PROJECT PERFORMANCE ASSESSMENT REPORT

BRAZIL

Sustainable Production in Areas Previously Converted to Agricultural Use Project

Report No. 178841
MARCH 27, 2023

IEG
INDEPENDENT EVALUATION GROUP

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Brazil

Sustainable Production in Areas Previously Converted to Agricultural Use Project (TF 17368)

March 27, 2023

Financial, Private Sector, and Sustainable Development

Independent Evaluation Group

Abbreviations

ABC	Low-Carbon Emissions Agriculture
Embrapa	Brazilian Agricultural Research Corporation
GGE	State Management Group
ICR	Implementation Completion and Results Report
IEG	Independent Evaluation Group
MAPA	Ministry of Agriculture, Livestock and Food Supply
SENAR	National Rural Learning Service
TMA	on-farm technical assistance

All dollar amounts are US dollars unless otherwise indicated.

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This report was written by John Heath (consultant) who, assisted by Francisco Oliveira (local consultant), assessed the project in August 2022, under the management of Samjhana Thapa. The report was peer reviewed by Christoph Diewald and panel reviewed by Jack Van Holst Pellekaan. Jean-Jacques Ahouansou provided administrative support.

Note: IEG = Independent Evaluation Group; PPAR = Project Performance Assessment Report.

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This is a Project Performance Assessment Report by the Independent Evaluation Group of the World Bank Group on the Sustainable Production in Areas Previously Converted to Agricultural Use (P143184) project in Brazil. This instrument and the methodology for this evaluation are discussed in appendix C. Following standard Independent Evaluation Group procedure, copies of the draft Project Performance Assessment Report were shared with relevant government officials for their review and comment. Comments are included in appendix E.

Sustainable Production in Areas Previously Converted to Agricultural Use (P143184)

Basic Data

Country	Brazil	World Bank financing commitment	US$10,620,000
Global Practice	Agriculture	Actual project cost	US$10,310,574
Project name	Sustainable Production in Areas Previously Converted to Agricultural Use	Expected project total cost	US$11,130,000
Project ID	P143184	Actual amount disbursed	US$10,310,574
Financing instrument	Trust fund	Environmental assessment category	B
Financing source	TF 17368		

Dates

Event	Original Date	Actual Date
Approval	July 18, 2014	July 18, 2014
Effectiveness	August 13, 2014	August 13, 2014
Mid-Term Review	January 23, 2017	January 23, 2017
Restructuring	April 24, 2018	April 24, 2018
Closing	November 20, 2018	November 20, 2019

Key Staff

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Summary

Background and Description

Focusing on the Cerrado biome—a savanna-forest mosaic located in central Brazil—the project was intended to shed light on the best way to provide private landholders on midsize farms with the knowledge and skills needed to adopt low-carbon technologies. The project, which was designed to include 9 of the 11 Cerrado states, was an adjunct to Brazil's Low-Carbon Emissions Agriculture (Agricultura de Baixa Emissão de Carbono; ABC) Plan, which supported technology transfer investments of $6.7 billion between 2010 and 2020, making it one of the largest climate-smart agriculture programs in the world. The project sponsored a randomized control trial to measure the effectiveness of training plus technical assistance in promoting technology adoption compared with training alone and with a control group of farmers who received no training or technical assistance.

At appraisal, the project development objective was to promote the adoption of selected sustainable low-carbon-emitting agricultural technologies by midsize producers in the Cerrado region. The objective was not altered during implementation.

Results

Three years after the project's completion, we judge that the project made a substantial contribution to learning about what works in the promotion of low-carbon farming technologies. However, it fell somewhat short in terms of expectations about institutional strengthening to achieve sustained low-carbon farming technologies.

Two separately authored papers in peer-reviewed scientific journals analyzed the data from the project-sponsored impact evaluation, finding that in terms of environmental impact and total factor productivity, training coupled with on-farm technical assistance produced more positive results than training alone, which in turn was more effective than no intervention. These results were limited to one of the four technologies promoted by the project (pasture renewal) because 82 percent of the participating farmers chose that option. The impact evaluation provides compelling evidence of the positive return to technical assistance on pasture renewal, but with some caveats.

Postproject, the National Rural Learning Service (Serviço Nacional de Aprendizagem Rural; SENAR), the private agency responsible for providing training and technical assistance, continues to play an important role but faces difficulties in recruiting trainers with the right skill set, lags in the uptake of pasture renewal, and shortfalls in its monitoring system (World Bank 2022).

Design and Preparation

Several of those interviewed for this Independent Evaluation Group evaluation questioned why the original project design targeted midsize farms. The assumption that small-scale producers were already adequately served by technical assistance and credit services specifically tailored to their needs is questionable. A further concern with the targeting is the selection of states. Originally, 9 of 11 Cerrado states were earmarked for inclusion in this project. The intention was to train farmers in all 9 states, but only 4 of them would be offered on-farm technical assistance after the training. In view of the project's status as a small pilot operation, it would have made more sense to limit it to 4 states. In addition, the project might have made better use of its limited resources if it had focused exclusively on pasture recovery, which was the revealed preference of Cerrado producers—a preference that could have been picked up through surveys conducted during project preparation.

Project preparation did not pay enough attention to spelling out the contribution expected from the three implementing partners: the Ministry of Agriculture, Livestock and Food Supply; SENAR; and the research agency, the Brazilian Agricultural Research Corporation (Empresa Brasileira de Pesquisa Agropecuária; Embrapa). In particular, collaboration between SENAR and Embrapa was limited. This was a missed opportunity for SENAR—an experienced trainer but a neophyte technical assistance provider—to harness the substantial knowledge base and proven capacity of Embrapa.

Finally, the design of the impact evaluation merits close examination. While from the perspective of methodological rigor it made sense to randomly assign participants to the three groups—control, training only, and training plus technical assistance—this arrangement led to significant delays and tensions in implementation. Farmers assigned to the control group were understandably frustrated at being denied both training and technical assistance, and many motivated producers who would have adopted the technologies were lost to the project.

Implementation and Supervision

Implementation got off to a slow start because of delays in recruiting farmers to the project. The initial reliance on radio spots and large public meetings to introduce producers to the project proved ineffective, and the state-level offices responsible for promoting the ABC Plan failed to participate. Supervision could have provided more help to SENAR in terms of training and follow-up on procurement and financial management.

Implementation of the impact evaluation posed another set of challenges. Because of delays in recruiting, training, and delivering technical assistance, the time frame for

conducting the baseline and follow-up surveys was compressed, limiting the scope for the new technologies to bear fruit and become an adequately tried and tested part of farming practice.

Independent Evaluation Group project ratings, including shortcomings in supervision, are described in appendix A. The evaluation methodology and evidence sources are described in appendix C.

Lessons

This assessment offers the following five lessons:

- Agencies signed up to deliver training and technical assistance to an extensive area, such as an agricultural region, need to have a strong decentralized presence and well-established outreach to producers to deliver good results.
- Once they have been persuaded of the profitability of adopting improved farming practices, farmers with adequate means are likely to be willing to pay for technical assistance.
- Impact evaluations that rely on randomized control trials can produce compelling findings about the constraints to adopting new farming technologies; however, it is challenging to accommodate the needs of control-group farmers who are among beneficiary farmers but denied project benefits. The design of these impact evaluations may actually reduce a project's total impact.
- The gains from a one-off evaluation of impact are likely less substantial than the rewards from building a systematic and well-integrated system of monitoring that remains in place for the long term.
- This assessment confirms an age-old lesson: technology transfer depends on effective collaboration between research and extension agencies.

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1. Background, Context, and Design

Background and Context

1.1 The Sustainable Production in Areas Previously Converted to Agricultural Use project was designed as an adjunct to a government-led credit initiative known as the Low-Carbon Emissions Agriculture (Agricultura de Baixa Emissão de Carbono; ABC) Plan. The ABC Plan aims to reduce carbon emissions by providing low-interest loans to crop farmers and ranchers who want to implement sustainable agricultural practices, specifically crop-livestock-forest integration, no-till cropping, planted forest, and pasture recovery. The original ABC Plan ran from 2010 to 2020, providing total investments of about $6.7 billion, which made it one of the largest climate-smart agriculture programs. It was succeeded by ABC+, which will continue until 2030.

1.2 The aim of the operation was to shed light on the best way to provide private landholders on midsize farms with the knowledge and skills needed to convert traditional agricultural practices to the use of low-carbon technologies. It provided a mix of classroom-based training and on-farm technical assistance to eligible crop and livestock farmers who responded to an information campaign inviting them to participate in the project. Unlike the broader ABC program to which it was linked, the project did not offer a credit line to participants.

1.3 The project focused on the Cerrado biome, a savanna-forest mosaic located in central Brazil that covers one-quarter of Brazil's land area and, at the time of appraisal, houses 43 million people. The Cerrado biome is vulnerable to the deforestation that has accompanied the expansion of cattle ranching and the subsequent mechanized production of soybeans, a process fueled by the 2000–10 global commodity boom.

1.4 Agricultural census data paint a clear picture of the gaps in technology transfer in the nine states originally targeted by the project. In 2006, only 11 percent of farms in these states received technical assistance, a figure that rose to a modest 15 percent in 2017 (appendix D, table D.3). The share of farms practicing no-till cropping was a mere 4 percent in 2006, inching up to 5 percent in 2017 (table D.4). The data on pasture rotation (a practice that promotes livestock intensification) are not much more encouraging: 19 percent of farms practiced this in 2006 (there are no comparable data in the 2017 agricultural census; table D.5).

Objective, Design, and Financing

1.5 The project development objective—which remained the same throughout implementation—was "to promote the adoption of selected sustainable low-carbon

emissions agricultural technologies by midsized producers in the Cerrado Region" (World Bank 2014b, 4). The target population was about 12,000 producers with medium-size farms. Progress toward the project objective would be measured using the following indicators: (i) the increase in the agricultural area using the technologies recommended by the ABC Plan in relation to the total productive area of the participating producers; (ii) the increase in the number of participating producers adopting at least one selected technology compared with the control group; (iii) the number of direct beneficiaries (including the percentage that were female); and (iv) sets of lessons learned from the project incorporated annually by the counterpart agencies and disseminated to the rural extension institutions of Brazil.

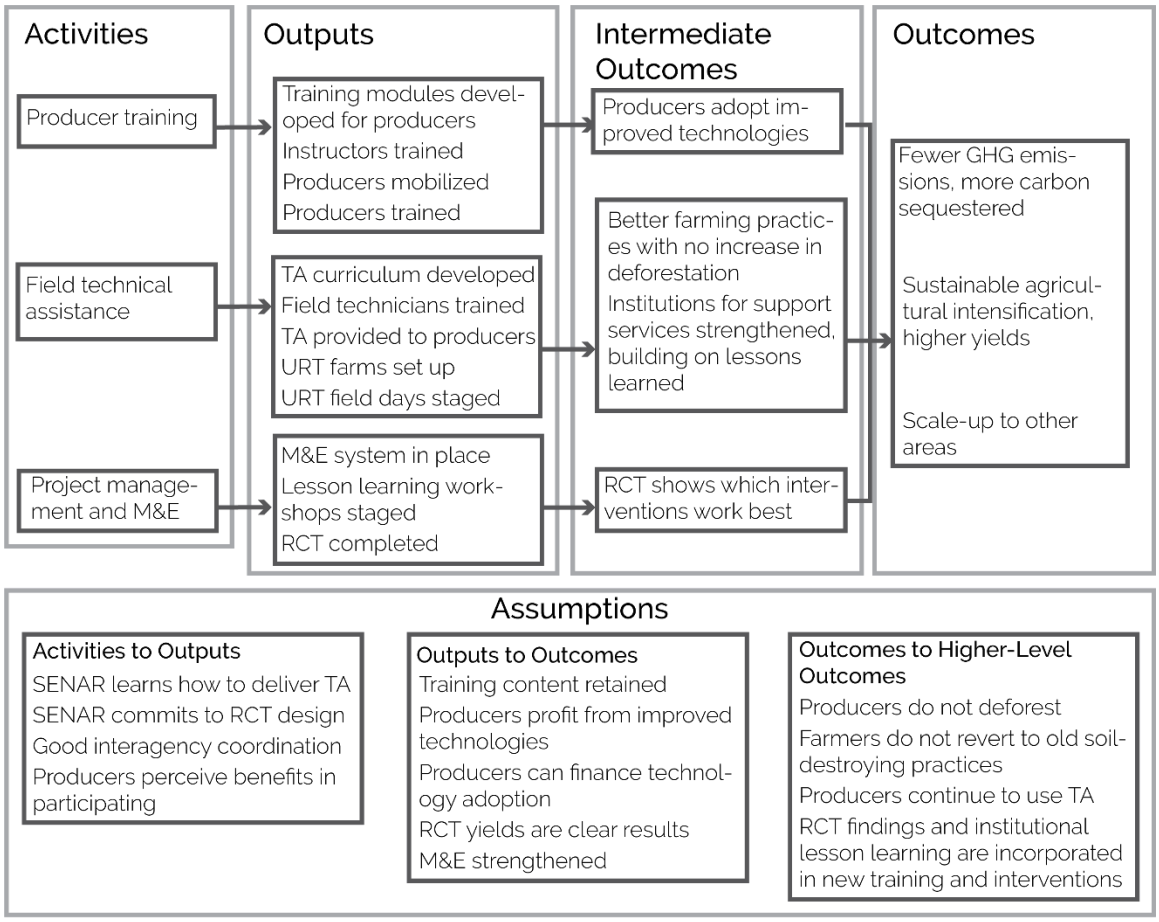
1.6 The lead implementing agency was the National Rural Learning Service (Serviço Nacional de Aprendizagem Rural; SENAR), acting on behalf of the Ministry of Agriculture, Livestock, and Food Supply (Ministério da Agricultura, Pecuária e Abastecimento; MAPA). SENAR is a private institution housed in the Brazilian Confederation of Agriculture and Livestock. When the project was approved, SENAR had 20 years of experience in planning, carrying out, and supervising the training programs and education of rural professionals in Brazil, including large and small producers, extension technicians, and technical assistance staff. MAPA and SENAR signed a project-specific cooperation agreement. A third project partner was the Brazilian Agricultural Research Corporation (Empresa Brasileira de Pesquisa Agropecuária; Embrapa), which was tasked with supporting SENAR at the technical level, training instructors and technicians in ABC Plan technologies, and monitoring the quality of technology adoption. A project monitoring committee (composed of MAPA, Embrapa, and SENAR) was expected to oversee project implementation. This committee was expected to (i) determine the overall implementation strategy, (ii) review and approve the project operational manual, (iii) review and agree on annual project implementation plans and budgets, and (iv) review monitoring and evaluation reporting.

1.7 The design and implementation of the project entailed a set of assumptions that were critical to realizing the expected objective.[1] These assumptions form a critical underpinning to the theory of change (figure 1.1), and their validity is examined in chapter 2 of this report.

1.8 Based on a careful consideration of the evidence available three years after project closing and informed by a hybrid (virtual and field-based) mission, this Independent Evaluation Group (IEG) project performance assessment finds no reason to revise the ratings proposed by the Implementation Completion and Results Report (ICR)—ratings that IEG supported in its ICR Review. The project development outcome was rated satisfactory, the World Bank's quality at entry and quality of supervision

performance were both rated moderately satisfactory, and the quality of monitoring and evaluation was rated substantial. The basis for these ratings is presented in appendix A.

Figure 1.1. Simplified Theory of Change



Source: Adapted from World Bank 2020, 4
Note: URTs are on-farm technology-demonstration sites. GHG = greenhouse gases; M&E = monitoring and evaluation; RCT = randomized control trial; SENAR = National Rural Learning Service (Serviço Nacional de Aprendizagem Rural); TA = technical assistance; TMA = on-farm technical assistance; URT = Technological Reference Unit.

2. What Worked, What Didn't Work, and Why

Results

2.1 Three years after completion, the project has made a substantial contribution to learning about what works in the promotion of low-carbon farming technologies. This report's assessment of project results is informed by interviews and documentary evidence related to the project under review and by the longer perspective offered by the 2022 Mid-Term Review of a subsequent project that built on the earlier operation's foundations and also used SENAR as the main implementing agency (World Bank 2022). In addition, two separately authored papers in peer-reviewed journals published in 2021

and 2022—neither completed before the ICR was issued—attest to the project's significant learning value-added (Bragança et al. 2022; da Silva e Souza et al. 2021). These papers analyze the data from the project-sponsored impact evaluation from different angles—change in environment-related variables and total factor productivity. In each case, they compare the results for three groups: the control group (G1), which comprised 663 producers; the training-only group (G2, 395 producers); and the training plus technical assistance–group (G3, 311 producers).

2.2 Da Silva e Souza et al. (2021) found that the combination of training and technical assistance had a bigger positive impact on environmental variables than training alone (G3 > G2) and that G3 and G2 each performed better than the control group, G1. The immediate impact of the treatment was to increase the area of pasture in good condition by 33 percent for G2 and by 51 percent for G3. This in turn boosted soil carbon stocks and reduced enteric emissions. In the case of both improvements, G3 substantially outperformed G2, and G2 performed better than G1 (appendix D, table D.1).

2.3 Bragança et al. (2022) examined the short-term effects of training and technical assistance) on the following measures of sustainable intensification: share of property composed of restored pastures, use of rotational grazing, adoption of good management practices, use of good soil-conservation practices, use of machinery to prepare pastures, use of pesticides for weed control, and total farm expenditures. The authors found that training alone did not improve any of the measured outcomes, but technical assistance provided to previously trained producers caused statistically significant increases in all the measured outcomes. They also found that as a result of the technical assistance provided to previously trained producers, total factor productivity grew by 7 to 8 percent per year. They suggest that "this increase in productivity might reduce land use if the program is implemented at scale, sparing land and decreasing emissions." They also argue that there is an adequate incentive for producers to use technical assistance. Training alone did not increase farm revenues, but providing technical assistance to previously trained producers increased revenues by 39 percent.

2.4 But the data on environmental impact raise several questions. Before examining the data, it is important to recall that the project development objective was limited to promoting the *adoption* of low-carbon technologies; it did not extend to achieving a better environmental outcome in terms of reduced deforestation or lower carbon emissions. The results of the impact evaluation show that, indeed, the adoption of pasture renewal increased, with a concomitant rise in total factor productivity, leading farmers who adopted this technology to achieve higher profits from cattle rearing (Bragança et al. 2022). The interviews that IEG conducted with a small, purposively selected group of producers in two states also showed that the combination of training and technology led farmers to rehabilitate their pastures: these producers continued

with pasture renewal at their own expense after free project assistance ended and were unanimous in praising the quality of the service provided by SENAR during and after the project (box 2.1).

Box 2.1. Interviews with Producers

The Independent Evaluation Group conducted detailed interviews with 6 producers in Goiás and 7 in Tocantins, using the same questionnaire for all interviews. The interviewees were purposively selected (see appendix C for selection criteria and questionnaire). All 13 interviewees had received training and technical assistance in the pasture-renewal technology option. The most striking finding was that they all continued implementing this technology *after* the completion of project-related technical assistance, paying for additional assistance (mainly from SENAR) to the extent that they were able. (Most preferred to self-finance rather than borrow, not wishing to bear interest charges or run the risk of being unable to repay the loan.) There was uniform praise for the excellence of the training and technical assistance offered by SENAR. Eight of the 13 interviewees said that neighboring farmers had visited to inspect the results of pasture renewal and were now practicing the same techniques—a combination of applying manure and lime to pastures and introducing improved grasses. Nine of the 13 had a larger cattle herd in 2022 than they had in 2012. However, several interviewees noted that some producers in the region were finding it more profitable to substitute soybean cultivation for cattle rearing.

Source: Independent Evaluation Group.
Note: SENAR = National Rural Learning Service.

2.5 The data from the impact evaluation do not allow for a precise quantification of the project's environmental impact. Da Silva e Souza et al. (2021) augment the impact evaluation data with data on carbon emissions supplied by Embrapa (appendix D, table D.1). Carbon emissions from agriculture in Brazil derive principally from forest clearing and enteric emissions from cattle. Any project that increases the number of head of cattle (by expanding the area in pasture or increasing stocking rates, or both) will increase enteric emissions. But the carbon emissions data reported by da Silva e Souza et al. (2021) and the raw data from the impact evaluation that IEG reviewed raised more questions than answers:

a. If the area of pastures in good condition has increased so impressively (appendix D, table D.1), how could the enteric emissions of cattle have decreased by 21 percent, assuming that more good pasture means more heads of cattle?

b. How do these results relate to those reported in table D.2 in appendix D (based on impact evaluation raw data), where both number of cattle decreased somewhat and stocking rate decreased even more within G3 (the group that received training and technical assistance)? In contrast, IEG's interviews with 13 producers who had received training and technical assistance found that 9 had *increased* their stocking rate (box 2.1).

c. How can the substantial increase in the legal reserve (protected forest) be explained, and why is the percentage increase higher for the control group than for G3 (table D.2)?

d. Why has the area in native vegetation unexploited for farming diminished so much, even in G3 (see table D.2)?

e. On deforestation, some coarse triangulation is possible using annually collected remote sensing data: between 2016 and 2021, there was a fall in the rate of deforestation in the nine states originally covered by the project (appendix D, tables D.6 and D.7; figure D.3). In terms of the four states that received on-farm technical assistance, deforestation fell substantially in Goiás, Minas Gerais, and Tocantins but rose substantially in Mato Grosso do Sul (table D.7).

2.6 In summary, the overall impact of the project on the environment is unclear, because the interactions among deforestation, pasture renewal, intensification of stock rearing, and enteric emissions are not clear from the data adduced by the project. More research is needed on this important topic. We hope that the Integrated Landscape Management in the Cerrado Biome Project—which also targets pasture renewal and has a larger scale than the small project that is the focus of the present assessment—will produce more reliable results on its environmental impact.

2.7 Another angle worth considering—but hard to measure—is the project's demonstration effect. One feature of the project worth replicating is the use of "farm field days" (not a new idea, but effective nevertheless), which extends outreach beyond the project's direct beneficiaries. Ten percent of the farms included in the project were selected as field demonstration units, which individuals interested in learning about ABC technologies could sign up to visit. During project implementation, 32 field days were staged, attracting 8,644 participants (144 percent of the original target; World Bank 2020). According to IEG interviews and a survey of beneficiary and instructor perceptions conducted at project completion, the showcases and demonstrations conducted during these field days greatly enhanced dissemination of ABC technologies. Moreover, the inclusion of beneficiaries who had received training but not technical assistance helped offset the demotivating effect for trainees not randomly assigned to receive on-farm support. Eighty-six percent of those who had previously attended training stated that the field days helped them put to practical use what the training had taught them. A scan of SENAR's website reveals that in September 2022, the use of Technological Reference Units (on-farm technology demonstration sites) remained an integral part of their training program (SENAR 2021).

2.8 SENAR was strengthened by the project and has continued to receive capacity-building support in the follow-on project.[2] But it still faces significant constraints. First, there is still an acute shortage of experts with the profile needed to offer the on-farm technical assistance (TMA) that SENAR piloted under the project assessed in this report. The 2022 Mid-Term Review for the follow-on project noted that "SENAR had difficulties finding candidates with the right profile for contracting as TMA field agents. This has slowed hiring by SENAR and consequently the implementation of TMA in the field. There are few, if any, technicians with a theoretical background and practical experience simultaneously in animal husbandry, nature conservation, and ABC practices. In fact, conservation practices are not widely taught as a subject of academic training. Most candidates were trained in animal husbandry" (World Bank 2022, 25).

2.9 Second, under the follow-on project, SENAR has experienced a lower-than-expected adoption of ABC technologies, and at midterm, the area brought under these technologies was well below target. Based on entries into SENAR´s monitoring system recorded by TMA field staff, there were only 1,200 adopters, even though agents had made at least one visit to more than 3,600 holdings. As stated in the Mid-Term Review, "it is not clear whether the low adoption rates reflect the difficulties and delays caused by COVID-19 restrictions or a lower-than-expected willingness of farmers to adopt" (World Bank 2022, 20).

2.10 Third, SENAR headquarters has not set up a dedicated monitoring and evaluation unit, which hampers its ability to program and adjust its training and technical assistance activities as needed. SENAR's 2020 annual report refers to a problem that was also picked up in the project ICR—a problem that does not appear to have been resolved since project implementation concluded. There are gaps in the information flow between the agency's central administration and its regional offices; the regions are often slow to report, and the collection of data on indicators in particular is not timely and lacks quality control (SENAR 2021). SENAR recently adopted a new tool, Sustainability Indicators in Agroecosystems (Indicadores de Sustentabilidade em Agroecossistemas), that enables its field agents to systematically assess the sustainability of farming practices. But the data from this tool are not integrated with the earlier monitoring system software, called SISATeG, set up by SENAR (World Bank 2022, 24). Also, SISATeG is not integrated with SICAR (Rural Environment Cadastre System [Sistema Nacional de Cadastro Ambiental Rural]), which records all forest land scheduled for conservation—an essential link for the technicians promoting low-carbon technologies to make. A separate 2020 report by the think tank Agroicone—which reviews implementation of the ABC Plan between 2010 and 2020—reveals that the monitoring shortfall is not specific to SENAR but extends to ABC program implementation more generally (Lima, Harfuch, and Palauro 2020). The next section

examines another institutional shortcoming: the lost opportunity for SENAR to work more closely with Embrapa.

Design and Preparation

2.11 In the original project proposal—which was prepared jointly by Embrapa, MAPA, and SENAR and submitted to the World Bank in 2013—the project development objective more strongly (and, in this assessment's view, appropriately) prioritized learning over adoption. One of those who helped prepare the proposal recalls that, as initially framed, the project development objective aimed to test and evaluate the effect of training and technical assistance actions on the adoption of new ABC technologies in the agriculture of the Brazilian Cerrado. But the final wording of the project development objective (as presented in the appraisal document) gave adoption prominence over testing and learning. For a small pilot project, this change of focus is hard to justify.

2.12 Several interviewees for this evaluation questioned why the project development objective targeted midsize farms. The initial project proposal emphasized that the objective of the project was of an environmental nature, not a social one, and that the intention was to reach large production areas, not large numbers of establishments. The World Bank endorsed this approach. The appraisal document gives three reasons for the midsize focus: "(i) medium-sized production units form the bulk of total agricultural land use in the Cerrado; (ii) small farmers can access other programs promoting sustainable agriculture and livestock, tailored to their realities, and with greater financial advantages; and (iii) large farmers can access the technological know-how without government assistance" (World Bank 2014b, 4–5). To begin with, the definition of *midsize* was broad enough (4 to 70 fiscal modules) to include farms that, by any measure, would qualify as large.[3] (Note, however, that this definition was not limited to property size but also considered farming income levels and use of hired labor.)

2.13 Indeed, there is some merit to focusing on midsize farms. As the initial proposal made clear, the ultimate objective of the Forest Investment Program (under which the project was launched) is environmental, not social: reducing greenhouse gas emissions. Larger target areas are thus better than large numbers of farmers. Targeting midsize farms allows the program to cover more area per dollar spent on technical assistance. Small farmers are likely to have difficulties in making investments for the adoption of ABC technologies, even if they are only selling some cattle for this purpose.

2.14 But this logic would be more persuasive if applied to a scaled-up operation with a much larger budget; it is less tenable when applied to a small pilot whose purpose was to experiment and whose impact, even if limited to midsize properties—highly scattered ones, at that—could not possibly be that substantial. Moreover, the assumption that small-scale producers were already adequately served by technical assistance and credit services specifically tailored to their needs is questionable. In particular, the publicly funded extension service catering for family farms (Emater) has languished for several

years. In any event, the lower size threshold for eligibility (four fiscal modules) was dropped at midterm, allowing for the inclusion of smaller farms.[4]

2.15 There is a mixed reading of farm size trends. During project preparation, the farm size criterion was based on data from the 2006 agricultural census. Many of those interviewed for this assessment suggested that, as a result of farm subdivision, the mean property size in project states shrank significantly between 2006 and the time of project implementation. This might appear to support the decision at midterm to lower the eligibility threshold, but the 2017 agricultural census does not bear this out: aggregating across the eight states, the mean farm size actually rose slightly (from 74 to 77 hectares), and only in the Distrito Federal and Goiás was there significant shrinkage (by 23 percent and 10 percent, respectively; appendix D, table D.8). (Admittedly, the trend in *median* farm size would be a better indicator, but these data were not available to IEG.)

2.16 A 2021 report focusing on the ABC Plan from the think tank Agroicone confirms the long-term marginalization of family farmers from the low-carbon agricultural initiatives. The design of the project evaluated in this IEG performance assessment was partly based on the assumption that the needs of small-scale farmers were already addressed through the National Program for Strengthening Family Farms, established in 1995. But the Agroicone report makes it clear that at no point was there any attempt to include the farmers targeted by the National Program for Strengthening Family Farms in the implementation of the ABC Plan after it was launched in 2010, nor has this changed since the launch of ABC+, which covers 2020–30.[5]

2.17 The ICR acknowledges that the profiling of producers during the preparation phase was inadequate in terms of the estimation of typical enterprise scale and farmer demand for credit (as well as in producers' limited interest in the full suite of ABC technologies).

> The group of "mid-sized producers" in the Cerrado turned out to comprise many more producers with smaller landholdings than had been estimated at Appraisal based on averages and official definitions, which required changing outcome targets at Restructuring. Beneficiaries also turned out to be predominantly cattle ranchers, which resulted in underachievement of the indicator for credit applications because these producers are generally unwilling to rely on the financial sector. It is recommended that, at preparation, rigorous efforts be made to outline a sound profile of relevant characteristics of the beneficiaries to be served, thinking proactively of their potential interplay with project activities and desired results. (World Bank 2020, 28)

2.18 A further targeting concern is raised by the selection of states. Originally, nine Cerrado states were earmarked for inclusion in the project. The intention was to train

farmers in all nine states, but only four of the nine would be offered on-farm technical assistance after the training.[6] This was inevitably a hard sell—all the states might reasonably be expected to want technical assistance. The ICR notes that "Mato Grosso opted out of the project in December 2014, when it became clearer that technical assistance was going to be initially provided only in four pilot states" (World Bank 2020, 5). It is unclear why a $10 million project would attempt to embrace such a vast territory. It would have made more sense to limit both the training and the technical assistance to the four states originally selected to receive technical assistance: the variation in agroclimates and settlement history within those four would have been sufficient to generate the learning expected of a pilot operation.

2.19 IEG also questions the range of technologies that the project sought to promote. The broader ABC Plan, under which the project was subsumed, included six technologies: (i) recovery of degraded pasture land; (ii) crop-livestock-forest integration; (iii) a no-tillage farming system; (iv) cultivated commercial forests; (v) biological nitrogen fixation; and (vi) treatment of animal waste (World Bank 2014b). The project itself addressed the first four technologies, on the grounds that "a MAPA demand study has identified that producers are most interested in adopting these four technologies" (World Bank 2014b, 22). As it turned out, the majority of producers who signed up to participate in the project were interested in the first technology: "The overwhelming majority (82.5 percent) of participants chose to be trained in recovery of degraded pasture land, followed by the ILPF [crop-livestock-forest integration] module (10 percent), whereas no-tillage farming and cultivated commercial forests together accounted for less than 8 percent of course preferences" (World Bank 2020, 10).

2.20 There is no discussion in the ICR of the reasons for producers' singular focus on pasture rehabilitation or any consideration that project design and preparation might have better anticipated this outcome. In retrospect, the producer preference seems obvious given that, in the nine states originally included in the project, pasture occupies three times as much area as crops do.[7] Additionally, the producers' preference, as revealed in this project, was in line with the uptake of credit under the wider ABC Plan: in this program, the few producers who borrow overwhelmingly do so to finance the recovery of degraded pasture. The same trend is evident in the World Bank's follow-on Integrated Landscape Management in the Cerrado Biome Project, where the pasture focus is even sharper than in the smaller project under evaluation here (World Bank 2018).[8] According to one agronomist interviewed by IEG, "pasture degradation is the biggest problem for farmers in today's Brazil." This observation is supported by recently published research.[9] IEG concludes that the overwhelming propensity of farmers to favor pasture renewal—unanticipated as it appears to have been at project appraisal—simply mirrored the greatest challenge facing the Cerrado.

2.21 All those interviewed by IEG said that there was no bias in the initial presentation of the four technologies to the producers: trainers gave an even-handed introduction to each, and it was only after that presentation that trainees chose the technology they wanted to be trained in. But producers had probably made up their minds in advance. The project might have made better use of its limited resources if it had focused exclusively on pasture recovery. However, it could be argued that even though pasture recovery was the first priority from the producers' perspective, they might pursue the other technologies at a later stage; the introduction to a broad menu of technologies may not have been wasted. Also, Embrapa—which developed the four technologies that the project promoted—may have resisted any attempt to narrow the focus to the single option of pasture renewal, an option that was conspicuously low-tech (for the most part, during implementation, it entailed little more than the introduction of rotational grazing) and whose adopters were typically conservative and innovation-averse.

2.22 Another design question concerns the choice of implementing partners and the roles they were assigned. Of the three partners—Ministry of Agriculture, Livestock and Food Supply; Embrapa; and SENAR—SENAR was given the biggest role in terms of day-to-day engagement in the field. None of the interviewees expressed any doubt that, of the available agencies, SENAR was the best equipped to handle both training and on-farm technical assistance. The obvious alternative—the public extension service, Emater—was generally perceived as hampered by substantial state-to-state variations in capacity and unable to match SENAR's outreach to farmers. There is, however, an important caveat. Although SENAR had decades of experience in training farmers, this was the first time it was asked to deliver on-farm technical assistance. This was an important motivator for the SENAR team, but it also led to tension with Embrapa.

2.23 Embrapa has built up a formidable reputation for excellence in agricultural research—and a global reputation as well. But in both the ICR and the comments of those interviewed by IEG, there is a strong suggestion that Embrapa gave less than expected to the project. The ICR observes that "the level of involvement and buy-in from Embrapa remained below potential throughout implementation" (World Bank 2020, 14).[10] It took longer than expected to review and approve the training materials that SENAR would use, and Embrapa delayed the production of the data on carbon stocks and emissions needed to inform the impact evaluation. The World Bank was concerned that the staff member assigned by Embrapa to high-level meetings among the three partners did not have the seniority to influence decisions.

2.24 But the story has another side. During project preparation, the World Bank did not anticipate the need to secure a place in Embrapa's macro-programming system. Without a defined slot in the agency's overall program, there was always a risk that the

project would be sidelined in terms of priority-setting and resource allocation. There is some indication that project funds were not earmarked to cover the travel expenses of Embrapa staff assigned to field-level work on the project. Field-level collaboration between SENAR and Embrapa was therefore limited. The decentralized capacity of Embrapa was not fully exploited. The experience and skills of the Embrapa experts assigned to offices in each state were not called on, and Embrapa's long-established network of farm-based experimental sites (the very same field demonstration units that the project would set up) was not consulted very much. The time wasted in preparing training materials could have been avoided if Embrapa had been commissioned to prepare these materials directly, rather than being assigned to merely review and approve the work of consultants hired by the project. Under the follow-on project, evidence shows a closer partnership between SENAR and Embrapa, with Embrapa directly producing training materials and providing training to SENAR's field technicians.[11]

2.25 Another flaw in project design arose from the one-off nature of the engagement expected by Embrapa: once it had signed off on the training materials, its job was done. There was no allowance for iterative design of the materials and no scope for tweaking based on feedback from the producers who had attended the training. On the one hand, this was a small project with limited resources to accommodate multiple iterations. On the other hand, the project's long-run impact might have been greater if it had drawn more fully on Embrapa's capacity. There was a case for assigning to Embrapa the lead oversight role that the Ministry of Agriculture, Livestock and Food Supply assumed. The ICR suggests that the incentive for Embrapa staff is to publish research rather than engage at the field level. Although it is true that Embrapa is first and foremost a research agency, a 2022 report by the Commission for Sustainable Agricultural Intensification, an international initiative, provides case study evidence of Embrapa's outreach to farmers—including the Balde Cheio initiative for dairy farmers that was launched by Embrapa in the late 1990s.[12]

2.26 Finally, the design of the impact evaluation merits close examination. Although from the perspective of methodological rigor it made sense to randomly assign participants to the three groups—control, training only, and training plus technical assistance—this arrangement led to significant delays and tensions in implementation.[13] It could be expected that, having shown the initiative to sign up for the project, participants were uniformly keen to learn about ABC technologies. The requirement that roughly half of those enrolled be allocated to the control group (meaning that they would receive neither training nor technical assistance) was highly demotivating for the producers who were left out;[14] many of these expressed their frustration by dropping out of the project. It could be argued that the project lost the input of some of the most

motivated producers in the catchment area (geographical areas covered by the project), thus reducing the scope for application of ABC technologies by direct beneficiaries and, equally important, the scope for positive spillovers to friends and neighbors who were not participating in the project. This trade-off between the rigor of the impact evaluation's design and the scope for the project itself to have an impact holds important lessons for other agricultural extension projects. The management of participants' expectations placed a strain on SENAR's staff, many of whom took a long time to commit to the experimental design, further delaying the launch of the training and technical assistance.[15]

2.27 The ethical objections raised by denying "treatment" to control group participants might have been addressed by taking a phased approach, whereby control group participants in phase 1 were guaranteed access to training and technical assistance in phase 2. But a small project of this nature arguably did not have the resources to accommodate a second phase. Moreover, the necessary delay between potential phases 1 and 2, and inevitable producer skepticism about the honoring of the guarantee, would probably still have led many control group participants to drop out. One interviewee suggested that an alternative was for SENAR to offer a different assistance package to control group participants—one unrelated to ABC technologies. Indeed, as partial recompense, SENAR did offer health care advice (related to human health care, not animal health care) to these producers. It is unlikely that this was an adequate substitute for the project treatment.

2.28 Another concern is that participants in the three experimental groups were widely dispersed over the four states where the experiment was conducted. This meant that at any one location there was not a critical mass of producers adopting ABC technologies, limiting the scope for lesson sharing and iterative improvements to technology design and promotion. Once again, there was a conflict between the rigor of impact evaluation and the scope for project impact. The follow-on project (the Integrated Landscape Management in the Cerrado Biome Project)[16] addressed this problem directly by covering all the producers in selected watersheds.

Implementation and Supervision

2.29 Implementation got off to a slow start because of delays in recruiting farmers to the project. The initial reliance on radio spots and large public meetings proved ineffective. At appraisal, the World Bank expected that the nine State Management Groups (Grupo Gestor Estadual; GGEs) for the ABC Program would play a critical role in mobilizing producers.[17] The role assigned to the GGEs by the project was "to carry out a survey on the priority demands in the State with regard to ABC Plan technologies, identify the main regions or municipalities to be included in the project's program, and

propose selection criteria for producers participating in the project. The GGEs of Goiás, Minas Gerais, and Tocantins will also participate in the selection of supervisors and field technicians in component 2 of the project" (World Bank 2014b, 28–29). But the GGEs were marginal players in project implementation. The ICR refers to the "weak or nonexistent performance by State Management Groups" without venturing any explanation (World Bank 2020, 65). Another reference to the "heterogeneous participation of unions" (65) does not provide any clues either as to why these producer associations (who usually wield a lot of influence on farmers) played a marginal role in mobilizing producers. The producer associations work closely with SENAR, and it is likely that they shared SENAR's own doubts about the rationale for randomly assigning producers to treatment and control groups. Ultimately, it was the field-level technicians who assumed responsibility for visiting farms to publicize and increase support for the project.

2.30 Implementation of the impact evaluation posed a fresh set of challenges. Owing to delays in recruiting, training, and delivering technical assistance, the time frame for conducting the baseline and follow-up surveys was very compressed, limiting the scope for the new technologies to make an impact and to become a tried and tested part of farming practice. The gap between the first and second interviews with producers (application of the questionnaire) was a mere 14 to 20 months.[18] Although the interviews, which lasted between two and four hours, were conducted on the farms and collected copious data, and although the interviewers reportedly walked around the property, it is possible that the data recorded leaned toward *expected* rather than proven and sustained returns on the treatment. The need for verification was reiterated in the Mid-Term Review of the follow-on project: "Adoption of practices, both for conservation and for ABC technology, should be verified by some form of ground checking (drones, satellite imagery, field inspection)" (World Bank 2022, 36).[19] The same problem potentially arose with respect to Embrapa's contribution. An important aspect of the overall estimation of impact centered on the reduction in carbon emissions, an area in which Embrapa has substantial experience. The ICR notes, however, that "measurement was carried out *based in part* on projections, since the short time frame of the pilot prevented obtaining direct measurements of results in the medium run" (World Bank 2020, 18; emphasis added). Just how large a proportion "in part" amounts to is unclear.

3. Lessons

3.1 The first lesson is that agencies signed up to deliver training and technical assistance are likely to deliver good results if they have a strong decentralized presence and well-established outreach to producers. In the absence of a strong public extension service of comparable capacity from one state to the next, the private agency, SENAR,

was a sound choice, because it had a network of regional offices and close ties to producer associations. Building on its long experience with training farmers, SENAR proved capable of learning to be an effective provider of on-farm technical assistance. One indication of its effectiveness is that farmers remembered most of what they had learned when tested six months after attending training.

3.2 Second, once they have been persuaded of the profitability of adopting improved farming practices, farmers with adequate means will be willing to pay for technical assistance. Given that the project provided technical assistance free of charge, it was possible that farmers would not continue to use technical assistance at their own expense once the project ended. This was not the case. The pasture renewal techniques adopted by farmers offered a satisfactory financial rate of return. The project uncovered a substantial latent demand for knowledge about the technology most relevant to the farmers in this region (pasture renewal), and farmers proved willing and able to pay for technical assistance after the project ended. The project demonstrated that knowledge, not access to credit, was the constraint to adoption. However, there are two caveats: Given that most of the participating farmers were primarily engaged in raising cattle, they had the means to self-finance by selling some of their herd; they didn't need—and were generally reluctant to use—credit. Financing could be a bigger constraint for crop producers of a comparable enterprise size. Moreover, the project did not address the needs of small-scale farmers—an oversight in project design that was only partially corrected during implementation. These farmers are more likely face financing constraints, which will reduce their use of technical assistance provided for a fee.

3.3 Third, impact evaluations that rely on randomized control trials can produce compelling findings about the constraints to adopting new farming technologies; however, it is challenging to accommodate the needs of control-group farmers who are denied project benefits, and the design of these impact evaluations may actually reduce project impact. The two peer-reviewed articles published in scientific journals after project completion are a testament to the substantive findings from the impact evaluation. However, SENAR, the agency responsible for training and providing on-farm technical assistance, and MAPA initially doubted that the impact evaluation would add value. Staff in SENAR's regional offices did not readily commit to the evaluation and had difficulty managing the disappointed expectations of farmers assigned to the control group. These farmers had taken the initiative to sign up for the project and, by virtue of that, probably had the motivation to adopt the technology being promoted. Many of those who were assigned to the control group dropped out, qualifying the project's impact to some extent. This loss might have been mitigated if these farmers had been offered some guarantee of future training and technical assistance.

3.4 Further consideration is needed as a consequence of the design of the randomized control trial. The designers of the project had an incentive to generate findings that would be statistically representative of a wide geographic area. This resulted in a scattershot approach: the farms selected for inclusion in the project were highly dispersed, resulting in no critical mass of technology adoption in any one area, reducing the scope for positive reinforcement through spillover effects between contiguous farms, and possibly lowering the likelihood of sustainability. The follow-on project addressed this limitation by taking a landscape approach that aimed to address all the farmers in selected watersheds. But the limited uptake of the various technologies originally proposed—and the resulting lack of data on what worked—are significant limitations to these interventions.

3.5 Fourth, the gains from a one-off evaluation of impact are likely less substantial than the rewards from building a systematic and well-integrated system of monitoring that remains in place for the long term. Monitoring is essential to verify that the technologies adopted are consolidated over time. Given the limited amount of time between the first and second interview rounds, it is not clear if the positive results demonstrated by the impact evaluation depended largely on projections made during the second round (farmers' reported intentions) rather than observations of new practices that were already fully embedded. In the absence of follow-up data from monitoring, it is not clear if farmers will continue to deforest or will revert to old practices.

3.6 IEG has a couple of further concerns about the integrity of the monitoring system. To begin with, the system can only be as good as the field technicians who are relied on to input data. There is a shortage of technicians with a skill set and mind-set conducive to close observation of the farm-level changes that are significant to environmental impact. In the Cerrado biome, the technicians hired by SENAR are, first and foremost, experts in animal husbandry; it is less clear that they have the interest or skills needed to closely track the impact of farm-level changes on the environment for any given farm and, more importantly, for the landscape beyond the farm. With respect to the monitoring of deforestation trends, it is concerning that SENAR's system, SISATeG, is not yet integrated with Sistema Nacional de Cadastro Ambiental Rural (National System for Rural Environmental Cadastre), the State Forest Bureau–maintained system responsible for verifying that the resources identified by the forest cadastre—resources protected by law—are indeed preserved. Also, there is unrealized potential for SENAR to make fuller use of the impressive remote-sensing capabilities now available that allow tracking of landscape changes at the submunicipal level.

3.7 Fifth, this assessment confirms an age-old lesson: technology transfer depends on effective collaboration between research and extension agencies. The design of the

assessed project made insufficient attempt to ensure that the capacity of the research agency, Embrapa, was fully committed. SENAR and Embrapa did not work together closely during implementation. This was as much the consequence of a failure to budget adequately for Embrapa's participation as it was of any difference in the incentives of the staff in these agencies. Also, future projects are advised to take an iterative approach to the design of training materials and technical assistance packages. The one-off intervention that this project envisaged for Embrapa did not allow for modifications in response to feedback from trainers and farmers about what worked best. It is important to note, however, that the follow-on project incorporated this lesson in its design. The terms of the collaboration between SENAR and Embrapa—and other agencies participating in the project—were more clearly spelled out, and the working relations between the two agencies are much closer. Embrapa now directly trains SENAR's field technicians, helping to ensure that the former's knowledge and skills are more fully transmitted.

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[1] Project components were as follows: (a) producer training (estimated spending = $3.4 million; actual spending = $2.8 million), which consisted of (i) identifying rural producers' and farm technicians' demand for low-carbon emissions agricultural technologies in 9 of the 11 Cerrado states, and (ii) providing training in prioritized Low-Carbon Emissions Agriculture (ABC) technologies and farm management; (b) field technical assistance (estimated spending = $5 million; actual spending = $4.9 million), which involved the development and implementation of a technical assistance pilot project for selected rural producers; (c) project management, monitoring, and evaluation (estimated spending = $2.3 million; actual spending = $2.6 million), including (i) project implementation and coordination, as well as monitoring and evaluation of project activities and impact based on an experimental design, and (ii) activities promoting institutional learning and the exchange of experiences among participants.

[2] Component 1 includes actions aimed at "(iii) strengthening of governance and institutional capacity at MAPA [Ministry of Agriculture, Livestock and Food Supply], SFB [Brazilian Forest Service], MCTIC/INPE [Ministry of Science, Technology, Innovation and Communication/National Space Research Institute], Embrapa [Brazilian Agricultural Research Corporation; Empresa Brasileira de Pesquisa Agropecuária], and SENAR [National Rural Learning Service; Serviço Nacional de Aprendizagem Rural]" (World Bank 2022, 10).

[3] A fiscal unit ranges from 5 to 100 hectares, and the size range varies between municipalities, reflecting agroclimatic constraints on productive potential (Project Appraisal Document, 4).

[4] This change is acknowledged in the aide-mémoire of the World Bank mission conducted from May 16 to 20, 2016 (World Bank 2016).

[5] "[Although family farming is mentioned 25 times in the Ministry of Agriculture's presentation of ABC+ . . . , no targets are defined for this group of producers.]" "Embora a agricultura familiar, agricultor ou produtor familiar sejam mencionados 25 vezes no PO do ABC+ . . . , não há qualquer meta definida para este grupo de produtores" (Garcia et al. 2021, 5).

[6] The original nine states were Bahia, Distrito Federal, Goiás, Maranhão, Mato Grosso, Mato Grosso do Sul, Minas Gerais, Piauí, and Tocantins. The four initially slated to receive technical assistance were Goiás, Mato Grosso do Sul, Minas Gerais, and Tocantins. "These states were prioritized by MAPA and SENAR based on the following criteria: (i) number of target producers; (ii) ABC Plan technologies already applied; (iii) number of extension agents; (iv) area deforested in 2009/2010; (iv) institutional strength of SENAR. Following the 2015 depreciation of the Brazilian Real and the consequent higher availability of resources (as the FIP grant was denominated in US$), the state of Maranhão was also added to the list in May 2015" (World Bank 2020, 6).

[7] Data are from the 2017 agricultural census. In the nine states originally covered by the project (Bahia, Distrito Federal, Goiás, Maranhão, Mato Grosso, Mato Grosso do Sul, Minas Gerais, Piauí, and Tocantins), the total area in farms was 215.6 million hectares, of which 84.8 million hectares (39 percent) were in pasture and 27.1 million hectares (13 percent) were in crops (IBGE 2019).

[8] The project promotes the following "low-carbon emission agricultural practices": restoration of degraded pasture, livestock intensification, crop-livestock-forestry integration system, and crop-livestock system. On page 33 of the Project Appraisal Document, the land area where these practices have been adopted is cited as one of the project development objective indicators (World Bank 2018).

[9] "In Brazil, the Atlas of Brazilian Pasturelands reports that 57 percent of the total 173 million hectares of pasture lands were degraded by 2018. More critically, the Atlas registered that approximately 40 million hectares of pasture suffer from a severe level of degradation. In contrast with this georeferenced estimate, rural producers recognize only 12 million hectares of pasture to be in poor condition on their properties, as reported on the last Agricultural Census, conducted in 2017. Discrepancy between geoprocessing analysis and the producers' self-reported measure of degraded conditions of their own pasturelands is expected. The difference may have several causes. Producers may have different subjective perceptions about what they consider to be a degraded pasture. They may also have incentives to under-report degraded land area to avoid regulatory sanctions" (Feltran-Barbieri and Féres 2021, 3–4).

[10] The same source notes that "the design of the project, however, did not establish a specific definition of attributions, internal guidelines, and resource flows between these institutions" (World Bank 2020, 19); that "a combination of lack of clear guidelines for the institution's role in the Project, dotted hierarchical decision lines, and misaligned incentives of career researchers (more focused on academic research than on policy advisory) made the contribution of Embrapa to the Project score below its potential…the institution maintained a low track record of participation in field activities and collective events, which could have been otherwise leveraged to spread more knowledge around low-carbon technologies" (20); that "ad hoc surveying and analysis of quality of technology adoption, which had to be validated by Embrapa, was not

undertaken throughout project implementation, and was only included in the impact evaluation data collection" (22); and that "Embrapa's estimate of the Project's impact on greenhouse gas emission and carbon sequestration was delayed until after project closing and was produced only for pasture rehabilitation (the most adopted ABC technology) instead of additional technologies as originally established" (22).

[11] On March 29, 2022, Embrapa reported that more than 50 of SENAR's field technicians participated in a training session run by Embrapa under the auspices of the World Bank–supported Integrated Landscape Management in the Cerrado Biome Project(Paisagens) (Embrapa 2022).

[12] "In Brazil, lectures given by researchers in local communities are one of the most common strategies for transferring technology to milk farmers. In one of these lectures, given in 1997, Embrapa researcher Artur Chinelato realized the limits of this strategy when a farmer asked who would teach the farmers to use the technologies presented and what the continuity of the proposals presented would be. This led a group of five researchers from Embrapa Sudeste to launch Balde Cheio, as a practical teaching method, using a dairy farm as a classroom for technicians and farmers. The initial syllabus consisted of a set of technological practices, tested on experimental farms belonging to educational and research institutions that could be adapted to different situations, locations, and farmer profiles (Novo et al. 2016; Chinelato 2018)" (Chiodi Bachion et al. 2022, 3). But there is another angle to consider. Shortly after project preparation (in 2014), the National Agency for Technical Assistance and Rural Extension was created in response to the decline of public agricultural extension services in many Brazilian states, as well as in response to the perception that only a small part of Embrapa´s research reached the small and medium producers. An Independent Evaluation Group interviewee notes that its creation was affected from the start by ideological divergencies regarding the target public of the agency (family agriculture versus commercial agriculture).

[13] The first randomization protocol was not stratified by area and therefore proved to be unworkable. Thus, in one municipality (Corumbá in Goiás), of the 22 eligible producers, 19 were assigned to the control group, meaning that there were not enough producers eligible for training to justify the provision of said training—and many of those assigned to the control group declined to continue working with the project. This error was partially remedied in phase 2, but participant attrition was a continuing problem (Faveri and Camboim 2019, 20).

[14] The final composition of the experimental groups assigned 663 of the participating producers to the control group; these producers represented 48 percent of all participants (Bragança et al. 2022).

[15] Project start-up (the date of grant "effectiveness") was August 2014; producer training was not completed until three years later (July 31, 2017); technical assistance was not completed until January 31, 2019 (Faveri and Camboim 2019, 40).

[16] The fiscal year 2019 Integrated Landscape Management in the Cerrado Biome Project (P164602) had an effectiveness date of March 1, 2019; the Mid-Term Review was dated August 30, 2022, and the closing date, as projected at midterm, is December 29, 2023.

[17] "The GGE [State Management Group; Grupo Gestor Estadual] are composed of representatives of the agricultural and livestock sector in each State and have the function of establishing an ABC technology introduction plan that meets the real needs of their State. The GGE assist farmers and ranchers with the introduction of sustainable practices and with access to credit offered by the ABC Program" (World Bank 2014b, 32).

[18] Baseline interviews were conducted between October 12, 2017, and January 30, 2018. Follow-up interviews were conducted between March 11, 2019, and May 8, 2019 (Faveri and Camboim 2019, 40).

[19] The same report notes, "SENAR´s system, while yielding immediate answers, would benefit from complementary actions of checking the precision and veracity of TMA [on-farm technical assistance] staff entries into the SISATeG system through on-the-ground or aerial, as was actually foreseen in the appraisal Results Framework" (World Bank 2022, 27).

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Appendix A. Ratings

Sustainable Production in Areas Previously Converted to Agricultural Use Project (P143184)

Table A.1. ICR, ICR Review, and PPAR Ratings

Indicator	ICR	ICR Review	PPAR
Outcome	Satisfactory	Satisfactory	Satisfactory
Bank performance	Moderately satisfactory	Moderately satisfactory	Moderately satisfactory
Quality of monitoring and evaluation	Substantial	Substantial	Substantial

Sources: World Bank 2020, 2021.
Note: The ICR is a self-evaluation by the responsible Global Practice. The ICR Review is an intermediate Independent Evaluation Group product that seeks to independently validate the findings of the ICR. ICR = Implementation Completion and Results Report; PPAR = Project Performance Assessment Report.

1. Relevance of the Objectives

Objectives

The project development objective was "to promote the adoption of selected sustainable low carbon emissions agricultural technologies by midsized producers in the Cerrado Region" (World Bank 2014, 4). This objective was not revised during implementation.

Relevance

When the project was prepared, its objective was well aligned with both Brazil's 2008 national plan for addressing climate change, which included voluntary commitments to reduce greenhouse gas emissions by 2020, and the 2010 Low-Carbon Emissions Agriculture (Agricultura de Baixa Emissão de Carbono; ABC) Plan, whose scope extended to reducing deforestation of the Cerrado biome and promoting adoption by farmers of technologies to reduce carbon emissions. At completion, the project objectives remained relevant in accordance with Brazil's commitment at the 2016 United Nations Climate Change Conference in Paris on nationally determined contributions to reduce 43 percent of greenhouse gas emissions. Brazil´s official policies on climate change mitigation have not changed significantly since 2009, and the World Bank´s assistance strategy still supports the project´s objectives. Additionally, clearing of forest for crop agriculture and cattle grazing still figures as a major contributor to greenhouse gas emissions, from both land-use change and methane release. Low-carbon-emitting agricultural technologies are central to achieving the goals of Brazil´s climate change policy and its international commitments. The Implementation Completion and Results Report (ICR) and the ICR Review both rate relevance as **high,** a judgment with which the present assessment concurs.

2. Efficacy

The project exceeded many of its outcome targets. The number of direct beneficiaries was 20,025—substantially above the appraisal target (12,000). These beneficiaries included trained farmers and ranchers, family members of producers receiving technical assistance, field day participants, and project-trained collaborators. This number does not include positive spillovers (sharing of knowledge by those other than direct beneficiaries). The demonstration effect achieved through the siting of Technological Reference Units on 10 percent of participating farms is not quantified but was probably significant. A total of 9,824 producers and technicians enrolled in training, well above the revised target of 6,000. The increase in the number of producers adopting at least one ABC technology compared with the control group was estimated at 15 percent (target > 10 percent) based on a weighted average of the results in the training only (treatment group 1) and training plus technical assistance (treatment group 2). No target was established for increasing carbon stocks and reducing carbon emissions, but a study by the Brazilian Agricultural Research Corporation (Empresa Brasileira de Pesquisa Agropecuária; Embrapa) estimated a difference of 6.6 million tonnes of carbon dioxide equivalent between treatment and control-group farms. The revised target for new land brought under ABC technologies was exceeded (378,513 hectares [ha] compared with 300,000 ha target), but this represented little more than one-third of the original target, a shortfall derived from flaws at preparation in farm profiling.

Arguably, for a small, experimental project of this nature, the most important outcome was the successful completion of the impact evaluation, which would allow for learning that could be applied to follow-up interventions. The project performed successfully in this respect, producing compelling evidence that training combined with on-farm technical assistance resulted in a higher level of technology adoption than training alone.

However, this assessment identifies a tension between achieving a sound evaluation of impact and maximizing the impact in terms of technology adoption and reduced carbon emissions: assigning roughly half of those producers who signed up to the control group (meaning that they received neither training nor technical assistance) undoubtedly had a demotivating effect, resulting in the loss of motivated producers who might otherwise have gone on to adopt the technologies. The assessment also found that the higher-level outcome of institutional strengthening and improved interagency collaboration would have been greater if the project design had allowed for fuller use of the strengths of the research organization, Embrapa—strengths that included a significant field presence and experience with delivering on-farm technical assistance.

Overall Efficacy

This assessment agrees with the ICR and the ICR Review, which rated the efficacy with which the project's objective was achieved as **substantial.**

3. Efficiency

This assessment did not revisit the economic and financial analysis conducted at appraisal and completion. These estimations were based on conservative assumptions that did not include the return to positive spillovers. At completion, the net present value was $136 million in financial terms and (after factoring in the value of carbon sequestration) $415 million in economic terms. By any standards, this was an impressive performance for a $10 million project. There was some loss of administrative efficiency resulting from delays in recruiting farmers to the project and farmer attrition (particularly among those assigned to the control group). Project management and monitoring and evaluation were a hefty burden, accounting for 25 percent of the project's total costs, mainly reflecting the demands made by the setup of the randomized control trial. Also, during implementation, the monitoring and evaluation strategy had to be adjusted to ensure the feasibility of the impact evaluation, which caused some additional costs such as hiring a new data collection firm. This assessment concurs with the ICR and the ICR Review in rating efficiency as **substantial.**

4. Outcome

This assessment ratifies the **satisfactory** rating proposed for the project's outcome in both the ICR and the ICR Review because there were no shortcomings in the relevance of the project's objective and only minor shortcomings in the project's efficacy and efficiency.

5. Bank Performance

Quality at Entry

The Independent Evaluation Group (IEG) rates quality at entry as **moderately satisfactory.** First, with the limited resources at its disposal ($10 million), it was very sensible for the project to focus on the learning that could be derived from a rigorous impact evaluation. With such a small budget, the project could not be expected to have a transformative effect in terms of massively expanding the area under low-carbon technology. Second, the impact evaluation tested a valid hypothesis. The low take-up of credit specifically earmarked for promoting low-carbon technology suggested that farmers' awareness of and knowledge about these technologies were the primary constraints to technology adoption—not access to finance. This hypothesis was borne

out by the impact evaluation findings. IEG agrees with the observation in the ICR that "a strong merit of the WBG [World Bank Group] team was to require and insist on the importance of the development of a solid M&E [monitoring and evaluation] framework, where no strong mechanisms in this sense had been previously in place" (World Bank 2020, 25, para. 100).

But quality at entry needs to be caveated in five ways. First, given the small size of the project, the project development objective should have been framed in relation to hypothesis testing and lesson learning about the constraints to technology adoption, not the level of adoption itself. Second, the initial definition of the producers that would be targeted by the project was problematic—the assumption that small-scale "family farms" were already served by other programs does not stand up now and did not when the project was prepared. Third, although during preparation the Ministry of Agriculture, Livestock, and Food Supply (Ministério da Agricultura e Pecuária) furnished the World Bank team with the results of a survey of farm characteristics and farmer demands, the extent to which farmers were almost exclusively interested in pasture renewal was either not evident from the survey or was not reflected in project design. Fourth, given the small project budget, the number of states (nine) chosen for inclusion in the project seems overambitious; it might have made more sense from the start to limit the project to the four states that were chosen to participate in component 2 (which offered on-farm technical assistance). Fifth, IEG agrees with the ICR (World Bank 2020, 19–21) that there was insufficient attention paid at entry to ensuring ownership and clarity on responsibilities for effective interinstitutional coordination, leading to lower-than-anticipated engagement by the Ministry of Agriculture, Livestock, and Food Supply and Embrapa. In particular, preparation arrangements did not make sufficient attempt to harness the skills and capacity of Embrapa, with a view to marrying this to the undoubted capacity of the National Rural Learning Service (Serviço Nacional de Aprendizagem Rural; SENAR) as a training institution; an opportunity to build a bridge between these agencies was missed.

Quality of Supervision

IEG rates quality of supervision as **moderately satisfactory.** This was the first time that SENAR had acted as an implementing partner on a World Bank project. Supervision could have provided more help to SENAR in terms of training and follow-up on procurement and financial management. Also, the international consultant hired by the World Bank to design and implement the impact evaluation could have provided clearer explanation of statistical procedures to the SENAR staff leading this part of the project. Finally, World Bank staffing changes—four financial management specialists in five years and a change of one of the task team leaders in September 2017—disrupted implementation. There was some loss of continuity in vision, particularly with respect to

the importance of the impact evaluation, and a delay in restructuring. The ICR notes, "Restructuring was recommended at Mid-Term Review in January 2017, but the related request was only initiated in November 2017 and restructuring was eventually approved in April 2018" (World Bank 2020, 26, para. 102).

6. Quality of Monitoring and Evaluation

Design

The establishment of a system for monitoring and evaluating the project—and the broader ABC program—was central to project design and responded to a significant need. During preparation, it was evident that the ABC program lacked data on uptake of its credit line. Using the project to sponsor a rigorous impact evaluation that would assess whether credit was the constraint to technology adoption was wholly justified and a good use of limited resources. However, there were some flaws in the design of the impact evaluation. First, not enough consideration was given to managing the expectations (and frustrations) of producers who were assigned to the control group. Second, the questionnaire was arguably too long and too complex, aiming to conduct a comprehensive farm survey when more focused attention to the uptake of ABC technologies would have been more appropriate. Third, the narrow gap between the survey rounds (14–20 months) invites questions about what degree of change in farming practices it would be feasible to reliably measure—and it was even less feasible to capture changes in carbon sequestration and greenhouse gas emissions in such a short time frame.

Separate from the design of the impact evaluation is the design of the project monitoring system. The project development objective indicators were suitably outcome oriented (area brought under ABC technologies, number of farmers adopting), except for the technical assistance variable, which measured hours delivered rather than beneficiary perception of the quality of delivery. Also, there was no baseline or end line indicator on carbon sequestration, which would have been the most direct measure of impact.

Implementation

Regional SENAR units were slow to commit to the impact evaluation and struggled at first with the strategies for promoting the project, randomization, and selection of beneficiaries. No attempt was made to accommodate the demands of disgruntled farmers assigned to the control group. Also, the flow of results framework monitoring data from region to center was erratic and suffered from weak quality control, although there was an improvement after the Mid-Term Review. As the ICR notes, Embrapa's estimate of the project's impact on greenhouse gas emissions and carbon sequestration was delayed until after project closing and was produced only for pasture rehabilitation

(World Bank 2020). Also, no annual monitoring reports were produced, reducing the scope for making midcourse corrections.

Use

The results of the impact evaluation were written up in two articles published in peer-reviewed scientific journals. Both articles make a compelling case for the positive impact of on-farm technical assistance and may be expected to have an influence on agriculture sector policy making. Attempts under the project to strengthen SENAR's monitoring system have not resulted in the creation of a dedicated monitoring and evaluation unit, and data flow between headquarters and regional offices is still subject to delays and quality deficits.

IEG rates the overall quality of monitoring and evaluation as **substantial**.

References

World Bank. 2014. "Brazil—Sustainable Production in Areas Previously Converted to Agricultural Use Project." Project Appraisal Document PAD701, World Bank, Washington, DC.

World Bank. 2020. "Brazil—Sustainable Production in Areas Previously Converted to Agricultural Use Project." Implementation Completion and Results Report ICR5045, World Bank, Washington, DC.

World Bank. 2021. "Brazil—Sustainable Production in Areas Previously Converted to Agricultural Use Project." Implementation Completion and Results Report Review ICRR0022153, World Bank, Washington, DC.

Appendix B. Fiduciary, Environmental, and Social Aspects

Financial Management

Throughout the implementation supervision missions, classified financial management performance was rated as satisfactory, and the Independent Evaluation Group found no evidence during this assessment that failed to support that rating. Interim financial reports submitted to the World Bank were deemed acceptable, and all audit reports were unqualified. There were no ineligible expenditures of a gravity sufficient to call into question the overall financial management rating.

Procurement

This assessment concurs with the judgment in the Independent Evaluation Group's review of the Implementation Completion and Results Report. This was the first time that the National Rural Learning Service (Serviço Nacional de Aprendizagem Rural) had worked with the World Bank, and the time needed to learn and apply the World Bank's procurement guidelines contributed to implementation delays. There was some belated capacity building; it was only in the last year of implementation that procurement performance ratings were adjusted from moderately satisfactory to satisfactory. This assessment found no evidence of irregularity in bidding processes.

Environmental and Social Safeguards

Environmental

This was a category B project because it was intended to promote the adoption of low-carbon farming practices, and there was no reason to expect it to have a negative environmental impact. The project triggered the following environmental operational safeguard policies: Environmental Assessment (Operational Policy [OP] 4.01), Natural Habitats (OP 4.04), Pest Management (OP 4.09), and Forests (OP 4.36). The main risk was related to possible adverse effects from the use of pesticides, but there were no reports of significant damage from this source. This assessment found no evidence to dispute the statement in the Implementation Completion and Results Report that the project complied with all the environmental requirements related to these safeguard policies (World Bank 2020).

Social

The relevant safeguards were Physical Cultural Resources (OP/ Bank Procedure [BP] 4.11), Indigenous Peoples (OP/BP 4.10), and Involuntary Resettlement (OP/BP 4.12). None of these were triggered at appraisal. A social assessment made during project preparation duly assessed possible risks to at-risk communities. A gender action plan was implemented, and training targets for female producers and technicians were exceeded. During this assessment, the Independent Evaluation Group found no evidence of noncompliance with social safeguards.

Reference

World Bank. 2020. "Brazil—Sustainable Production in Areas Previously Converted to Agricultural Use Project." Implementation Completion and Results Report ICR5045, World Bank, Washington, DC.

Appendix C. Methods and Evidence

This report is a Project Performance Assessment Report. This instrument and its methodology are described at https://ieg.worldbankgroup.org/methodology/PPAR.

The consultants took an iterative exploratory approach, aimed at teasing out answers to the questions proposed in the Concept Note. The work was carried out in three stages: consultation of all available project documentation; formulation of the main questions; and first interviews, field visits, and a second round of interviews with key players.

Initially, all the documentation related to the Low-Carbon Emissions Agriculture (Agricultura de Baixa Emissão de Carbono; ABC) Cerrado project was made available for consultation and analysis, including reports, the Mid-Term Review, summaries of regular meetings, scientific papers, and any other document that could contain important information for the formulation of the Concept Note and the questions to be explored in this evaluation.

The next step was the interviews. From the reading of the documents we identified the main actors involved in the project to be interviewed: (i) managers of the three institutions that partnered to implement the project: the Ministry of Agriculture, Livestock, and Food Supply (Ministério da Agricultura, Pecuária e Abastecimento; MAPA), the Brazilian Agricultural Research Corporation (Empresa Brasileira de Pesquisa Agropecuária; Embrapa), and the National Rural Learning Service (Serviço Nacional de Aprendizagem Rural; SENAR); (ii) managers located in the project target states where training and technical assistance took place; (iii) technicians supervising the training and technical assistance in the states; (iv) SENAR field technicians; (v) project master consultants (specialists in the four technologies offered by the ABC Cerrado project, namely, no-till, pasture recovery, crop-livestock-forest integration (ILPF) and planted forests); (vi) rural producers involved in the project; (vii) researchers; and (viii) World Bank managers.

Two questionnaires were prepared for the interviews, one for all managers focusing on the design, implementation, and unfolding of the project, and another for the rural producers who received training and technical assistance. At the start of the interview, all interviewees were assured that none of their responses used as evidence in the final report would be attributed to them.

For the interviews with the rural producers, the first step was to select from the total of eight states two states where project beneficiaries had received both training and technical assistance. These states were chosen to represent areas of long-established settlement with no open frontier (Goiás) and frontier areas where new land was still

being opened to farming (Tocantins). Given that 82 percent of all producers participating in the project opted for pasture renewal, the Independent Evaluation Group purposively selected producers who had chosen this option and received both training and technical assistance. Thirteen producers were selected from the database produced by the impact evaluation, with care taken to include different sizes of farms and owners of all genders. Once selected, the producers were contacted by SENAR to schedule the interviews and subsequent field visits. The field visits were carried out with most of the owners interviewed on their farms, with the exception of those who were not on their properties at the time of the visits (August 26 through September 2, 2022).

After the field visits and the first round of interviews concluded, some key managers were selected for second interviews to clarify points that were ambiguous.

Interview Protocols

1. Questions for Stakeholders

(*Note:* These stakeholders did not include producers who participated in the project.)

Project Design

- Was it appropriate for the project to target producers with midsize farms?
- Were the producer eligibility criteria appropriate?
- Why were small-scale producers left out? Was it appropriate to omit them?

Box C.1. Size of Target Population

A população alvo é de cerca de 12.000 produtores com propriedades de médio porte (área de produção entre 4 e 70 módulos fiscais)[a] e 160 técnicos de campo, inclusive técnicos das Emater´s, que fornecerão assistência técnica aos produtores. Esses produtores foram considerados pelas seguintes razões: (i) unidades de produção de médio porte formam a maior parte do total de terras de uso agrícola do Cerrado;[b] (ii) pequenos produtores podem acessar outros programas que promovem a agropecuária sustentável, adequados às suas realidades e com maiores vantagens financeiras (Por exemplo, o PRONAF (Programa Nacional de Fortalecimento da Agricultura Familiar) provê crédito subsidiado e assistência técnica); e (iii) grandes produtores podem acessar o Know-how tecnológico sem a assistência do governo.

Source: World Bank 2014.

Note: a. Um módulo fiscal cobre entre 5 e 100 há, dependendo do município.
b. A agricultura familiar (78 por cento das propriedades) ocupa apenas 14,7 por cento das propriedades da área produtiva total; enquanto os 22 por cento das propriedades restantes, de médias e grandes propriedades, ocupam 85,3 por cento das propriedades da área produtiva.

On-farm technical assistance was limited to producers in four pilot states (Goiás, Tocantins, Mato Grosso do Sul, and Minas Gerais). What was the rationale for choosing these states? Was it valid?

There were three project partners: SENAR, MAPA, and Embrapa. Were the roles and responsibilities of each partner, and the provisions for coordination, clearly defined when the project was prepared?

Why was SENAR selected to lead the training and technical assistance? Was it the best available agency for the job?

What was the intended function of the GGEs [Grupos Gestores Estaduais]?

Box C.2. Composition of Grupos Gestores Estaduais (State Management Groups)

Estadual Operacional: foram constituídos em todas as Unidades Federativas (Estados e Distrito Federal) Grupos Gestores Estaduais para promover a coordenação e a articulação do Plano Setorial da Agricultura nos estados. O Grupo é coordenado pelo representante da Secretaria de Agricultura do Estado, com a participação do MAPA, do MDA, da Secretaria de Estado de Meio Ambiente, da Embrapa, das Organizações Estaduais de Pesquisa Agropecuária, dos bancos oficiais (Banco do Brasil, Banco da Amazônia ou Banco do Nordeste), e com a integração de representantes da sociedade civil (setor produtivo, trabalhadores, universidades, pesquisa, cooperativas, federações de agricultura, organizações não governamentais etc.).

Source: World Bank 2014.
Note: MAPA = Ministry of Agriculture, Livestock and Food Supply.

Project Implementation

How good was the publicity campaign that was intended to encourage producers to sign up for the project? (Was it limited to SENAR's existing client base? Were some producers left out?)

Did SENAR trainers introduce producers to all four technologies before asking them to select the course module to be trained in? (Or did producers specify the module they were interested in *before* receiving any training?)

Box C.3. Type of Training Provided

Provisão de cursos em, entre outros: (i) Sistemas de Plantio Direto; (ii) Recuperação de Pastagens Degradadas; (iii) Integração Lavoura-Pecuária-Floresta; (iv) Florestas Comerciais Plantadas; (v) gestão de propriedades rurais e formulação de propostas de projetos a serem financiados pelo Plano ABC.

Source: World Bank 2014.

Did the producers who were randomly assigned to the control group (no training; no technical assistance) receive any benefit from the project?

Why did 82% of the producers opt for training and TA [technical assistance] in the pasture renewal technology?

Were there factors that tended to exclude midscale producers dedicated mainly to crop farming?

To what extent did the availability and terms of credit influence producer participation? (Were producers in need of credit less likely to participate? Were ranchers more likely to sign up than crop farmers because they were less dependent on credit?)

Was the supply of technical expertise adequate? (Consultores Master, supervisors técnicos, técnicos de campo)?

Was there an equivalent level of expertise available for each of the four technologies? Or was more expertise available for some technologies than others? Were technical experts biased in their advocacy, favoring some technologies over others?

Were there big differences between states in the availability and quality of technical expertise?

Were the four technologies equally easy to promote—or were some easier to promote than others?

Did SENAR do a good job in organizing the training and on-farm technical assistance?

How good were the training materials supplied by Embrapa?

How effective was the coordination between the three project partners—SENAR, MAPA, Embrapa?

Did the Grupos Gestores Estaduais (GGE) play a significant role in the project?

How effective were the Technology Reference Units (URTs)?

Box C.4. Role of On-Farm Demonstration Sites (Technological Reference Units)

Estabelecimento de unidades de referência tecnológica (URTs), entre as propriedades assessoradas, definido dentro dos critérios de seleção das propriedades a serem beneficiadas pelo Componente 2. Essas URT´s estarão localizadas em propriedades privadas que poderão ser disponibilizadas para visitas e estudos técnicos futuros.

O projeto deverá estabelecer procedimentos de garantia da manutenção das URTs tanto no decorrer de sua vigência quanto após seu encerramento. Inicialmente, durante o processo de seleção das propriedades que receberão essas Unidades, será incluída na discussão dos compromissos de cada ator (proprietário, técnico de campo, instituições envolvidas), as respectivas responsabilidades na provisão de insumos e manutenção das atividades de implementação e de rotina. As respostas da estruturação de um determinado sistema de produção – que constitui uma URT – certamente não se darão de forma integral no decorrer do prazo de vigência do projeto. Há interesse de acompanhamento dessas unidades além desse período para fins de observar e perceber os reais impactos ambientais e econômicos dessas transformações [emphasis added]. Esse interesse define a necessidade de discutir, ao estabelecer o compromisso com essa propriedade, como esse vínculo entre o produtor e as instituições de interesse – como, por exemplo, uma unidade de pesquisa da Embrapa – será estabelecido e como serão compartilhadas as responsabilidades. Além de outros projetos, considera-se a possibilidade de apoio através de projetos direcionados custeados pelo governo brasileiro, através do MAPA em parceria com as secretarias de agricultura dos estados e dos GGEs, como já tem acontecido em outras regiões do país. Outras formas de custeio e acompanhamento também poderão ser consideradas, conforme contexto, localização, abrangência, ou outros fatores que forem considerados relevantes.

Condução de "dias de campo" nas URTs.

Source: World Bank 2014.
Note: GGE = State Management Group; MAPA = Ministry of Agriculture, Livestock and Food Supply; URT = Technological Reference Unit.

Were there other actors that played a significant role in the promotion and diffusion of ABC technologies?

What were the biggest problems that arose during project implementation?

Project Follow-up

What other ABC+ projects devoted to a similar menu of technologies are now being implemented or are under preparation (by SENAR or other agencies; financed by World Bank or other entities)?

To what extent have lessons learned in "ABC Cerrado" been incorporated in these other projects? In particular, how has the 'landscape' approach improved on the extent and quality of technology adoption, and has it led to a different mix of technologies being adopted?

Has there been any follow-up with the URTs [Technological Reference Units]? (Are they still monitored?)

Has the M&E [monitoring and evaluation] system developed for "ABC Cerrado" been replicated elsewhere in the ABC+ Program?

Was the training and on-farm technical assistance offered by "ABC Cerrado" sufficiently cost effective (compared with alternatives) for it to be scaled up? Or were adjustments needed to make it cost effective?

Is there any evidence of a demonstration effect—producers outside the project adopting the technologies that "ABC Cerrado" promoted?

Is there any evidence of institutional capacity building as a result of "ABC Cerrado"—strengthening of SENAR, MAPA, Embrapa or other agencies affected by the project?

How widely have the 4 "ABC Cerrado" technologies been adopted in the Cerrado? How does the level of adoption vary between states and ecological zones? (Is there a reliable data series that can be disaggregated by year and by location?)

2. Information Requested from Producers

(*Note: Producers* includes persons who received both training and technical assistance from ABC Cerrado Project in the states of Goiás and Tocantins.)

Name of municipality and state where farm is located.

Area farmed today (ha) [If the producer operates several farms, refers to area of all farms combined]

Area farmed in 2012 (ha)

Registered in CAR [Rural Environmental Cadastre]? (When?)

Land use: Approximate % of total farm area in (a) crops, (b) pasture and (c) forest

Change in these % shares since 2012: Increase? Decrease? Unchanged?

Head of cattle today (number)

Head of cattle in 2012 (approximate number)

How did you hear about the ABC Cerrado project?

Before the project, how much did you know about the four technologies offered?

Before the project...	...adopted	...heard of but not adopted	...never heard of
FP Florestas Plantadas			
ILPF Integração Lavoura-Pecuária-Floresta			
RPD Recuperação de Pastagens Degradadas			
SPD Sistema Plantio Direto			

Did the training you received from the project influence your choice of which technology to adopt—or had you made your mind up BEFORE the project?

Did the project trainers explain the basics of ALL four technologies before inviting you to choose which technology to be trained in?

Which technology was you trained in?

Why did you choose that technology?

Did you subsequently receive on-farm technical assistance in that technology?

Did you subsequently adopt that technology?

Today, are you still using that technology on your farm? (If not, why not?)

Are you aware of other farmers who have adopted this technology after visiting your farm?

On a scale of 1–10 where 10 is 'completely satisfied,' how satisfied were you with the training you received from the project?

On a scale of 1–10 where 10 is 'completely satisfied,' how satisfied were you with the on-farm technical assistance you received from the project?

Can you suggest ways in which (a) the training and (b) the on-farm technical assistance could have been improved?

Since 2012 have you received credit to help you finance adoption of the technology? If yes, which source: (a) ABC Cerrado Program; (b) Other (specify).

	Credit
ABC Cerrado Program	Date(s) received
Other	

Have you received training and technical assistance OUTSIDE the project? If yes, (a) for which technology, (b) from which source(s) and (c) when?

	Training	On-farm TA
Source 1	Technology, Date(s) received	
Source 2		
Source 3		
Source 4		
Source 5		

What is the biggest problem that your face on your farm today?

Since 2012, how has the severity of that problem changed: Increased? Decreased? Same? (If it changed, why?)

Reference

World Bank. 2014a. "Brazil—Sustainable Production in Areas Previously Converted to Agricultural Use Project." Manual Operativo do Project. Brasilia, Brazil: World Bank.

Appendix D. Additional Data

Table D.1. Environmental Impact: Source 1

Producer Groups	Time 0 (Before intervention)	Time 1 (After intervention)	Percent Change
	Pasture in good condition (ha)		
G1 (control), *N* = 663	7,748	5,611	−27.6
G2 (training only), *N* = 395	8,924	11,892	33.3
G3 (training + technical assistance), *N* = 311	7,554	11,390	50.8
	Carbon stocks (tons of CO_2 equivalent/ha)		
G1 (control), *N* = 663	55	48	−12.7
G2 (training only), *N* = 395	47	53	12.8
G3 (training + technical assistance), *N* = 311	47	54	14.9
	Enteric emissions (tons of CO_2 equivalent/year)		
G1 (control), *N* = 663	33,131	35,603	7.5
G2 (training only), *N* = 395	39,765	39,731	0.0
G3 (training + technical assistance), *N* = 311	48,150	38,175	−20.7

Source: da Silva e Souza et al. 2021, 5.
Note: CO_2 = carbon dioxide; ha = hectares.

Table D.2. Environmental Impact: Source 2

Producer Groups	Time 0 (Before intervention)	Time 1 (After intervention)	Percent Change
	"Forest area" (ii): area in legal reserve (ha)		
Variable A			
G1 (control)	9,071	15,533	71.2
G3 (training + technical assistance)	11,592	17,468	50.7
	"Forest area" (ii): area in native vegetation unexploited for farming (ha)		
Variable B			
G1 (control)	2,788	1,842	−33.9
G3 (training + technical assistance)	3,530	3,172	−10.1
	Total area in pasture, all qualities (ha)		
Variable C			
G1 (control)	18,461	18,060	−2.2
G3 (training + technical assistance)	21,893	24,366	11.3
	Head of beef cattle (*N*)		
Variable D			
G1 (control)	23,363	20,572	−11.9
G3 (training + technical assistance)	28,649	28,208	−1.5
	Stocking density (head per ha of total pasture)		
Variable E			

Producer Groups	Time 0 (Before intervention)	Time 1 (After intervention)	Percent Change
G1 (control)	1.27	1.14	−10.0
G3 (training + technical assistance)	1.31	1.16	−11.5

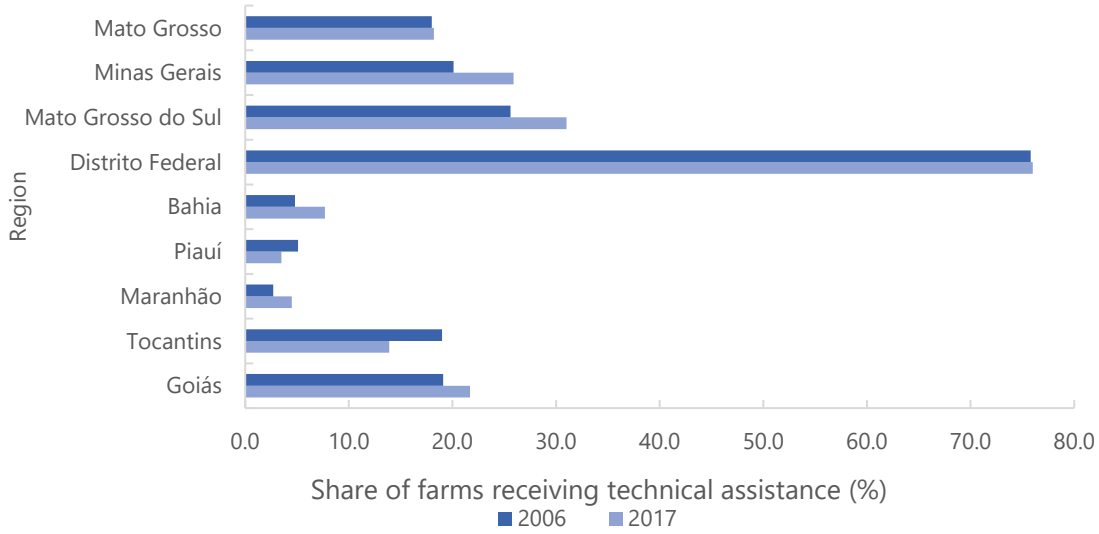
Sources: SENAR 2021.
Note: There is some (unexplained) difference in the size of the experimental groups, relative to table D.2: in table D.2, at t0, G1 = 416 and G3 = 475; at t1, G1 = 420 and t1 = 475. ha = hectare.

Table D.3. Use of Technical Assistance by Project States, 2006 and 2017

State	Farms (no.)	Farms Receiving Technical Assistance (no.)	B/A (%)
2006			
Goiás	135 692	25 966	19.1
Tocantins	56 567	10 724	19.0
Maranhão	287 039	7 839	2.7
Piauí	245 378	12 513	5.1
Bahia	761 558	36 311	4.8
Distrito Federal	3 955	2 998	75.8
Mato Grosso do Sul	64 864	16 587	25.6
Minas Gerais	551 621	110 712	20.1
Mato Grosso	112 987	20 304	18.0
TOTAL	2 219 661	243 954	11.0
2017			
Goiás	151,906	32,888	21.7
Tocantins	63,039	8,788	13.9
Maranhão	202,276	9,111	4.5
Piauí	237,272	8,311	3.5
Bahia	756,822	57,902	7.7
Distrito Federal	5,240	3,983	76.0
Mato Grosso do Sul	70,962	22,024	31.0
Minas Gerais	607,557	157,204	25.9
Mato Grosso	118,433	21,498	18.2
Total	2,213,507	321,709	14.5

Sources: IBGE 2009, 2019.
Note: The data for 2006 are taken from table 2.2.5 (26), which refers to "technical orientation received" by source; as presented in the table, the data exclude "orientation provided by the producer himself" to enhance comparability with the 2017 data, which refer to "technical assistance received." According to the appraisal document, "The 2006 census data from the Brazilian Institute of Geography and Statistics indicate that 9 percent of the farms in the Cerrado occasionally receive some form of technical orientation while barely 6 percent receive technical assistance on a regular basis. Hence 85 percent of the farms do not receive any technical orientation" (World Bank 2014, 4). B/A = Technical Assistance/Farms.

Figure D.1. Use of Technical Assistance in 2006 and 2017



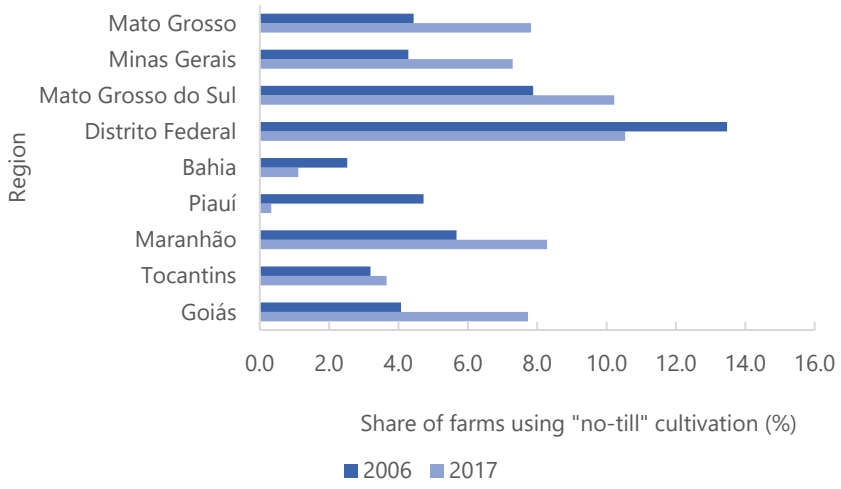
Sources: Based on IBGE 2009, 2019.

Table D.4. Use of "No-Till" Technique of Crop Cultivation

	2006			2017		
State	All farms	No-till farms	B/A (%)	All farms	No-till farms	B/A (%)
Goiás	135,692	5,524	4.1	151,906	11,752	7.7
Tocantins	56,567	1,805	3.2	63,039	2,306	3.7
Maranhão	287,039	16,282	5.7	202,276	16,759	8.3
Piauí	245,378	11,587	4.7	237,272	788	0.3
Bahia	761,558	19,207	2.5	756,822	8,384	1.1
Distrito Federal	3,955	533	13.5	5,240	552	10.5
Mato Grosso do Sul	64,864	5,114	7.9	70,962	7,255	10.2
Minas Gerais	551,621	23,636	4.3	607,557	44,294	7.3
Mato Grosso	112,987	5,013	4.4	118,433	9,264	7.8
Total	2,219,661	88,701	4.0	2,213,507	101,354	4.6

Sources: IBGE 2009, 2019.
Note: A = all farms; B = farms using the no-till technique.

Figure D.2. Use of "No-Till" Cultivation in 2006 and 2017



Source: Based on IBGE 2009, 2019.

Table D.5. Farms Practicing Pasture Rotation in 2006

State	All Farms	Farms with Pasture Rotation	B/A, %
Goiás	135,692	39,374	29.0
Tocantins	56,567	21,801	38.5
Maranhão	287,039	29,803	10.4
Piauí	245,378	18,663	7.6
Bahia	761,558	143,550	18.8
Distrito Federal	3,955	783	19.8
Mato Grosso do Sul	64,864	22,296	34.4
Minas Gerais	551,621	107,234	19.4
Mato Grosso	112,987	40,631	36.0
TOTAL	2,219,661	424,135	19.1

Source: IBGE 2009.
Note: There were no data on this in the 2017 census. A = all farms; B = farms with pasture rotation.

Table D.6. Annual Tree Cover Loss, 2016–21 (percent, relative to 2000 tree cover)

State	2016	2017	2018	2019	2020	2021
Goiás	0.63	1.20	0.43	0.52	0.49	0.52
Tocantins	1.30	1.80	1.10	0.87	0.84	0.77
Maranhão	3.80	2.10	1.90	1.20	1.50	1.40
Piauí	1.30	0.65	0.84	0.54	0.52	0.63
Bahia	1.50	0.87	0.67	0.55	0.58	0.63
Distrito Federal	0.50	0.72	0.39	0.23	0.10	0.10

State	2016	2017	2018	2019	2020	2021
Mato Grosso do Sul	0.47	0.51	0.37	0.55	1.30	1.20
Minas Gerais	1.00	0.93	0.58	0.47	0.54	0.46
Mato Grosso	1.00	1.60	0.76	0.75	1.50	0.93

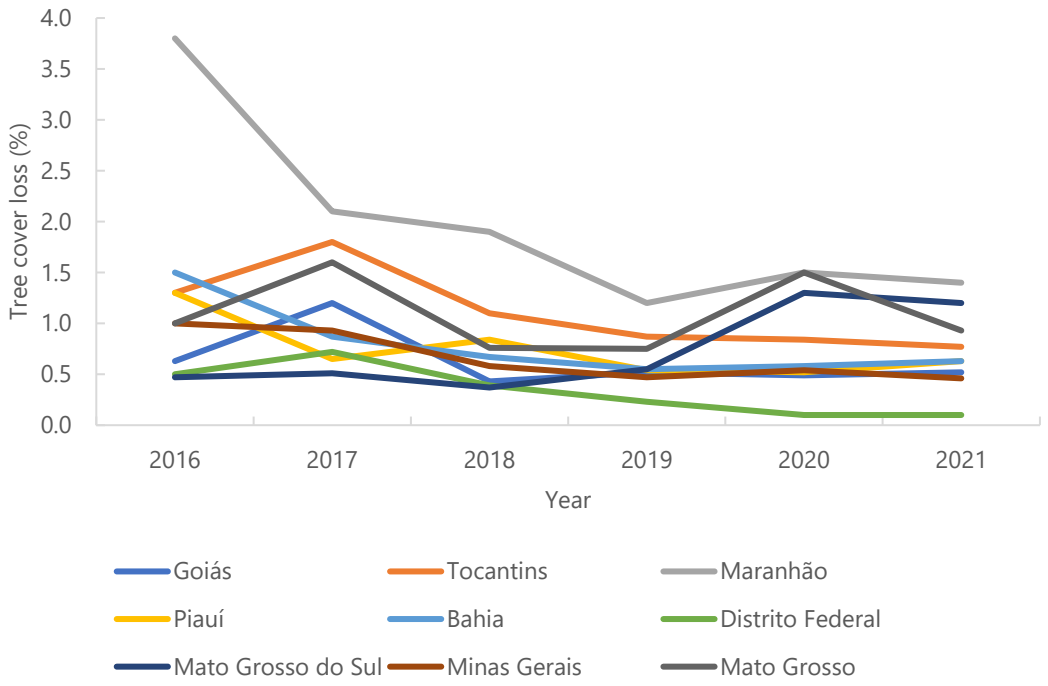
Source: Global Forest Watch database, https://www.globalforestwatch.org/dashboards/country/BRA/?category=summary&dashboard.
Note: Based on Landsat8 imaging, using a method consistent since 2015. Tree cover comprises canopy of > 30 percent. Tree cover gain not included.

Table D.7. Mean Tree Cover Loss, 2016–18 Compared with 2019–21 (percent, relative to 2000 tree cover)

State	Mean, 2016–18	Mean, 2019–21
Goiás	0.75	0.51
Tocantins	1.40	0.83
Maranhão	2.60	1.37
Piauí	0.93	0.56
Bahia	1.01	0.59
Distrito Federal	0.54	0.14
Mato Grosso do Sul	0.45	1.02
Minas Gerais	0.84	0.49
Mato Grosso	1.12	1.06

Source: Global Forest Watch database, https://www.globalforestwatch.org/dashboards/country/BRA/?category=summary&dashboard.
Note: Based on Landsat8 imaging, using a method consistent since 2015. Tree cover comprises canopy of > 30 percent. Tree cover gain not included.

Figure D.3. Annual Tree Cover Loss, 2016–21 (percent, relative to 2000 tree cover)



Source: Based on data from Global Forest Watch, https://www.globalforestwatch.org/dashboards/country/BRA/?category=summary&dashboard.
Note: Based on Landsat8 imaging, using a method consistent since 2015. Tree cover comprises canopy of > 30 percent. Tree cover gain not included.

Table D.8. Mean Farm Size by State, 2006 and 2017 (hectares)

State	2006	2017	Percentage Change
Goiás	193	173	−10.2
Tocantins	254	241	−5.3
Maranhão	45	61	33.2
Piauí	39	42	8.9
Bahia	39	37	−4.7
Distrito Federal	64	49	−22.8
Mato Grosso do Sul	467	431	−7.8
Minas Gerais	60	63	4.7

Sources: IBGE 2009, 2019.

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Appendix E. Borrower Comment

MINISTÉRIO DA AGRICULTURA E PECUÁRIA
Secretaria de Inovação, Desenvolvimento Sustentável e Irrigação

RELATÓRIO

Brasília, 10 de janeiro de 2023.

INTERESSADOS(AS): DEPROS/SDI E WORLD BANK

Mrs **Gabriela M. Oliveira**

In response to email dated 23 Dec. of 2022, follow our comments regarding the Project for Sustainable Production in Brazil in Areas previously converted to Project for Agricultural Use (ABC Cerrado).

On December 23, 2022, Mapa received from the World Bank the preliminary version of the performance evaluation report of the Sustainable Production in Areas Previously Converted to Agriculture project - ABC Cerrado project (see annex) for analysis and manifestation by this Ministry, aiming at the inclusion from the perspective of the Brazilian government in the final version of the document in question.

This report was prepared based on interviews and consultation of documents by the Independent Evaluation Group of the World Bank, which aims to review all projects supported by the World Bank to assess the achievement of their objectives, the reasons for possible variations between the results planned and achieved, and the effectiveness of Bank support to projects.

The ABC Cerrado project, in force between 2014 and 2019, aimed to promote the adoption of low-carbon technologies by small and medium-sized rural producers in the Cerrado biome through training and technical assistance. With a budget of US$ 10.6 million from a donation from the Forest Investment Program (FIP), the aforementioned project was coordinated by Mapa and executed by the National Rural Learning Service (Senar), in partnership with Embrapa. Closed.

The main results achieved by the ABC Cerrado project were: 8,044 trained producers; 7,346 participants in field days; 1,957 producers receiving technical assistance; 312,757ha of pastures directly and indirectly recovered; for every US$1 allocated with technical assistance, producers invested US$7.2 in pasture recovery.

According to the aforementioned report, the main lessons drawn from the project were:

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• The offer of training and technical assistance took place in a wide area (9 states), which requires a strong decentralized presence so that producers can deliver good results in adopting low carbon emission practices;

• Once they have been convinced of the cost-effectiveness of adopting CBA practices, producers with adequate means are likely to be willing to pay for technical assistance after project completion;

• Impact evaluations that rely on randomized control groups can yield compelling findings about constraints to the adoption of new agricultural technologies, but it is challenging to accommodate the needs of control group farmers;

• The gains from a one-off impact evaluation are likely to be less substantial than those from a long-term monitoring system;

• Technology transfer depends on effective collaboration between research and extension agencies.

We consider that the evaluation team's findings are consistent with the reality experienced during and after the project's execution, considering that ABC Cerrado was the first international cooperation project carried out under the ABC Plan, and that it was a pilot project . However, the obstacles encountered were not strong enough to compromise the project's objectives. In that sense, we agree with the report attached.

Best regards,

Silvia Regina S. de Oliveira Bento

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