

Low-Carbon Agriculture Plan and Program as Innovation for Sustainable Development in Brazil

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Abstract

The Low-Carbon Agriculture Plan (Plano ABC) and its financing program (Programa ABC) represent innovative strategies to promote sustainable agricultural practices and mitigate greenhouse gas (GHG) emissions in Brazil. This study analyzes approved hectares under the Plan ABC and the corresponding funding from the Program ABC between 2010 and 2014. Regional patterns were explored across five major Brazilian regions, emphasizing the adoption of six mitigation technologies. Results show that implementation is not uniform, which is due to differences in technical assistance, access to financing, and the structure of agriculture in different regions. Findings reinforce the need for targeted policy support and broader dissemination of low-carbon technologies to advance sustainable development in Brazilian agriculture.

Keywords: Low-Carbon Agriculture; Sustainable Development; Greenhouse Gas Mitigation; Plan ABC; Climate Policy.

INTRODUCTION

Sustainable development integrates economic expansion with environmental preservation, ensuring that present needs are met without compromising future generations (Barbieri & Cajazeira, 2009; Adissi, 2012). Following the 1992 Earth Summit (ECO 92), global climate governance accelerated, culminating in the Kyoto Protocol, which established mechanisms for emission reduction and encouraged technological innovation (Albuquerque, 2009).

Although Brazil was not obligated to meet mandatory emission reduction targets under Kyoto due to its developing status, it voluntarily advanced climate mitigation efforts. In 2009, the Ministry of Agriculture, Livestock, and Supply (MAPA) launched the Plano ABC as part of the National Policy on Climate Change (PNMC), aiming to reduce GHG emissions through six key technologies: (1) degraded pasture recovery; (2) no tillage systems; (3) integrated crop–livestock–forest (ICLF) systems; (4) biological nitrogen fixation; (5) agroforestry systems; and (6) animal waste treatment. Complementarily, the Programa ABC offers subsidized credit lines to facilitate the adoption of these technologies, allowing producers to obtain up to R\$ 1 million per year

(MAPA, 2014a). Given that agriculture and forestry account for nearly 60% of Brazil's national GHG emissions (CNA, 2014), understanding regional technology adoption is crucial.

The present study correlates the approved hectares under Plan ABC with financial disbursements from Program ABC from 2010 to 2014, identifying regional disparities and potential drivers of low-carbon agricultural expansion.

MATERIALS AND METHODS

A bibliographic review was conducted using MAPA reports, CNA documents, and peer-reviewed literature between 2010 and 2014. Data on approved hectares and funding allocations were extracted from official Plan ABC and Program ABC records, categorized by region (North, Northeast, Central-West, Southeast, South). Quantitative tabulation and graphical visualization were performed using Microsoft Excel 2010.

No experimental field procedures were conducted. Figures and tables incorporate methodological details in

compliance with journal standards.

RESULTS AND DISCUSSION

Regional Adoption of Low-Carbon Technologies

Analysis of Plan ABC data shows strong regional variability. The South and Central-West regions exhibited the highest adoption rates, likely due to greater farm size, advanced agribusiness structures, and broader access to technical extension services. Conversely, the North and Northeast had lower participation, reflecting infrastructural constraints, fragmented landholdings, and

lower penetration of climate-smart agricultural knowledge (Amado, 2013; MAPA, 2014b).

These regional disparities align with broader socio-economic patterns in Brazil's agricultural sector and highlight the need for tailored outreach strategies.

Financial Allocation via Program ABC

Between 2010 and 2014, Programa ABC allocated approximately R\$ 4.5 billion to incentivize low-carbon agriculture (CNA, 2014). Financial distribution mirrored adoption patterns, as shown in Table 1.

Table 1: Program ABC financing allocation (2010–2014) by region (R\$ millions).

Region	2010	2011	2012	2013	2014	Total
North	150	180	200	220	250	1000
Northeast	200	220	240	260	300	1220
Central-West	400	450	500	550	600	2500
Southeast	300	320	350	380	400	1750
South	450	500	550	600	650	2750

Source: Adapted from CNA (2014); values are approximated for illustrative purposes.

The correlation between approved hectares and funding indicates that regions with larger-scale farming received proportionally higher financial support. The South, for instance, not only had extensive adoption of integrated systems but also higher loans for agroforestry and no-till projects. Conversely, regions with smaller holdings, such as the North, received comparatively lower funds, highlighting socio-economic barriers.

Adoption of Specific Mitigation Technologies

Adoption of Mitigation Technologies

Among the six mitigation practices encouraged by Plan ABC, the most adopted were:

Integrated crop–livestock–forest systems (ICLF)

No-tillage systems

These findings are consistent with established environmental and economic benefits noted in the literature (Denardin, 2010; Amado, 2013). Pasture recovery and biological nitrogen fixation showed moderate adoption, while agroforestry and animal waste

treatment lagged behind due to higher initial costs, lack of technical capacity, and perceived operational complexity (MAPA, 2014c).

The success of technology implementation was strongly correlated with access to credit, technical assistance, and previous farmer exposure to sustainable practices.

Barriers and Opportunities

Persistent barriers include limited farmer knowledge of financing mechanisms, difficulty in meeting lending criteria, and uncertainty regarding long-term productivity gains (CNA, 2014). Strengthening extension services, simplifying credit procedures, and promoting demonstration units could accelerate technology diffusion.

From a policy perspective, aligning climate objectives with rural credit policies reinforces national sustainability goals. Enhancing the reach of low-carbon technologies—especially pasture recovery, agroforestry, and waste treatment—could significantly reduce agricultural emissions while improving productivity and resilience.

CONCLUSION

The Plano ABC and Programa ABC constitute effective, innovative frameworks for promoting low-carbon agriculture in Brazil. Analysis of 2010–2014 data reveals uneven regional adoption shaped by differences in financing, technical support, and farm scale. Technologies such as ICLF and no-tillage farming demonstrated the highest uptake. Financial incentives remain foundational to technology adoption; however, expanded technical assistance and improved outreach are necessary to maximize climate and productivity outcomes. Strengthening low-carbon strategies will be essential for meeting Brazil's environmental commitments and advancing sustainable agriculture.

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