Technical Notes

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Daniel Nepstad
Marcelo C. C. Stabile
Andréa Azevedo
Judson F. Valentim
Elsa Mendoza
Claudenor P. Sá

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Volume 5

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Research Team

Daniel Nepstad[1], Marcelo C. C.Stabile[1], Andréa Azevedo[1], Judson F. Valentim[2], Elsa Mendoza[1], Claudenor P. Sá[2]

Affiliations

[1] Instituto de Pesquisa Ambiental da Amazônia - IPAM

[2] Embrapa Acre

In partnership with

Instituto de Mudanças Climáticas do Acre–IMC

Embrapa Acre

Financial support

Gordon and Betty Moore Foundation

Climate and Land Use Alliance

Photo

Judson F. Valentim

Suggested citation

D. Nepstad, M. C. C. Stabile, A. Azevedo, J. F. Valentim, E. Mendoza, C. P. Sá. Technical Notes Vol. 5 – Subsidies for a Cattle Ranching Intensification Subprogram in Acre: A State Analysis. Instituto de Pesquisa Ambiental da Amazônia. Brasília, Brazil. May 2013.

Available at: http://bit.ly/IPAM686

Revised on June 5th 2013

Visit: www.ipam.org.br

Summary

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Preface

The main objective of this technical report is to provide background information for Acre's Incentive Program for Environmental Services (SISA) concerning the cattle ranching intensification subprogram.

Here, we present a variety of cattle ranching intensification scenarios using different herd expansion rates, percentages of pasture area to be intensified and economic data to demonstrate the difference in income from these scenarios. This analysis uses the rate of increase in herd projections from the federal government, as well as a more ambitious projection. The scenarios also consider four different intensification scenarios that would allow herd expansion, without incurring in new deforestation.

These data are used in conjunction with economic data (production cost, beef price scenarios and income) to analyze the overall income of cattle ranching in Acre from 2010 to 2021. While intensification can be profitable, it must be linked to public policies and access to credit, so that the increase in income does not become a threat, possibly causing new deforestation.

1. Cattle ranching in Acre: characterization of production and the beef industry

In 2010, Acre's cattle herd was composed of 2,578,500 animals (IBGE, 2012a) distributed in 19,920 rural properties (IDAF, 2006), 95.4% of these properties had fewer than 500 animals and corresponded to 50% of the total herd. This shows that the majority of the ranchers are small- and mid- scale producers. From 1975 to 2010, the increase in herd size in Acre was almost exponential, growing 2068% during the period. In 2010, according to official statistics 485 thousand animals were slaughtered (57% male and 43% female) and resulted in a beef production of 109 thousand metric tons of beef (IBGE, 2012b). It is estimated that the unofficial slaughter rates correspond to approximately 15% of the official statistics, resulting in an additional slaughter of 73 thousand animals in 2010. Furthermore, in 2010, over 51 thousand animals were exported alive.

Acre's exports to other states generated an income of R$ 540 million (U$270 million) in 2010. The cattle ranching sector was responsible for 92% of the total earnings from exports with an income of R$ 498 million (U$249 million) (SEFAZ, 2011).

Pasture areas in the state occupied 1,746,000 ha (4.3 million Acres) corresponding to 83.2% of the state's deforested area (UCGEO, 2011).

2. Scenarios of cattle ranching expansion in Acre

Four different intensification scenarios were simulated in order to calculate their income and costs to the State of Acre. The premise was that the herd size would increase, but rather than promoting an increase in pasture areas, the increase in herd size would be accommodated in the existing pasture areas, through intensification techniques which are used and have already been tested by EMBRAPA-Acre.

The size of cattle ranching in Acre was estimated until 2021 using two projections: a) an official projection by Brazil's Agricultural Ministry (MAPA) (Brazil e MAPA, 2011), which indicated an annual increase rate of 2.2% (projection A); b) an ambitious increase rate of 3.5% per annum (projection B).

Table 1. Stocking rate for four scenarios of intensification of cattle ranching in Acre, considering Rate of herd expansion from MAPA and ambitious

Scenario 1: Intensificationin 100% of the area	Projected stocking rate (AU / ha)											
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Projection A	1.18	1.21	1.23	1.26	1.29	1.32	1.35	1.38	1.41	1.44	1.47	1.50
Projection B	1.18	1.22	1.27	1.31	1.36	1.40	1.45	1.50	1.56	1.61	1.67	1.72
Scenario 2: Intensification in 75% of the area[1]	Projected stocking rate (AU / ha)											
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Projection A	1.18	1.22	1.25	1.29	1.32	1.36	1.40	1.44	1.48	1.52	1.56	1.61
Projection B	1.18	1.24	1.29	1.35	1.41	1.48	1.54	1.61	1.68	1.75	1.83	1.91
Scenario 3: Intensification in 50% of the area[1]	Projected stocking rate (AU / ha)											
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Projection A	1.18	1.23	1.29	1.34	1.40	1.45	1.51	1.57	1.63	1.69	1.76	1.82
Projection B	1.18	1.26	1.35	1.44	1.53	1.62	1.72	1.82	1.93	2.04	2.15	2.27
Scenario 4: Intensification in 25% of the area[1]	Projected stocking rate (AU / ha)											
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Projection A	1.18	1.29	1.39	1.50	1.61	1.72	1.84	1.96	2.08	2.20	2.33	2.46
Projection B	1.18	1.35	1.52	1.70	1.88	2.07	2.26	2.47	2.68	2.90	3.12	3.36

[1] In these scenarios, the areas which are not intensified maintain the current stocking rate of (1.18 UA/ha) through 2021.

Supposing that there would not be any further deforestation up to 2021 or pasture area conversion to other uses, the stocking rates (in animal units per hectare) were calculated for the four intensification scenarios (100%, 75%, 50% e 25%) and were presented in Table 1, above.

Considering the work by Sá et al. (2010), in which the authors propose three systems with different support capacities (UA/ha), being: the traditional (1 UA/ha), the improved (1.5 UA/ha) and the advanced system (2.5 UA/ha); Table 1. shows that the advanced system would support most of the intensification scenarios, except for Scenario 3 (intensification in 25% of the pasture area) with Projection B (annual herd growth rate of 3.5%), as in this scenario the stocking rate would surpass the support capacity of the system.

Alternatively, if we were to maintain the current stocking rate, but to fit the increased herd according to the two different projections (MAPA and ambitious), new pasture areas would be needed. This is illustrated in Table 2. Considering an annual growth rate of 2.2% (MAPA) up to 2021, 472 thousand hectares of new pasture would be needed (27% increase in pasture area compared to 2010); however if the annual increase in herd were of 3.5%, then 803 thousand hectares of new pasture would be needed (46% increase in pasture area compared to 2010).

Table 2. Need for new areas of pasture without any intensification of cattle ranching in Acre.

	Herdin 2021		Stocking rate without intensification		Area needed (ha)	Current pasture area (ha)	New pasture (ha)
	Herd	AU	Animals/ha	AU/ha			
Projection A	3 275 822	2 620 657	1.48	1.18	2 218 145	1 745 943	472 202
Projection B	3 764 474	3 011 579	1.48	1.18	2 549 024	1 745 943	803 081

This horizontal expansion of ranching is not interesting as it would stimulate new deforestation. Furthermore EMBRAPA-Acre has already developed technologies which support a gradual intensification, without incurring in deforestation. However, public policies, technical assistance, extension services and credit are needed for small and mid-scale producers, as they own half the herd and 95% of the properties.

3. Intensification costs

Intensification costs are subdivided in two different components. The first component is the transition cost, the investment needed to change from one system to another. According to cattle ranching experts in Acre, this cost was estimated to be U$250/ha (R$500/ha) for 2000 ha properties. This would cover costs associated to pasture improvement and picketing. The model presented here allows for the transition costs to be distributed in multiple years, or at once on the first year.

The second component is an increase in operational cost that occurs with an increase in the stocking rate. Data from Sá et al. (2010, 2011) were used to calculate this component. These data included productivity (@/ha/yr)[2] and production cost (U$/kg) for the three different systems (traditional, improved and advanced) (Table 3). As an example, a ranch which has a stocking rate of 1.4 AU/ha will have a higher operational cost than one operating the traditional system, however its costs will be lower than a farm which has an improved system. Considering this approach, it is possible to calculate the cost of cattle ranching as a whole, by using the stocking rate and the four intensification scenarios (on 25%, 50%, 75% and 100% of the pasture area). If we consider the change from the traditional to the advanced system, one can see that while production costs per hectare increase by 139%, the increase in productivity is substantially higher (202%). This is a consequence of the decrease in production cost per kg of beef when comparing the traditional to the advanced system.

Table 3.Annual production cost estimate extracted from Sá et al. (2011)

System	Stocking Rate (AU/ha)	Productivity (@/ha/yr)	Production cost (U$/@)	Cost perha (U$/ha/yr)
Traditional	1.0	4.06	26.51	107.65
Improved	1.5	7.69	21.97	168.95
Advanced	2.5	12.26	21.00	275.46

Considering the data and tables above, it is possible to calculate the total cost of cattle ranching under the four intensification scenarios and both herd expansion projections. The first component of the intensification cost, related to the transition cost, is independent from the stocking rate. This was

[2] The unit in which beef is measured in Brazil is the @, or "arroba". One @ is equivalent to 15 kg

calculated by multiplying the intensification cost (R$/ha) by the area to be intensified yearly (ha). The second component, however, varied according to the stocking rate. The total cost (2010 to 2021) varied between U$427.3 million (projection A, intensifying 25% of the area) and U$1.317,80 (projection B, intensifying 100% of the area). Both costs are detailed in Table 4[3] and consider the projected inflation rate[4], as well as a 12% discount rate[5], which is above the pre-fixe rates for national treasure bonds for 2021.

Table 4. Total cost of intensification, for 2010-2021, according to intensification scenario and projected herd increase (preset values of nominal values)

Percentage of pasture area to be intensified (%)	Total transition cost, estimated at R$500/ha		Projection of yearly herd growth (%)	Operational cost of intensification		Total cost of intensification	
	million R$	million U$		million R$	million U$	million R$	million U$
100%	633.9	312.3	Projection A - 2.2	2384.6	1174,7	3018,5	1486,9
			Projection B - 3.5	2635.5	1298,3	3269,4	1610,5
75%	475.5	234.2	Projection A - 2.2	1888.6	930,3	2364,1	1164,6
			Projection B - 3.5	2125.1	1046,8	2600,6	1281,1
50%	317.0	156.2	Projection A - 2.2	1379.1	679,4	1696,1	835,5
			Projection B - 3.5	1616.4	796,3	1933,4	952,4
25%	158.5	78.1	Projection A - 2.2	867.5	427,3	1026,0	505,4
			Projection B - 3.5	Not possible with current technology			

Table 4 shows very different scenarios. In the case where 100% of the pastures were intensified, even using the ambitious projection for herd increase, the stocking rate in 2021 would be 1.72 AU/ha. Therefore, intensifying all of the pasture to an advanced system is not reasonable because the costs are very high and the investment is unnecessary, as the final sticking rate is much lower than the support capacity of the advanced system. Alternatively, if only 25% of the area were intensified to the advanced system, and the herd expanded according to the ambitious projection, then the final stocking rate in 2021 would be 3.36 AU/ha (Table 1). This is higher than the support capacity of the advanced system used in

[3] The exchange rate used here was R$2.03/U$1.00
[4] Inflation estimates from Itaú Macro Visão, available at: http://bit.ly/Itau_Inflacao_Projetada
[5] Rates for Brazilian government pre-fixed bonds for 2021available at: http://bit.ly/Titulos_Publicos_2012

Acre. Anyhow, supposing that the herd grew according to Government projections (2,2% per annum) and intensification was done on 25% of the pasture areas, the final stocking rate would be close to the support capacity of the system, while having the lowest overall cost (underlined in Table 4).

Once the production costs (including the transition costs) and beef production estimates are known, by simulating different beef prices it is possible to calculate the total income of cattle ranching from 2010 to 2021.

This is presented below, in Figure 1, where we have the total income of cattle ranching for: the two herd expansion scenarios, the four intensification scenarios and three beef prices. The values presented in Figure 1 are present values of nominal values.

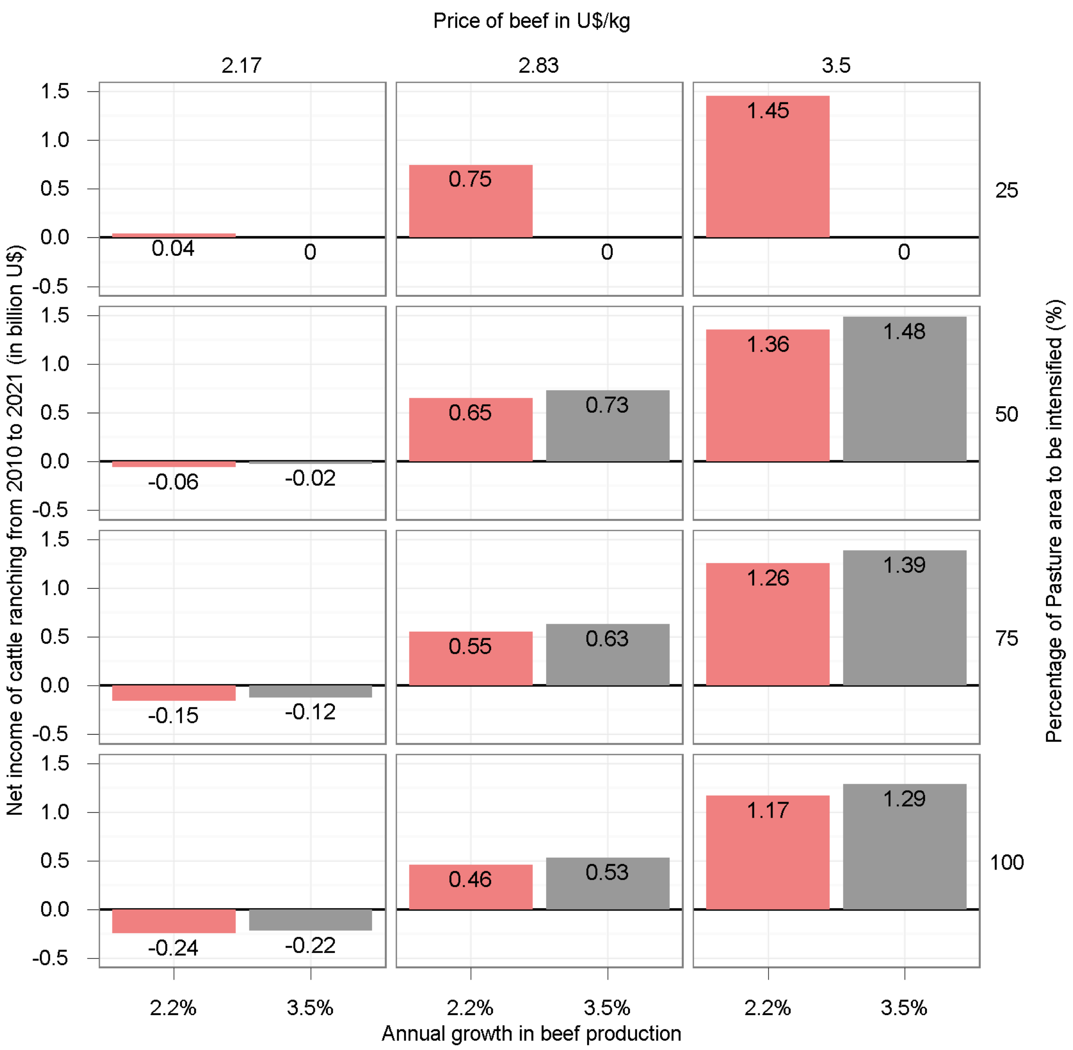

Figure 1. Total income of cattle ranching from 2010 to 2021 (present values of nominal values)

The first conclusion from the figure above is that in a scenario with low beef prices (U$2.17/kg), the majority of the systems are only marginally lucrative, with one indicating a net loss of U$240 million.

In the scenarios with higher beef prices, all systems are lucrative. One of the most profitable systems is where the intensification occurred in 25% of the area and the herd expanded according to Government estimates. This is caused by: 1) lower intensification investment (see Table 4); and 2) that the increase in operational cost from an improved to an advanced system is proportionally smaller than the increase in cost from a traditional to an improved system. It is also important to note that considering the ambitious projections and intensification in 25% of the area, Figure 1 does not show an income. This happens because the aforementioned scenario (ambitious projection with intensification in 25% of the area) surpasses the support capacity of the advanced system.

Consequently, in order to fulfill the projected demand for beef, while not incurring in any new deforestation, it would be more profitable to intensify only a portion of the pasture areas, as this is more cost-effective, as shown above. However, if the intensification was focused on 25% of the pasture area, the remaining pastures (75%) would be sub utilized.

Producers in these sub utilized areas could be a threat to maintaining a zero deforestation policy, even though demand would be fulfilled by the beef produced in intensified areas. Therefore, choosing where to target intensification involves social, economic and political issues which should be discussed in the state, with participation of government and other stakeholders.

Even though intensification can be self-financed, the transition to a more efficient and sustainable ranching practices will depend on specific lines of credit (ABC or other), technical improvement in the workforce, technical assistance for producers and research to improve productive techniques.

4. Investments in intensification: available sources of funding?

The book "REDD in Brazil: A focus on the Amazon" states that if Brazil simply its targets in reducing emissions, the country would cut its emissions from deforestation by 5,747 million metric tons ofCO_2 (Pg. 102, CGEE et al. 2011). According to IPAM's stock and flow approach[6], Acre would receive 6.5% of these credits. This would amount to a reduction of 186.79 million metric tons in flow of CO_2. Around 81.44 million metric tons of CO_2 would be allocated to settlements and private properties (see Table 5).

Therefore, considering the three values of carbon (US$ 5/t CO_2, US$ 10/t CO_2 e US$ 20/t CO_2), this would result in carbon credits worth U$ 407.2 million, U$ 814.4 million and U$ 1.6 billion respectively. These credits should be used in programs related to agriculture and cattle ranching. A portion of these credits could be directed towards the cattle ranching intensification subprogram within SISA. Ideally, this program would benefit small, medium and large scale producers, but with decreasing benefits.

A cattle ranching intensification subprogram at the stet-level in Acre could generate credits of avoided deforestation that could be used in other conservation subprograms (UC, TI, and others) (For more details see page 36 of the Executive Summary of the study case from Acre).

Table 5. Sectorial distribution of CREDDs and estimated income according to different carbon prices.

	Sectorial distribution of stock and flow (%)	Distribution (million T CO_2)	Value of credits (in U$ million)		
			US$ 5/ t CO_2	US$ 10/ t CO_2	US$ 20 / t CO_2
Indigenous lands	11.00	20.55	102.73	205.47	410.94
Conservation units	22.00	41.09	205.47	410.94	821.88
Settlements	28.00	52.30	261.51	523.01	1046.02
Private property	15.60	29.14	145.70	291.39	582.78
Public lands	23.40	43.71	218.54	437.09	874.18
Total	100.00	186.79	933.95	1867.90	3735.80

[6] IPAM's stock and flow methodology distributes CREDD's according to the flow (deforestation reduction) and also according to the existing forest carbon stock. It is considered that 50% of those credits would come from flow reduction.

This intensification should be targeted, initially, to small-scale producers (up to 100 ha). As a result of the intensification, pasture areas would be freed up for agriculture (annual or perennial crops), integrated productive systems (e.g. integration of farming-ranching and farming-ranching-forestry), as well as afforestation for energy production or for timber to be used in the industries which are being installed in the state.

Finally, an integrated state- and federal-level strategy is needed to promote the synergies between the programs that already exist. Furthermore, one should conosider that resources from avoided deforestation could be used to finance the intensification of beef production, improvement in agricultural practices, as well as to improve the livelihoods of the socially and economically vulnerable producers in Acre.

Furthermore, the Brazilian government has specific sectorial plans, such as the Low Carbon Agriculture Plan (Plan ABC), which was developed to stimulate the transition from traditional to intensive and integrated agriculture and ranching systems. Such transition would contribute to Brazil achieving its voluntary emissions reductions as proposed in the National Climate Change Policy in 2009. Plan ABC has a specific line of credit which has a lower interest rate and longer grace period, which are more compatible with this transition. However the volume of resources applied in this program is only a fraction of what the country invests in its agricultural programs.

5. Conclusions

In this report we have shown that well planned intensification of cattle ranching in Acre can have a positive impact in the state's economy. Furthermore, even when considering the transition costs and increase in operational cost, intensification is profitable as long as beef prices are higher than U$2.17/kg.

For this progress in cattle ranching to happen, however, there are a series of pre-requisites, such as: access to subsidized credit, access to technical assistance and training of the agricultural workforce.

While it has been shown that intensification is profitable, it is important to note that profitability is maximized when intensification is done only in part of the pasture areas. Therefore it is necessary that social, economic and policy mechanisms are in place that promote a zero deforestation beef production in the state.

Here, it is also shown that intensification can be self-financed, but that it will demand an initial investment and initiative from producers. The reduction of deforestation by the cattle ranching sector can generate carbon credits to be used in Acre's SISA.

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