Can beef cattle intensification reduce environmental pressure on Brazilian areas? A case study for Corumbá city(Pantanal biome) and Mato Grosso state(Legal Amazon) using a mathematical model

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Bovine raising in Brazil

- 225 millions hectares of grazing areas[1]
- 195,5 millions of animals[1]
- High levels of deforestation associated: 70% of the deforestated area in Legal Amazon[2]
- 8,8% of Pantanal total area in 2000 was deforested by grazing cultivation[2]

Three systems of beef cattle production in Brazil

- Extensive: It represents 80% of bovine meat production, and uses only grazing as proteic and energetic source.
- Semi-Intensive: The dietary base is also grazing, but animals receive proteic and energetic supplements during the dry period.
- Intensive: The animals are confined, quitting from grazing and receiving voluminous feed, which is rich in protein[1]

Systems of beef cattle production in Brazil

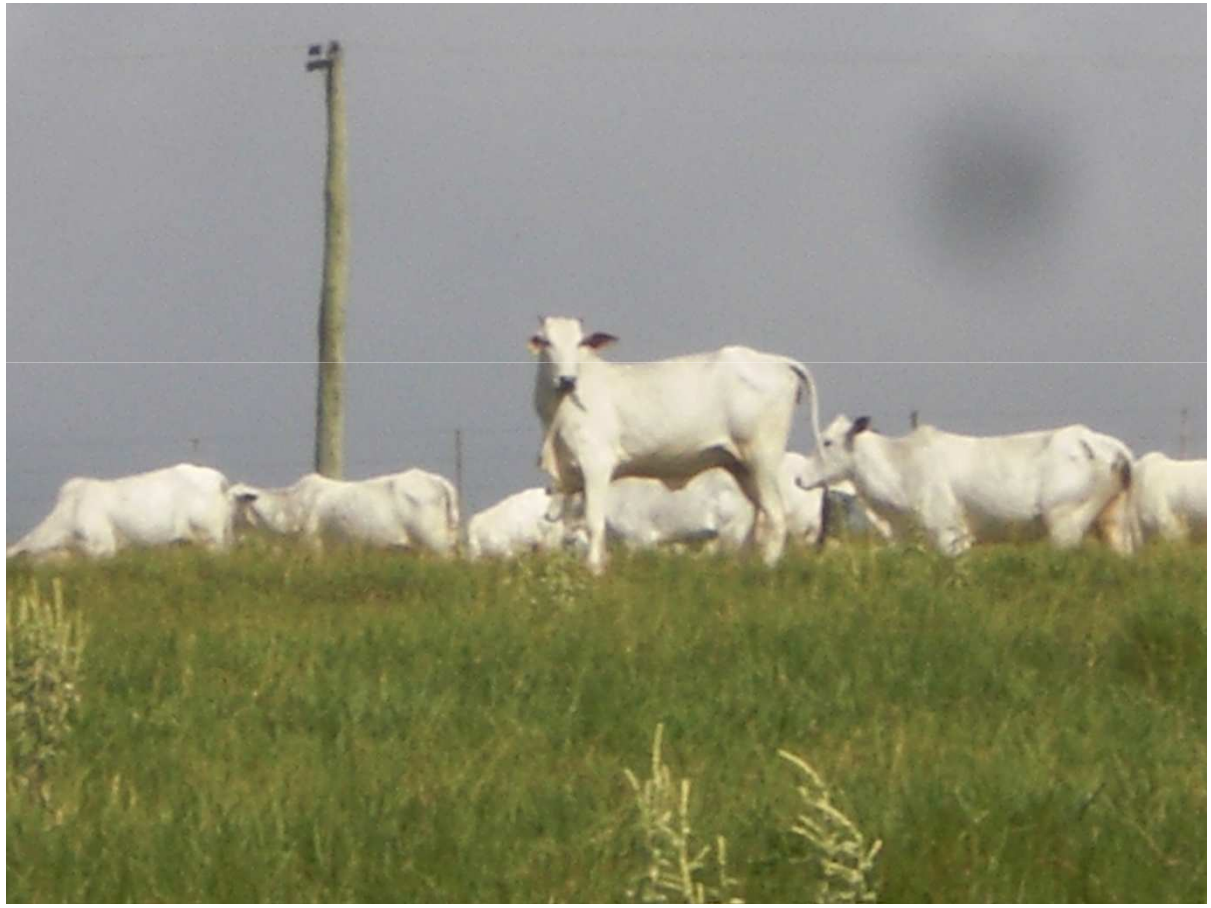

Figure 1: Extensive system of beef cattle production(by Adriano Garcia,2011)

Systems of beef cattle production in Brazil

Figure 2: Intensive system of beef cattle production(by Adriano Garcia,2011)

Bovine raising in Brazil

- In 2003, the Senate approved a credit line to cattle creators who change from extensive to intensive production[4]

- There are about 61 million hectare of area being used as grazing, which has high productivity levels for agriculture[5]

- The intensification, however, demands supplements based principally in soy, what can create a competition between areas allocated for animal and human alimentation [6]. It also brings about soil lixiviation because of the high levels of water used for irrigation in this culture [7].

Objectives

- To do an analysis using a mathematical model published in [8], whose input variable is the animals number in a herd and output variables are the quantity of grazing area, water used for animal consumption and water and plantation area used on soy culture(total lifetime consumption). After that, using the results, compare the environmental pressure in extensive and intensive systems in a simulation to Corumbá city (Pantanal biome) and to Mato Grosso state (Legal Amazon). The model was elaborated using specialized literature and consulting to experts in animal nutrition.
- To do a socioeconomically analysis linked to beef cattle simulation for Pantanal and Legal Amazon.
- To verify if intensification really reduces the deforestation.

Methodology

- The analysis was accomplished using a mathematical model in fuzzy language

- Two simulations were accomplished using the model: one for Pantanal biome (Corumbá city) and other for the Legal Amazon (Mato Grosso state).

- Socio-economic dates from specialized literature were studied with the model results to verify the sustainability of systems.

Fuzzy ruled-based system

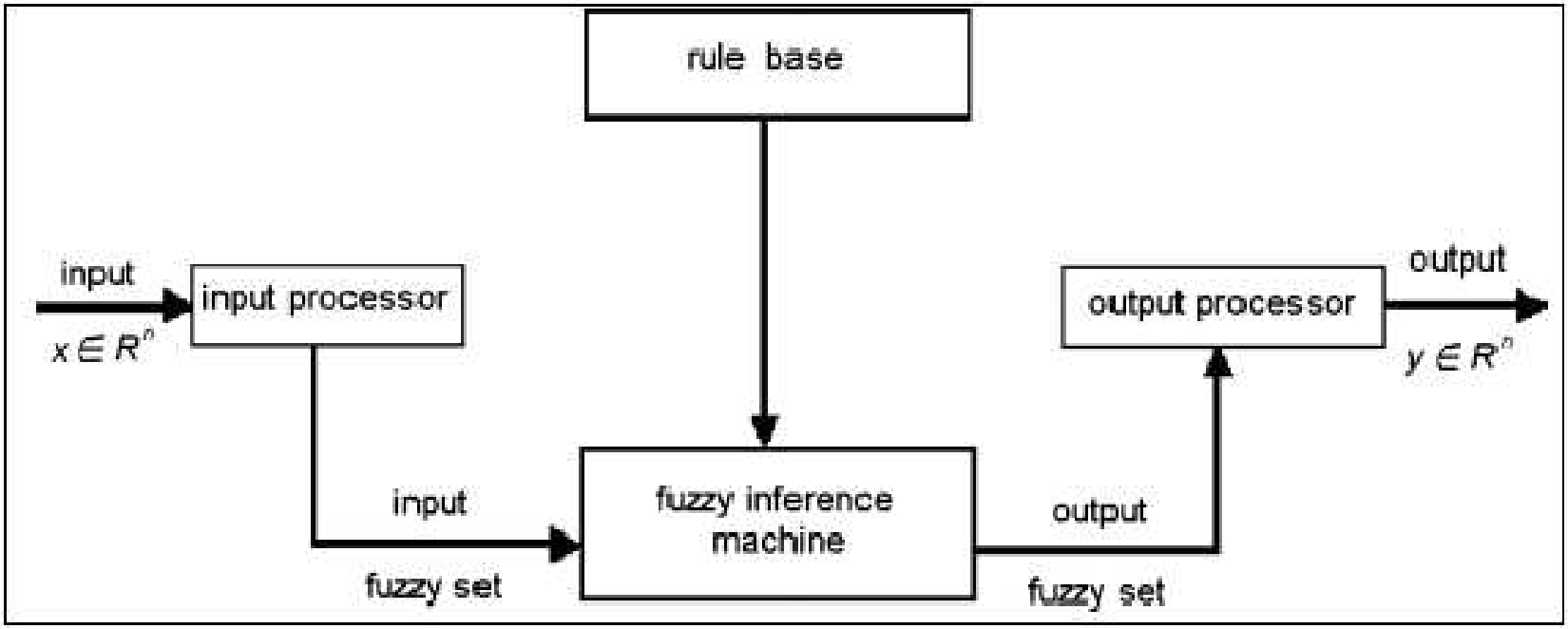

Figure 3: Fuzzy ruled-based system components

Fuzzy model

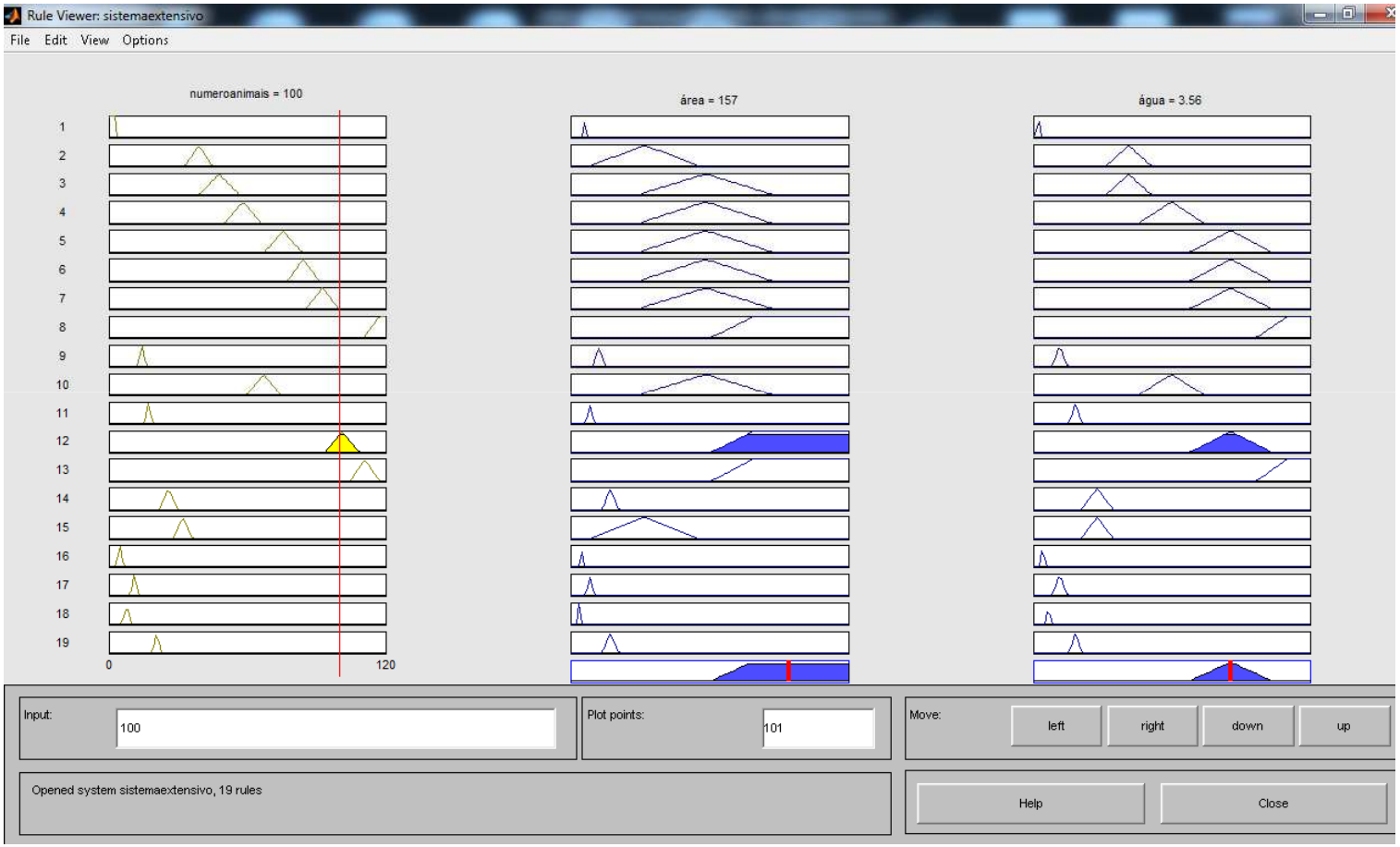

Figure 4: Fuzzy model interface(MatLab,2011)

Results and Discussion

Table 1- Simulation results for the Corumbá bovine herd.

	Extensive	**Semi-intensive**	**Intensive**
Grazing area (10^4ha)	440,5	92,9	19,8
Water for animal consumption nk(10^{11}L)	0,41	0,25	0,25
Soy used for animals feed(10^7kg)	-	12	18,3
Area used for soy plantation(10^4ha)	-	0,46	0,72
Water used in the irrigation for soy plantation(10^{11}L)	-	2,67	4,56

Results and Discussion

- In a first look, the intensification seems to be a way to reduce the environmental impact of grazing areas in Pantanal: the intensification can reduce until 96% of grazing area, but these dates can dissemble the reality.

- The extensive beef cattle in Pantanal have a low impact, because the cattle are established as part of the ecosystem, being fed with natural grazing and without occurrence of deforestation for grazing implantation

Results and Discussion

- The demand of water in intensive systems is higher than in the other systems, what causes a strong stress on the region, mainly because this area goes through periodic dry periods. In the semi-intensive system, considering only the main compound of proteic supplement, the soy, the water quantity demanded increases 1100% in the intensive system simulation

Results and discussion

Figure5: Bovine raising in Pantanal(in http://economiainterativa.com.br)

Results and Discussion

Table 2: Simulation results for Mato Grosso state

	Extensive	**Semi-intensive**	**intensive**
Grazing area (10^6ha)	20,7	13,9	4
Water for animal consumption (10^{12}L)	0,76	0,46	0,46
Soy used for animals feed(10^8kg)	-	19,6	19,6
Area used for soy plantation(10^5ha)	-	0,46	0,72
Water used in the irrigation for soy plantation(10^{12}L)	-	4,35	4,35

Results and Discussion

- It’s noticed that grazing area, the factor that more menaces the forest destruction currently, decreases more than 30% in the transition to semi-intensive system and 78% in the transition to intensive system

- But… [9] believes that intensification doesn’t solve the question of Amazon deforestation. The economic production wouldn’t be decelerated and the great farmers would buy the small farmers properties, which have less environmental impact. Besides, the purchase of properties to grazing areas establishment has a stronger real estate speculation character than beef production. The grazing implantation, even in bad situations, is more profitable than having it for forests only.

Results and Discussion

Figure 6: Deforestation in the Legal Amazon(in eco4planet.uol.com.br)

Growth without limits

- The evaluation of intensification benefits must be done carefully, without creating a delusional sustainable speech of environmental neoliberalism that intensification comes to be a solution for environmental degradation, and represents a rational use of natural sources, because the economic activities are looking for unlimited growing without considering ecosystem carrying capacity, disregarding the sustainability [10]. Therefore, it's necessary to consider ecosystems carrying capacity to grant deforestation decrease and it must direct the economic activity growing, not the inverse.

Conclusion

- Results indicate that intensification strongly decreases the grazing areas, what theoretically reduces deforestation.

- Analyzing the socio-economical context , the intensification doesn't solve the deforestation problem, because in Legal Amazon it revolves around the estate speculation, not linked to beef production, and in Pantanal, the extensive beef cattle have caused less impact on environment, because it is developed by small creators that produce without going beyond ecosystem capacity.

- Besides the water demanded increases about more than 5 times in intensives system what indicates a strong pressure on this source

References

- 1.[in portuguese]Cezar, I.M.; Queiroz, H.P.; Thiago, L.R.L.S.; Cassales, F.L.G.; Costa, F.P. *Uma descrição com ênfase no regime alimentar e no abate.* Embrapa Gado de Corte. Campo Grande, 2005.

- 2.[in portuguese]Margulis,S. *Causas do desmatamento da Amazônia brasileira*. Mundial bank, Brasília, 2003.

- 3.[in portuguese]Padovani, C.R.; Cruz, M.L.L.; Padovani, S.L.A.G. *Desmatamento do Pantanal para o ano 2000.* Anais do Simpósio sobre recursos naturais e sócio-econômicos do Pantanal. v.4, Corumbá, 2004.

- 4.[in portuguese]Castanho,V. *CAE aprova incentivo à pecuária intensiva e ao sistema orgânico de produção*.AgênciaSenado,2008.In <http://www.senado.gov.br/noticias/verNoticia.aspx?codNoticia=76394&codAplicativo=2>.Acess in 04-04-2011.

- 5.[in portuguese]SOS Florestas. *Cartilha Código Florestal: Entenda o que está em jogo com a reforma da nossa legislação ambiental*.2011.

References

- 6.[in portuguese]Alcade, C.R.; Zambom,M.A.;Santos,G.T.; Modesto,E.C.; Gonçalves,G.D.; Silva, D.C.; Silva,K.T.; Faustino, J.O . *Valor nutritivo de rações contendo casca do grão de soja em substituição ao milho moído para cabritos*. R. Bras. Zootec., 2009, v. 38, n. 11, pgs 2198-2203 .

- 7.[in portuguese]WWF. *Análise dos Impactos Ambientais da Atividade Agropecuária no Cerrado e suas inter-relações com os recursos hídrico na região do Pantanal*. Brazil,2006.

- 8.[in portuguese]Garcia,A.G; Peixoto,M.S. *Bovinocultura de corte:Uma avaliação dos recursos exigidos pelos diferentes sistemas de produção através de modelagem matemática fuzzy*. Biomatemática. 2011,21, 141-152.

- 9.Fearnside, P.M. *Can pasture intensification discourage deforestation in the Amazon and Pantanal regions of Brazil*? C.H. Wood & R. Porro (eds.). Deforestation and land use in the Amazon. 2002, pp. 283-364.

- 10.[in portuguese]Leff, E. *Saber Ambiental:Sustentabilidade, Racionalidade,Complexidade e Poder*.Editora Vozes,8ºEd,2011