Economic growth x environment: forecasts for the Brazilian economy and its 5 macro regions, 2002 to 2012

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2002

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ABSTRACT

Using the MIBRA model, an Applied Interregional General Equilibrium Model, constructed for the Brazilian economy and its five macro regions (North, Northeast, Central West, Southeast, an South), this papers tries to identify which would be the impact of the economic growth in the Brazilian economy an in its macro regions, from 2002 to 2012, on environmental variables, i.e., organic and inorganic materials, particulates, sulfurates, water, energy, CO_2, and the Amazon rain forest. Concerning the economic growth rates, two scenarios are constructed, one pessimist and other optimistic, and the impact of both scenarios on the environmental variables are then measured. Some major environmental concerns are raised for each one of the Brazilian macro regions: a) for the North region, represented mainly by the Amazon rain forest, it is taken into the consideration the trade off between the area used by agricultural activities with the area used by the rain forest; b) for the Northeast region, the main concern is the restriction on water use; c) for the Central West region, it is taken into consideration the expansion of the agriculture frontier; d) for the Southeast and South regions, the more industrialized regions, pollutants are a problem.

1. Introduction[1]

As the link between economic growth and the environment is becoming a constant concern among the nations and the people, this paper makes an study of what would be the impact of two scenarios of economic growth in the Brazilian economy, in the 2002 to 2012 time period, over a set of environmental variables, i.e., organic and inorganic materials, particulates, sulfurates, water, energy, CO_2, and the Amazon rain forest.

To do so, it was used the results of two models, a macroeconometric model, by IPEA, that gives the growth trend of the economy and the MIBRA model, an interregional and intersectoral applied general equilibrium model of the Brazilian economy, that gives growth projections for the macro Brazilian regions (North, Northeast, Central West, Southeast, an South) and its economic sectors.

Concerning the economic growth rates, two scenarios are constructed, one pessimist and other optimistic. In the pessimist scenario, the average national growth rate, in the time period being analyzed, was of 2.3% per year while for the optimistic, this growth rate was of 4.4% per year. While the growth rates are different in both scenarios, in defining the scenarios for the regions, it was assumed that the regions would have different levels of investment and federal government expenditure such that it would be possible for the Brazilian economy to grow in a process of convergence among the regions.

In next section it is presented the basic structure of the MIBRA model, in the third section it is made a brief overview of the Brazilian macro regions, the fourth section shows and discuss the results obtained with the simulations, while in the last section the final comments are made.

[1] The authors would like to thank Eustáquio J. Reis, Otávio Tourinho and Marcelo Lara Rezende from IPEA, for the valuables comments on modeling issues. They also acknowledge the help of Márcia Pimentel, Yann Alves, and Rodrigo Padilha, also from IPEA, on data treatment and collection.

2. The MIBRA Model

The MIBRA model is an interregional and intersectoral applied general equilibrium (AGE) model constructed for the Brazilian economy, and at its present stage, it comprehends the 5 Brazilian macro regions (North, Northeast, Central West, Southeast, and South) and 16 economic sectors. A complete description of the MIBRA model, which is based on structure of the Monash-MRF model (Peter el alii, 1996), is found in Guilhoto, Hasegawa, and Lopes (2001).

In common with the conventional AGE models, the demand and supply curves of products, capital and labor, are determinate by the optimum behavior of agents in the market. In this model, each regional economy had a treatment similar to the treatment of a unique region, but considering the inter-regional linkages.

The model's equations are presented in five modules:

- The AGE core module
- The government finance module
- The capital and investment module
- The debt accumulation module
- The labor market and regional migration module

The AGE core module is separated into four main equation blocks determining: a) consumer demands; b) producer and consumer prices; c) market clearing conditions; and, d) macroeconomic variables as summations of microeconomic variables.

The government finance module incorporates equations determining: a) gross products of each region from the income and expenditure sides; and, b) sources of income and various expenditure accounts for regional and federal governments.

The capital and investment and debt accumulation modules are added to make endogenous: a) changes in total investment and capital stock over a forecast period; and, b) the accumulation of foreign debt.

The labor market and regional migration module defines equations determining regional population by taking into account: a) natural growth; b) inter-regional migration;

and, c) foreign migration. Regional labor supply is linked to regional population via accounting identities that allow for shifts in the relationship between regional population and the regional population of working age and the workforce-participation rate. The module also includes equations defining changes in regional unemployment rates.

In the model, each sector has only one product and produce only one type of capital, with only one class of work. There are two margins: transportation and commerce. The margins are very important variables, specially the transportation margin, since they allow very detail analyses of the impact of the infrastructure over the others sectors of the economy.

The results are based in a *bottom-up* approach, which allows the aggregation of regional results into national ones. This approach make easy the analyze of regional polices, but demand a bigger data base, since its necessary to make the specification of the regional flows.

The 16 sectors defined in the model are presented into Table 1. The agents of the model are: a) industries; b) households (one household for each region); c) government (federal and regional); and , d) exports.

Table 1
Sectors in the MIBRA Model

	Sectors
1	Agriculture
2	Mining and Non-metallic minerals
3	Metallurgy
4	Mechanics
5	Electronic material
6	Transportation material
7	Wood, Furniture, Cellulose, Paper and Graphical
8	Chemistry and Druggist
9	Textile, Clothes and Footwear
10	Food and Beverage
11	Others industries
12	Communications
13	Civil construction
14	Commerce
15	Transportation
16	Services

The model also takes into account six regions of product source: a) North; b) Northeast; c) Center West; d) Southeast; e) South; and f) imports. The first five regions are also destiny regions.

3. A Brief Overview of The Brazilian Macro Regions

According to the classification of Brazilian Institute of Geography and Statistics (IBGE) the Brazilian Economy is divided into 5 macro regions, see Figure 1: a) North (7 States); b) Northeast (9 States); c) Central West (3 States and the Federal District); d) Southeast (4 States); and e) South (3 States).

The overall size of the Brazilian territory is 8,514,215 Km^2 of which 45.25% belongs to the North region, 18.25% to the Northeast, 18.87% to the Central West, 10.86% to the Southeast, and 6.77% to the South. However the economic and population distribution do not follow the geographical distribution, as can be seen in Table 2.

Having 45.25% of the Brazilian territory the North region has only 7.60% of the Brazilian population and the smallest number peoples living per km^2, it also has one of the smallest urban population shares (69.87%), the smallest share in the Brazilian GDP (4.45%), and its GDP per-capita is 41% below the national average. The most developed regions in Brazil are the Southeast and the South region. The Southeast region has a share of 58.25% of the Brazilian GDP with 42.65% of its population and 10.86% of the territory, while the South region has a share of 17.75% in the Brazilian GDP with 6.77% of the territory and 14.79% of the population. The Southeast and South regions are the most industrialized regions in Brazil with the first one having a per-capita GDP 37% above the national average, while the South region has a per-capita GDP 20% above the national average. The Central West region has been an important region for Brazil in terms of agriculture, mainly because of the favorable type of land that this region has, an it has a reflex in its share in the population (6.85%) and GDP (6.44%) of Brazil, with a per-capita GDP 6% below the national average. The Northeast region has serious problems of draught and in the beginning of the formation of the Brazilian State it used to be it most important region, this region has 18.25% of the Brazilian territory, 28.12% of its population, 13.11% of its GDP, and a GDP per-capita 53% below the national average, recently oil extraction and processing has been one of the most growing business in the region and with the openness of the Brazilian economy a lot of industries have been installing they production units in the region (in part due to the fiscal incentives giving by the various levels of the state).

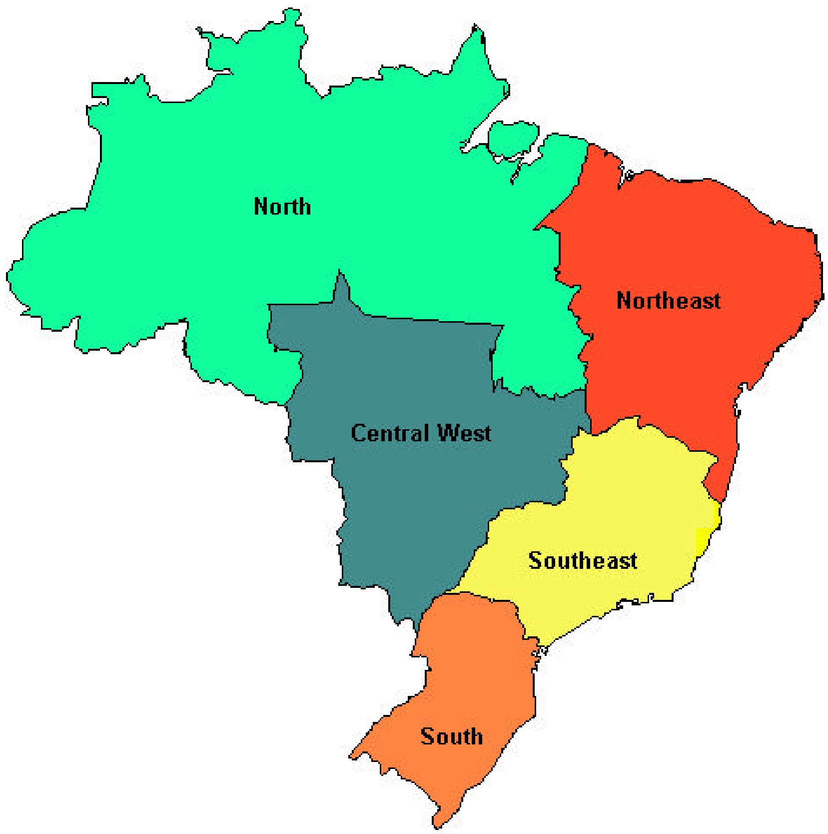


Figure 1- Map of Brazil and Its 5 Macro Regions

Table 2
Main Economical and Geographical Characteristics
of the Brazilian Macro Regions

	Size		Population (2000)		Urban Population	GDP Share	Relative Per-Capita
	km^2	Share (%)	Number (1,000)	Share	%	(%) 1999	GDP 1999
North	3,852,968	45.25	12,901	7.60	69.87	4.45	0.59
Northeast	1,553,917	18.25	47,742	28.12	69.07	13.11	0.47
Central West	1,606,446	18.87	11,637	6.85	86.73	6.44	0.94
Southeast	924,574	10.86	72,412	42.65	90.52	58.25	1.37
South	576,301	6.77	25,108	14.79	80.94	17.75	1.20
Brazil	8,514,215	100.00	169,799	100.00	81.25	100.00	1.00

Source: IBGE (2001a and 2001b).

4. Model Results

This section analyses the results for the model. To do so, it is divided into two parts, in the first one the hypotheses underlining the model are presented, while in the second one the environmental results are discussed.

4.1. The Economic Scenarios

To analyze the impact of two different economic scenarios of economic growth for the Brazilian economy, in the 2002 to 2012 period, over environmental variables, it was used the results of two models. The macroeconometric model, by IPEA, gives the growth trend of the economy and the MIBRA model is them used to make growth projections for the regions and its economic sectors. In the pessimist scenario, the average national growth rate, in the time period being analyzed, was of 2.3% per year while for the optimistic, this growth rate was 4.4% per year.

As a way to stress the economic expansion of the North and Central West regions, and of the need of the development in the Northeast region, the expenditures of the Federal government and the growth of investment were directed to a great extend to these regions, leaving a more modest growth of these variables to the Southeast and South regions.

Tables 3 and 4 show the main hypothesis and results for the pessimistic and optimistic scenarios.

In the pessimistic scenario, the Brazilian GDP shows an average growth rate of 2.28% in the 2002 to 2012 period, while this value goes to 4.36% in the optimist scenario. For the macro regions North, Northeast, Central West, Southeast and South, the results for the pessimistic scenarios are, respectively, 2.76%, 2.15%, 2.65%, 1.75%, and 2.16%, while for the optimistic, they are, respectively, 5.40%, 4.20%, 5.03%, 3.78%, and 3.98%.

Table 3
Main Economic Hypothesis of the Model: Average Growth Rates (%) — 2002-2012

Variable	Scenarios	
	Pessimistic	**Optimistic**
Inflation - Brazil	5.36	5.36
Exports - Brazil	7.65	7.65
Imports - Brazil	7.15	7.15
Real Wages	0.92	0.92
Investment - North	3.35	6.52
Investment - Northeast	1.36	2.90
Investment - Central West	6.72	10.88
Investment - Southeast	0.12	0.93
Investment - South	0.13	1.06
Federal Government Expenditure - North	3.35	6.52
Federal Government Expenditure - Northeast	1.54	3.44
Federal Government Expenditure - Central West	6.72	10.88
Federal Government Expenditure - Southeast	0.11	0.59
Federal Government Expenditure - South	0.11	0.59
Labor Productivity - North	5.45	5.45
Labor Productivity - Northeast	3.63	3.63
Labor Productivity - Central West	5.45	5.45
Labor Productivity - Northeast	3.63	3.63
Labor Productivity - South	3.63	3.63
Population - Brazil	1.20	1.20
Population - North	2.19	2.19
Population - Northeast	0.89	0.89
Population - Central West	1.97	1.97
Population - Southeast	1.13	1.13
Population - South	1.03	1.03

Source: Research data.

Table 4
Main Economic Results of the Model: Average Growth Rates (%) — 2002-2012

Variable	Scenarios	
	Pessimistic	Optimistic
GDP - Brazil	2.28	4.36
GRP - North	2.76	5.40
GRP - Northeast	2.15	4.20
GRP - Central West	2.65	5.03
GRP - Southeast	1.75	3.78
GRP - South	2.16	3.98
Investment - Brazil	1.58	3.42
Federal Government Expenditure - Brazil	1.80	3.62
Household Consumption - Brazil	1.75	4.18
Household Consumption - North	1.75	4.79
Household Consumption - Northeast	1.41	4.01
Household Consumption - Central West	3.23	7.15
Household Consumption - Southeast	1.60	3.84
Household Consumption - South	1.79	3.77
Exchange Rate (R$/US$)	5.28	5.28

Source: Research data.

These results are linked with the initial hypothesis of convergence among the regions. However, one should call attention that the process of convergence is more feasible in the optimistic scenario. In a scenario of low growth. a greater convergence would only be attained if there was a decrease in the grow rates of the Southeast and South regions. However, giving the national productive structure, a decrease of the economic growth rates in these regions would certainly mean a decrease of growth in the other regions. In summary, a process of regional convergence in Brazil is more feasible under an optimistic scenario of growth, however this scenario will have a greater impact over the environmental variables, as it will be show in the following section.

4.2. The Environmental Scenarios

In this section it is analyzed the environmental impacts of the industrial emissions, the consumption of water and electrical energy, and the Amazon deforestation under the two economic scenarios presented above. The goal here is to compare how the national and regional averages of the pressure over the environment, in the two scenarios, would change when compared with the results found for 2002.

Initially one observes the scale of the impact, then its growth rates in the period, and finally, its intensity on the production value.

Next, it is summarized the estimation procedures and then the results will be discussed.

4.2.1. The Estimations Procedures

The environmental results in each scenarios were estimated by multiplying the total value of production in each sector by the coefficients of pollution intensity or of use of an environmental resource. The analyzed cases and the estimations procedures are as follow:

Industrial Pollution

- Total emission of liquid effluents in organic and inorganic materials.
- Total atmospheric emission of particulates and sufurates materials.

The sectoral intensities of pollution used here are the ones estimated in Seroa da Motta (2002) for the year of 1996 and adjusted for the year of 2001 (base year of this paper).

Water Use

- Volume of gross water used in the economic activities.

The base for the water intensity used in this work are the ones estimated in Lima (2002), for the state of Ceará for the year of 1999, and adjusted for the year of 2001. In the case of water consumption in the Agricultural sector, the main sector of water use, the intensity of water consumption in each region were adjusted tanking into consideration the work of Fontenele (1999) that presents an estimation of total water used in irrigation in each one of the Brazilian macro regions.

Electrical Energy

- Quantity of electrical energy used in the economic activities

The National Energetic Balance for 2000 was used to estimated the intensity of electrical energy use.

Emission of CO_2

- Emission of CO_2 by the economic activities.

Using information from the National Energy Balance for 2000 and the emission of NO_2 and CH_4 by the agricultural sector it was estimated the intensity of CO_2 for each one of the economic activities.

Deforestation of the Amazon Rain Forest

- Deforest area for agricultural activities in the Amazon rain forest region.

Using data from the 1970-95 agricultural census it was estimated the elasticity of 0.39 between the growth rate of production value an the growth rate of new area for agricultural activities in the legal Amazon. Applying this elasticity on the growth rate of the agricultural production in both scenarios it is possible to get an estimation of the additional area need by the agricultural activity, which by its turn is also the deforest area.

4.2.2. Results

It is going to be analyzed first the results for the economy as a whole, then the regional differences are discussed, and finally the results for the deforestation of the Amazon rain forest are presented.

4.2.2.1. National Economy

As observed above, in the optimistic scenario, the economic growth rate is almost twice the one for the pessimistic scenario. As it was also assumed that the technology standard is kept equal in the two scenarios, the emissions and the consumption levels of water and energy will grow in both scenarios. Besides the overall level of production, the sectoral differences are the ones that will make the differences on the estimations in each scenario.

Each scenario results in a greater growth rates for the CW and N regions, that today are more specialized in the agricultural activities, against the growth rates for the SE and S regions, were the industrial activity is much stronger. An average growth rate was assumed for the NE region were the industry, however less than in the South of the country, is also important. In this way, the share of the agricultural activities in the national product in 2012, according to our scenarios, will decrease.

As can be observed in Graphs 5 to 8, 14, 17 and 20 below, the simulations allows one to observe that the national averages, in the optimistic scenario, of emission intensity and product use are always smaller than the measures for the optimistic scenario. This means that the efficiency of the economy environmental standard as a whole improves with an accelerated growth. However, there are cases where this relation is inverse for some regions, as it will be analyzed bellow.

4.2.2.2. Regional Differences

As it was expected for all the pollutants and levels of water and energy use, the growth rate follows the GDP growth rate, as showed in Graphs 1 to 4. As so, the greatest growth of pollution occurs in the CW region, followed by the N and NE regions.

A differences by the type of environmental result are equally affected by the sectoral composition of the GDP and by the population growth rate. As it will be seen, only in some cases there will differences from the scenario of reference.

Industrial Pollution

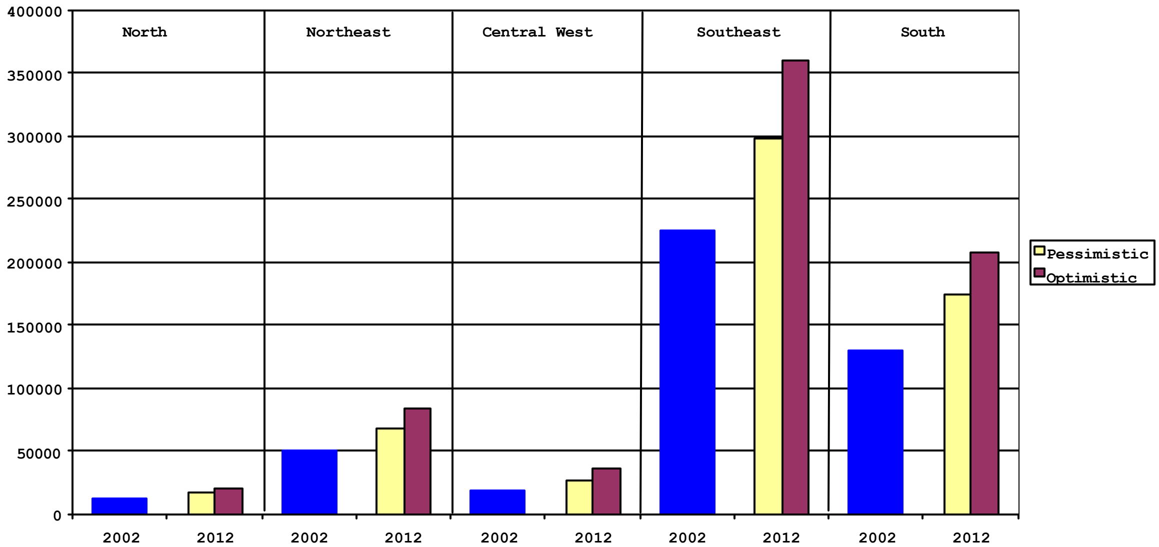
As show in Graphs 1 to 4, in terms of total pollution generation, in both scenarios, the SE region is by far the one that presents the highest values, except for the organic material were the NE and, mainly, the S regions present higher values. A possible exhaustion of support capacity of the SE region, in relation to the industrial pollution, should then be analyzed towards the future growth of the industrial product.

The sectoral composition of the CW region GRP, however, generated a negative growth rate for the product intensity in both scenarios, even with the high growth rates of the product, as showed in Graphs 5 to 8. Observing the estimates of product intensity in Graphs 9 to 12, the CW region would present in the year 2012 an industrial product less intensive in pollution.

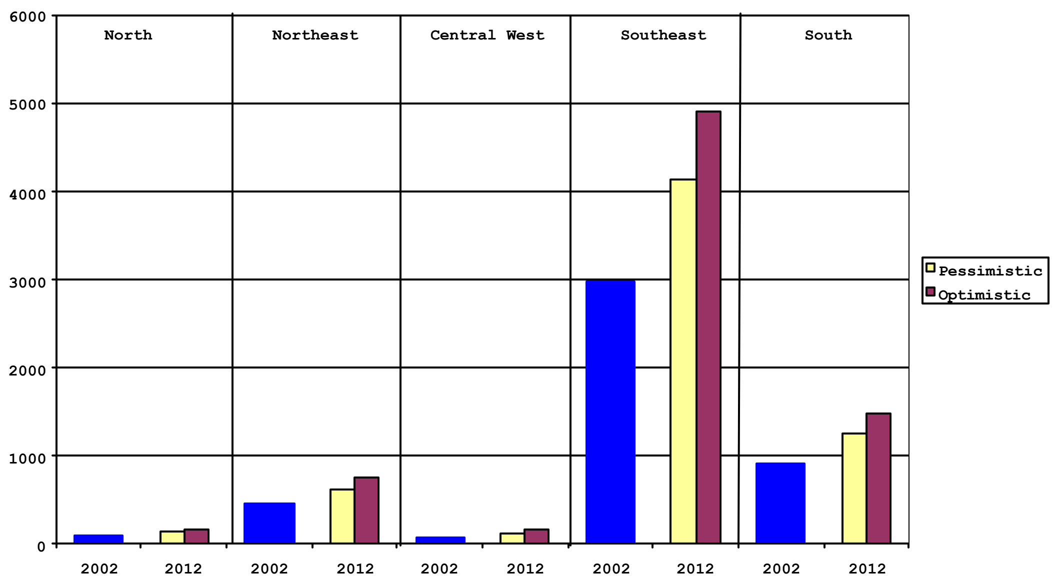
The only cases were the growth rates of product intensity are greater in the optimistic scenario than in the pessimistic scenario are for the organic material, Graph 9, in the SE and S regions, and inorganic, Graph 10, in the N region. As so, an acceleration of growth in these region shows a tendency of theses region being more dirty in these pollutants.

In summary, despite the greater growth rates presented by the CW, N and NE regions, the generation of industrial pollution, in level as well as in intensity, would be concentrated in the SE and S regions.

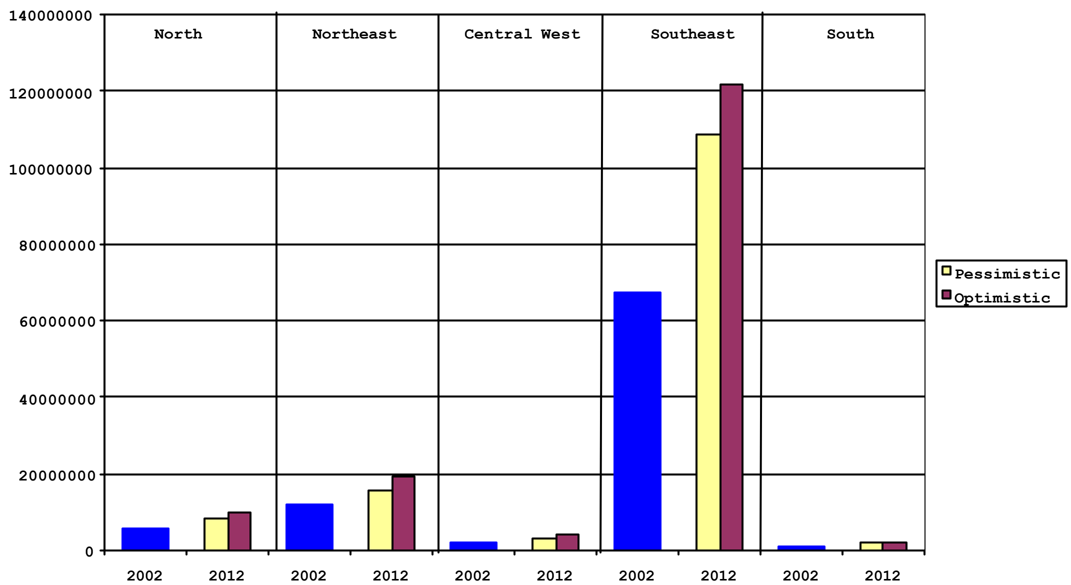
Graph 1 - Emission of Organic Pollutants, in ton of Kg, by Region and by Scenario, in 2002 and 2012



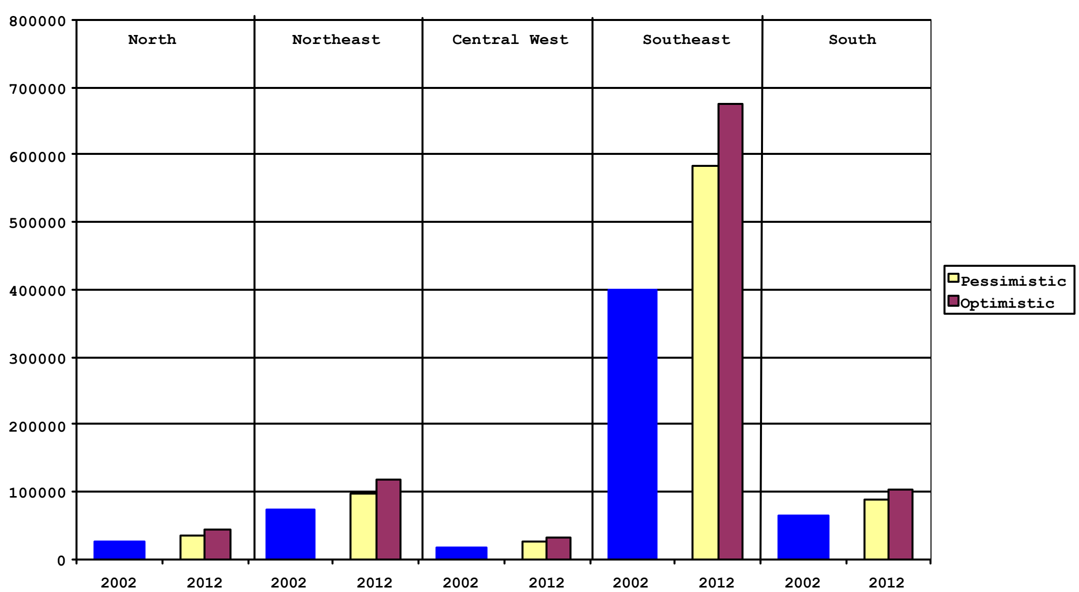
Graph 2 - Emission of Inorganic Pollutants, in ton of Kg, by Region and by Scenario, in 2002 and 2012



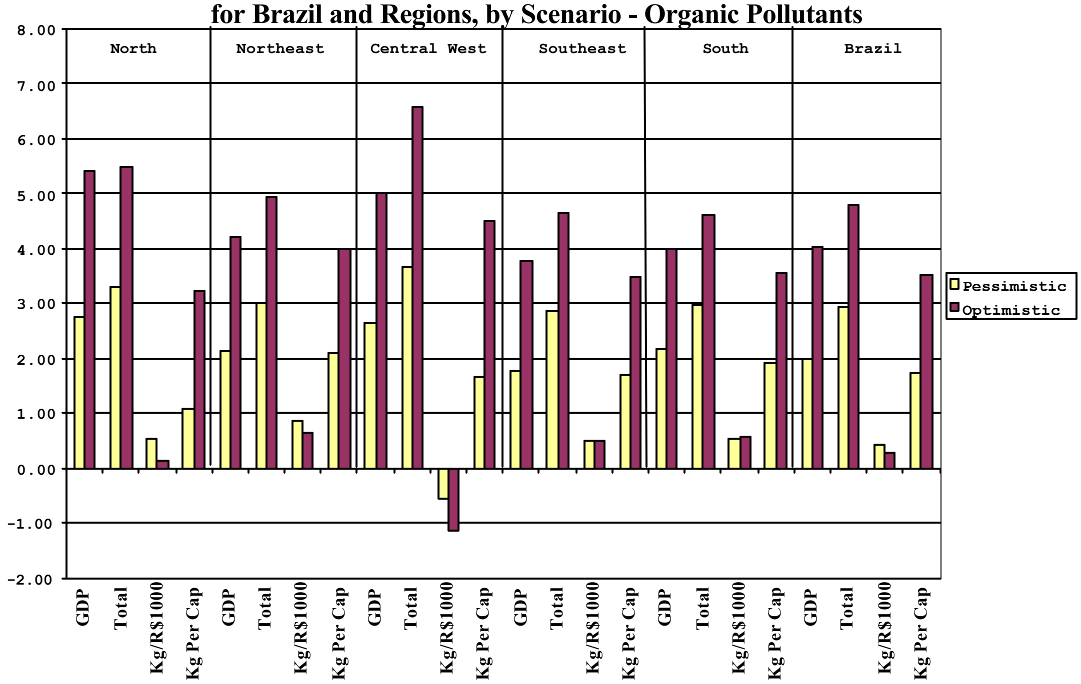
Graph 3 - Emission of Particulates, in ton of Kg,
by Region and by Scenario, in 2002 and 2012



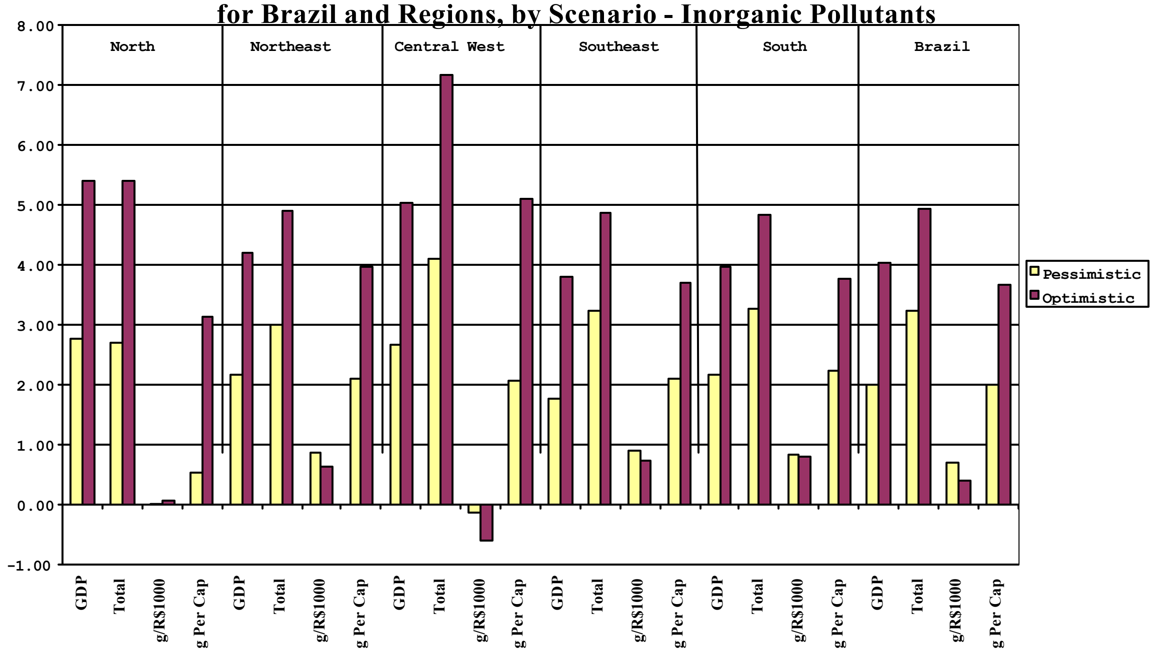
Graph 4 - Emission of Sulforates, in ton of Kg,
by Region and by Scenario, in 2002 and 2012



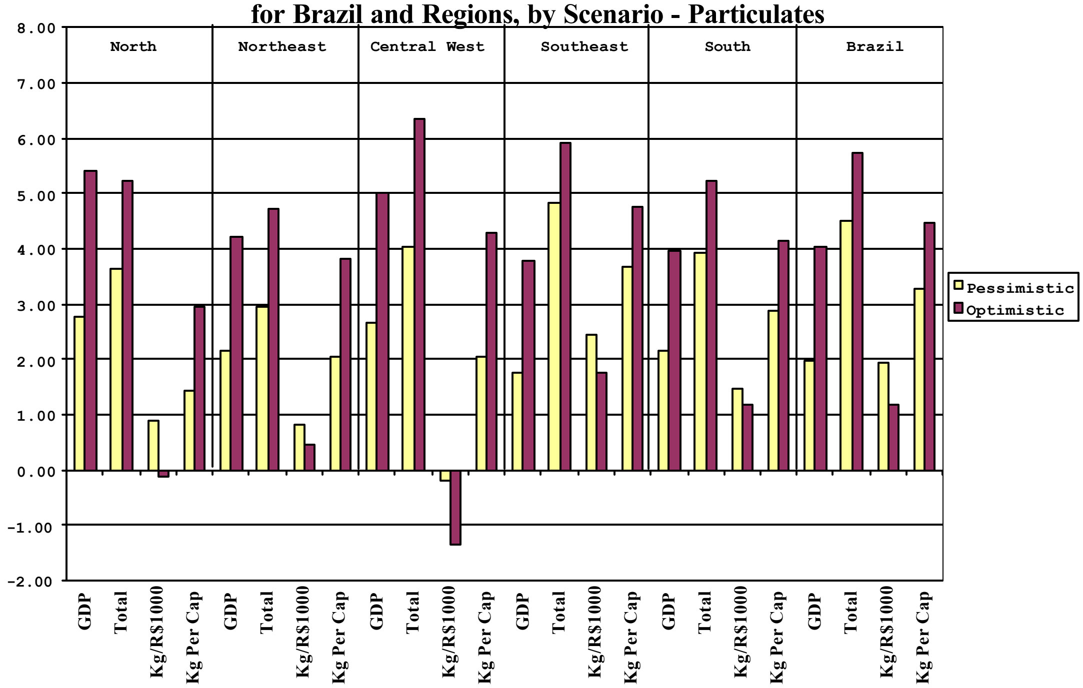
Graph 5 - Growth Rate of Main Indicators, for Brazil and Regions, by Scenario - Organic Pollutants



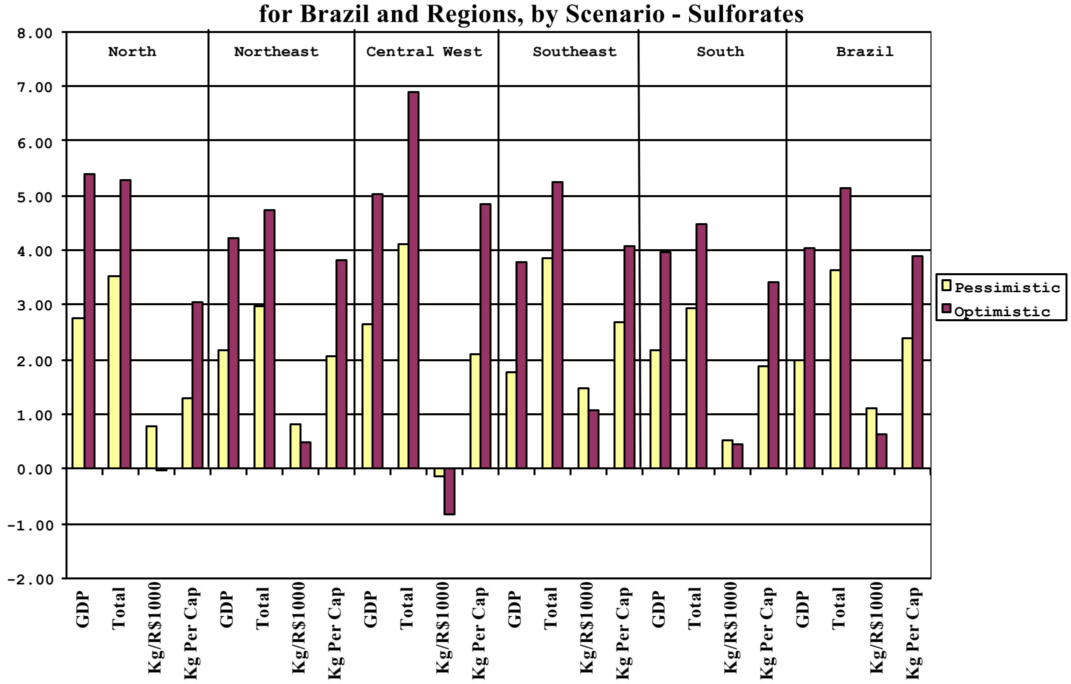
Graph 6 - Growth Rate of Main Indicators, for Brazil and Regions, by Scenario - Inorganic Pollutants



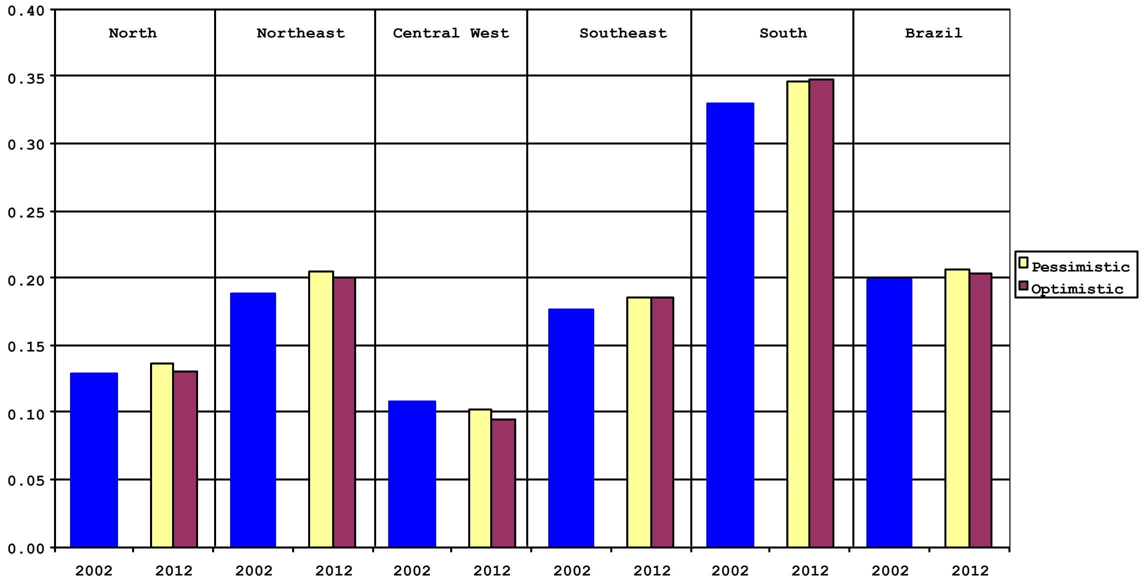
Graph 7 - Growth Rate of Main Indicators, for Brazil and Regions, by Scenario - Particulates



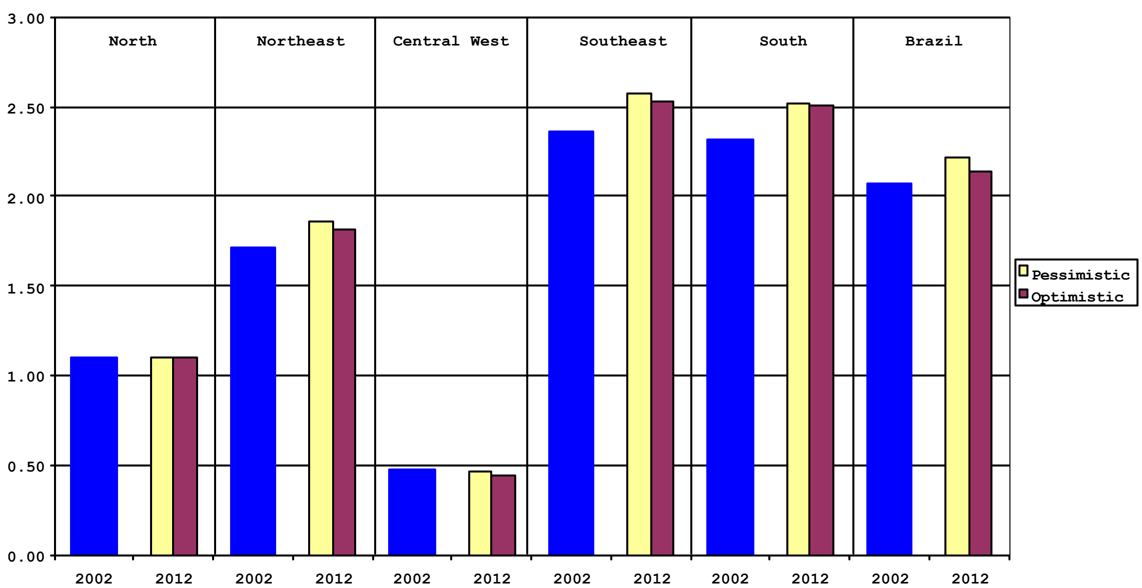
Graph 8 - Growth Rate of Main Indicators, for Brazil and Regions, by Scenario - Sulforates



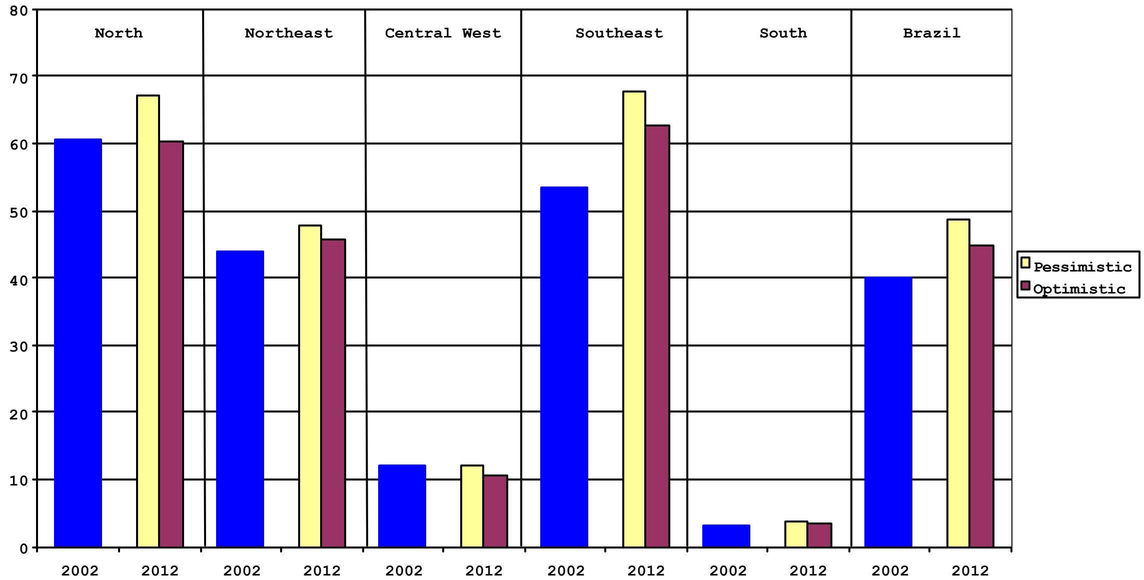
Graph 9 - Emission of Kg of Organic Pollutants by R$ 1000 of Production, for Brazil and Regions, by Scenario



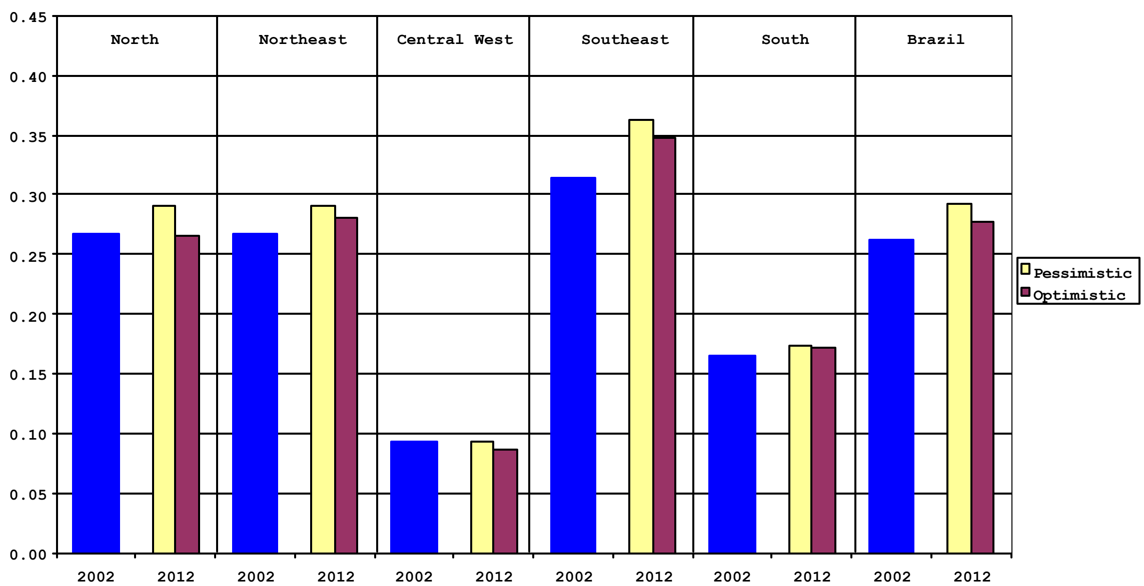
Graph 10 - Emission of Gram of Inorganic Pollutants by R$ 1000 of Production, for Brazil and Regions, by Scenario



Graph 11 - Emission of Kg of Particulates by R$ 1000 of Production, for Brazil and Regions, by Scenario.



Graph 12 - Emission of Kg of Sulforates by R$ 1000 of Production, for Brazil and Regions, by Scenario.



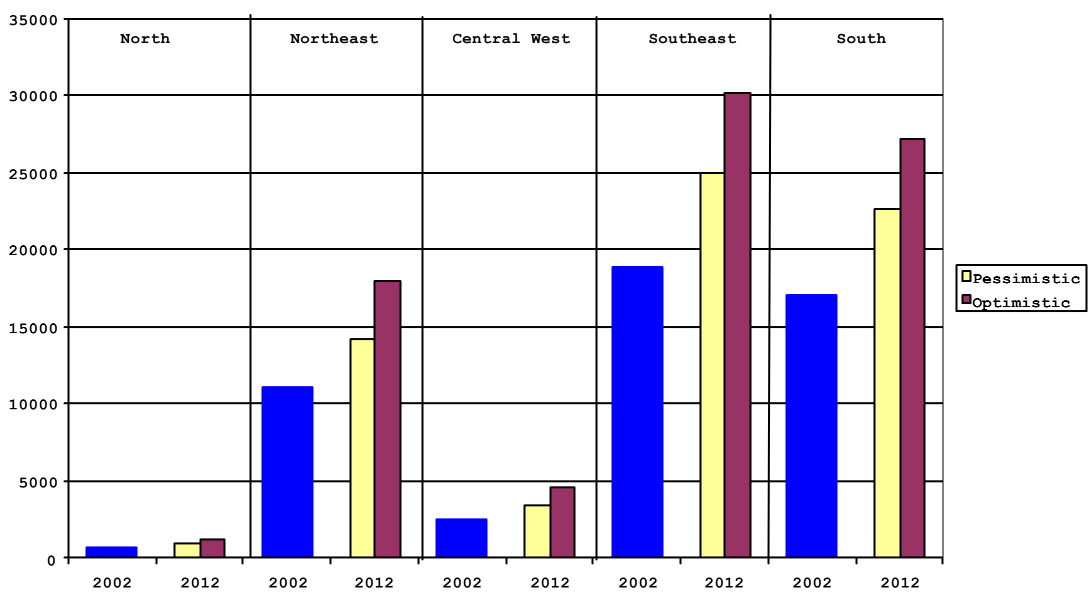
Water Consumption

The SE and S regions, followed by the NE region, as showed in Graph 13, in both scenarios, are the regions that would be using more water in the production process in 2012.

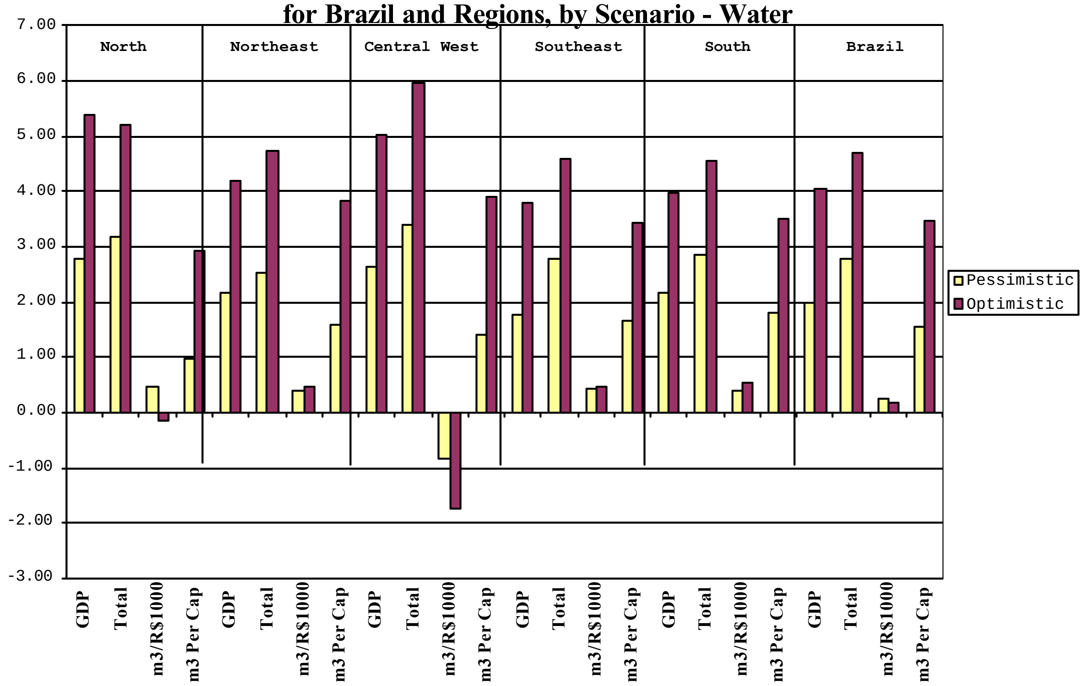
Against the country average, the SE, S and NE regions, Graph 14, show in the optimistic scenario product intensity growth rates greater than the one estimated for the pessimistic scenario. The S and NE regions present in Graph 15 estimates of product intensity much higher than the ones for the other regions, inclusive in relation to the SE region.

In conclusion, considering the low level of water resources available in the NE region, an accelerated economic growth in this region, as here simulated, would increase the problems of water use in the region.

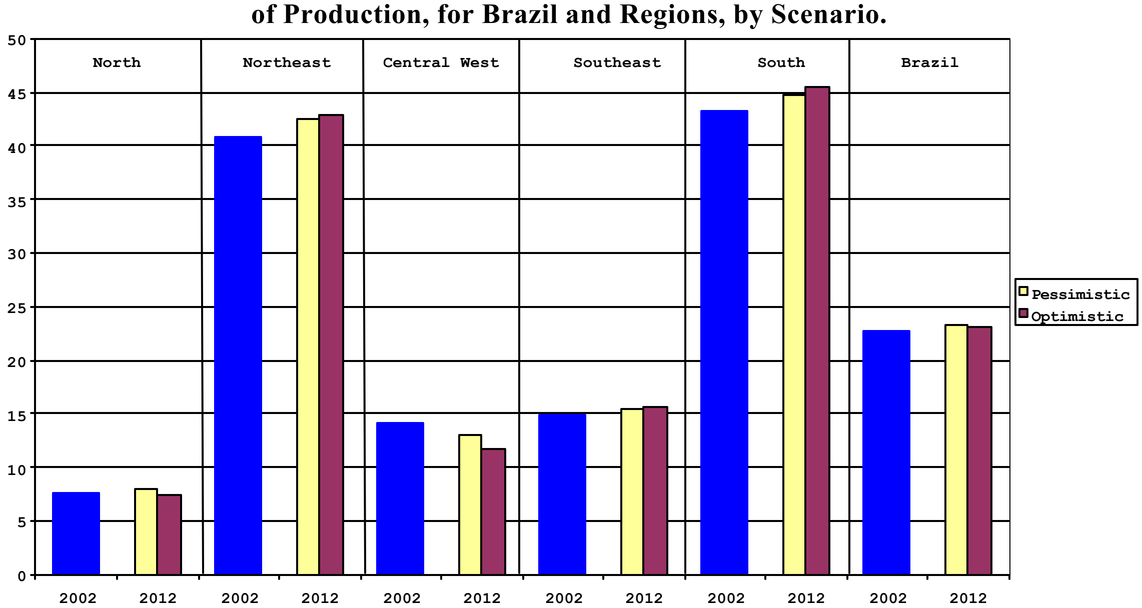
Graph 13 - Total Water Consumption, in hm^3, by Region and by Scenario, in 2002 and 2012



Graph 14 - Growth Rate of Main Indicators, for Brazil and Regions, by Scenario - Water



Graph 15 - Water Consumption in m^3 by R$ 1000 of Production, for Brazil and Regions, by Scenario.

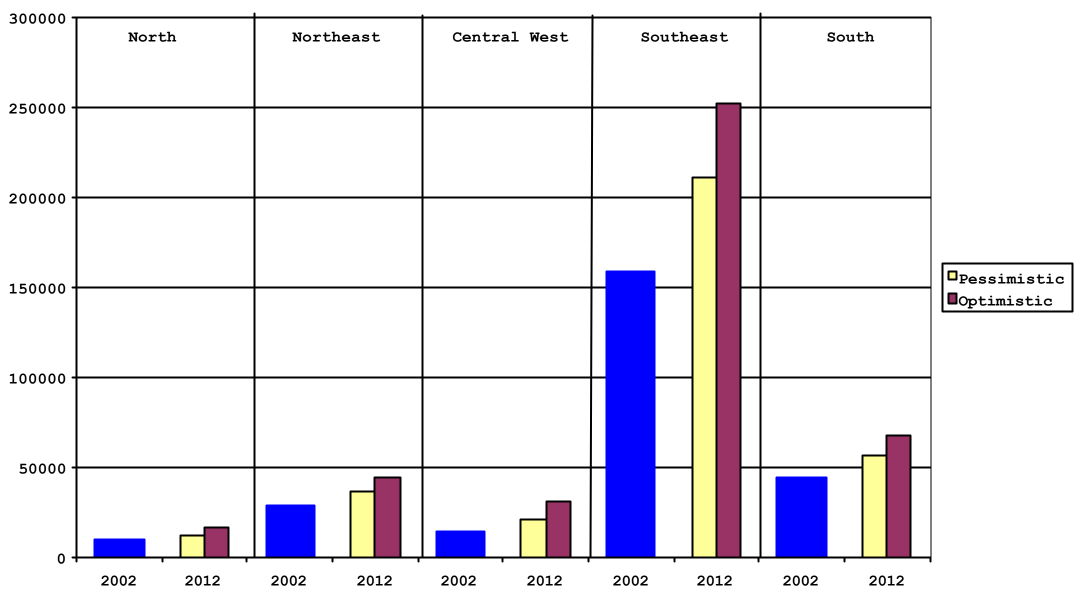


Electrical Energy Consumption

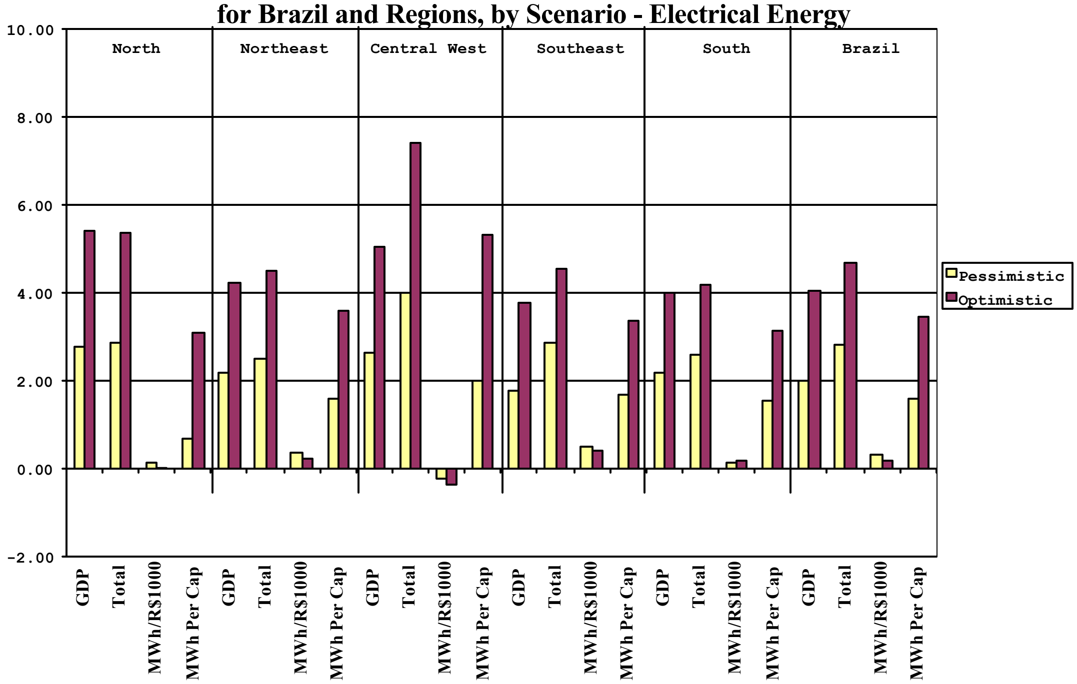
As showed in Graph 16, the SE region shows, by far, the greatest magnitude in electrical energy consumption, inclusive with a far greater difference with the other regions when compared to the relative regional use of water.

For the S region, however, it is observed in the optimistic scenario a growth rate in the product intensity greater than in the pessimistic scenario, showing that in this region an accelerated growth, against the trend showed by the rest of Brazil, would mean an intensification of the electrical energy content of its product.

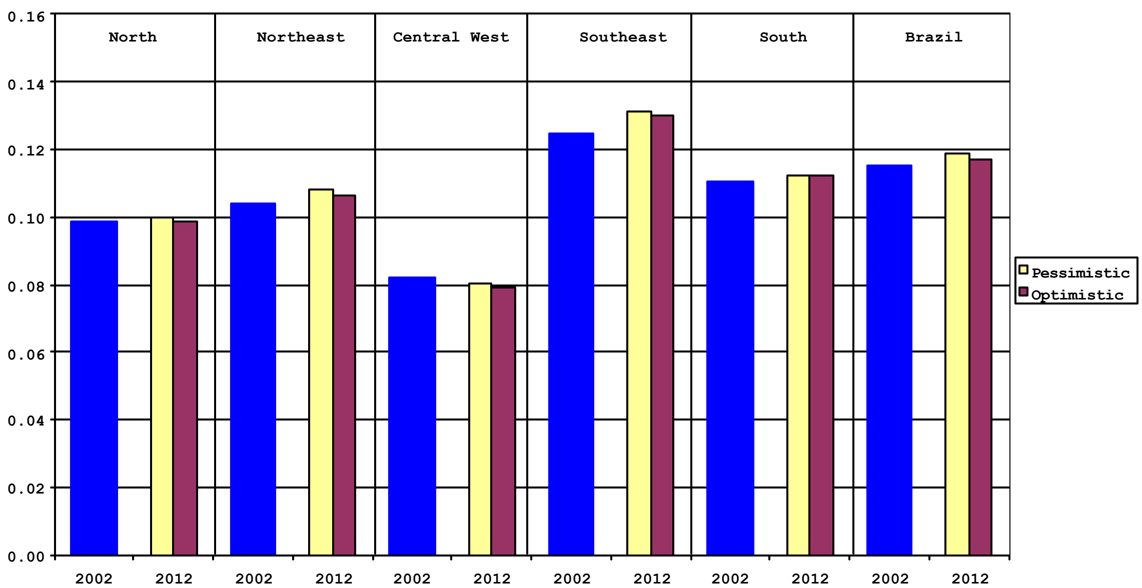
Graph 16 - Total Electrical Energy Consumption, in Thousand of MWh, by Region and by Scenario, in 2002 and 2012



Graph 17 - Growth Rate of Main Indicators, for Brazil and Regions, by Scenario - Electrical Energy



Graph 18 - Electrical Energy Consumption in MWh by R$1000 of Production, for Brazil and Regions, by Scenario.

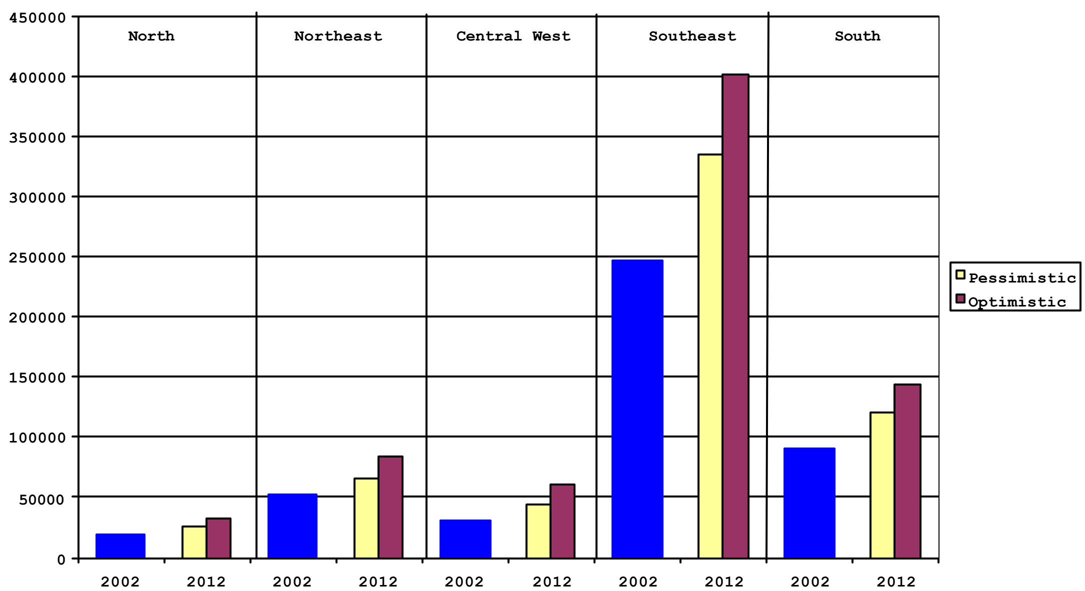


CO_2 Emission

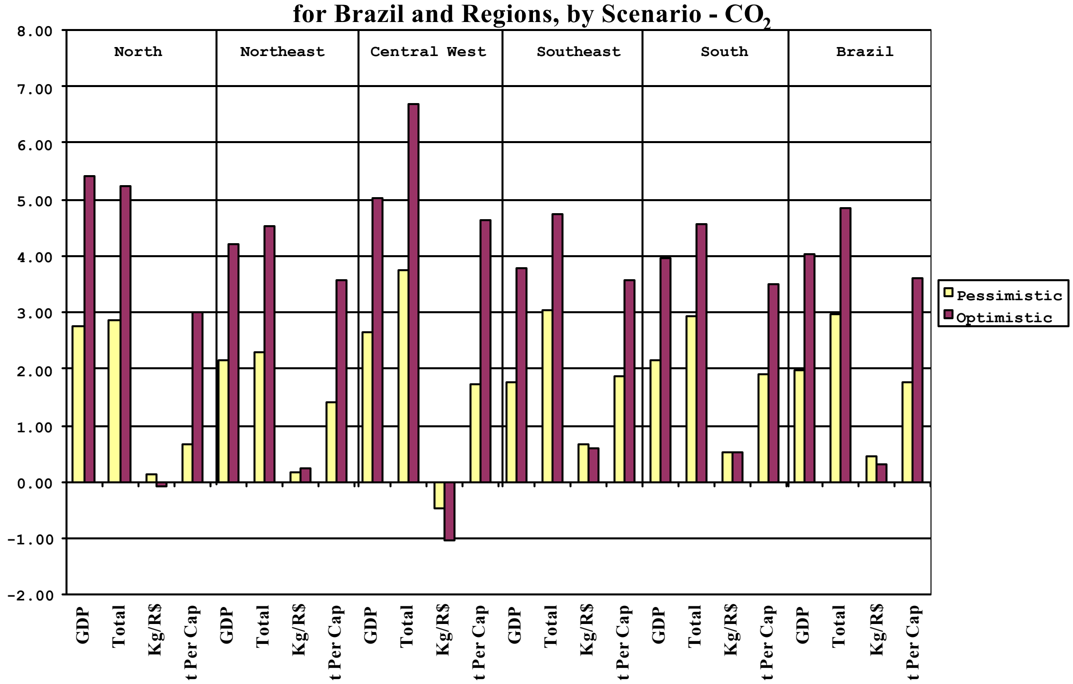
Again, as showed in Graph 19, the SE region is the leading region in emission of CO_2, in both simulations for 2012. However, the NE and S regions, opposing the national average, show growth rates in the product intensity greater in the optimistic scenario than in the pessimistic one (Graph 20).

Such a tendency was already expected giving that these regions have already presented product intensities higher for the atmospheric emissions of particulates and sulforates materials strongly connected with sources of CO_2 in the industry. Alias, as in the electrical energy case, all the regions, as showed in Graph 21, show very close values for the product intensities.

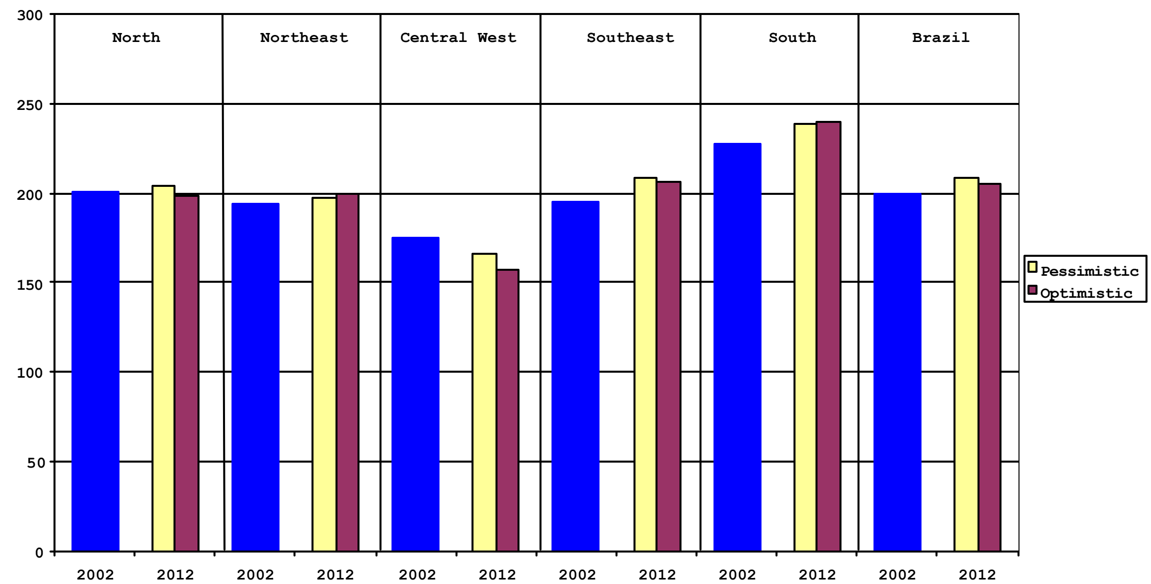
Graph 19 - Total Emission of CO_2, in kt,
by Region and by Scenario, in 2002 and 2012



Graph 20 - Growth Rate of Main Indicators, for Brazil and Regions, by Scenario - CO_2



Graph 21 - Emission of Kg of CO_2 by R$ 1000 of Production, for Brazil and Regions, by Scenario



4.2.2.3. Deforestation of the Amazon Rain Forest

The deforested area in the Amazon rain forest to be used for agricultural purpose increases with the increase in the agricultural activities. As it was said before, assuming a correlation with the production value in the agriculture and the area used for its production, it is possible to estimate for both scenarios being considered here the total additional area to be used by the agricultural activities.

As showed in Table 5, in the optimistic scenario of growth, it is estimated that the in 2012 there would be an additional deforestation of 10.5 million of hectares, or 25.1% of the already deforested area in 2001. With the pessimistic scenario of a smaller growth, the deforested area would be smaller, i.e., around 6 million of hectares, or 14.1% of the area initial presented in 2001. As so, the optimistic scenario would mean a deforested area almost 80% greater than the one estimated for the pessimistic scenario. However, it should be called attention that the deforestation for agricultural purposes would not exceed more than 2% of the current area of the Legal Amazon region.

Table 5
Deforested Area in the Amazon Rain Forest to be Used in Agricultural Production

Scenario	Deforested Area 2002-2012 (ha)	Change in Relation to 2001 (%)	Share in the Area of the Amazon Rain Forest (%)
Optimistic	10,588,294	25.1	2.0
Pessimistic	5,937,430	14.1	1.1

Source: Research data.

5. Final Comments

This study has simulated the environmental impacts in the Brazilian economy, and in each one of its five macro regions, of two different scenarios of economic growth, from 2002 to 2012. Using the MIBRA interregional and intersectoral applied general equilibrium model of the Brazilian economy, a pessimistic and an optimistic scenario were constructed. The pessimistic scenario shows an yearly average growth rate of the Brazilian GDP of 2.3% while the optimistic scenario shows an average yearly growth of 4.4%.

Using coefficients of pollution intensity and of use of natural resources associated of the production value of the economic activities, it was estimated the environmental impacts of these two scenarios for Brazil as a whole and for each one of its macro regions, i.e., N, NE, CW, SE, and S.

The environmental results were estimated for industrial emissions of liquid effluents of organic and inorganic materials, industrial atmospheric emission of particulates and sufurates materials, water and electrical energy consumption, emission of CO_2 and deforestation of the Amazon rain forest.

Except for the deforestation case, it was estimate the product intensity, for each emission of use, dividing the total level of pollution or use by the value of production. For the deforestation it was estimated the difference in the deforested area for each scenario.

Despite a growth rate being obtained for the economy as a whole, each scenario results in growth rates 20% to 40% greater for the CW an N regions than the ones obtained for the SE and S regions. For the NE region, the results show growth rates around the national average. As it would be expected, it is observed in the period being analyzed an equivalent growth in the level of pollution, water an electrical energy use, and deforestation of the Amazon region.

However, even with lower growth rates, the SE region, followed by the S region, continue, in most of the cases, as the main sources of pollution generation an use of natural resources. Only in the water consumption case is that the NE regions gets close to these regions.

Concerning the product intensity, it is observed that for the emissions of particulates and sulforates, electrical energy consumption, and emission of CO_2, the estimates for the other regions are closer to the ones estimated for the SE and S regions.

On one hand, an interesting result is that the national averages, on the optimistic scenario, of the intensities of industrial pollution and water and electrical energy use by economic product are always smaller than the ones obtained in the pessimistic scenario. This means that the efficiency of the environment standard in the economy as a whole improves as more accelerated is the economic growth.

However, there are cases were this relation inverts in some region, as: a) in the generation liquid effluents of organic and inorganic materials in the SE region; b) in the water use in NE, SE and S regions; c) in the consumption of electrical energy in the S region; and e) in the emission of CO_2 in the NE and S regions.

The deforestation of the Amazon region, however, as it would be expected, grows more in the accelerated growth of the optimistic scenario. It was estimated for the year of 2012 an additional deforestation of 10.5 million of hectares, i.e., 25.1% of the deforested area in 2001. In the pessimistic scenario with a lower growth, the deforest area would be of 6 million of hectares. However, the deforestation for agricultural purposes would not exceed more than 2% of the current area of the Legal Amazon region.

Concluding, as it would be expected, the economic growth of the Brazilian economy would increase the pressure over the base of natural resources. However, in national terms, a greater regional growth outside of the SE-S regions, in a convergence of regions, allows that higher growth rates increase the gains of the environmental efficiency by generating lower growth rates in the intensities of pollution generation, and water and electrical energy use.

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