their normal activities and way of life. On the other hand, family farmers who resisted the pressure from the sugar and ethanol mill, for any reason, are surrounded by sugarcane fields and have their farms damaged with the aerial spraying of pesticides. Therefore, no matter how family farmers react in a sugarcane monoculture context, the prospects for their survival do not look good.

In order to support family farmer livelihoods in sugarcane growing regions and mitigate the adverse impacts of its production, we proposed with this study a reliable methodology that involves and empowers stakeholders to seek common goals in decision-making process in public policies addressing family farming.

Thus, the main contribution of this thesis is the use of the AHP approach in the prioritization of public policies geared towards family farming, including the family farmers among the stakeholders, for the first time in Brazil. The AHP is a qualitative-quantitative technique which relies on the judgment and experience of stakeholders to ranking alternatives for better decisions. The decision-making process in public policy may be influenced by political and subjective preferences of the public managers involved. Then, the AHP can be a

useful tool when decisions must be guided by objective and transparent technical criteria. It is also possible to organize collective processes of decision-making and built solutions and choices negotiated from consensual basis. When analyzing a problem, it is crucial for stakeholder groups to know aspects that they agree and disagree. The AHP is one accessible method that helps in obtaining different perceptions within a group of people. Furthermore, the solution found can be validated through sensitivity analysis assessing the impact that small variations in the weights of the criteria have on the final ranking of alternatives. This step is important to test the robustness of the results.

In this study case, we discovered that environmental and economic benefits should be the most important drivers of public policies, focusing on air and water quality, subsidies for production and guarantee of purchase and minimum price. Although there were differences concerning the priorities of criteria and decision attributes, all stakeholders groups agreed on the priority of diversified production as the most appropriate choice to promote public policies addressing family farming. Indeed, rural sector diversification is regarded by many researchers as an important goal of development policies, because it characterizes the survival and income strategies of poor individuals and families in rural areas (ELLIS, 1998).

In general, the AHP results were insensitive to any change in the weights of the criteria or decision attributes. The alternative with the greatest global priority for all the stakeholders (diversified production) was insensitive to any hypothetical variations in weights. In no way would changes in the weights of criteria and attributes result in the rent land to sugarcane alternative being any more than last in stakeholder preferences. Therefore, the implementation of public policies addressing family farming in Ipiranga de Goiás lies primarily in strengthening family farmers in such a way they will not need to rent their land to the sugarcane industry. The Pronaf, PAA, PNAE, Community Farming are examples of policies that provide subsidies for production and guarantee of purchase and minimum price for family farmers, besides other benefits such as food security and permanence in the countryside. Regarding the environmental benefits, mainly air and water quality, more efforts are needed to ensure their development. PES programs for the conservation of watershed services were presented here as a possibility to improve water quality in Ipiranga de Goiás. It requires coordinated actions of the Emater, Cooperagro, Municipal Secretary of Agriculture, and farmers, among other potential stakeholders.

To conclude, for future works, we suggest further studies comparing the application of the AHP approach in areas within a similar context, with sugarcane or any other monoculture cultivation. We also suggest to explore the possibilities of the AHP in (a)

creating scenarios by modifying the “power of influence” of the stakeholders, i.e. weights can be assigned to give different importance to stakeholders’ judgments; and (b) organizing collective processes of decision-making, with the group of multi-stakeholders acting together as a unit, building a group preference from individual preferences, taking advantage of the political channels (such as Councils for Sustainable Rural Development) where family farmers can participate and influence public policies. It is also interesting to develop a comprehensive list of criteria and decision attributes as a guideline to use the AHP aimed at public policies in rural communities, focused on family farming.

We hope that this thesis instigates policy makers to conduct rural policy enabling rural communities to objectively determine their own priorities through participatory methods along with stakeholders that have goals of improving rural livelihoods.

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Appendix 1 – Questionnaire applied to family farmers

Universidade Estadual de Campinas – Unicamp
Faculdade de Engenharia Agrícola – Feagri
Doutorado em Planejamento e Desenvolvimento Rural Sustentável

PESQUISA DE CAMPO
Responsável: Maria Angélica Petrini

QUESTIONÁRIO SOCIOECONÔMICO - AGRICULTORES FAMILIARES

Entrevistada realizada por: _____ Data: _____

I. Identificação

1. Nome do entrevistado: _____
2. Idade: _____
3. Estado civil: ( )solteiro ( )casado ( )viúvo ( )desquitado ( )divorciado
   ( )amasiado ( )outro
4. Cidade de origem: _____
5. Há quanto tempo está nesta cidade: _____
6. Contato (telefone e email): _____
7. Localização do lote (coordenadas): _____ e _____

II. Dados socioeconômicos

8. Escolaridade: ( )Analfabeto ( )Alfabetização de adultos ( )Supletivo
   ( )EF - 1º grau - incompleto ( )EF - 1º grau - completo
   ( )EM - 2º grau - incompleto ( )EM - 2º grau - completo
   ( )Superior incompleto ( )Superior completo ( )Pós-graduação

9. Quantas pessoas moram na propriedade?

_____

10. Tem filho(s) morando fora daqui? ( ) Não ( ) Sim. Quantos? _____

11. Qual é a principal fonte de renda da propriedade? Quem contribui com a renda?

_____

_____

_____

12. Renda média mensal da família:

( ) Até R$ 724,00 (até 1 SM)
( ) De R$ 724,00 até R$ 1.448,00 (de 1 a 2 SM)
( ) De R$ 1.448,00 a R$ 2.172,00 (de 2 a 3 SM)
( ) De R$ 2.172,00 a R$ 2.896,00 (de 3 a 4 SM)
( ) De R$ 2.896,00 a R$ 3.620,00 (de 4 a 5 SM)
( ) Acima de R$ 3.620,00 (mais de 5 SM)

III. Dados da propriedade e produção

13. Condição do produtor em relação às terras:

    ( )proprietário ( )arrendatário ( )parceiro ( )ocupante ( )assentado ( )outro

14. Área total do lote: _____

15. Valor da terra (R$): _____

16. Histórico do cultivo na propriedade ou em outras:

Já plantou e/ou criou:	
Planta e/ou cria atualmente:	

17. O Sr. Produz para consumo próprio ou compra os alimentos?

_____

18. O que possui de infraestrutura (maquinários, insumos, transporte próprio etc.)?

_____

19. Utiliza a assistência técnica? ( )Não ( )Sim. De quem?_____
20. Fez/faz financiamento? ( )Não ( )Sim, ( )do governo ( )particular
21. Participa de alguma associação ou cooperativa? ( )Não ( )Sim. Qual? _____
22. Gostaria de participar de algum programa do governo de compra de alimentos?

    ( ) Não. Por quê? _____

    ( ) Sim. Por quê? _____

IV. Sobre a expansão da cana-de-açúcar

23. Em sua opinião, quais são as vantagens e desvantagens da cana-de-açúcar para o município/região?

_____

_____

_____

_____

_____

24. Arrendou terra para a cana-de-açúcar nos últimos anos? Se sim, quando e por qual valor? Qual é a participação desse arrendamento na renda total da família?

_____

_____

_____

25. Se nunca arrendou terra para a cana-de-açúcar, o Sr. já recebeu ofertas? Se sim, quando e por qual valor? Por que não aceitou?

_____

_____

_____

Observações:

_____

_____

_____

_____

_____

_____

Appendix 2 – Informed Consent Form

TERMO DE CONSENTIMENTO LIVRE E ESCLARECIDO

Título da pesquisa: Expansão canavieira e seus impactos socioeconômicos: subsídios para tomadas de decisão em políticas públicas para agricultura familiar
Nome do(s) responsável(is): Maria Angélica Petrini
Número do CAAE: 30248014.1.0000.5404

Você está sendo convidado a participar como voluntário de um estudo. Este documento, chamado Termo de Consentimento Livre e Esclarecido, visa assegurar seus direitos como participante e é assinado e datado em duas vias, uma que deverá ficar com você e outra com o pesquisador.

Por favor, leia com atenção e calma, aproveitando para esclarecer suas dúvidas. Se houver perguntas antes ou mesmo depois de assiná-lo, você poderá esclarecê-las com o pesquisador. Se você não quiser participar ou retirar sua autorização, a qualquer momento, não haverá nenhum tipo de penalização ou prejuízo.

Justificativa e objetivos:

O objetivo do estudo é analisar a expansão do cultivo da cana-de-açúcar no Estado de Goiás e seus impactos socioeconômicos na agricultura familiar, com vistas a propor uma metodologia piloto que possa auxiliar as tomadas de decisão em políticas públicas voltadas para o setor agrícola familiar, tendo como estudo de caso o município de Ipiranga de Goiás.

Procedimentos:

Participando do estudo, você está sendo convidado a responder um questionário composto por 39 (trinta e nove) perguntas sobre quais critérios são mais importantes na elaboração de políticas públicas para agricultura familiar. O tempo necessário para as respostas é estimado entre 30 (trinta) minutos e 1 (uma) hora.

Desconfortos e riscos:

Não há desconfortos ou riscos previsíveis ou passíveis de prevenção. Você pode desistir de sua participação na pesquisa a qualquer momento, caso sinta-se constrangido de alguma forma durante a aplicação do questionário.

Benefícios:

Ao participar deste estudo, você não terá nenhum benefício direto imediatamente. Porém, espera-se que este estudo traga informações importantes para auxiliar a elaboração de políticas públicas para a agricultura familiar, considerando as preferências de todas as partes interessadas. O pesquisador se compromete a divulgar os resultados obtidos.

Sigilo e privacidade:

Você tem a garantia de que sua identidade será mantida em sigilo e nenhuma informação será dada a outras pessoas que não façam parte da equipe de pesquisadores. Na divulgação dos resultados desse estudo, seu nome não será citado.

Ressarcimento:

A sua participação é totalmente voluntária. Você não terá nenhum tipo de despesa para participar desta pesquisa e também nada será pago por sua participação.

Contato:

Em caso de dúvidas sobre o estudo, você poderá entrar em contato com a pesquisadora Maria Angélica Petrini, localizada no Laboratório de Geoprocessamento da Faculdade de

Rubrica do pesquisador:_____ Rubrica do participante:_____

Engenharia Agrícola da Universidade Estadual de Campinas, Av. Cândido Rondon, 501, Barão Geraldo, CEP 13083-875, Campinas/SP, telefones: (19) 3521-1114 ou (19) 98112-8134, e-mail: maria.petrini@feagri.unicamp.br.

Em caso de denúncias ou reclamações sobre sua participação e sobre questões éticas do estudo, você pode entrar em contato com a secretaria do Comitê de Ética em Pesquisa (CEP) da UNICAMP: Rua: Tessália Vieira de Camargo, 126; CEP 13083-887 Campinas – SP; telefone (19) 3521-8936; fax (19) 3521-7187; e-mail: cep@fcm.unicamp.br

Consentimento livre e esclarecido:

Após ter sido esclarecimento sobre a natureza da pesquisa, seus objetivos, métodos, benefícios previstos, potenciais riscos e o incômodo que esta possa acarretar, aceito participar:

Nome do(a) participante: _____

_____ Data: ____/_____/_____.
(Assinatura do participante ou nome e assinatura do seu responsável LEGAL)

Responsabilidade do Pesquisador:

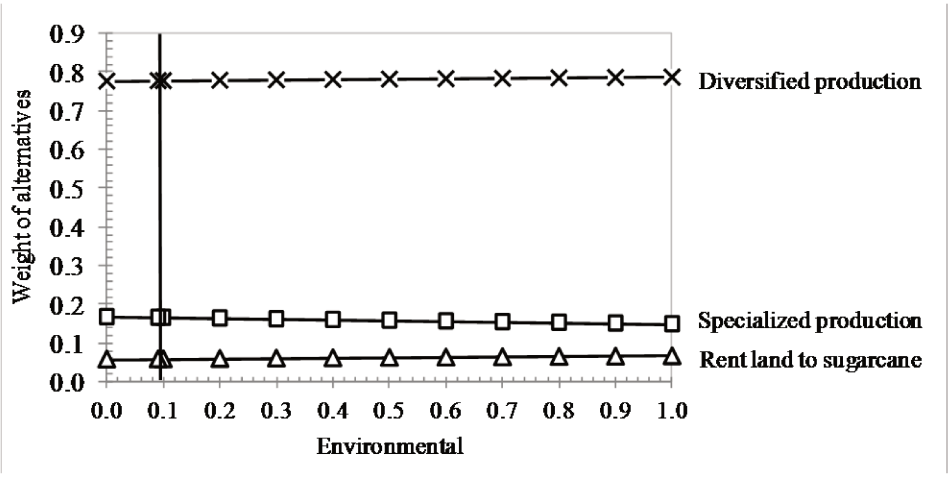
Asseguro ter cumprido as exigências da resolução 466/2012 CNS/MS e complementares na elaboração do protocolo e na obtenção deste Termo de Consentimento Livre e Esclarecido. Asseguro, também, ter explicado e fornecido uma cópia deste documento ao participante. Informo que o estudo foi aprovado pelo CEP perante o qual o projeto foi apresentado. Comprometo-me a utilizar o material e os dados obtidos nesta pesquisa exclusivamente para as finalidades previstas neste documento ou conforme o consentimento dado pelo participante.

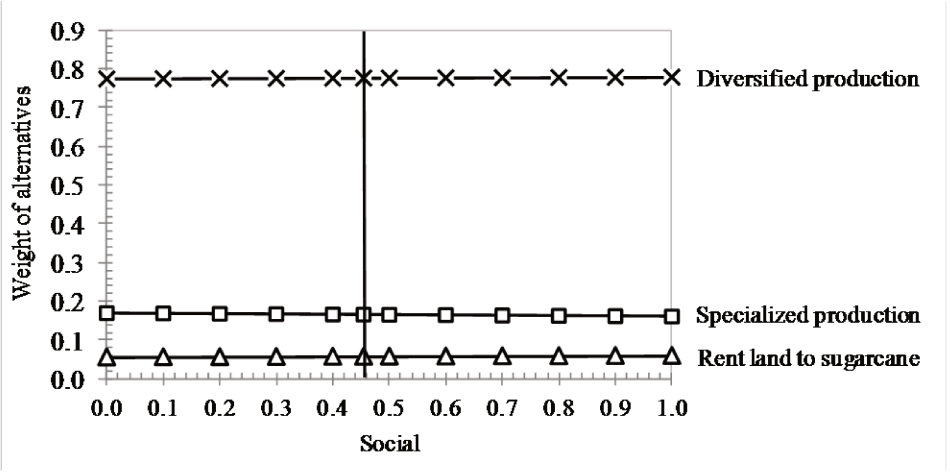
_____ Data: ____/_____/_____.
(Assinatura do pesquisador)

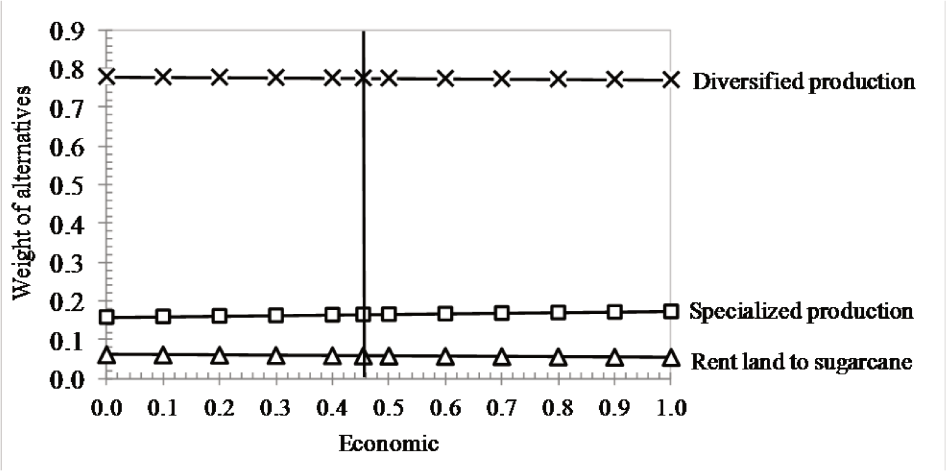
Rubrica do pesquisador:_____ Rubrica do participante:_____

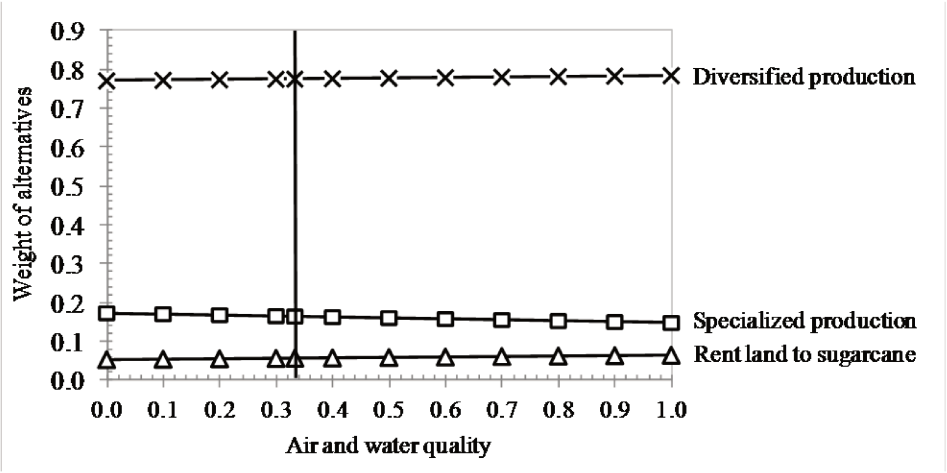
Appendix 3 – Sensitivity analysis graphs

3.1. Conab





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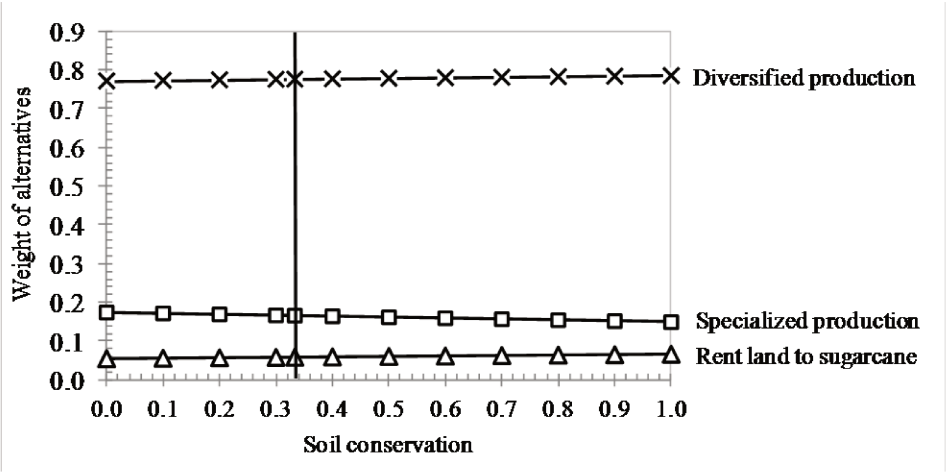
Specialized production
Rent land to sugarcane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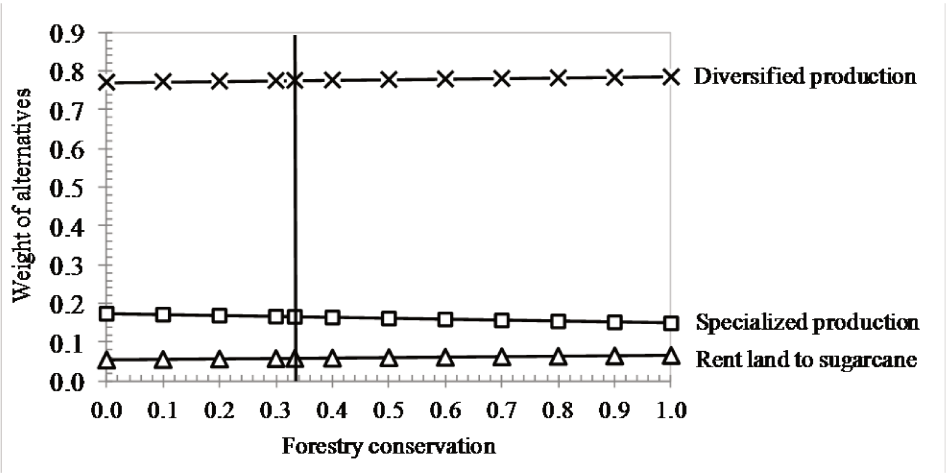
Diversified production
Specialized production
Rent land to sugarcane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Forestry conservation
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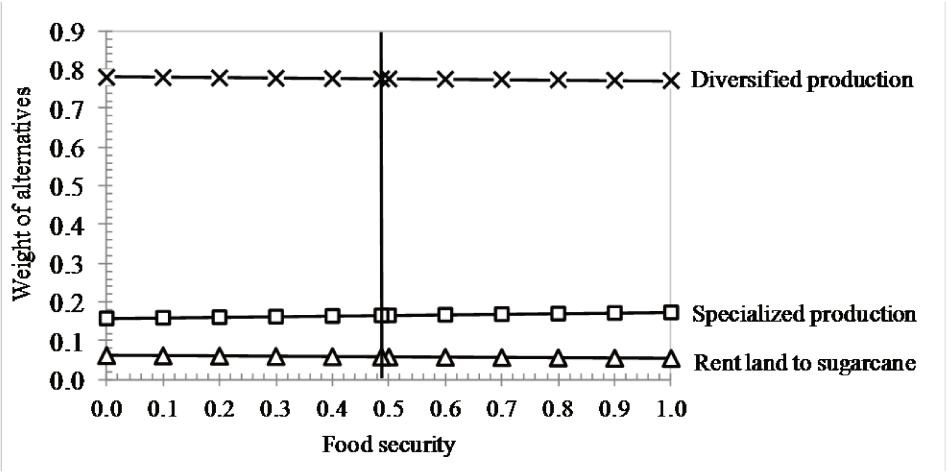
Rent land to sugarcane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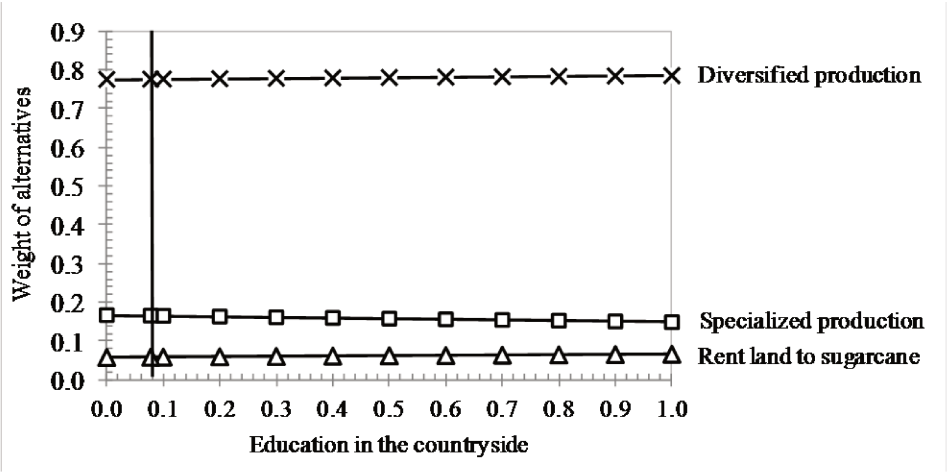
Food security
Diversified production
Specialized production
Rent land to sugarcane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Education in the countryside
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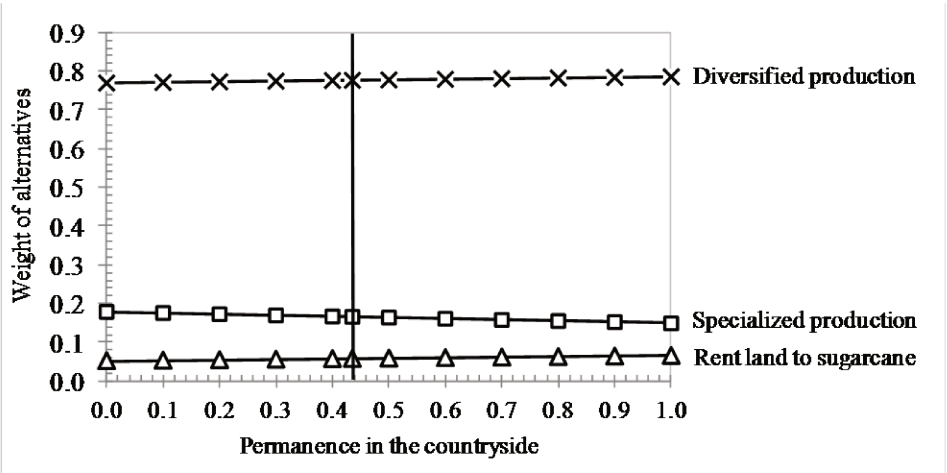
Rent land to sugarcane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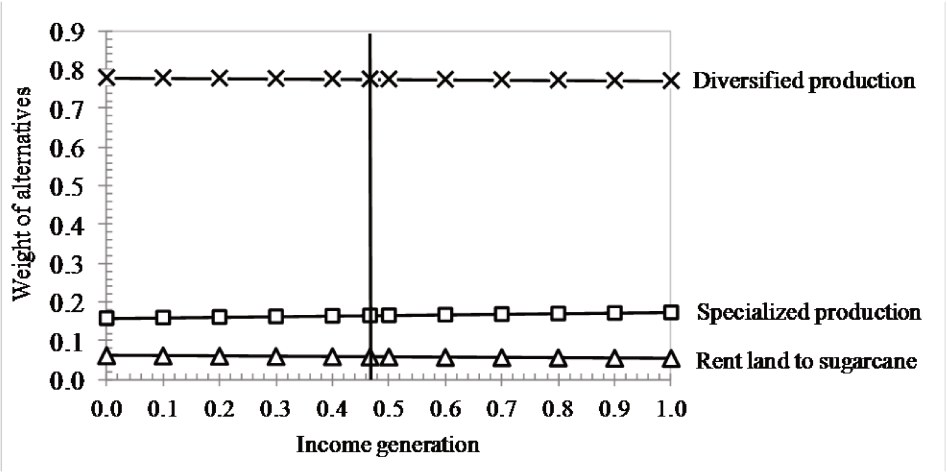
Permanence in the countryside
Diversified production
Specialized production
Rent land to sugarcane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Income generation
Diversified production
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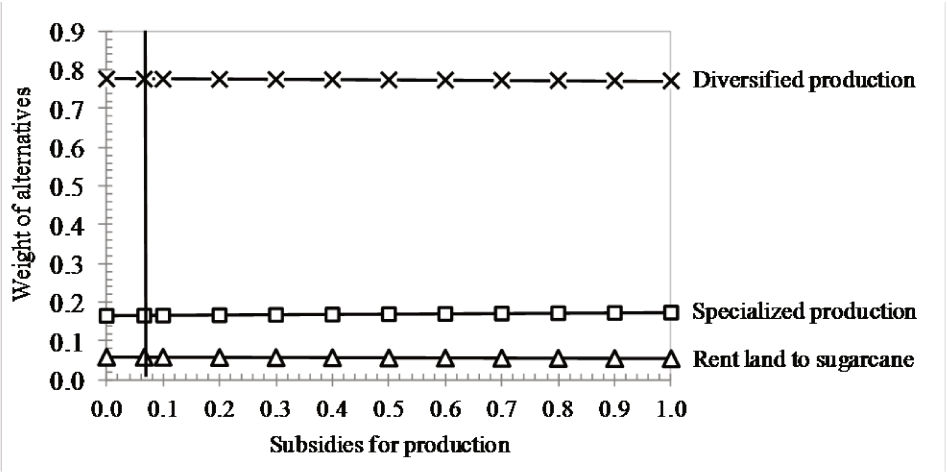
Rent land to sugarcane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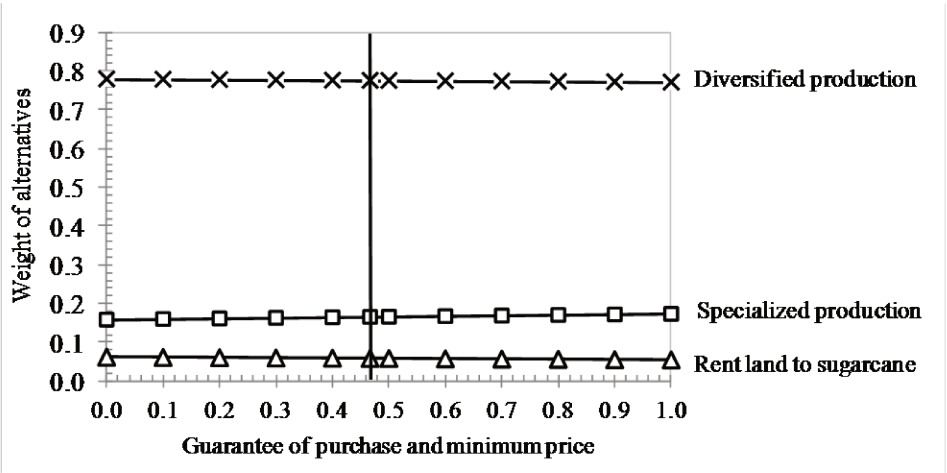
Subsidies for production
Diversified production
Specialized production
Rent land to sugarcane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Diversified production
Specialized production
Rent land to sugarcane

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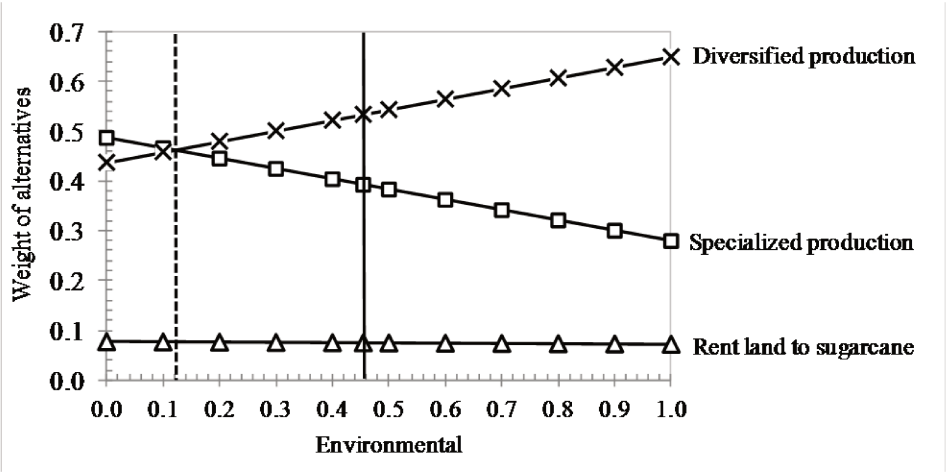
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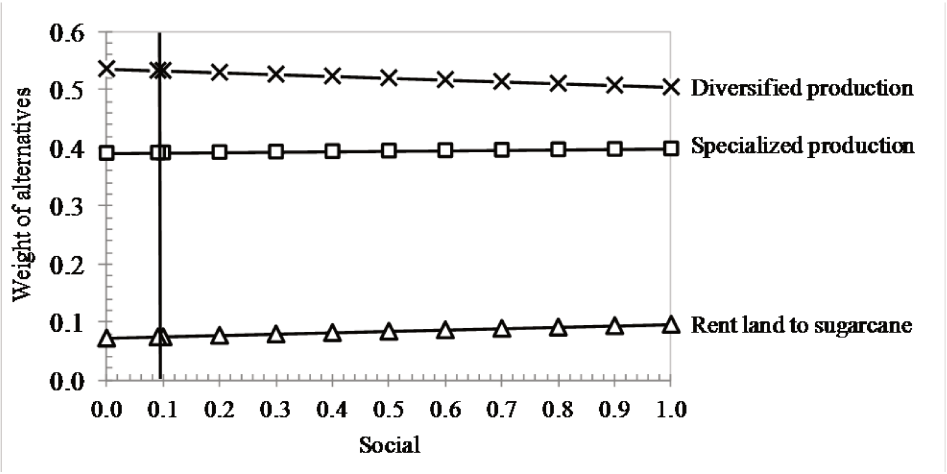
Environmental
Diversified production
Specialized production
Rent land to sugarcane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Social
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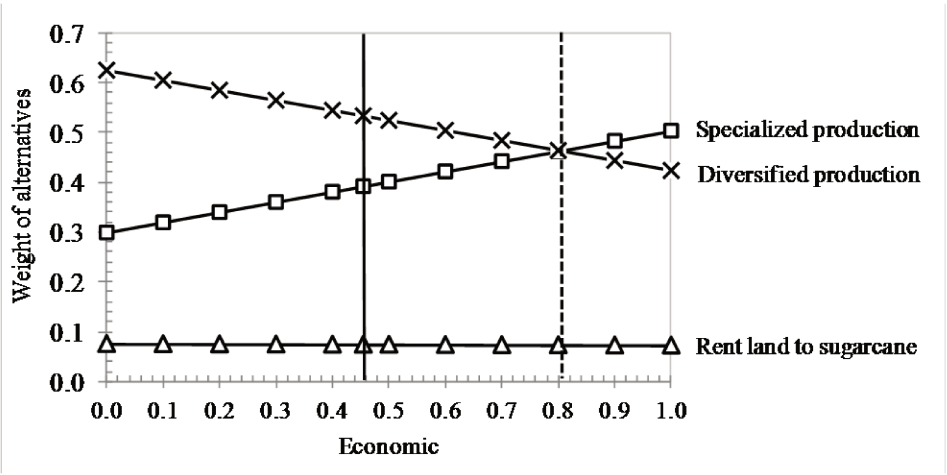
Specialized production
Rent land to sugarcane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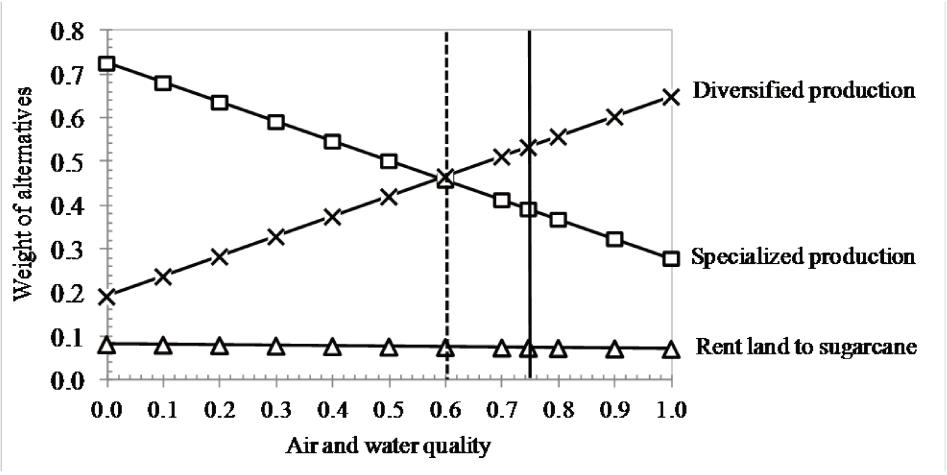
Economic
Specialized production
Diversified production
Rent land to sugarcane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Diversified production
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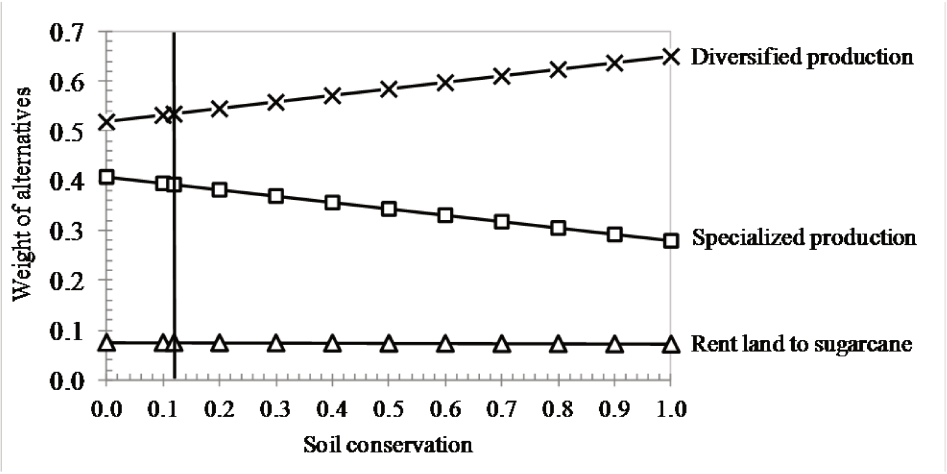
Rent land to sugarcane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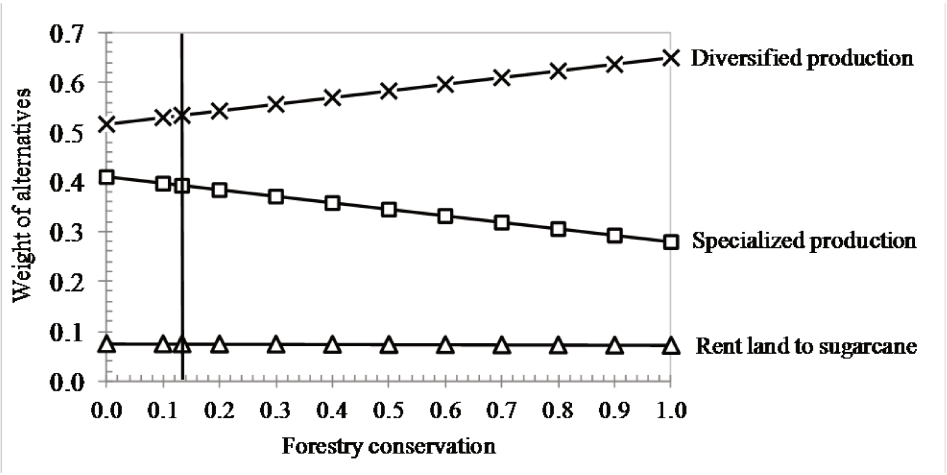
Soil conservation
Diversified production
Specialized production
Rent land to sugarcane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Forestry conservation
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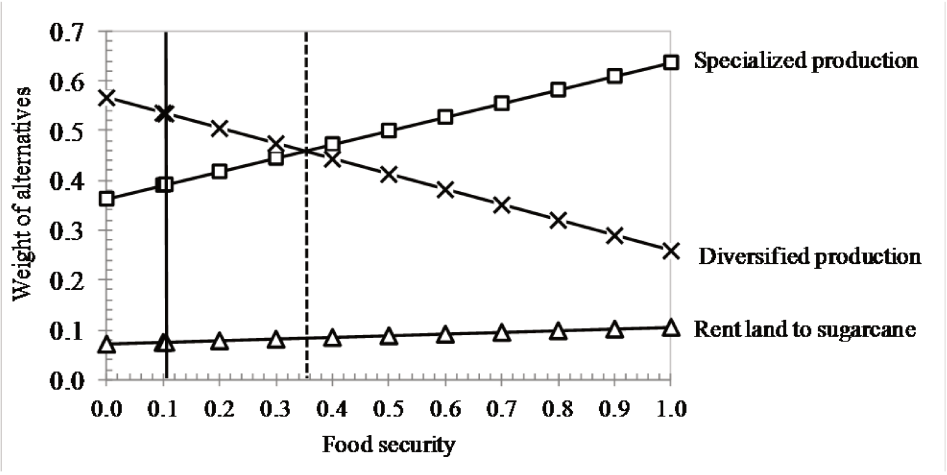
Specialized production
Rent land to sugarcane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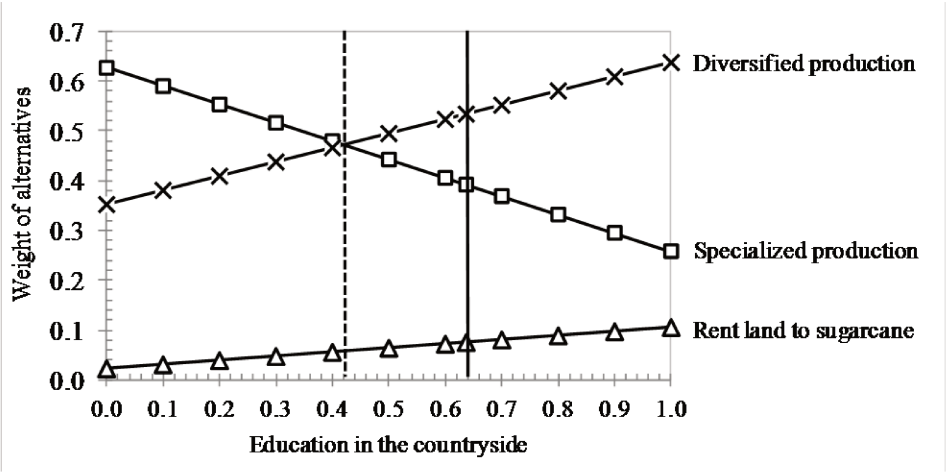
Food security
Specialized production
Diversified production
Rent land to sugarcane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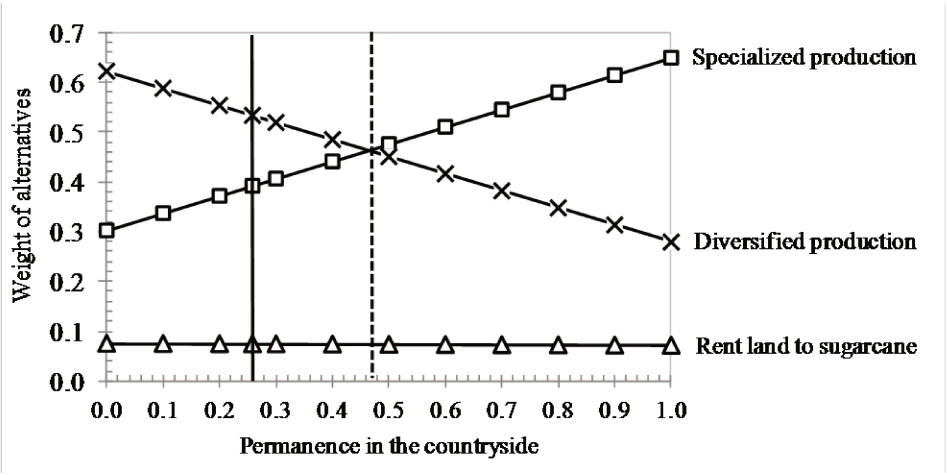
Education in the countryside
Diversified production
Specialized production
Rent land to sugarcane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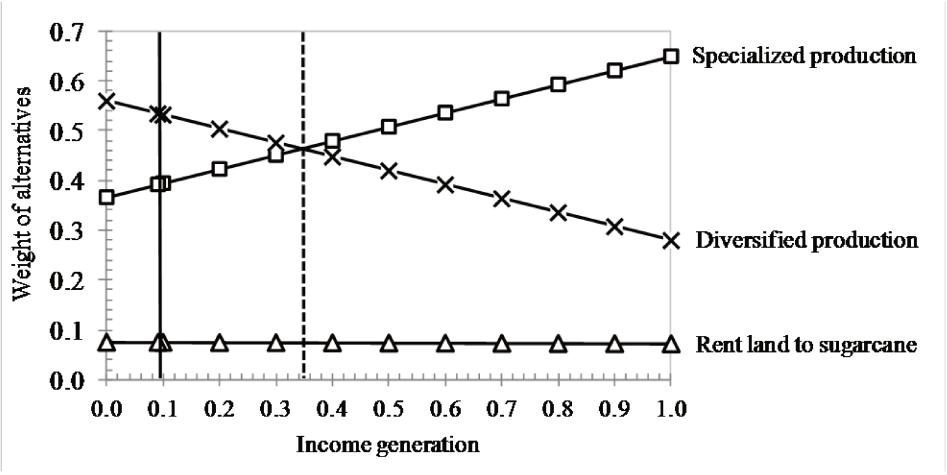
Permanence in the countryside
Specialized production
Diversified production
Rent land to sugarcane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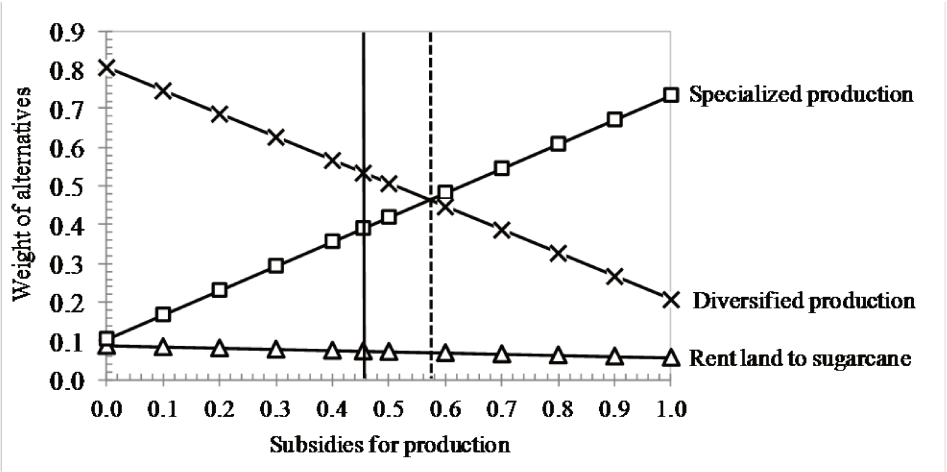
Income generation
Specialized production
Diversified production
Rent land to sugarcane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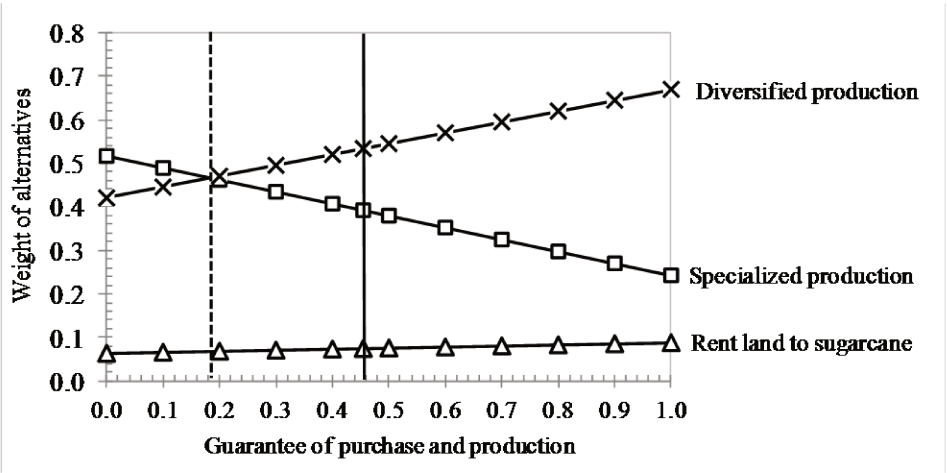
Subsidies for production
Specialized production
Diversified production
Rent land to sugarcane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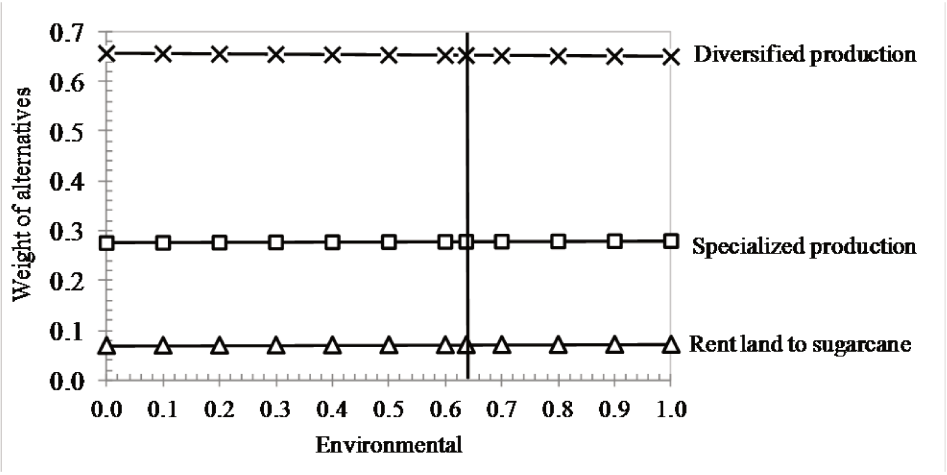
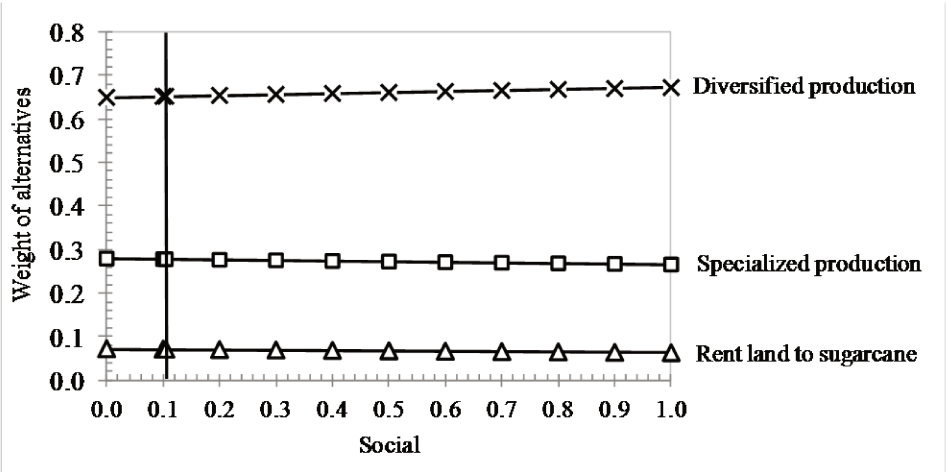
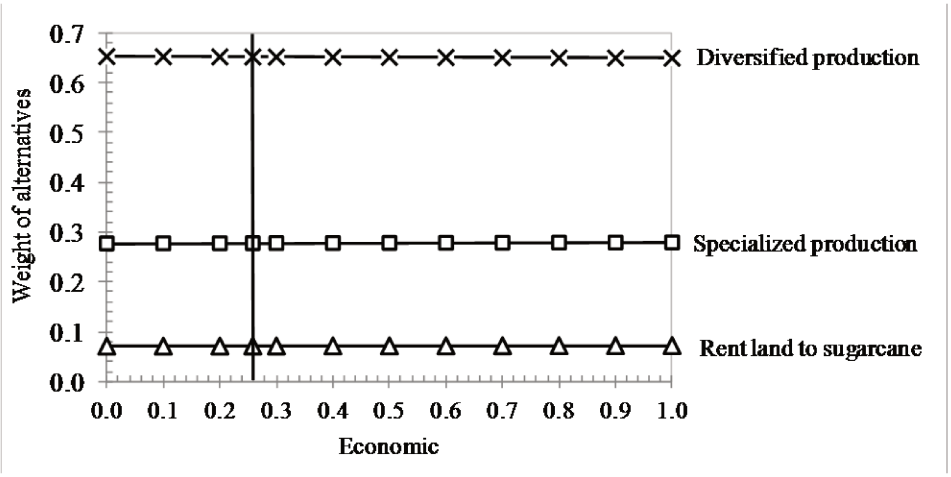
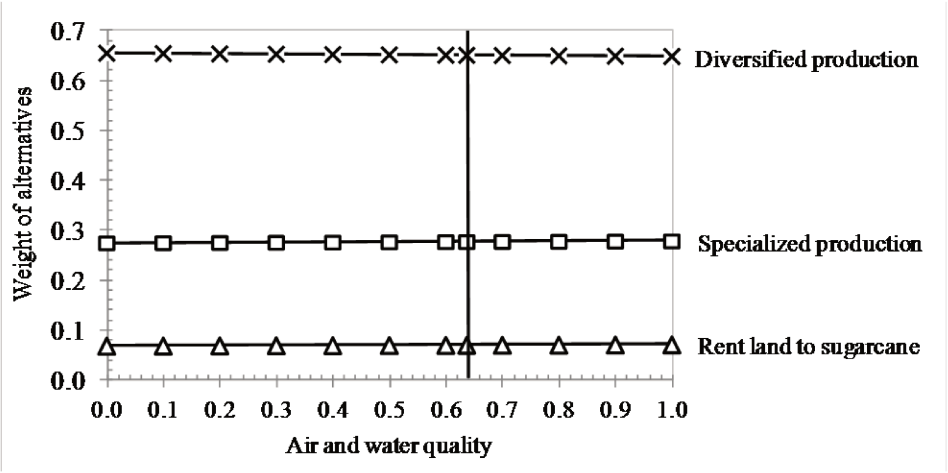
Guarantee of purchase and production
Diversified production
Specialized production
Rent land to sugarcane

3.3. Municipal Secretary of Agriculture





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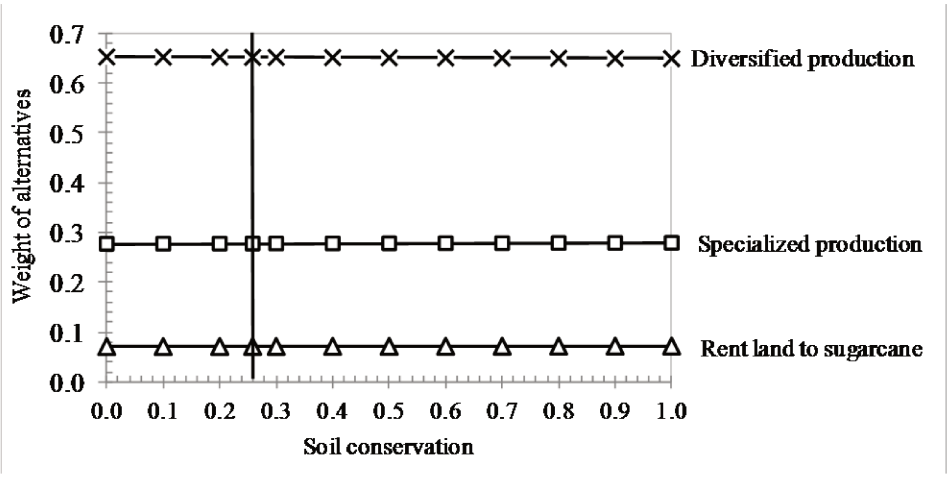
Air and water quality
Diversified production
Specialized production
Rent land to sugarcane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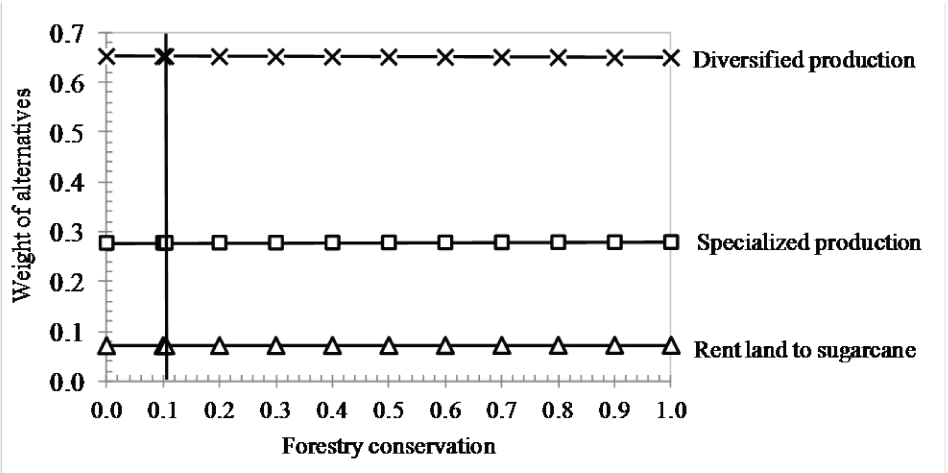
Soil conservation
Diversified production
Specialized production
Rent land to sugarcane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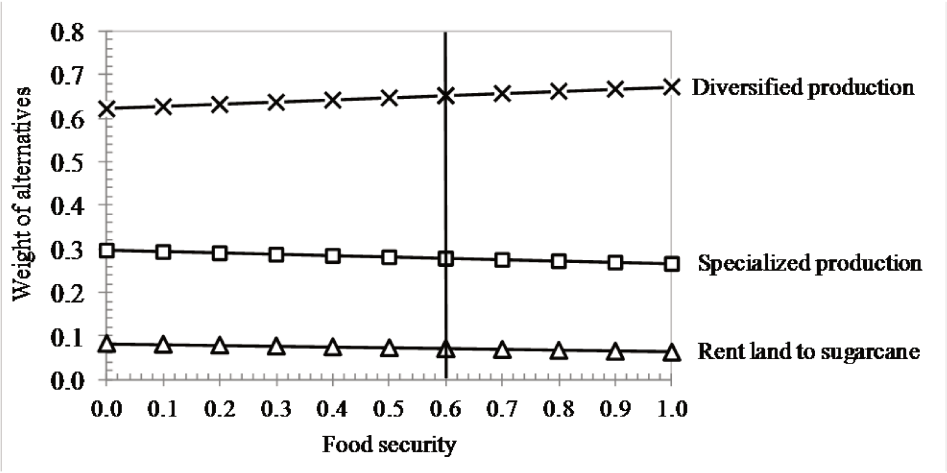
Forestry conservation
Diversified production
Specialized production
Rent land to sugarcane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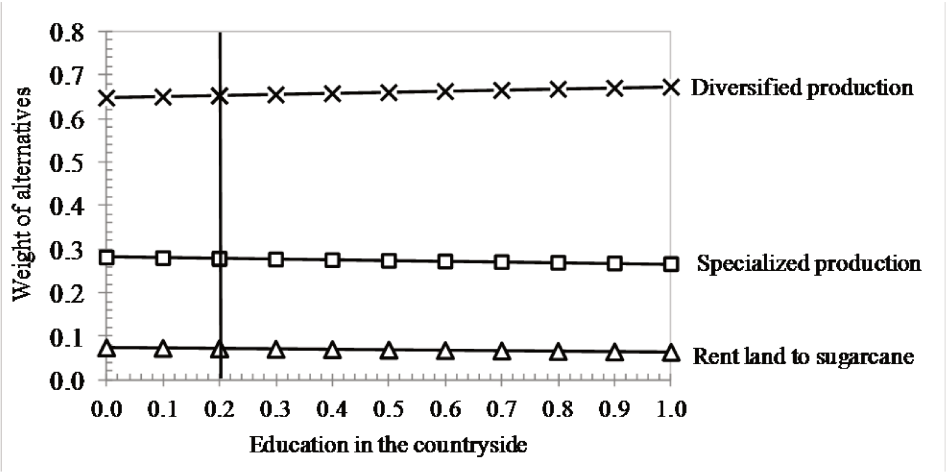
Food security
Diversified production
Specialized production
Rent land to sugarcane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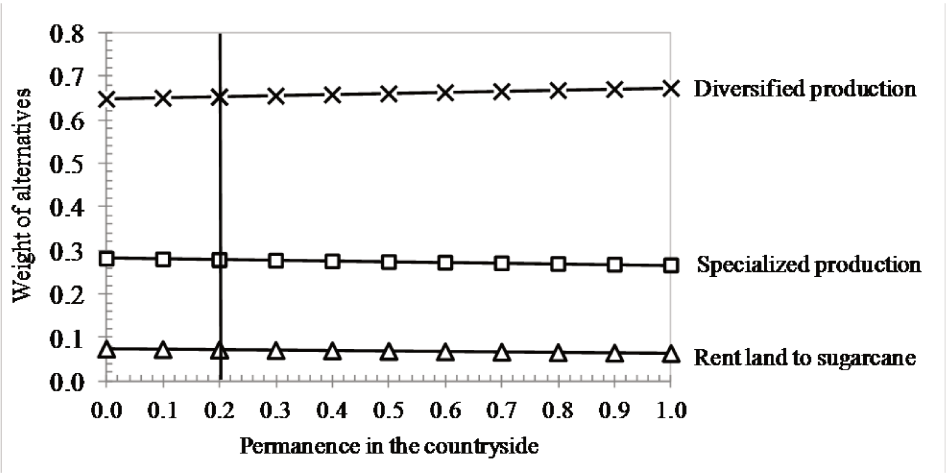
Education in the countryside
Diversified production
Specialized production
Rent land to sugarcane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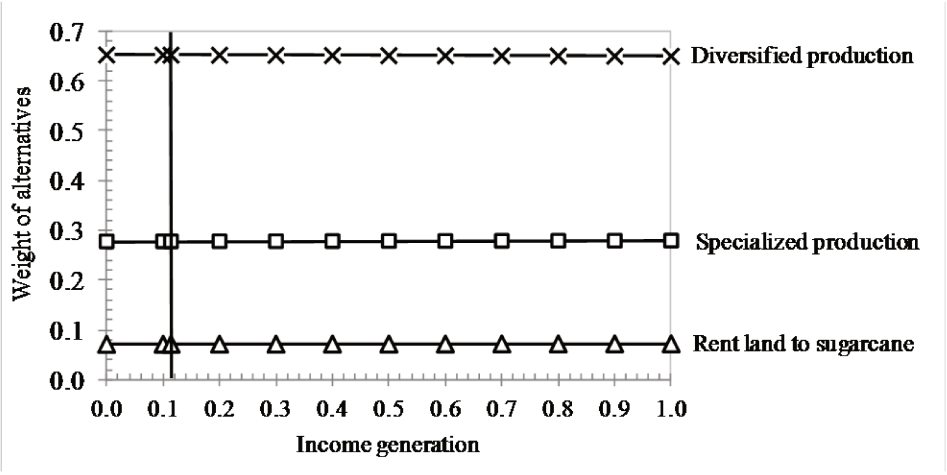
Permanence in the countryside
Diversified production
Specialized production
Rent land to sugarcane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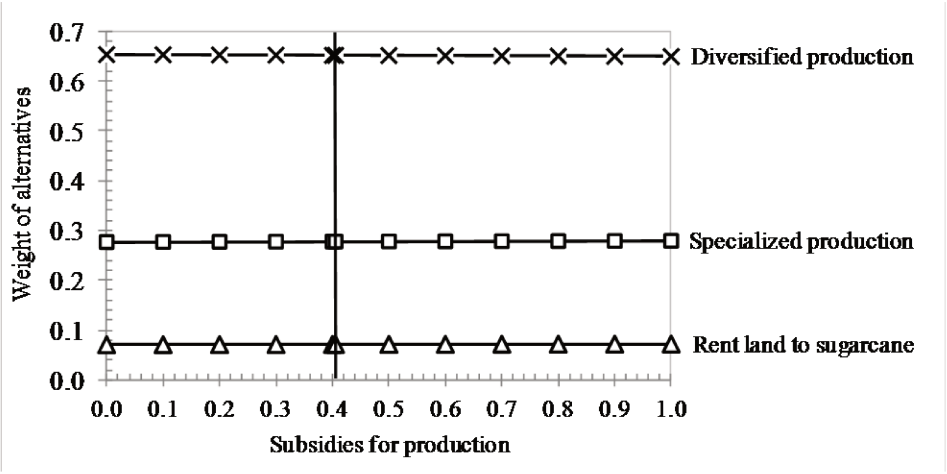
Income generation
Diversified production
Specialized production
Rent land to sugarcane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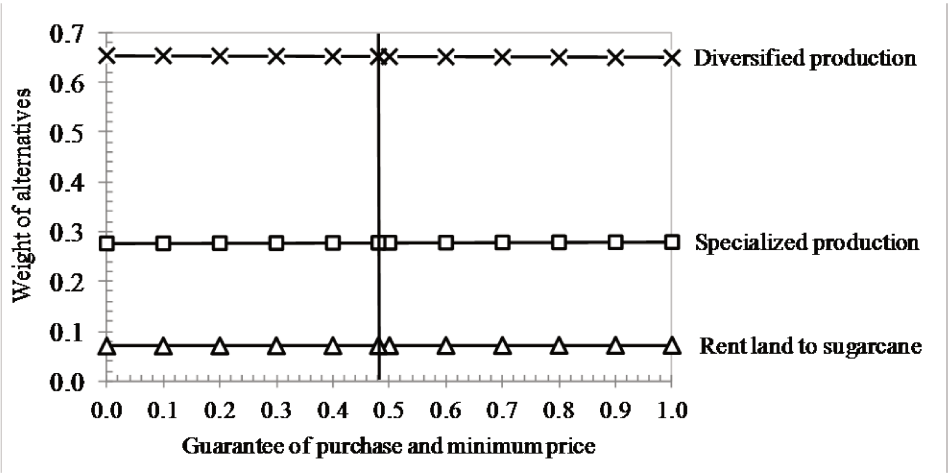
Subsidies for production
Diversified production
Specialized production
Rent land to sugarcane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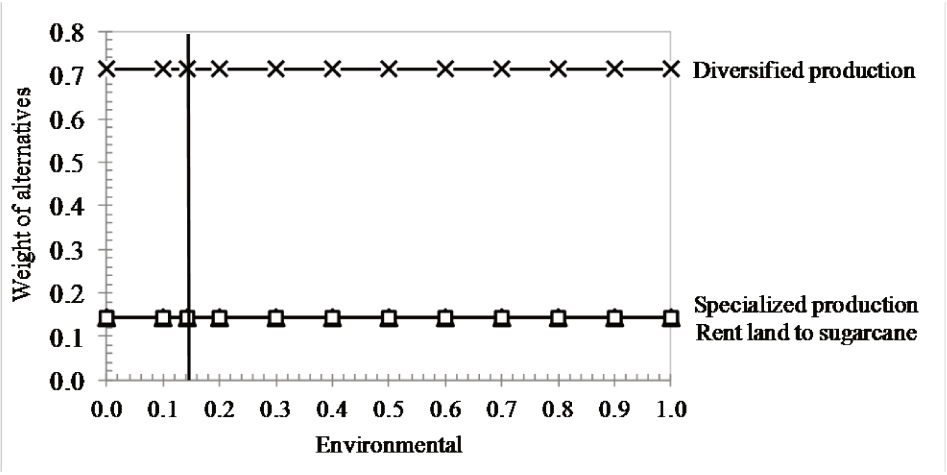
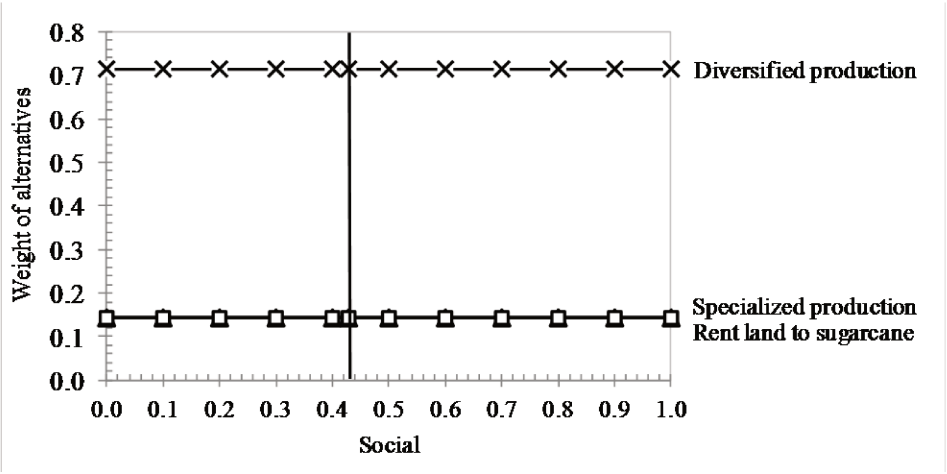
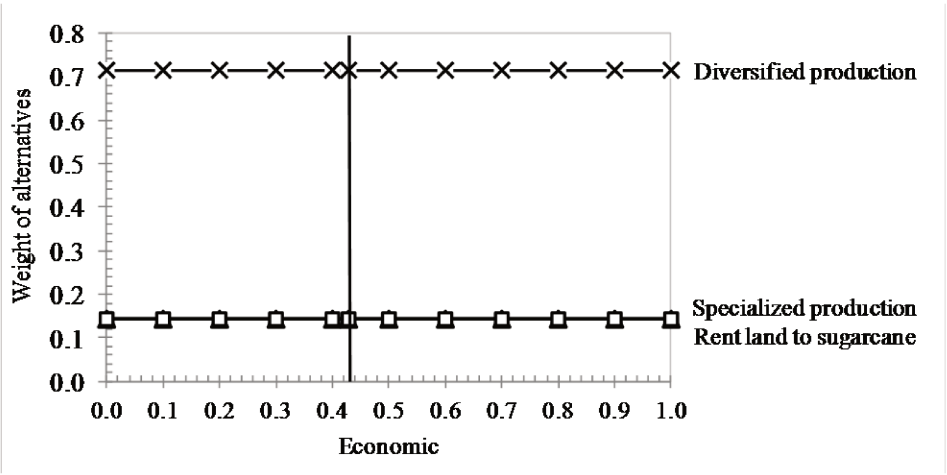
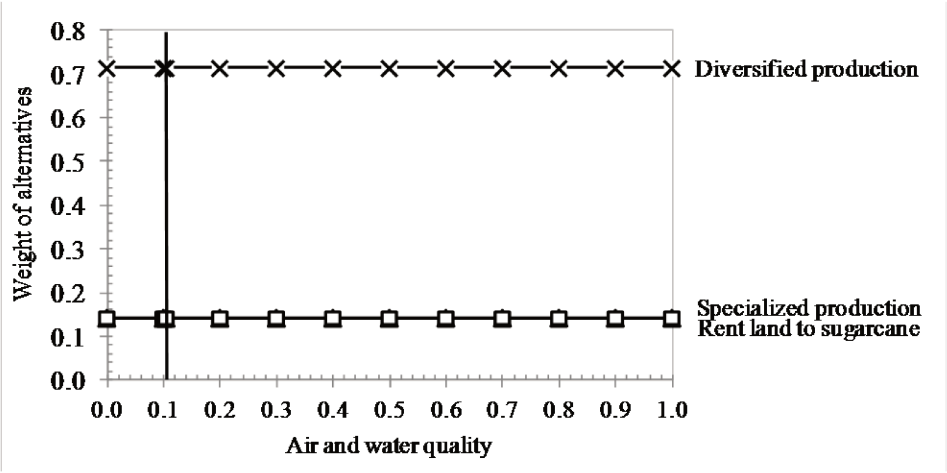
Guarantee of purchase and minimum price
Diversified production
Specialized production
Rent land to sugarcane

3.4. Cooper-Rubi





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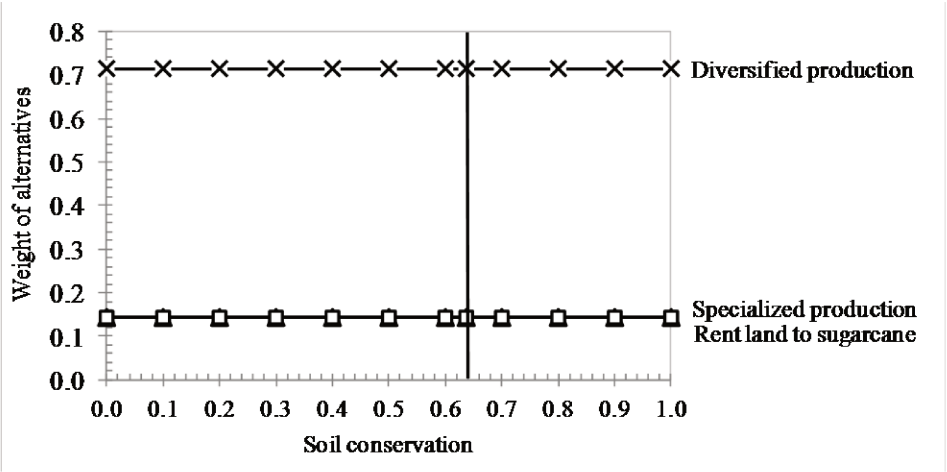
Air and water quality
Diversified production
Specialized production
Rent land to sugarcane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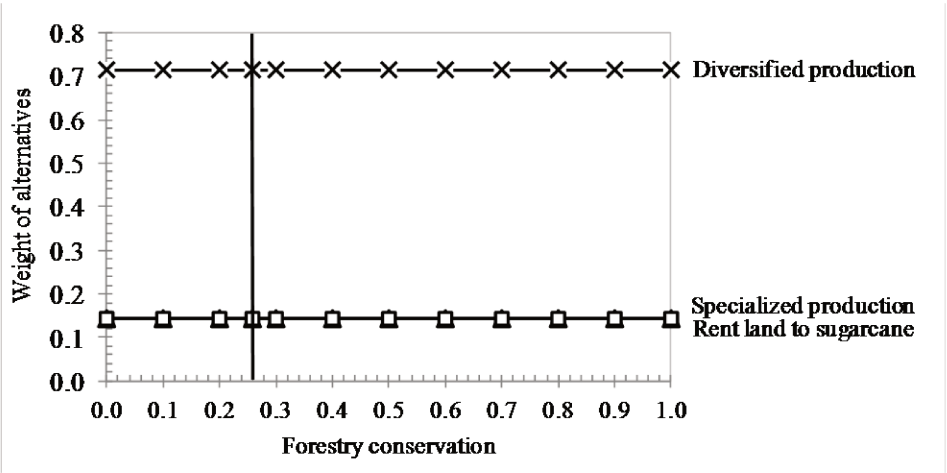
Soil conservation
Diversified production
Specialized production
Rent land to sugarcane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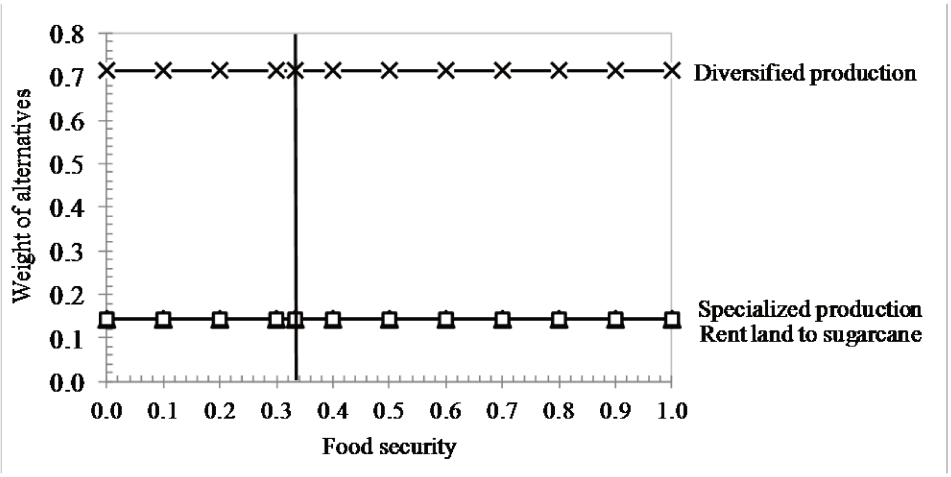
Forestry conservation
Diversified production
Specialized production
Rent land to sugarcane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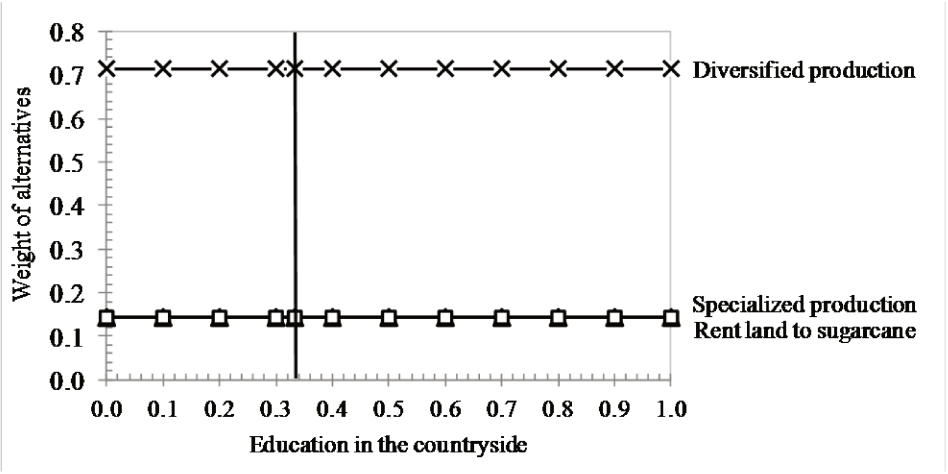
Food security
Diversified production
Specialized production
Rent land to sugarcane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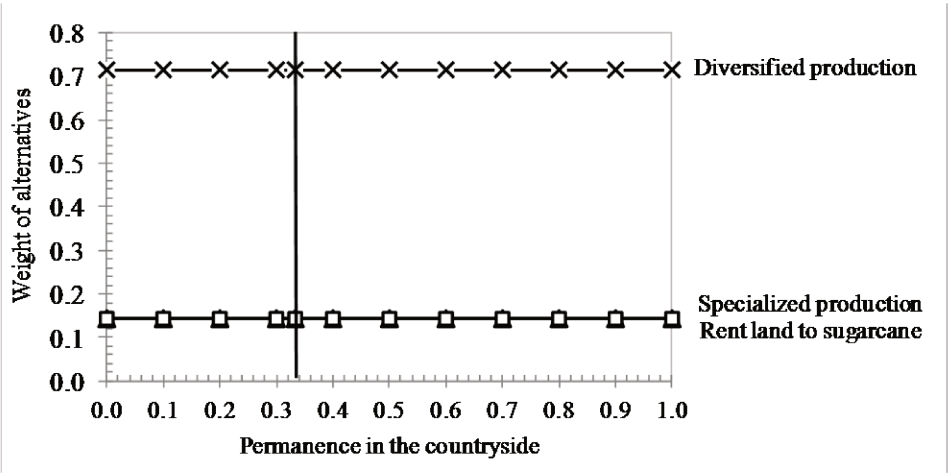
Education in the countryside
Diversified production
Specialized production
Rent land to sugarcane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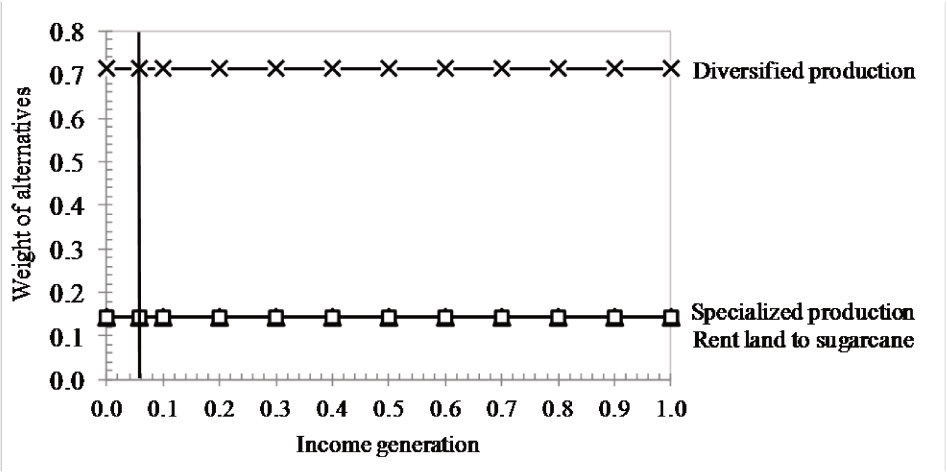
Permanence in the countryside
Diversified production
Specialized production
Rent land to sugarcane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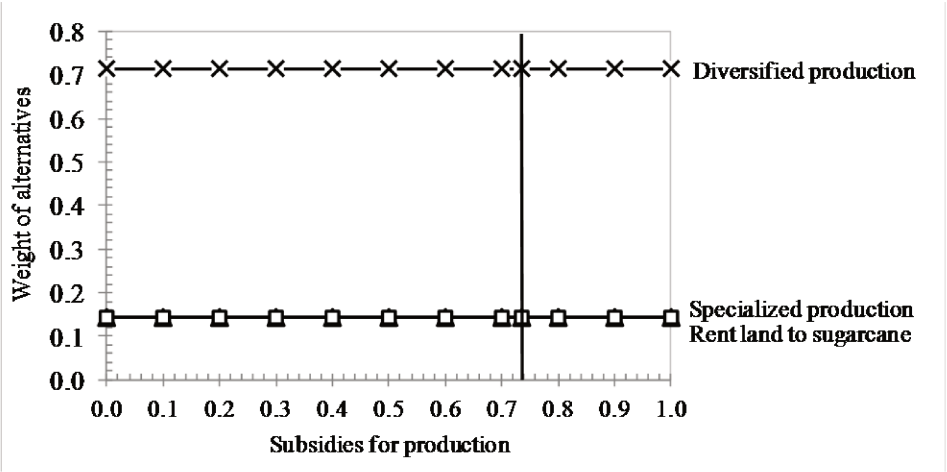
Income generation
Diversified production
Specialized production
Rent land to sugarcane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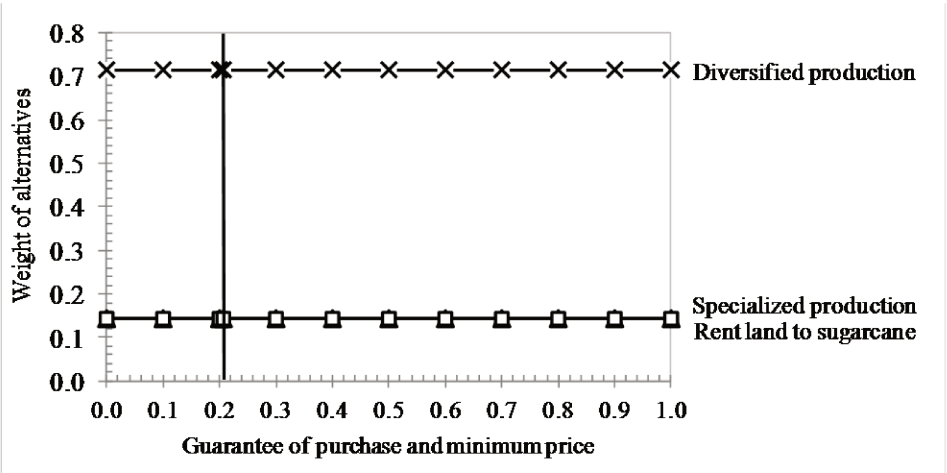
Subsidies for production
Diversified production
Specialized production
Rent land to sugarcane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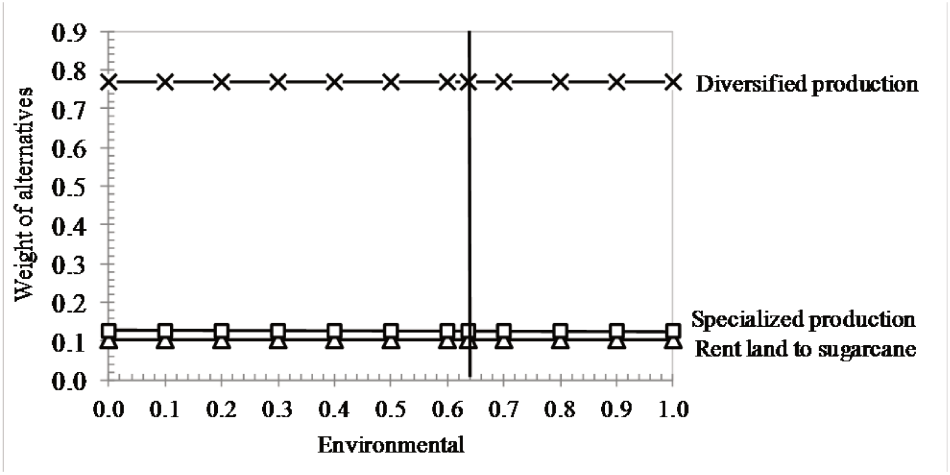
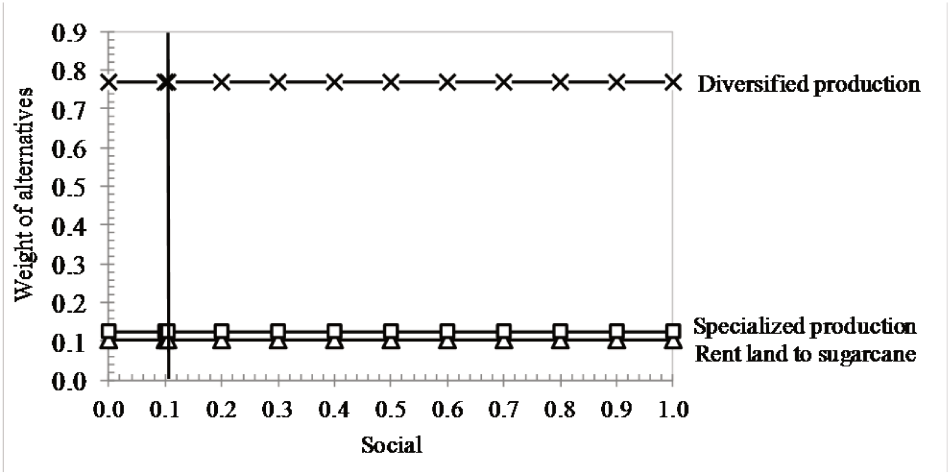
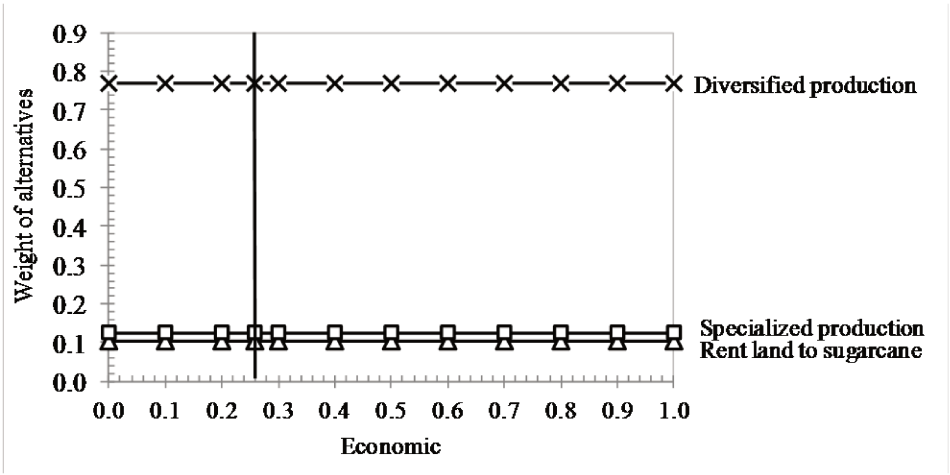
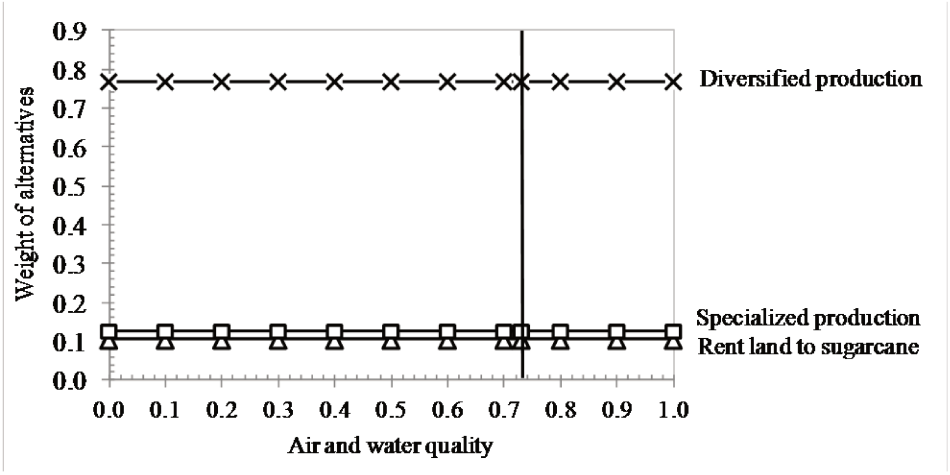
Guarantee of purchase and minimum price
Diversified production
Specialized production
Rent land to sugarcane

3.5. Cooperagro








Weight of alternatives
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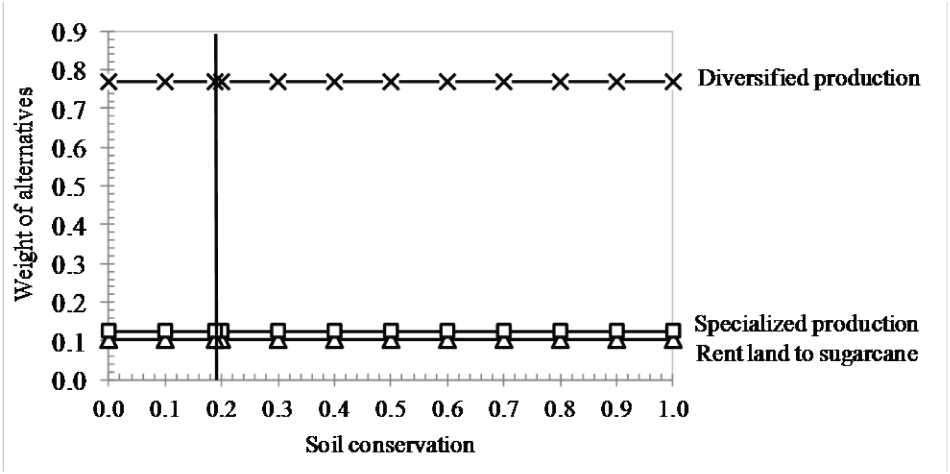
Air and water quality
Diversified production
Specialized production
Rent land to sugarcane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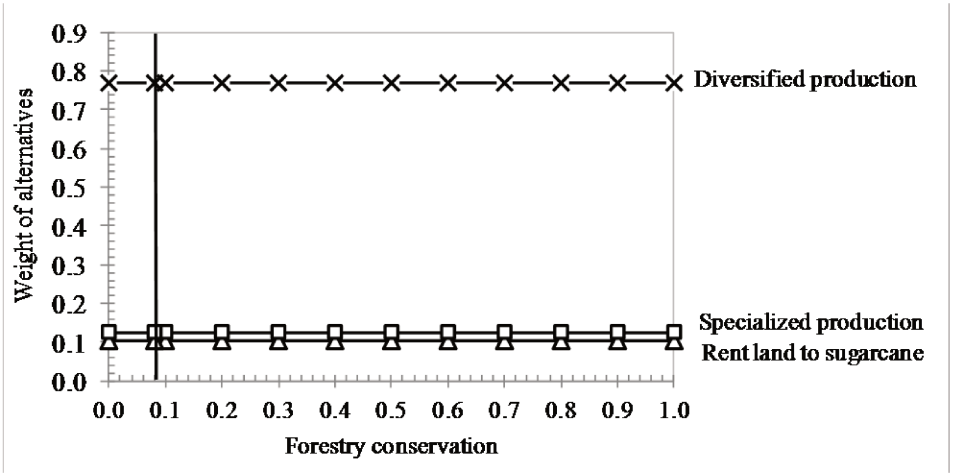
Soil conservation
Diversified production
Specialized production
Rent land to sugarcane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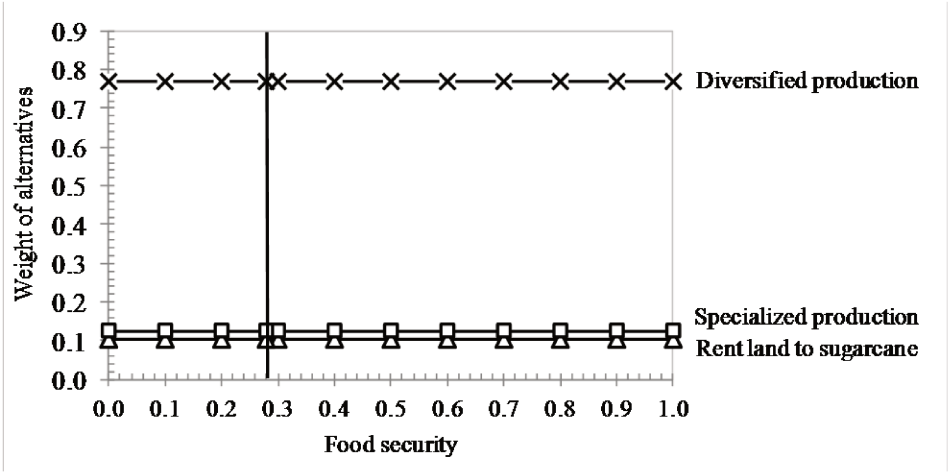
Forestry conservation
Diversified production
Specialized production
Rent land to sugarcane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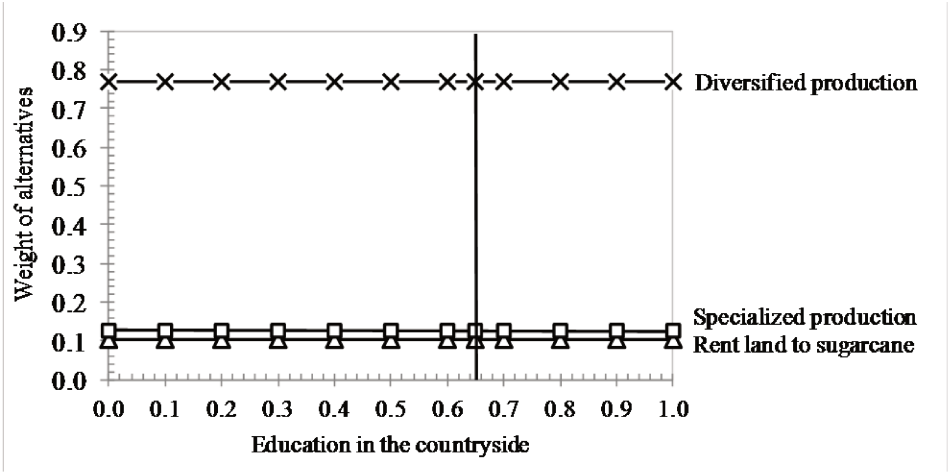
Food security
Diversified production
Specialized production
Rent land to sugarcane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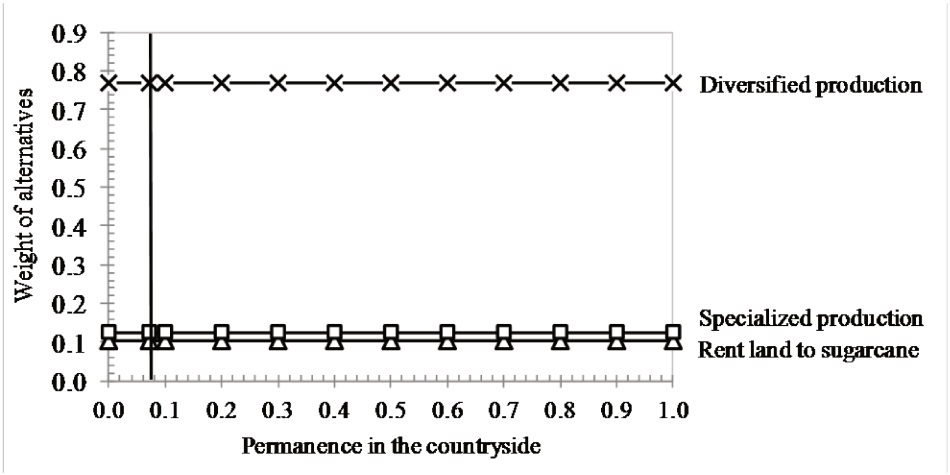
Education in the countryside
Diversified production
Specialized production
Rent land to sugarcane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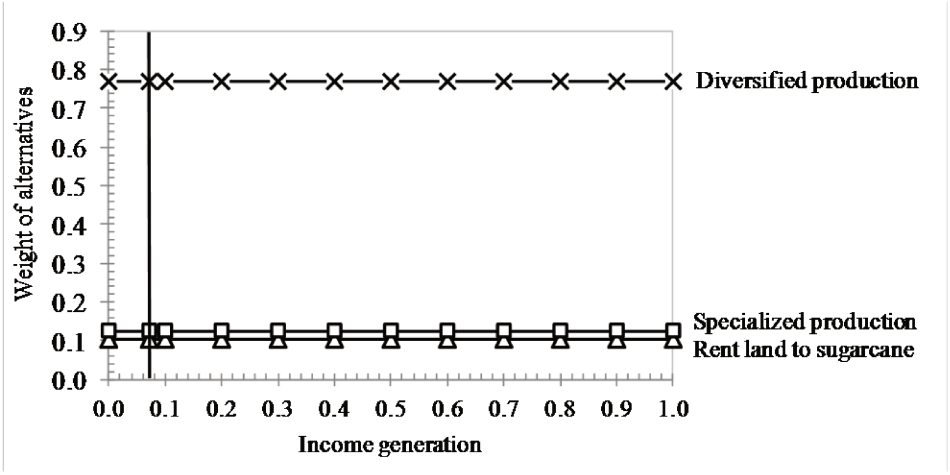
Permanence in the countryside
Diversified production
Specialized production
Rent land to sugarcane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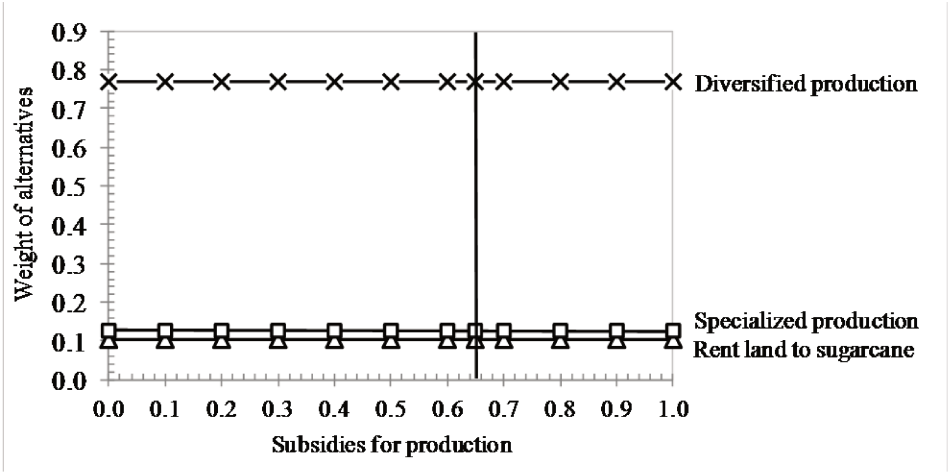
Income generation
Diversified production
Specialized production
Rent land to sugarcane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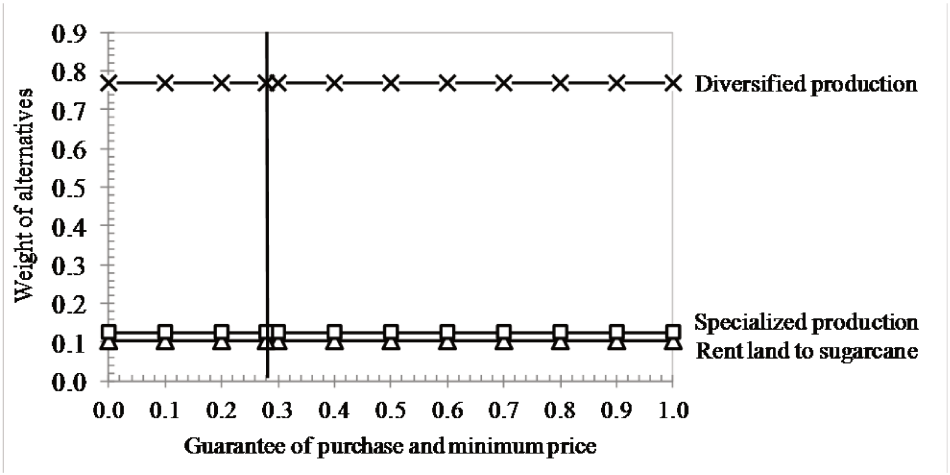
Subsidies for production
Diversified production
Specialized production
Rent land to sugarcane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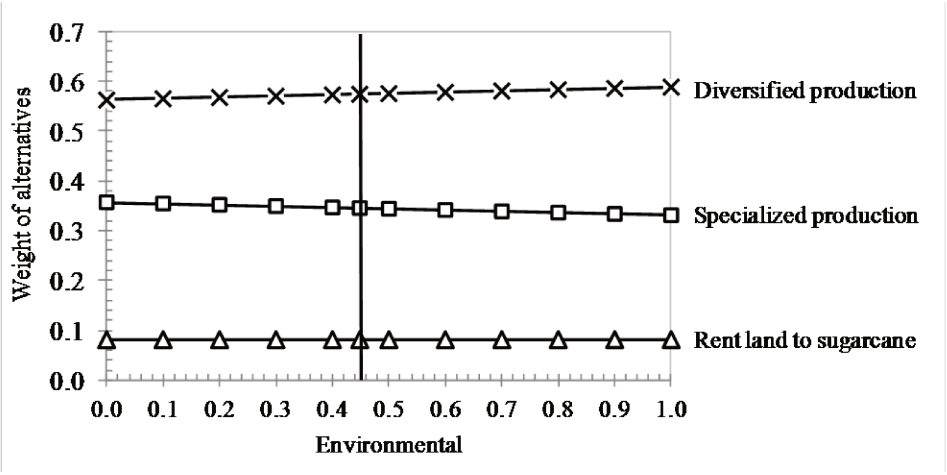
Guarantee of purchase and minimum price
Diversified production
Specialized production
Rent land to sugarcane

3.6. Farmers 1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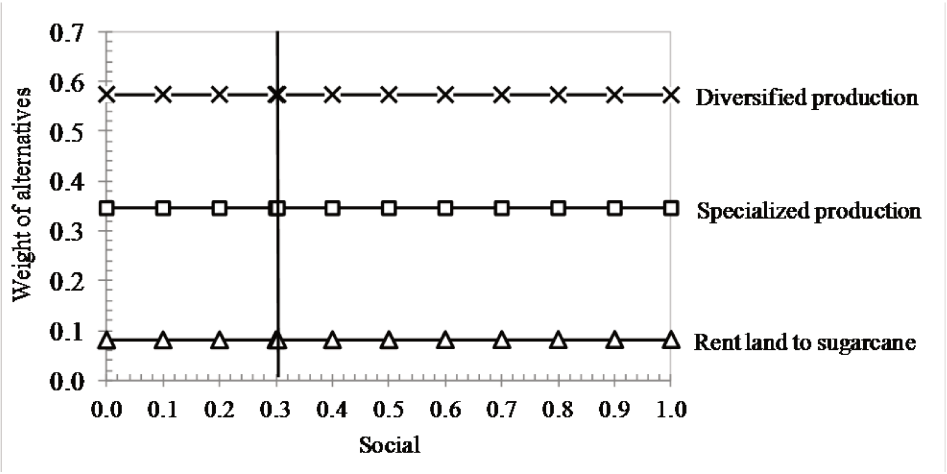
Environmental
Diversified production
Specialized production
Rent land to sugarcane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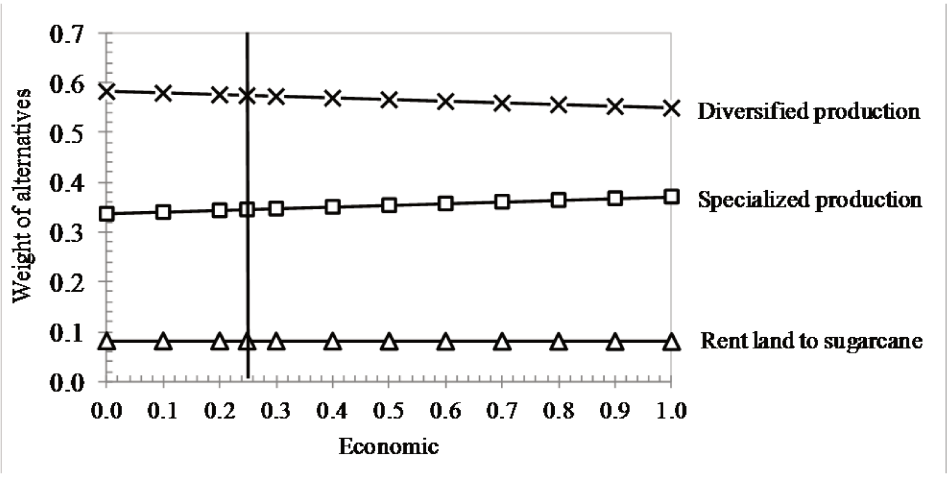
Social
Diversified production
Specialized production
Rent land to sugarcane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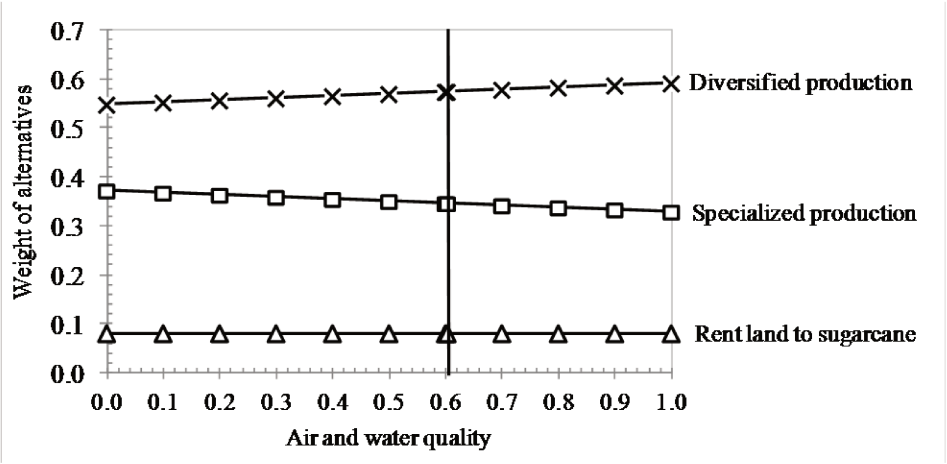
Economic
Diversified production
Specialized production
Rent land to sugarcane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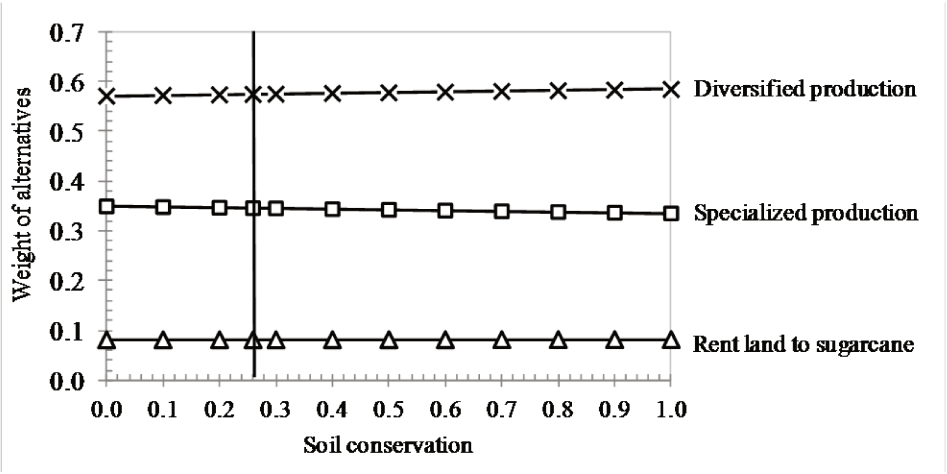
Air and water quality
Diversified production
Specialized production
Rent land to sugarcane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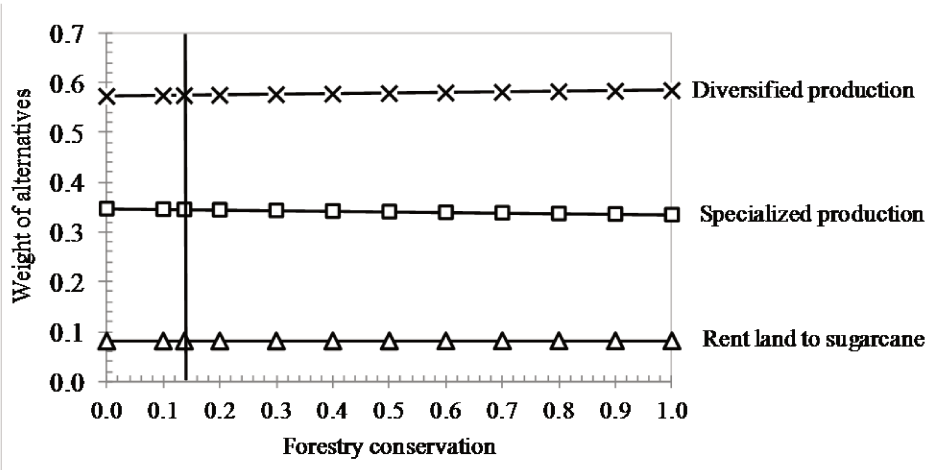
Soil conservation
Diversified production
Specialized production
Rent land to sugarcane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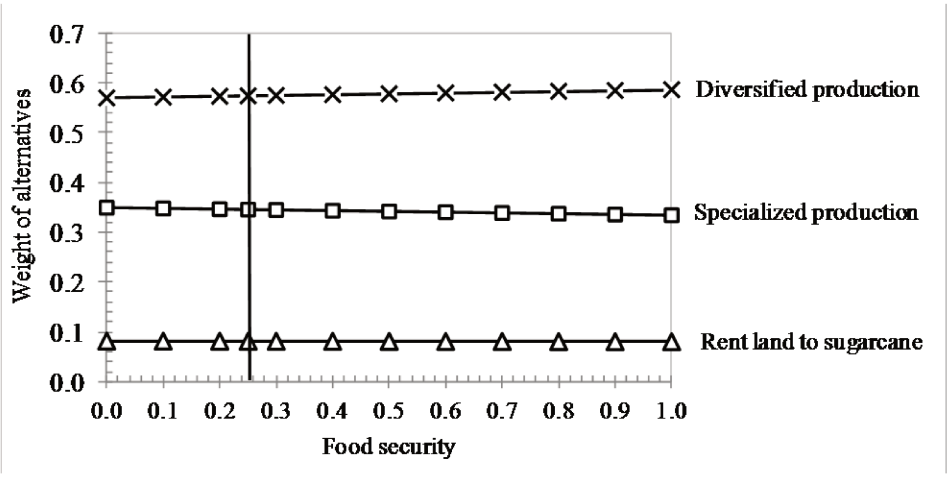
Forestry conservation
Diversified production
Specialized production
Rent land to sugarcane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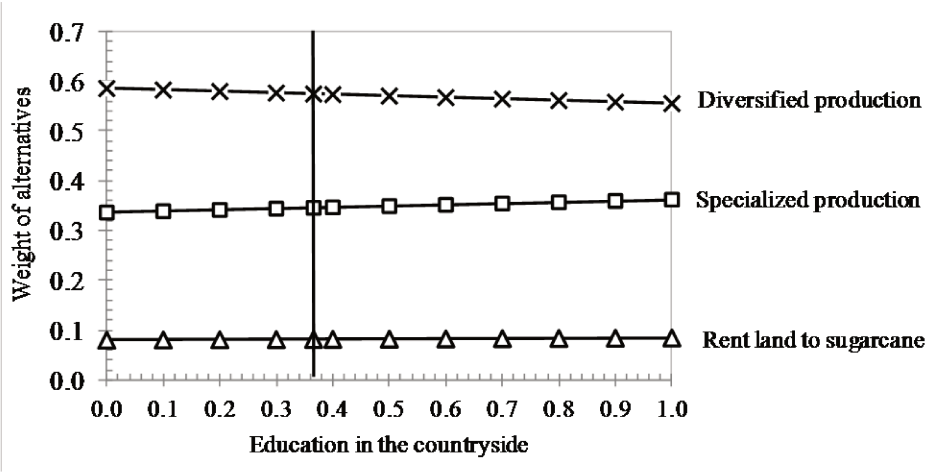
Food security
Diversified production
Specialized production
Rent land to sugarcane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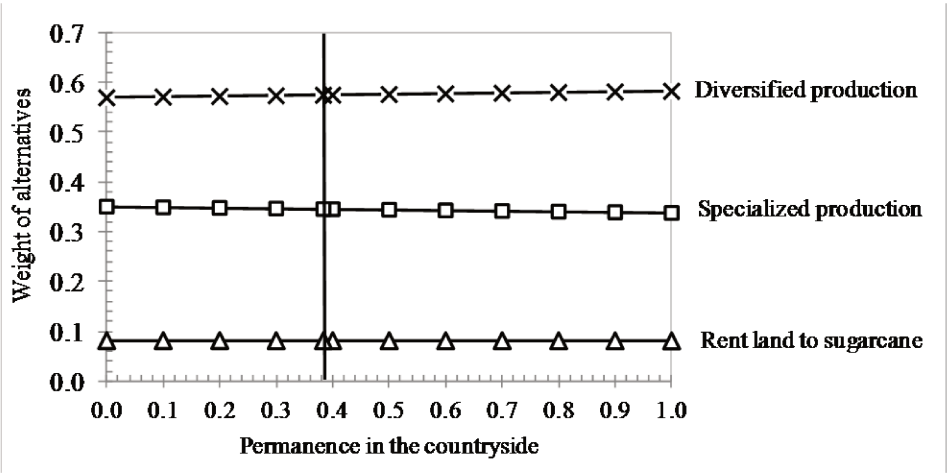
Education in the countryside
Diversified production
Specialized production
Rent land to sugarcane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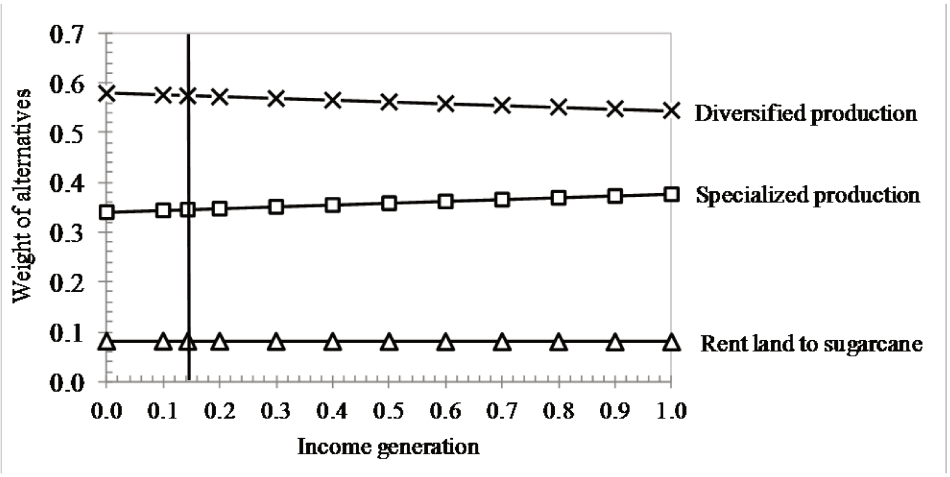
Permanence in the countryside
Diversified production
Specialized production
Rent land to sugarcane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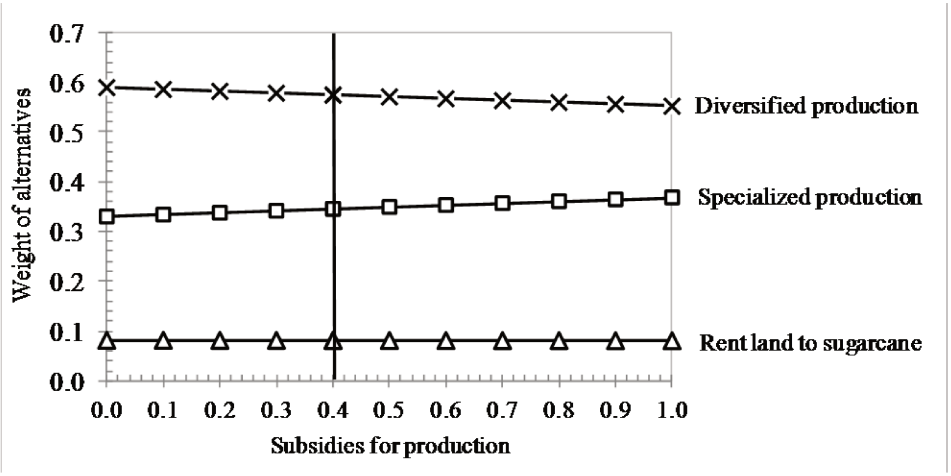
Income generation
Diversified production
Specialized production
Rent land to sugarcane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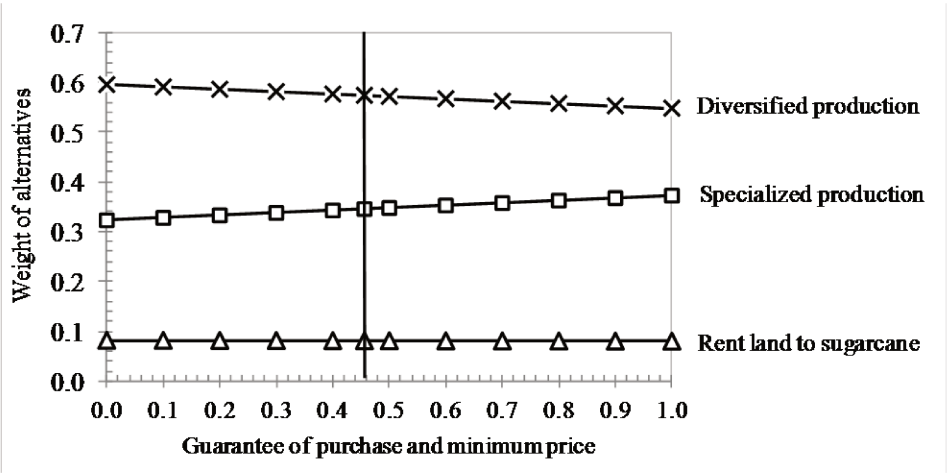
Subsidies for production
Diversified production
Specialized production
Rent land to sugarcane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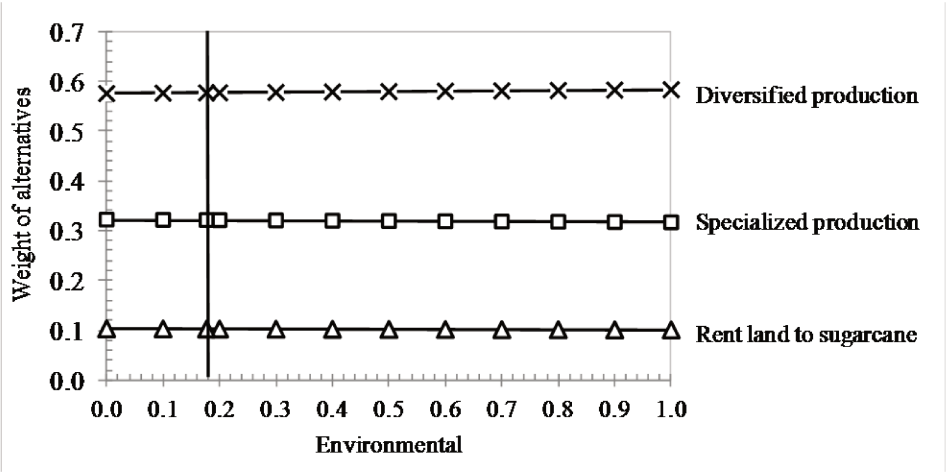
Guarantee of purchase and minimum price
Diversified production
Specialized production
Rent land to sugarcane

3.7. Farmers 2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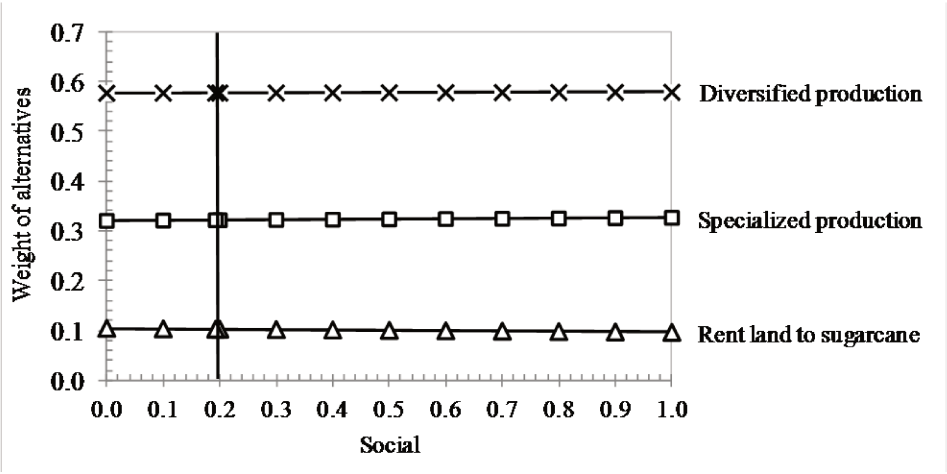
Environmental
Diversified production
Specialized production
Rent land to sugarcane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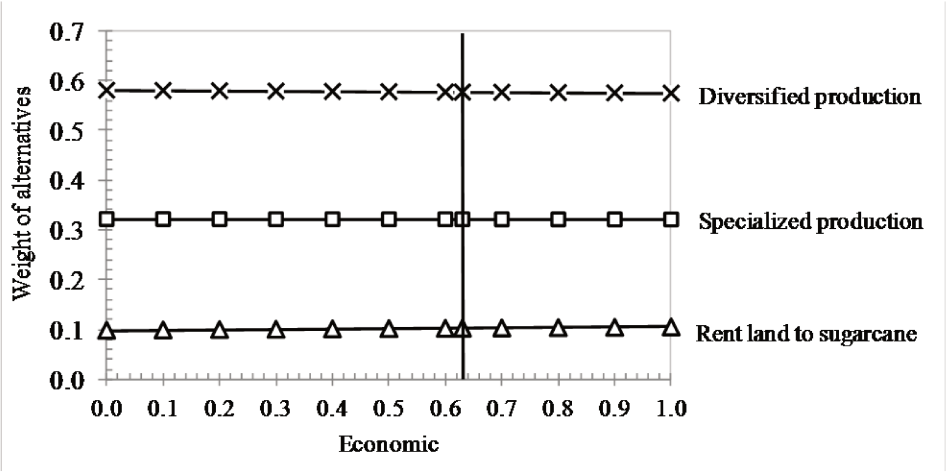
Diversified production
Specialized production
Rent land to sugarcane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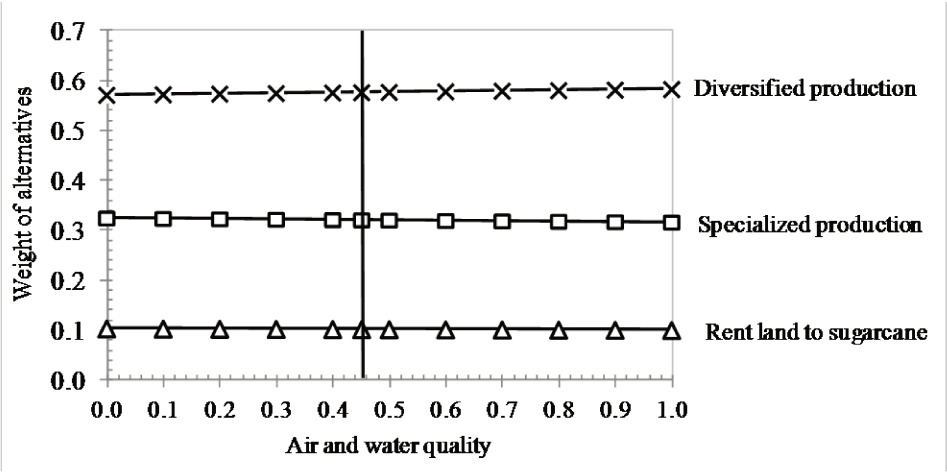
Economic
Diversified production
Specialized production
Rent land to sugarcane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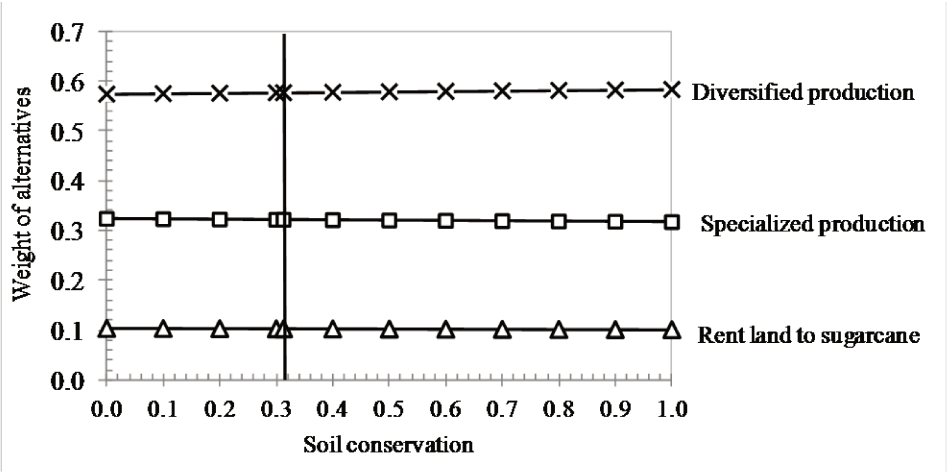
Air and water quality
Diversified production
Specialized production
Rent land to sugarcane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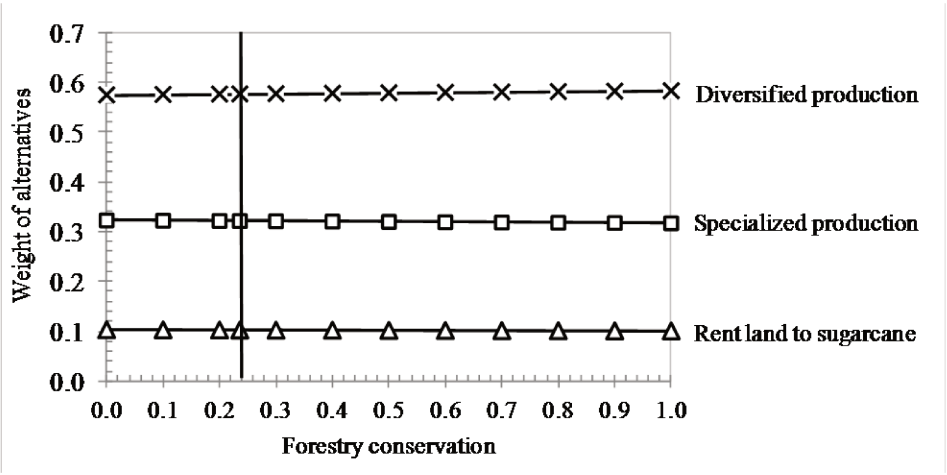
Soil conservation
Diversified production
Specialized production
Rent land to sugarcane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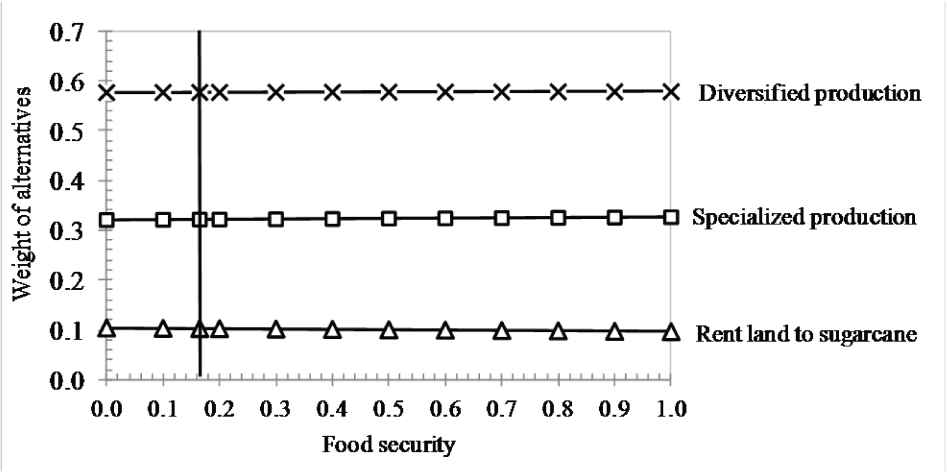
Forestry conservation
Diversified production
Specialized production
Rent land to sugarcane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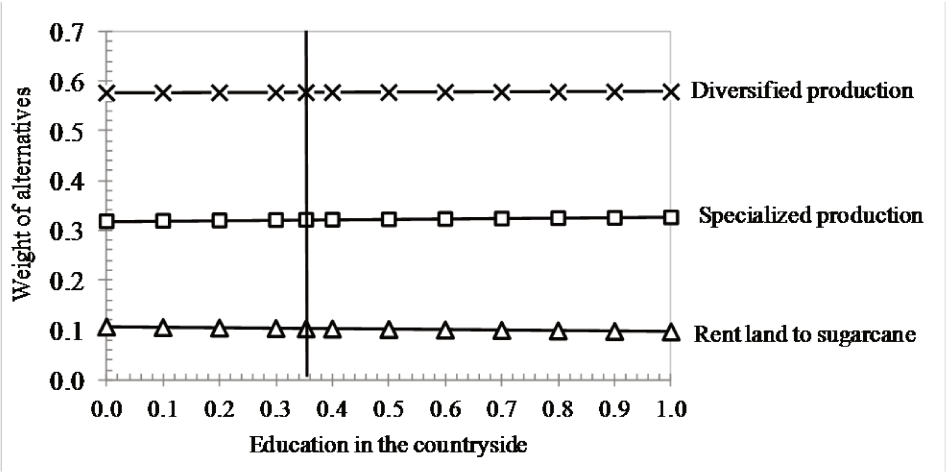
Food security
Diversified production
Specialized production
Rent land to sugarcane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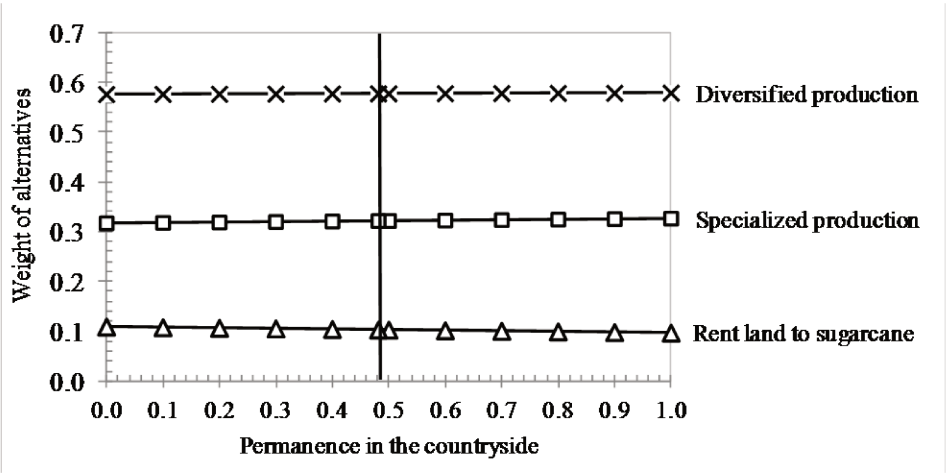
Education in the countryside
Diversified production
Specialized production
Rent land to sugarcane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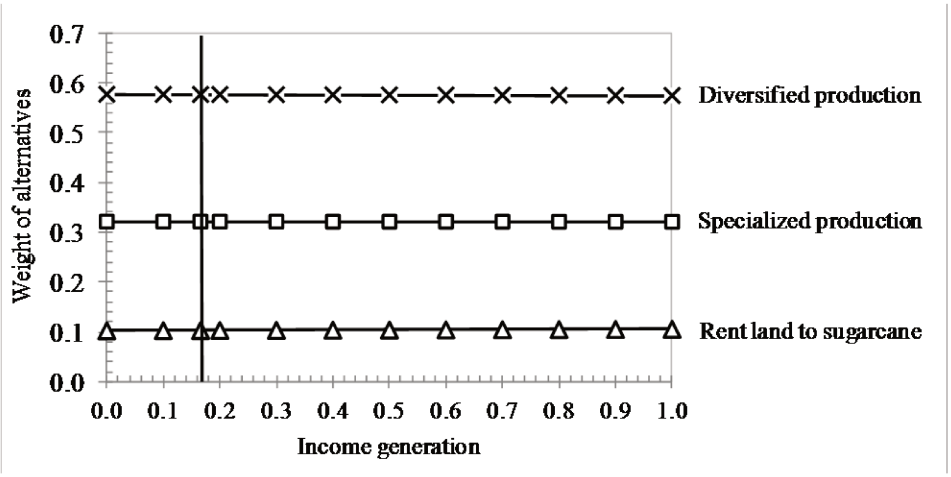
Permanence in the countryside
Diversified production
Specialized production
Rent land to sugarcane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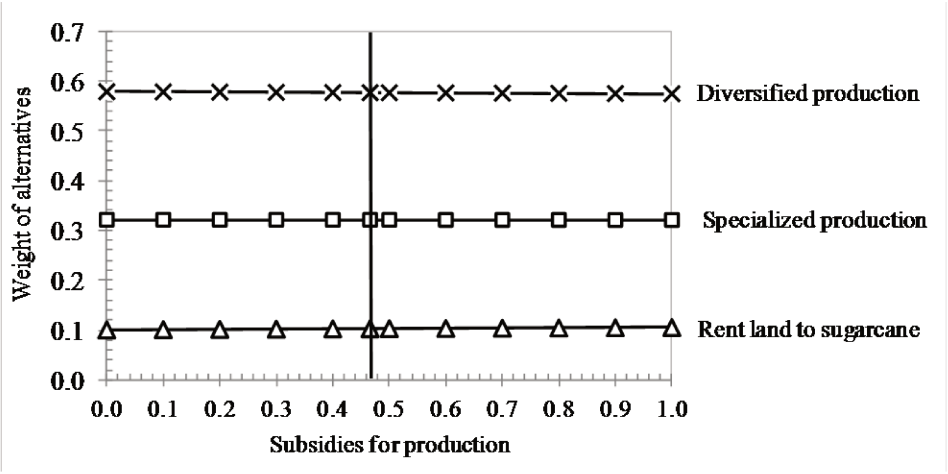
Income generation
Diversified production
Specialized production
Rent land to sugarcane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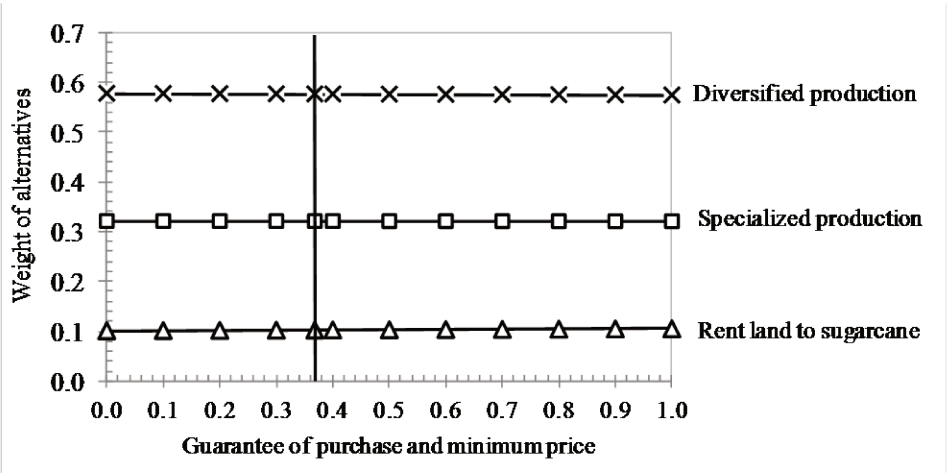
Subsidies for production
Diversified production
Specialized production
Rent land to sugarcane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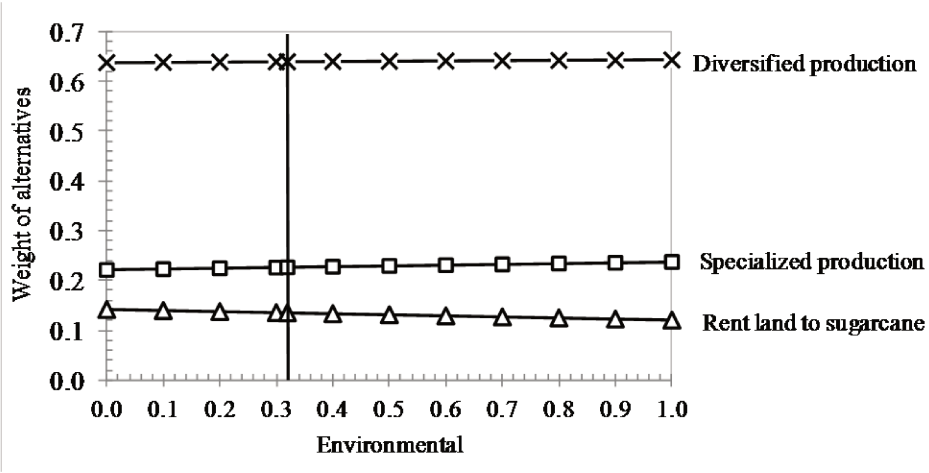
Guarantee of purchase and minimum price
Diversified production
Specialized production
Rent land to sugarcane

3.8. Farmers 3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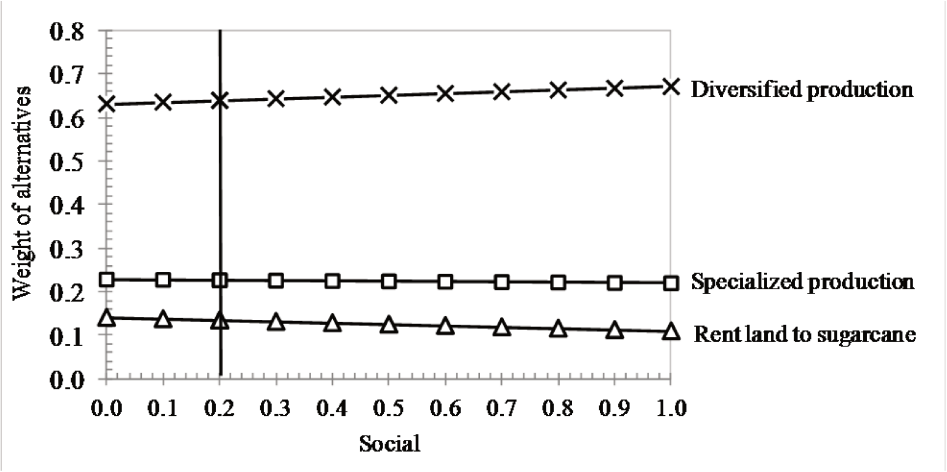
Environmental
Diversified production
Specialized production
Rent land to sugarcane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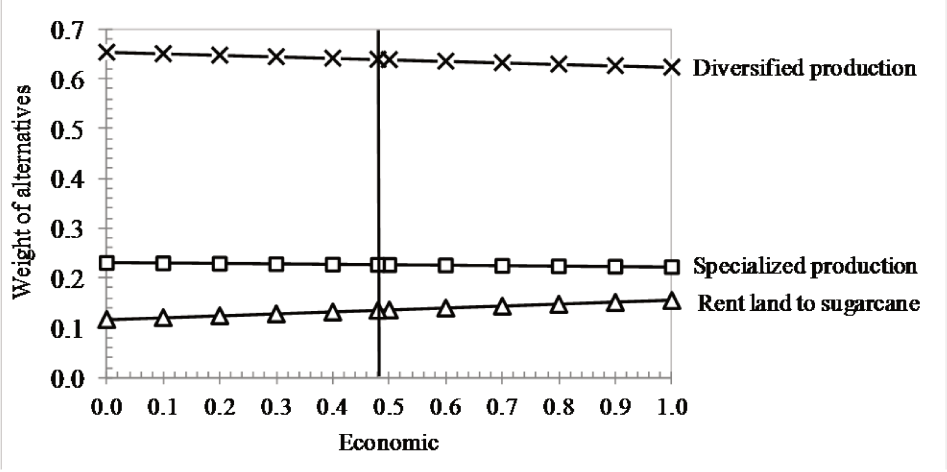
Diversified production
Specialized production
Rent land to sugarcane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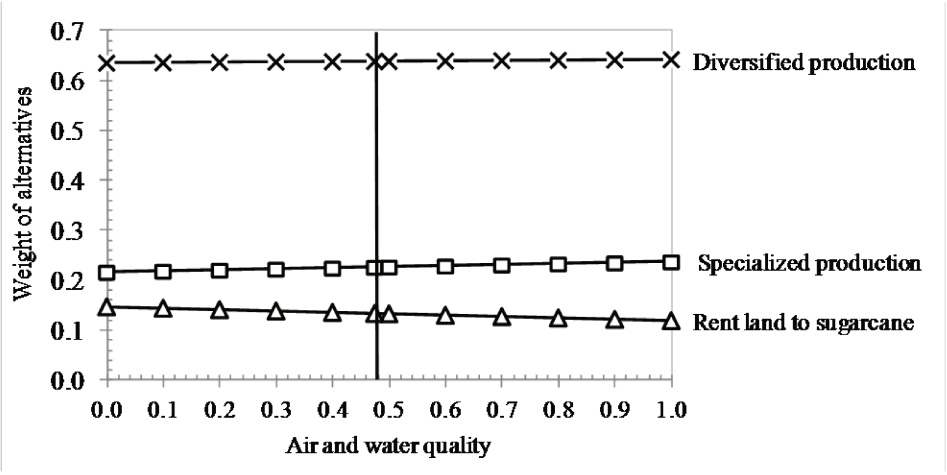
Economic
Diversified production
Specialized production
Rent land to sugarcane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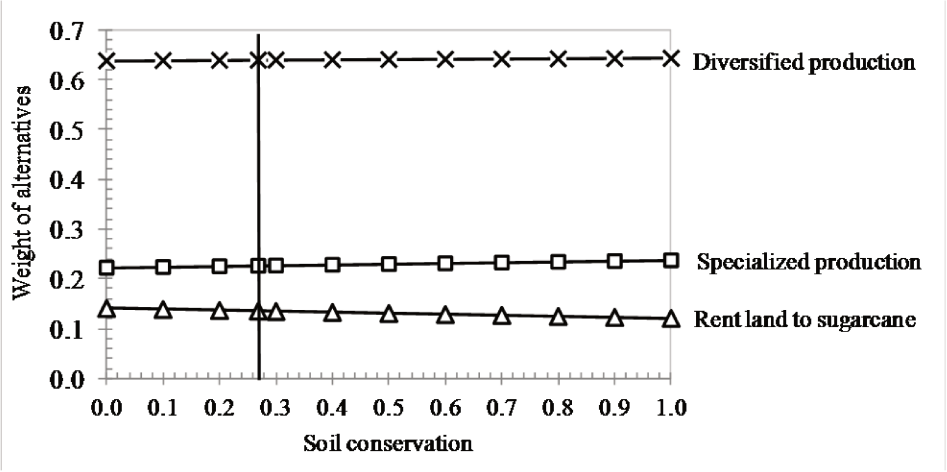
Air and water quality
Diversified production
Specialized production
Rent land to sugarcane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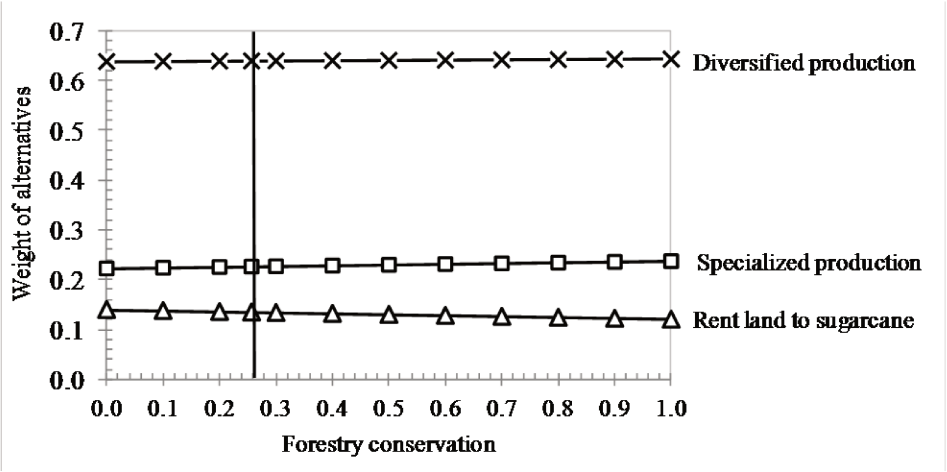
Soil conservation
Diversified production
Specialized production
Rent land to sugarcane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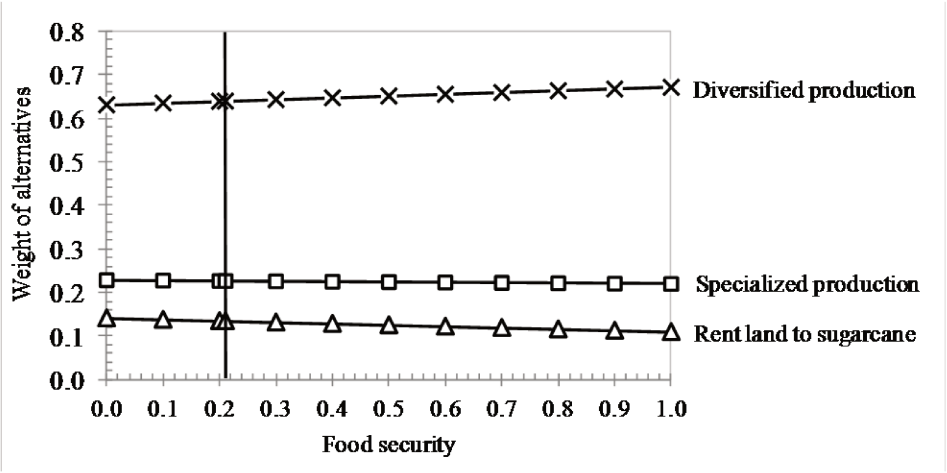
Forestry conservation
Diversified production
Specialized production
Rent land to sugarcane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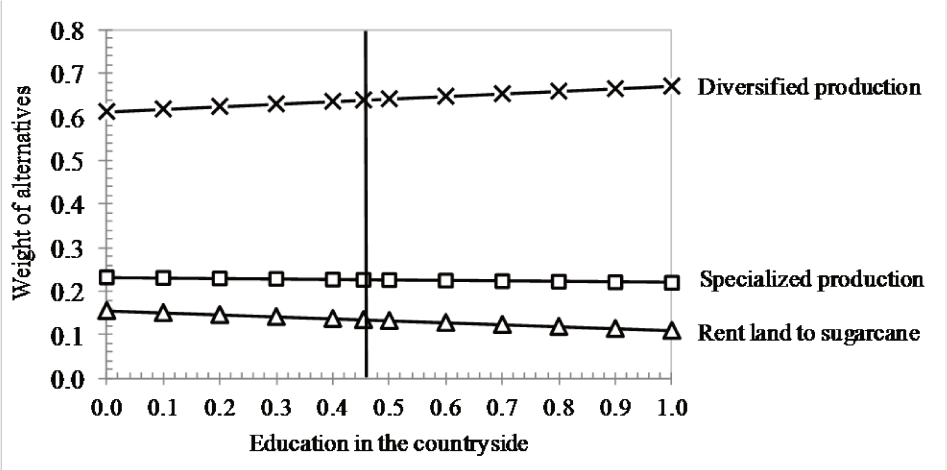
Food security
Diversified production
Specialized production
Rent land to sugarcane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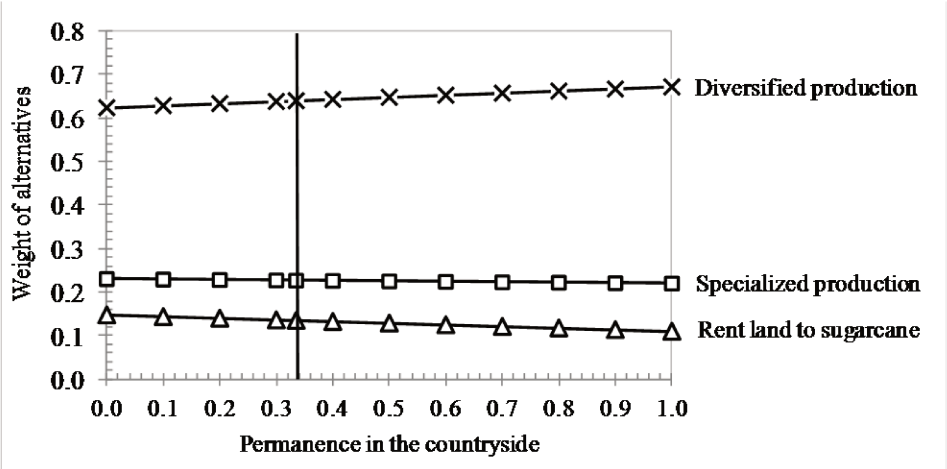
Education in the countryside
Diversified production
Specialized production
Rent land to sugarcane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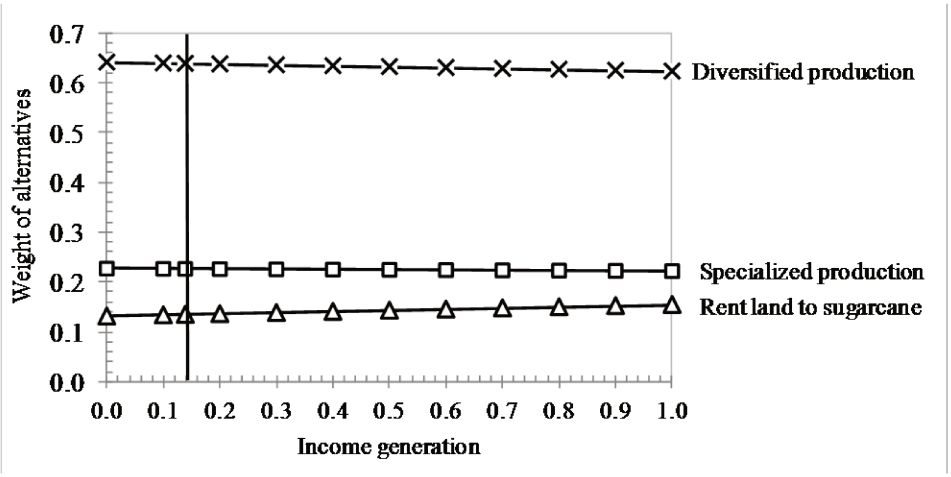
Permanence in the countryside
Diversified production
Specialized production
Rent land to sugarcane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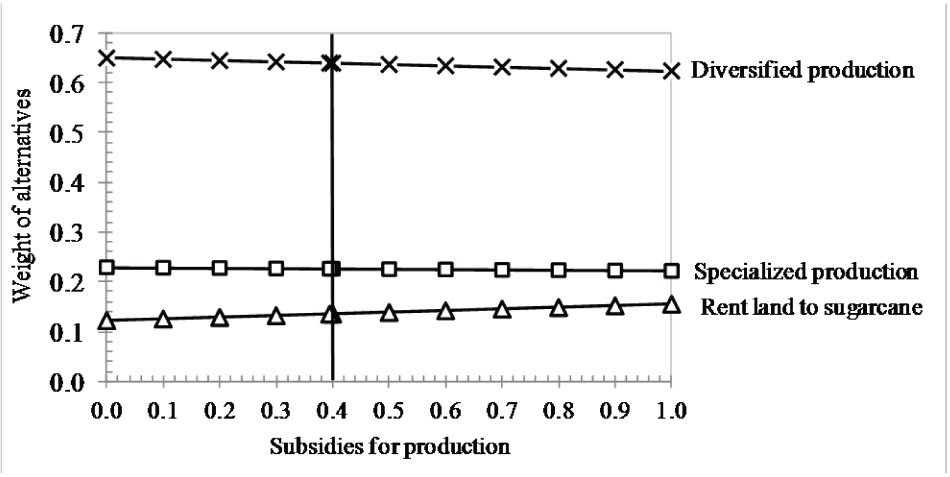
Income generation
Diversified production
Specialized production
Rent land to sugarcane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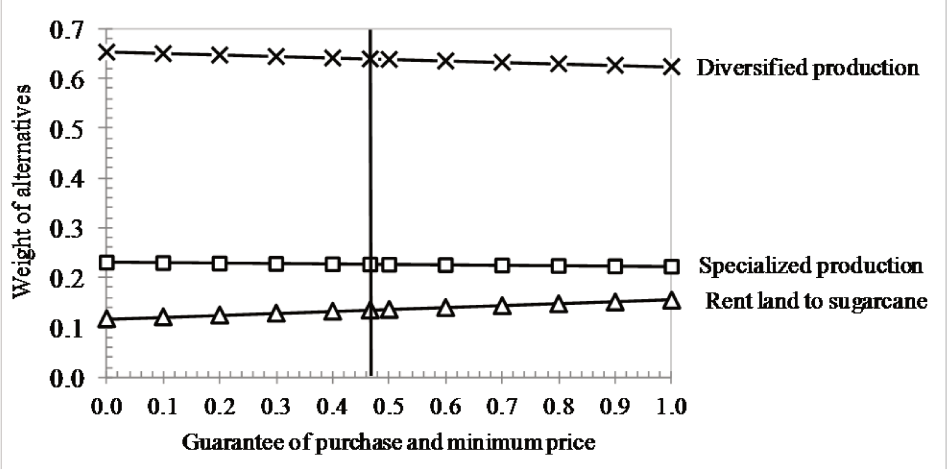
Subsidies for production
Diversified production
Specialized production
Rent land to sugarcane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Guarantee of purchase and minimum price
Diversified production
Specialized production
Rent land to sugarcane

Annex 1 – Approval of the Ethics in Research Committee

FACULDADE DE CIENCIAS MEDICAS - UNICAMP (CAMPUS CAMPINAS)

Plataforma Brasil

PARECER CONSUBSTANCIADO DO CEP

DADOS DO PROJETO DE PESQUISA

Título da Pesquisa: Expansão canavieira e seus impactos socioeconômicos: subsídios para tomadas de decisão em políticas públicas para agricultura familiar

Pesquisador: Maria Angélica Petrini

Área Temática:

Versão: 2

CAAE: 30248014.1.0000.5404

Instituição Proponente: Faculdade de Engenharia Agrícola

Patrocinador Principal: Financiamento Próprio

DADOS DO PARECER

Número do Parecer: 658.425

Data da Relatoria: 29/05/2014

Apresentação do Projeto:

Trata-se de um projeto de Tese de doutorado da Faculdade de Engenharia Agrícola da Unicamp. Será analisada a expansão do cultivo da cana de açúcar em Goiás, através do mapeamento da mudança de uso da terra com imagens de satélite e os impactos socioeconômicos na agricultura familiar decorrentes dessas mudanças. Serão também identificadas as demandas existentes para minimizar os impactos. Será realizado um estudo de caso na cidade de Ipiranga de Goiás, com aplicação de um questionário do Método de Análise Hierárquica, para priorizar critérios nas tomadas de decisão em políticas públicas. Este município foi escolhido devido ao fato de que 34,5% de sua área agrícola é ocupada com cana-de-açúcar; 92,5% de seus estabelecimentos agropecuários são de

agricultura familiar e 62,8% da área dos estabelecimentos agropecuários são de agricultura familiar. Serão abordados agricultores familiares, dirigentes vinculados ao poder público e da Companhia Nacional de Abastecimento, e por último da usina sucroalcooleira.

Objetivo da Pesquisa:

- Analisar a dinâmica da expansão do cultivo da cana-de-açúcar no Estado de Goiás e seus impactos socioeconômicos na agricultura familiar.

Endereço: Rua Tessália Vieira de Camargo, 126
Bairro: Barão Geraldo **CEP:** 13.083-887
UF: SP **Município:** CAMPINAS
Telefone: (19)3521-8936 **Fax:** (19)3521-7187 **E-mail:** cep@fcm.unicamp.br

FACULDADE DE CIENCIAS MEDICAS - UNICAMP (CAMPUS CAMPINAS)

Continuação do Parecer: 658.425

Avaliação dos Riscos e Benefícios:

Riscos informados no TCLE:

Não há desconfortos ou riscos previsíveis ou passíveis de prevenção. O participante pode desistir de sua participação na pesquisa a qualquer momento, caso sinta-se constrangido de alguma forma durante a aplicação do questionário.

Benefícios informados no TCLE:

Não haverá benefício direto imediatamente para os sujeitos participantes da pesquisa. Porém, espera-se que este estudo traga informações importantes para auxiliar na elaboração de políticas públicas para a agricultura familiar.

Comentários e Considerações sobre a Pesquisa:

Projeto detalhado apresenta os critérios de inclusão dos sujeitos, que são:

- agricultores familiares, poder público e usina sucroalcooleira.
- Serão entrevistados quatro representantes do poder público, divididos em: prefeito e secretário de agricultura (municipal), técnico local da Emater (estadual) e representante da Conab (federal).

Na usina sucroalcooleira, serão entrevistados três representantes, de áreas diversas de atuação.

Em relação aos agricultores familiares, há previsão de inclusão de 137 agricultores familiares ativos no município.

Considerações sobre os Termos de apresentação obrigatória:

Foram apresentados:

- Projeto de pesquisa detalhado e a folha de rosto devidamente datada e assinada.
- instrumento de coleta de dados: Questionário AHP.
- formulário de informações básicas do projeto e TCLE adequados, na forma atualizada.

O TCLE está detalhado e cumpre as exigências do sistema CEP/CONEP e da Res. CNS 466-2012.

Recomendações:

Não há.

Conclusões ou Pendências e Lista de Inadequações:

Projeto aprovado sem restrições, após resolução satisfatória de pendências.

Situação do Parecer:

Aprovado

Necessita Apreciação da CONEP:

Não

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FACULDADE DE CIENCIAS MEDICAS - UNICAMP (CAMPUS CAMPINAS)

Continuação do Parecer: 658.425

Considerações Finais a critério do CEP:

- Cabe ao pesquisador desenvolver a pesquisa conforme delineada no protocolo aprovado, elaborar e apresentar os relatórios parciais e final, bem como encaminhar os resultados para publicação com os devidos créditos aos pesquisadores associados e ao pessoal técnico participante do projeto (Resolução 466/2012 CNS/MS). Os relatórios deverão ser enviados através da Plataforma Brasil- ícone Notificação.
- Eventuais modificações ou emendas ao protocolo devem ser apresentadas ao CEP de forma clara e sucinta, identificando a parte do protocolo a ser modificada (com destaque) e suas justificativas. As modificações deverão ter aprovação ética do CEP antes de serem implementadas.

CAMPINAS, 23 de Maio de 2014

Assinado por:
Fátima Aparecida Bottcher Luiz
(Coordenador)

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