Subproject 1: Evaluation of social-economic and environmental impacts on the diffusion of Bt cotton varieties in Brazilian cotton growers communities

component c.1.2. strengthening technical capacity for socio-economic impact assessment

Three parallel investigations, using different approaches: a) CGE models; b) conjoint analysis; c) case studies, applying net-map.

I. GM cotton in Brazil: impact evaluation using CGE bottom up models

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- **Lucilio Rogerio Aparecido Alves (field research coordination)**
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Objectives

- Evaluate cost differentials of GM cotton in Brazil, 2010/2011 harvest.
- Comparison between conventional x GM production systems.
- Additionally, evaluate the potential general equilibrium impacts.

Methodology

- First step: field survey by CEPEA on the main cotton production regions. Cost differentials.
  - Sorriso (MT)
  - Campo Novo Parecis (MT)
  - Campo Verde (MT)
  - Mineiros (GO)
  - Luiz Eduardo Magalhães (BA).
- Surveys: “Panel” method. Costs and area with GM and conventional varieties estimates.

Survey results: adoption

Region	State	Season	Row spacing	GM use
Luiz Eduardo Magalhães	BA	First harvest	conventional	No
Mineiros	GO	First harvest	conventional	Yes (LibertyLink)
		Second harvest	conventional	Yes (LibertyLink)
Primavera do Leste	MT	First harvest	conventional	No
Campo Verde	MT	First harvest	conventional	No
		Second harvest	conventional	Yes (LibertyLink)
Campo Novo do Parecis	MT	First harvest	conventional	No
		Second harvest	conventional	Yes (LibertyLink)
		Second harvest	narrow	Yes (LibertyLink)
Lucas do Rio Verde / Sorriso	MT	First harvest	conventional	No
		Second harvest	conventional	No
		Second harvest	narrow	Yes (LibertyLink)

Region	1st. Harvest		2nd. Harvest	
	Conventional	GM	Conventional	GM
Sorriso/MT	100%	0%	50%	50%
Campo Novo do Parecis/MT	100%	0%	8%	92%
Campo Verde/MT	100%	0%	0%	100%
Mineiros/GO	60%	40%	60%	40%
Luiz Eduardo Magalhães/BA	100%	0%	0%	0%

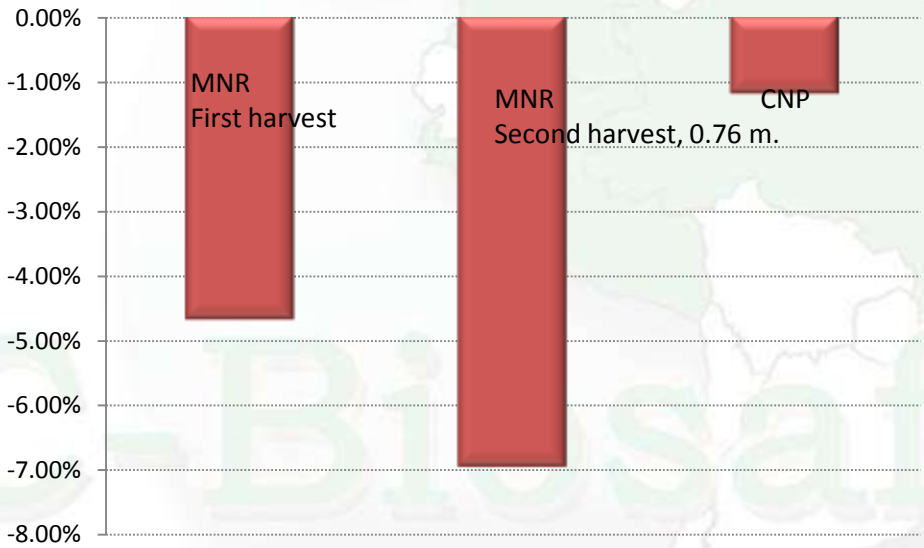
GM adoption in regions

- Only herbicide tolerant (HT) GM cotton in use.
  - Mineiros: low potential of GM varieties.
  - Luiz Eduardo: low potential, BT cotton do not control other common pests in the region.
- Only Mineiros used GM cotton in the first harvest.
- Use of HT in the second harvest to facilitate weed control.
- Low availability of seeds reported for this year.
- No price differentiation for the fiber.

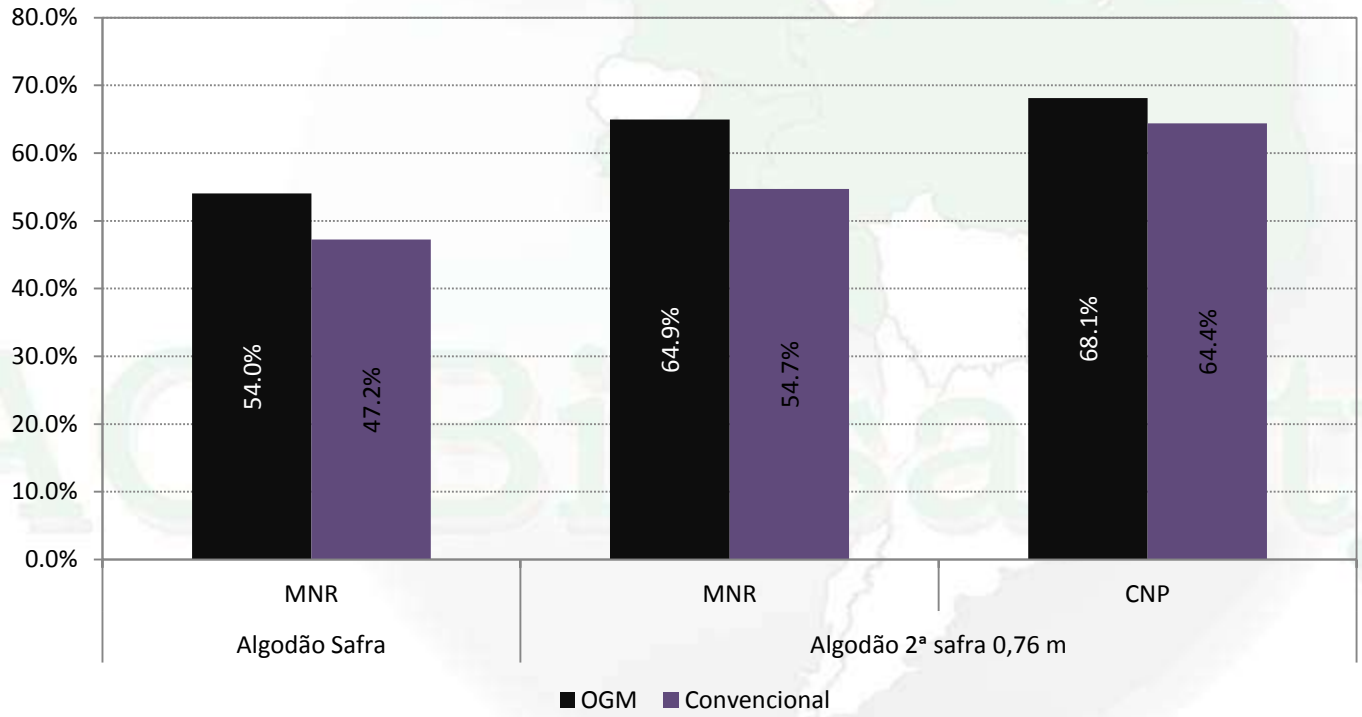
Cost comparison, R$/ha. No GM cotton in Bahia.

Cost item	Cotton 1st Harvest		Cotton 2nd. Harvest			
	MNR		MNR		CNP	
	OGM	NOGM	OGM	NOGM	OGM	NOGM
Fertilizers	875.05	875.05	551.55	551.55	759.60	759.60
Chemical inputs	739.38	847.06	541.53	693.21	690.83	669.26
Herbicides	270.24	377.92	186.80	338.48	218.89	197.33
Insecticides	369.04	369.04	304.68	304.68	400.64	400.64
Fungicides	100.10	100.10	50.05	50.05	71.29	71.29
Seed treatment	0.00	0.00	0.00	0.00	0.00	0.00
Seeds	117.94	79.04	117.94	79.04	81.00	42.00
Emulsionable oil	95.66	95.66	95.66	95.66	39.65	39.65
Mechanical operations	406.54	417.11	397.88	408.45	335.33	367.80
Transportation	0.00	0.00	0.00	0.00	0.00	0.00
Labor	111.97	188.40	106.41	182.84	295.63	358.10
Trade/Storage	795.27	795.27	745.81	745.81	648.23	648.23
Taxes	148.66	148.66	141.23	141.23	202.80	202.80
Insurance	18.21	18.83	19.70	20.32	19.86	22.05
Technical assistance	46.93	50.05	36.22	40.21	44.04	44.73
Interest over capital	233.85	250.63	312.50	336.92	228.86	232.44
CO	3589.44	3765.76	3066.41	3295.24	3345.83	3386.65
COT	3825.54	4011.77	3327.86	3566.61	3600.74	3669.99
CT	4195.73	4389.96	3722.82	3969.57	4053.51	4145.69

Operational costs differentials GM - conventional



Profitability comparison



Impacts of adoption of GM cotton

- Evaluated through the use of a inter-regional, static computable general equilibrium model of Brazil: TERM BR model:
  - 27 regions
  - 41 sectors and commodities
  - 10 labor types, classified by wages
  - 10 household types, classified by income.
- Short run closure.

Shocks to the model

- Shocks calculated based on the cost survey information: % cost variation.
- Adapted from the survey to fit model definitions.
- Shocks adaptation include sector definition and cost shares adjustments.
- Two simulations:
  - SIM1: Regional shocks as in the table below to every state but Bahia.
  - SIM2: Uniform shocks to every region.
- Example: in the first simulation Chemical inputs will be reduced by 5% in every state but Bahia state.

Description in cost spreadsheet	Description in CGE model	Shocks (%)
Chemical inputs	Inorganic Chemicals	-5.0
Seeds	Seeds	8.5
Mechanical operations	Machines and vehicles	-1.0
Insurance + Technical assistance	Services	-1.0
Labor	Labor	-2.75

Model closure: short run feature

- The capital stock is fixed by industry. This means that by assumption the enterprises cannot change their capital stock in the short run. The rate of return to capital is the variable to adjust in order to ratify the fixed capital stocks;
- Land stocks are fixed in each region, but mobile between agricultural activities inside regions, through a CET mechanism driven by profitability;
- Real wages are fixed in the short run, and employment is variable. Labor can migrate between regions and activities, in order to keep the real wages fixed. Initial inter-regional labor differentials are not eliminated.
- Total (aggregated) investment in the economy is fixed.

Results

- The total value of cotton production in Brazil in the base year (2005) represented about 0.12% of total value of production in Brazil, and about 0.26% of total value of primary agriculture and livestock. The shocks will produce only small changes at aggregate level in the Brazilian economy.

Macro variable	% variation	% variation
	SIM1	SIM2
Real Household Consumption	0,001	0,001
Real Exports	0,027	0,031
Real Imports	-0,002	-0,003
Real GDP	0,005	0,006
GDP Price Index	Numeraire	Numeraire
Consumer Price Index (CPI)	0,000	0,000
Exports Price Index	-0,001	-0,001
Imports Price Index	0,005	0,005

Results: land use and production

- GM reduces land use in cotton, frees up land for other activities.
- Cotton production increases more in SIM2 (includes Bahia).

	Land use		Production	
	SIM1	SIM2	SIM1	SIM2
Rice	0,02	0,03	0,01	0,01
Other	0,01	0,01	0,01	0,01
Sugar cane	0,01	0,01	0,00	0,00
Soybean	0,14	0,15	0,08	0,09
Cotton	-0,84	-0,94	0,26	0,29
Forestry	0,01	0,01	0,00	0,01
Livestock	0,03	0,03	0,01	0,01
Milk	0,01	0,01	0,00	0,00

Regional production: % variation.

- SIM1: Bahia does not adopt GM. Production falls.
- SIM2: General adoption. Cotton production increases in every producing state.

	Regional production	
	SIM1	SIM2
Bahia	-0,77	0,25
Minas Gerais	0,51	0,39
São Paulo	0,54	0,46
Parana	0,44	0,38
Mato Grosso Sul	0,33	0,31
Mato Grosso	0,43	0,29
Goias	0,34	0,20

Household consumption bundle variation (%)

- Food bundle price index falls slightly for the poorest. This is due to the increase in production of staple food which are important in their bundle.

	SIM1	SIM2
Household 1 (poorest)	-0,002	-0,003
Household2	-0,002	-0,002
Household3	-0,001	-0,001
Household4	-0,001	-0,001
Household5	0,000	0,000
Household6	0,000	0,000
Household7	0,001	0,001
Household8	0,001	0,001
Household9	0,001	0,002
Household10 (richest)	0,002	0,002

Final remarks

- GM cotton is a labor saving technology.
- Labor will be released from cotton to other economic activities, with beneficial effects under full employment.
- Regions that do not adopt the GM technology will tend to reduce production.

II. Determinants of Adoption o GM on Cotton

Research Team

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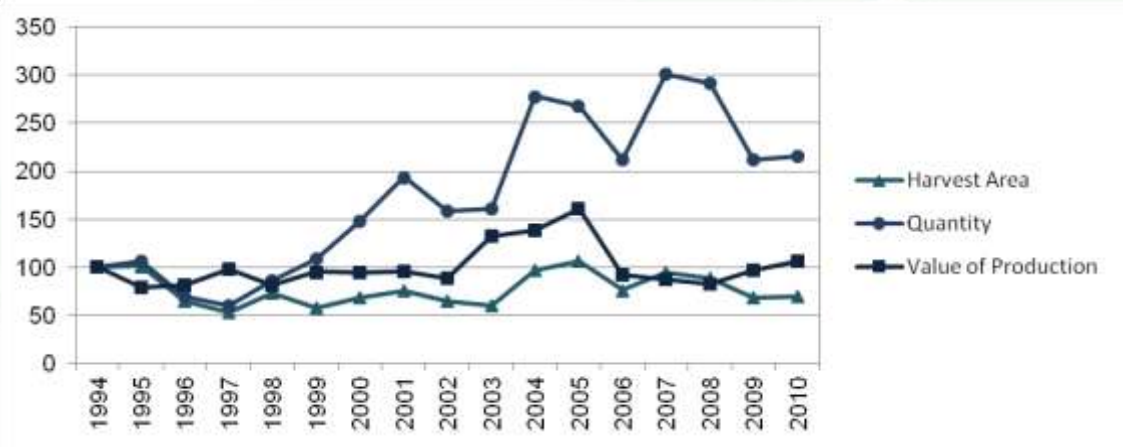
Bruno César Brito Miyamoto- IE/Unicamp

Dynamics of cotton in Brazil

- High growth of quantity due to incresing productivity;
- High price variability;



Graphic 1 - Index for acreage, quantity produced and production value (R$/t) of cotton in Brazil (1994 = 100)

Source: IBGE - Municipal Agricultural Production

Spatial Distribution of Cotton

- Mato Grosso and Bahia accumlate the highest shares of total production (49% and 34%, respectively);

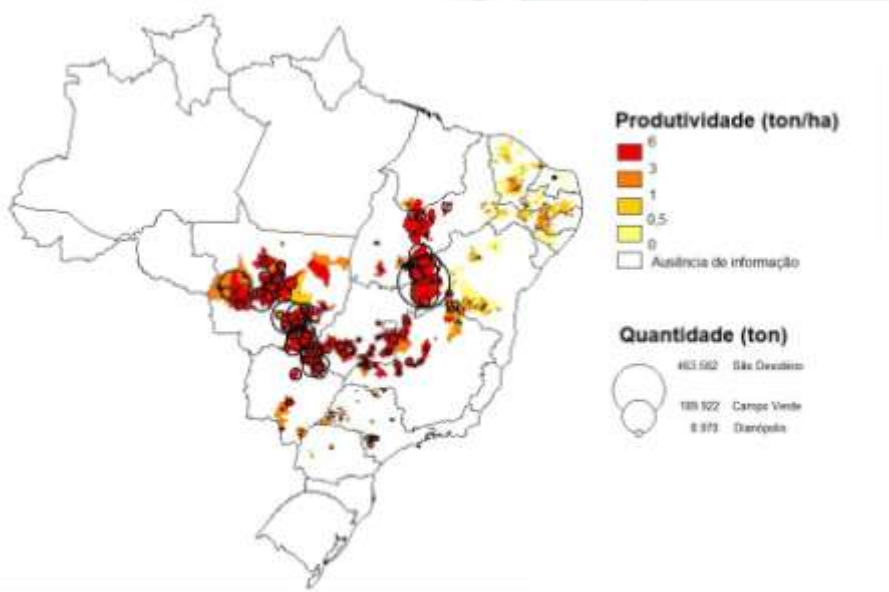


Figure 1 - Spatial distribution of the quantity produced (circles, in tons) and productivity (colors, in tons/ hectare) of cotton - Brazil, 2010

Source: IBGE - Municipal Agricultural Production
Elaborated with Phicarto. Available http://philcarto.free.fr/.

Material and Methods

- **Sample**: 175 small producers:

tipo	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Bt	36	20.57	36	20.57
RR	20	11.43	56	32.00
Organico	71	40.57	127	72.57
Branco	27	15.43	154	88.00
Colorido	21	12.00	175	100.00

- **Coverage**: States of Bahia, Paraíba, Rio Grande do Norte, Minas Gerais and Goiás;

UF	Frequency	Percent	Cumulative Frequency	Cumulative Percent
BA	26	14.86	26	14.86
GO	26	14.86	52	29.71
MG	32	18.29	84	48.00
PB	59	33.71	143	81.71
RN	32	18.29	175	100.00

- **Ex-ante analysis**: Multiple Correspondence Analysis in order to identify patterns of associoation among types of cotton and farmers' characteristics;
- **Ex-post analysis**: Conjoint Analysis in order to estimate utilities for each characteristics of cotton production;

Multiple Corresponce Analysis

Negative Values		Positive Values
Area up to 1 ha Absence of boll weevil Organic Cotton	Dimension 1 (16% of the total variability)	Area over 5 ha Mechanization
Bt cotton Area between 2 – 5 ha Pink Bollworm Low use of festicide	Dimension 2 (9% of the total variability)	Area up to 1 ha Permanent Employee White Cotton
RR Cotton Silverleaf No mechanization	Dimension 3 (8% of the total variability)	Acces to credit

Multiple Corresponce Analysis

- **Pattern 1**: Organic + small area + low education + no credit;
- **Pattern 2**: Colored + no mechanization + no employee;
- **Pattern 3**: White + higher education + mechanization + employee;
- **Pattern 4**: Bt + area 2-5 ha + credit + lower use of pesticide;
- **Pattern 5**: RR + Budworm + Silverleaf;

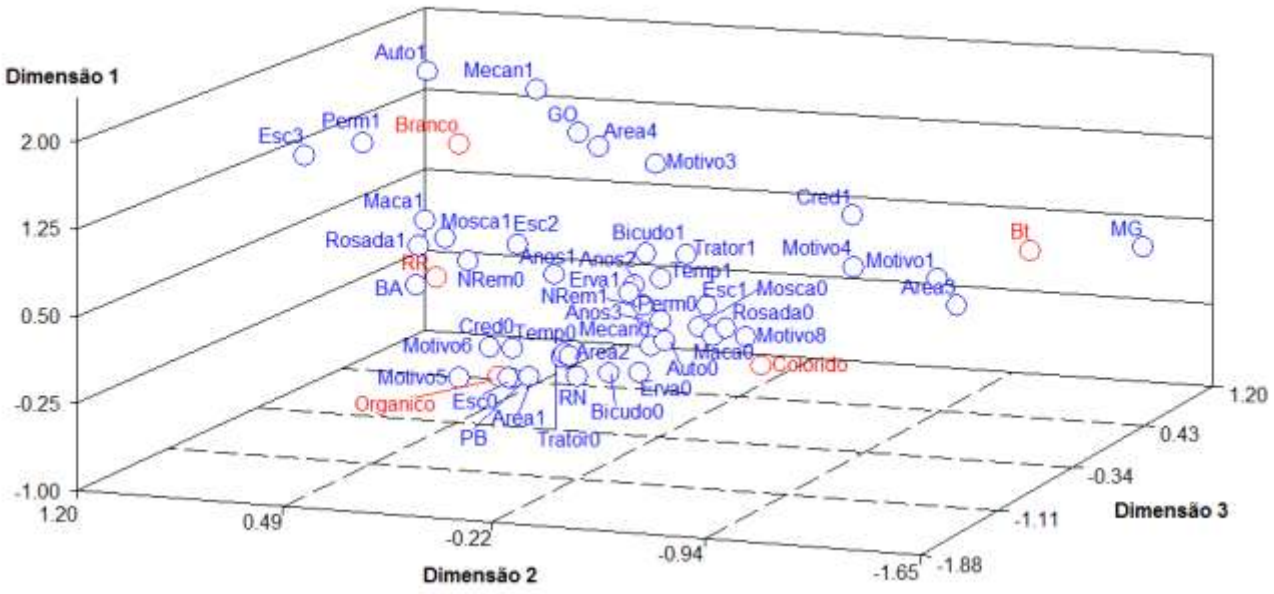


Figure 2 - Distribution of categories in the three main dimensions of the MCA

Source: Research data

Conjoint Analysis

- Organic cotton has the higher utility;
- Bt cotton in second place, with low royalties (R$ 20/ha);
- High rates of royalties imply negative utility in comparison with other choices;

Table 2 – Utilities based on the non-metric conjoint analysis of the ordered-rank evaluations

Variable	$\hat{\beta}$	$S_{\hat{\beta}}$	$\hat{\beta}/S_{\hat{\beta}}$
Intercept	2,336	0,051	45,681
Bt Pirate	-0,179	0,115	-1,555
Bt R$20/ha	0,328	0,138	2,370
Bt R$55/ha	-0,298	0,313	-0,950
Bt R$90/ha	-0,533	0,121	-4,418
RR Pirate	0,154	0,145	1,064
RR R$20/ha	-0,102	0,174	-0,587
RR R$55/ha	0,044	0,169	0,261
RR R$90/ha	-0,473	0,129	-3,661
Organic	0,987	0,102	9,634
White conventional	0,028	0,127	0,221
Colored	0,043	0,140	0,311

Source: Research data

III. Case studies

SOCIAL NETWORKS and SMALL COTTON PRODUCERS IN BRAZIL: analysis of two alternatives in the semi-arid region

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Adriana. P. Vieira- UESC- Santa Catarina
Bruno C. B Miyamoto. – IE- Unicamp,
José Maria F.J da Silveira.- IE Unicamp

Methodology

a) Local meetings with small holders who are cotton producers: Catuti, North of Minas Gerais and Paraíba, Brejo;

b) Building a Net-Map (Schiffer, 2009)

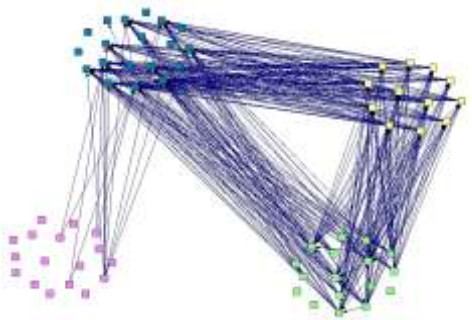
Semi- arid Agro-ecological Network: participants by functions

Objective	Production	Private Sector	Public Sector	Third Sector	TOTAL
Economic Objectives	16	16			32
Group Cohesion	13	8	15	12	48
Development	12	15	14	12	53
Political Objectives	15	2	16	12	45
Exploration	4	3			7
Destructuration	1				1

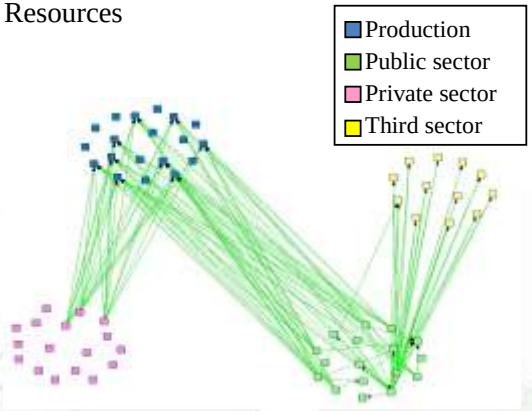
Catuti- North of Minas Semi-arid Region: participants and functions

Objective	Production	Private Sector	Public Sector	Third Sector	TOTAL
Economic Objectives	3	5	1		9
Group Cohesion	5		7		12
Development			4	1	5
Political Objectives	2		3		5
Exploration		1			1
Destructuration			2		2

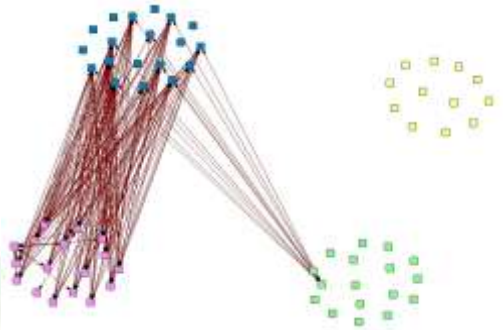
Organizational, informational and technical support



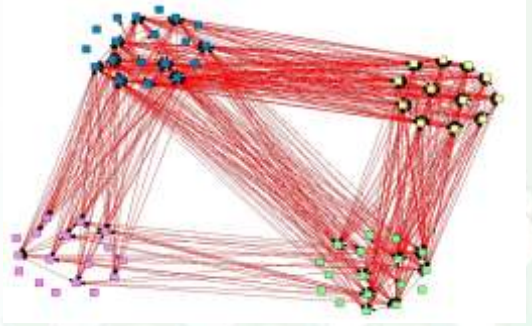
Resources



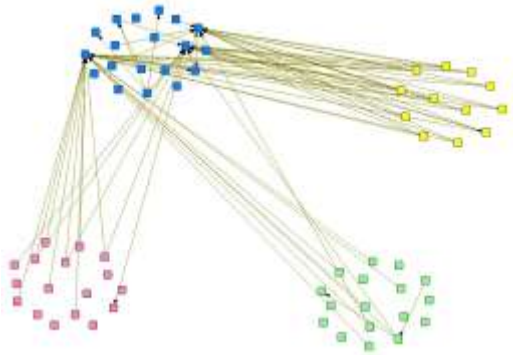
Buying and selling



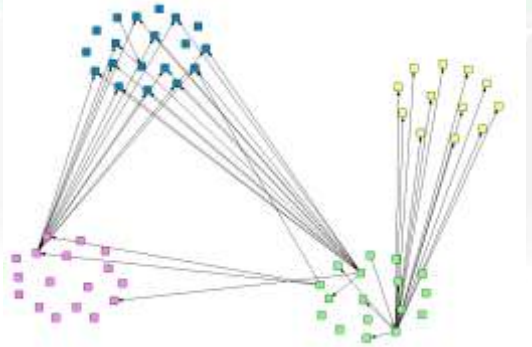
Personal relationships

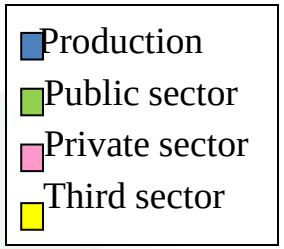


Conflict



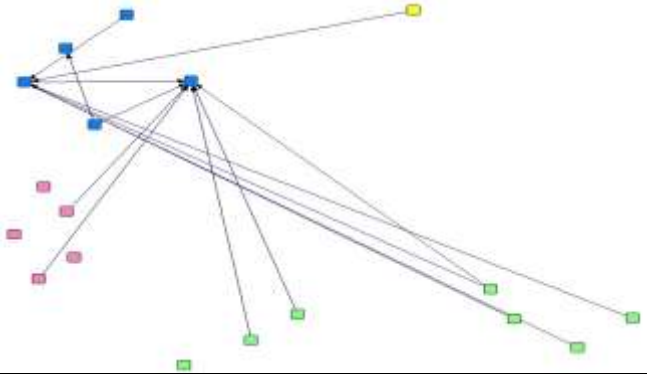
Norms and lines of command



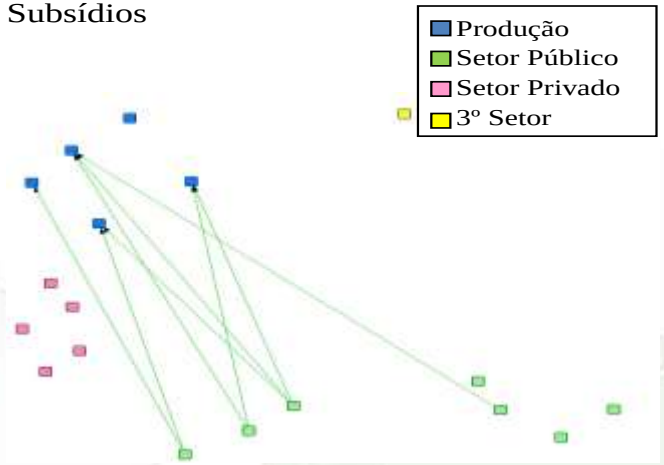


Rede de Catuti

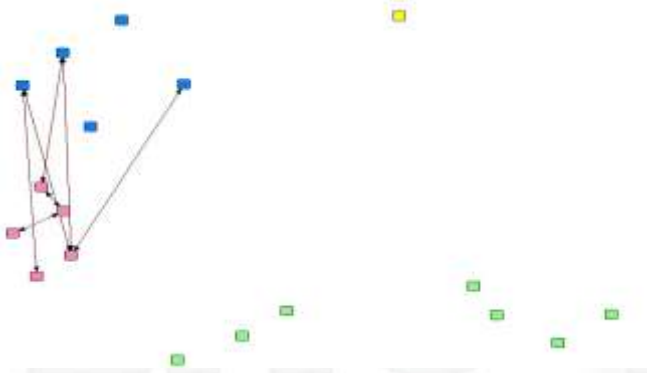
Apoio Organizacional, Informacional e Técnico



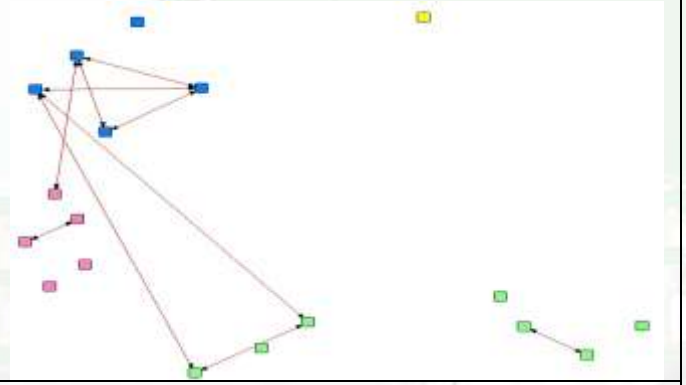
Subsídios



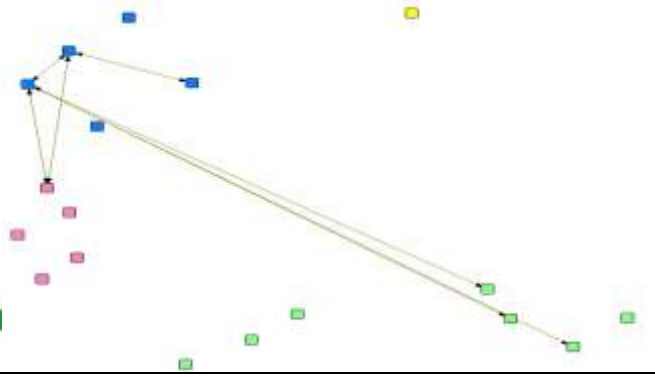
Relações Comerciais



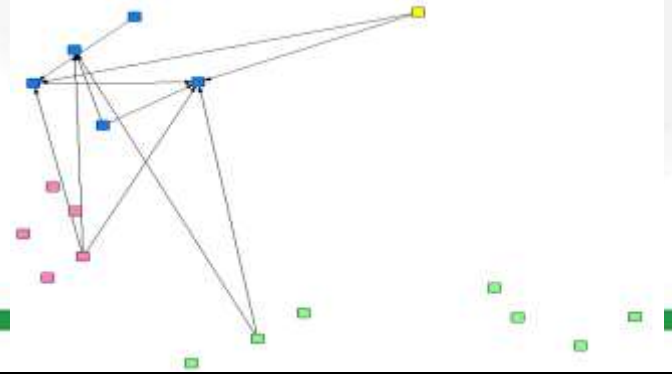
Relações Pessoais



Conflitos



Normatização, Domínio, Comando



Agroecological network

The existence of a complex network established in order to support market access for cotton growers in the semi-arid areas, where most actors do not obtain direct financial returns and many do not aim to.;

This goal has been achieved thanks to collective work, which entails organizational, technical and relational issues. It can therefore be concluded that the collective actions performed by the Network are driven by various motivations in addition to economic goals.;

These motivations are not easy to identify or measure. However, where actions geared to equality, justice and solidarity are concerned, subjective values are necessarily present.

Agro-ecological network

The low incidence of conflict, intensive farming and destructuring, alongside the high incidence of personal relationships, enhances ***network stability*** and facilitates domestic and foreign market access for small ecological cotton growers;

The Network also actively seeks to prevent participation by actors with goals that clearly conflict with its priorities;

This empowers participants and increases their independence not from the market as a whole but from conventional market relationships.

The processes used to create these niches, in conjunction with this organizational structure, enabled them to establish new arrangements and facilitate market access for more actors.

Comparing the two networks

- In the Semi-Arid Agro-ecological Cotton Network, the public sector was comprised of seventeen participants: research and extension centers, universities, development agencies, regulatory agencies, programs, and other government agencies.
- The third sector is comprised of NGOs that are largely involved through technical assistance, but which are also involved in increasing awareness and organization among ecological producers;
- In the network in Catuti, the public sector consists of federal and state research centers, financial institutions, and political representatives from both the federal level and the city government.

Final Remarks

1. Diffusion process of GM cotton crops is still under way: is depends crucially of the quality of the varieties;
2. Impacts in Brazil of Bt cotton and even stacked varieties is not as high as in other countries, like China and India;
3. There is limit to accept the payment of royalties in cotton by small grower. However, the case of Catuti shows that Bt cotton could be important in certain situations;
4. Agro-ecological networks are complex, demanding a huge effort by different types of stakeholders, part of them not directly involved in profit seeking activities.