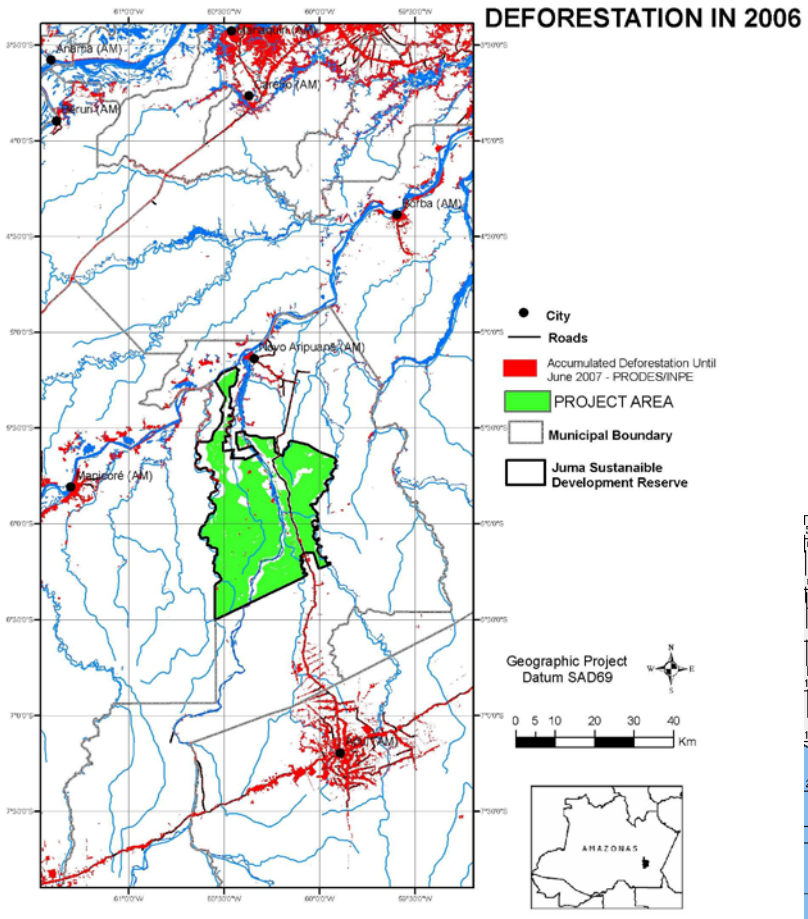
The Juma Sustainable Development Reserve Project: Reducing Greenhouse Gas Emissions from Deforestation in the State of Amazonas, Brazil

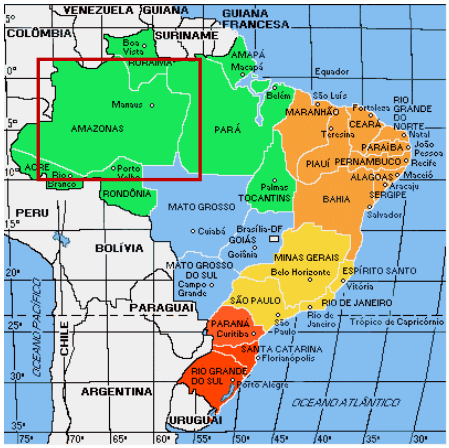
Source(s):

The Juma Sustainable Development Reserve Project: Reducing Greenhouse Gas Emissions from Deforestation in the State of Amazonas, Brazil

Project location

The Juma Reserve RED Project includes all of the Juma Reserve, which is located in the municipality of Novo Aripuanã, in the southern region of the State of Amazonas (p. 48).





The Juma Reserve was created in an area of 589,612 ha of Amazonian forest located alongside the BR-319

highway and crossed by the AM-174 highway (p. 6).

The western boundary of the Reserve is defined by the Mariepauá River, which forms the frontier between the municipalities of Novo Aripuanã and Manicoré. The southern boundary is defined by Federal land (100 km north of Transamazon Highway – BR-230), and the eastern boundary is defined by the left bank of the Acari River. The Reserve's relatively narrow northern boundary is defined by the Madeira River (p. 8).

Forest area and types

According to the phyto-ecological definitions established by the RADAMBRASIL Project (RADAMBRASIL, 1978) and VELOSO *et al.* (1991), there are 3 major forest types in the project site, as described below (p.13).

Submontane Ombrophyllous Dense Forest: This is the dominant forest type in the southern region of the Juma Reserve. In the plateaus, the forests have a uniform structure, with wide, tall trees (over 40 m). This forest has an intense secondary regeneration of tree species. This vegetation type has an estimated average carbon stock of 135.77 tons of carbon per hectare (tC/ha) to 184.71 tons tC/ha (the 2 main estimates found in the literature).

Lowland Ombrophyllous Dense Forest: This is the dominate type found in the northern area of the Juma Reserve. Significant densities of palm trees are found. This vegetation type has an estimated average carbon stock of 139.49 tC/ha to 184.31 tC/ha (the 2 main estimates found in the literature).

Ombrophyllous Dense Alluvial Forest: This type of arboreal forest is characteristically found along the banks of the Aripuanã River and part of the Acari River region along the eastern limit of the Juma Reserve. This forest type is found in areas that are subject to seasonal flooding and has an estimated average carbon stock of 139.49 tC/ha to 172.95 tC/ha (the 2 main estimates found in the literature).

Since the RADAMBRASIL classification was made for the scale of the entire Amazon Basin (5.4 million km^2) a "remote sensed" flyover was undertaken to validate the classification at the project scale. The Submontane Ombrophyllous Dense Forest and Lowland Ombrophyllous Dense Forest were grouped into a new class – Dense Forest. This grouping was made because no clear difference was detected in the vegetations during the flyover, and because the carbon stocks presented in the literature for the two vegetation classes, (submontane = 186.8 tC/ha; lowland = 184.3 tC/ha), are not significantly different (p. 14).

The Juma Reserve RED Project is located in one of the two most important interfluvial regions in Amazonas, between the Madeira and Purus Rivers. The area is drained by a complex system of rivers and streams, including both banks of the lower region of the Aripuanã River, the main tributary of the Madeira River. The main tributaries of the Aripuanã River in the region of the Reserve are the Acari River (the left bank of which defines the eastern boundary of the Reserve), the Mariepauá River (the right bank of which defines the western boundary of the Reserve) and the Juma River (which defines the southern limit of the Juma Reserve) (p. 9).

According to World Map of Köppen-Geiger Climate Classification, the climate of the region of Nova Aripuanã is equatorial (KOTTEK *et al*., 2006). The average temperature is about 25º C with a minimum temperature of 21º C and a maximum temperature of 32º C. The average annual rainfall is about 2,000 mm with 70% of the region's precipitation being concentrated between the months of October and April. The region's average relative humidity is about 85%. Novo Aripuanã receives 2,000 hours of sun per year (SDS, 2007) (p. 12).

The project is located in the center of endemism of Rondônia, which is defined by the Madeira River (to the left) and the Tapajós River (to the right).This area encompasses 475,000 km^2, of which 12.56% has already been deforested. This area contains a large number of endemic species, many of which occur in a very restricted area (p. 109). One of the most relevant characteristics of the region of the Reserve is the high degree of species richness due to the high heterogeneity of habitats, being considered one of the world's richest regions in bird species diversity (p. 26).

Forest management and use context

The Juma Reserve was divided into two areas:

1. **Carbon Credit Area of the RED Project:** the entire forest area that would be deforested under the baseline scenario and in which the carbon stocks are fully known at the baseline and at the start of project implementation (p. 48).
2. **Excluded Areas of the RED project** (116,935 ha; p. 50)**:** characterized by areas that would be deforested under the baseline scenario, but due to different and particular situations of previous land use, forest cover and land tenure, will not be included as areas eligible for RED crediting, as described below (p.49):

    - **Deforested areas** (6,493ha)*:* Areas that have already been deforested before the beginning of the Project. The data for the image classification was obtained from PRODES (INPE, 2008).
    - **Titled lands** (within the project site there are approximately 20 private land title claims in a total of 15,038 ha; p. 25)*:* Areas that have title registry, claims or that are in the process of land tenure normalization (see item *G.5*), according to the Amazonas Land Institute (*Instituto de Terras do Amazonas* - ITEAM), which is the official state organization dealing with land tenure issues, and which provided the GIS shape-files necessary for the classification.
    - **Areas under influence of the Apuí – Novo Aripuanã highway (AM-174***)* (9,778ha): Areas with forest cover, but which have potentially undergone disturbance, such as selective logging, deforested areas in regeneration, etc. To deliminate these areas, the most distant area with deforestation along the road was identified on PRODES's Image Classification and then a buffer was established for both sides of the road. This was also checked with the GIS flyover in 2008.
    - **Community use areas** (38,480ha): Areas currently under use by the communities or that will be potentially used in the future for small-scale agriculture, logging, forest management and other uses that can potentially affect the carbon stocks inside the Reserve. The source of this data is SDS (2006); it was collected through a community participative mapping process for the Studies for the Creation of the Juma Reserve.
    - **Non-Forest areas** *(15,647ha)***:** Natural areas on which vegetation is not classified as forest, i.e. not reaching the Brazilian definition of "forest": a) A single minimum tree crown cover value of 30%, b) A single minimum land area value of 1 ha, c) A single minimum tree height value of 5 meters.
    - **Water**: 31,499 ha

According to the latest social inventory taken in July 2008, there is an estimated population of 339 families living in 35 communities within the Juma Reserve and its surrounding area (p. 22).

Rates and drivers of deforestation and degradation

Rates of deforestation and degradation

The Brazilian Amazon is under great pressure. An estimated 17% of the original forest cover has already been lost. From 2000 to 2007, more than 150,000 km^2 of the region's forests were destroyed, an area equal to 3.7% of the total area of the Legal Amazon (INPE, 2008). In contrast, during this same period the State of Amazonas, the largest Brazilian State (1.5 km^2), lost only 0.4% of its forested area (INPE, 2008). Historically, Amazonas has always had the lowest deforestation rate in the Brazilian Amazon with 98% of the State's original forest cover still intact (p. 5).

Many experts consider the SOARES-FILHO *et al.* (2006) deforestation simulation model, "SimAmazonia I" (designed by the program "Amazon Scenarios," and led by the Amazonas State Institute for Environmental Protection (IPAM), The Federal University of Minas Gerais and the Woods Hole Research Center) to be one of the most refined models for the Amazon region. SimAmazonia I projects a strong deforestation trend in

the near future, which could result in a loss of up to 30% of Amazonas' forest cover by 2050 (p. 5).

According to the SimAmazonia I model, the region in which the Novo Aripuanã municipality is located is in an area under high risk for deforestation. Under the "business as usual" scenario, the paving of large highways (BR-319 and AM-174) will result in the loss of large expanses of forest by 2050 (p. 6). If the infrastructure predicted for the State of Amazonas, such as the paving of highways, is implemented, and if the historic trends elsewhere in the Amazon continue, the state of Amazonas will rapidly be occupied by large expanses of pasture and agricultural fields, and millions of ha of forest will disappear in the process (p. 31).

According to the most recent data, as of June 2007, only 6,493 ha of forest in the Juma Reserve (1.18% of the total area) had been cleared (INPE, 2008). About 98.82% of the forests in the Juma Reserve are still intact.

The patches of deforestation in the project area result basically from land clearing for small scale agriculture practiced by the local communities, and medium to large scale deforestation in areas illegally occupied by land grabbers and cattle ranchers along the sides of the road connecting Novo Aripuanã to Apuí (AM-174), which crosses the project area in a north to south direction (p.15).

The very small percentage of deforestation that does exist can be explained by small-scale agricultural production for domestic consumption (see section *G1.4*). Forest disturbance found along the Novo Aripuanã-Apuí road is attributable to the illegal extraction of timber by loggers from outside the Reserve (mainly along the road) (p. 24).

Project proponent

Amazonas Sustainable Foundation - FAS (Fundação Amazonas Sustentável - FAS) (p. 3)

FAS was created in partnership with the Government of the State of Amazonas to trade the environmental services provided by the State's protected areas and to invest all of these funds in the implementation of the protected areas. Article 6 of the Climate Changes Law (AMAZONAS, 2007b) authorized the participation of the Executive Power in a sole non-profit Private Foundation whose purpose and objective are the development and administration of Climate Change, Environmental Conservation, and Sustainable Development, as well as the management of environmental services and products.

The mission of the Amazonas Sustainable Foundation (FAS) is to promote sustainable development in Amazonas' Protected Areas, focusing on environmental conservation and improving the quality of life of traditional populations. FAS actions are focused on reducing deforestation, eradicating poverty, supporting social organizations, improving social indicators and generating income based on sustainable activities within Amazonas' Protected Areas. FAS seeks to approach companies and institutions that are interested in collaborating on sustainable development and management of protected areas in Amazonas. To achieve this goal it offers its partners opportunities to support actions on socio-environmental responsibility within protected areas. FAS also works to develop a market for environmental services and products (p. 58).

Implementation timeframe

July 3, 2006 – January 2050 (p. 51,158)

Project goals

The project aims to address deforestation and its resulting emission of greenhouse gases (GHG) in an area of the State of Amazonas, which is under great land use pressure. Its implementation is part of a wide strategy planned and initiated in 2003 by the current Government of the State of Amazonas to halt deforestation and promote sustainable development, based on giving value to the environmental services provided by its forests (BRAGA & VIANA *et al.,* 2003; AMAZONAS, 2002) (p. 40).

Through a mechanism of payments for environmental services, the project seeks to provide value for forest conservation. The Project aims to prevent emissions of at least 189.7 MtCO2 (> 2.9 MtCO2 over the first 10 years (p. 73).

Implementation activities

The success of this project depends on activities and measures developed in two major areas (p. 41):

1) The development and implementation of the Reserve and its Management Plan and;

2) The generation of funds from carbon credits through reducing GHG emissions from RED.

The creation and implementation of the Juma Sustainable Development Reserve was the first step in realizing this project. This process began with several studies in the Project area conducted by different institutions (SDS, IPAAM, CI, ITEAM, INPA and UFAM) between April and May of 2005 with the goal of diagnosing biological and socio-economic aspects, the ethno-characterization of the landscape and the mapping of natural resources, archaeological sites and land tenure surveys. Public consultation meetings with local stakeholders and the publication of the Decree of the Creation of the Juma Sustainable Development Reserve in April 2006 followed these studies.

The development and implementation of the Reserve Management Plan includes identifying demands and implementing all the necessary measures to promote the conservation of natural resources and biodiversity and to promote sustainable development within the limits of the Reserve. The actions and investments will be based on a Sustainability Matrix, which is a tool developed by SDS (*Secretaria do Meio Ambiente e do Desenvolvimento Sustentavel do Governo do Estado do Amazonas*) for community actions to plan the construction of the production chain, in order to verify economic losses and gains.

The project envisages the following programs and groups of activities (pp. 6-7):

1. **Strengthening of environmental monitoring and control** by making improvements in the existing monitoring system managed by the local communities and by making large investments in the work of the environmental protection infrastructure and staff and the land titling agencies, as well as in advanced remote sensing monitoring techniques.
2. **Income Generation through the Promotion of Sustainable Businesses:** Community organization and business training will be combined to improve local capacity in forest management and forest product extraction. Research and development of new technologies will allow for innovation in the quality and types of products local communities produce. Furthermore, market development activities will be undertaken to improve market access. This combination should enhance the production of forest products from the local communities involved in the project.
3. **Community Development, Scientific Research and Education:** Education centers will be constructed to train and transmit scientific information to local communities in conservation efforts as well as to provide opportunities for the training of professionals specializing in biology, forest management, environmental education, etc. The involvement of local communities will only be possible through the existence of solid and active organizations, which are also necessary for organizing and strengthening local populations.
4. **Direct Payment for Environmental Services ("Bolsa Floresta" Program):** The communities will receive direct benefits for their contributions to conservation, such as access to clean water, healthcare, information, productive activities and other improvements in their quality of life. Furthermore, a portion of the financial resources generated by the project will be paid to traditional communities in the Juma Reserve for environmental services through the establishment of all four components of the "Bolsa Floresta" Program: i) Bolsa Floresta Family; ii) Bolsa Floresta Social; iii) Bolsa Floresta Association; and iv) Bolsa Floresta Sustainable Income Generation. This translates into concrete and direct benefits for some of the most marginalized and vulnerable populations, who are dependent on the forest for their survival.

As for capacity building, the Bolsa Floresta Program, which provides a monthly payment of R$50 (about US$ 30) per family, is made in the name of the female household head. This is done to support the social inclusion of women and provide them with an incentive to participate as equals in the family economy by

giving them greater control over financial resources. It is believed that women have a better understanding of their family situation and needs. Equal rights and opportunities will be provided to local people without consideration of their gender. If during the process of implementing the Reserve a need to promote gender equality is identified, then appropriate programs will be developed and implemented (pp. 103-104).

Actors' roles and responsibilities

The organisations that must be involved in the approval of the activities proposed by the Juma RED Project are (p. 70):

Agency/Institution	Function
Fundação Amazonas Sustentável (FAS)	Responsible for overall project coordination (p.3). FAS actions are focused on reducing deforestation, eradicating poverty, supporting social organizations, improving social indicators and generating income based on sustainable activities within Amazonas' Protected Areas (p. 58).
State Secretariat of the Environment and Sustainable Development of Amazonas (SDS)	Design and implementation of public policies for the environment and sustainable development; Coordinates the creation and establishment of new Protected Areas and implements and coordinates them through the State Center for Protected Areas (*Centro Estadual de Unidades de Conservação*, CEUC) and the CECLIMA (State Center on Climate Change.
Amazonas State Institute for Environmental Protection of (IPAAM)	Monitoring and Law enforcement
State Center for Protected Areas (CEUC)	Implementation and administration of the Reserves and related programs; Works closely with local communities, organizations and key stakeholders to implement the Protected Areas (p.4); Has developed indicators to verify the effectiveness of the implementation of the Protected Areas as well as a series of programs that are part of the process of implementing and monitoring Protected Areas, such as ProBUC, the Biodiversity and Natural Resource Use Monitoring Program in State Protected Areas of Amazonas (pp. 58-59).
State Center on Climate Change (CECLIMA)	Implementation of public policies and programs for climate change, development of mechanisms for payment of environmental services to guarantee financial sustainability of the Reserve, and monitoring of the dynamics of the carbon cycle within the scope of this project
Amazonas Land Institute (ITEAM)	Implementation of land titling activities in populated areas of Amazonas
Juma SDR Deliberative Council (*Conselho Deliberativo da RDS do Juma*)	Take part in decisions and contribute to planning

Others

- **The Institute for Conservation and Sustainable Development of Amazonas – IDESAM** *(Instituto de Conservação e Desenvolvimento Sustentável do Amazonas*) will be responsible for the technical coordination of the development process for the Baseline Methodology and Monitoring as well as the Project Design Document (PDD) (p. 7). IDESAM has been involved in climate initiatives with the Government of the State of Amazonas since its creation in 2004, and the work has a strong focus on conservation and climate change in the Amazon.
- **Mariott International, Inc.**: A partnership is being implemented with Marriott International exclusively for the Juma Reserve RED Project. An agreement exists between Marriott International and the Government of the State of Amazonas for the purchase of the RED credits (p. 45).

Community participation

The Juma Reserve RED Project was created to serve different demands. Local communities identified the creation of the Reserve as a way to protect their forests and to improve their welfare and quality of life. Throughout the process of creating the Juma Sustainable Development Reserve, there was participation by

all types of local residents, involved in many lines of work (fishermen, extractivists, farmers, ranchers, etc.). The process also included informal community associations (mothers, professors, artisans, etc.). (p. 53).

The stakeholders were informed verbally and the FAS website announced that the Project Design Document was available with the Head of the Reserve for reading and commenting. During all the process, the stakeholders had the opportunity to express their concerns about the project, and to support some actions and decisions. The meetings held with the communities were also a moment when the community, as the main stakeholder, could better understand and opine about the project. All comments from any stakeholder are taken into consideration and, if considered adequate by the project team, they are incorporated into it. In addition to these events, comments can be made and incorporated into the project during its planning and implementation stages (p. 98).

The local communities and stakeholders will be involved in the development and implementation of the Reserve's management plan, and in the management decisions regarding the Juma RED Project through its Deliberative Council (*Conselho Deliberativo).* The Deliberative Council is in charge of deliberating on the running of the protected area, and has the right to speak and vote on foreseen activities. The Deliberative Council consists of people who live inside the protected area (50% of the Council) and government and other organizations acting in the protected area. Its main roles include approving the budget for the protected area, following up and approving the management plan, and reporting on actions that may have significant impact inside and around the area (p. 56).

The Reserve Council is a judicial body for the management of a protected area that is constituted by law and has the final authority over decisions made regarding the Reserve. The Reserve Council comprises all the relevant local organizations and actors in the area of the Reserve, including representatives of the communities located within the reserve, municipal governments around the Reserve, government agencies and the local business community, with the presidency of the Council occupied by the State Center for Protected Areas (p.69, 98).

Project financing

FAS, the project proponent, has an initial endowment fund of R$ 40 million (about US$ 23 million) invested to generate funds for its activities. This endowment was created with donations from the Government of the State of Amazonas and private investors, who will provide additional funds for the operation of the Foundation (p. 64).

As an advance for executing initial project activities, Marriott International will make an initial deposit of US$ 2 million (approximately R$ 3.4 million) and FAS will contribute US$ 294,117 (R$ 500,000), to be spent from 2008 to 2011. In addition, the Government of the State of Amazonas already disbursed US$ 105,471 from 2005 to 2007 develop the project. By the end of the period 2008 to 2011, the Government of Amazonas will disburse US$ 469,175 for project activities (p. 65).

All the carbon credits generated by the Juma Reserve RED Project belong to FAS, and afterwards will be sold to Marriott International. This relationship of carbon rights will remain the same through to the end of the project (p. 87).

Based on the current contract signed by the Government of Amazonas, FAS, and Marriot International, Marriot International will purchase the RED credits generated by the Juma Project at a price not less than US$ 1 per ton of CO2. The Juma RED Project is expected to generate more than US$ 189 million by 2050 through the sale of RED carbon credits. The base price for the initial carbon credits will be negotiated, to guarantee the financial sustainability that the project requires to achieve its environmental and social objectives.

An endowment fund will be created to guarantee project sustainability. Endowment funds are received from a donor with the restriction that the principal is not expendable. The FAS Administrative Board is in charge of approving the Investment Objective and Policy, which drive the portfolio decisions (pp. 73-74,p.115).

Benefit sharing

The carbon credits belong to FAS as a result of the environmental services management, a right legally transferred to FAS through Law No. 3135 and the Decree No. 27.600.

A share of the Project's financial resources will be allocated to direct payments for environmental services to traditional communities that live in the Juma Reserve through the establishment of the Bolsa Floresta Program components: i) Bolsa Floresta Family; ii) Bolsa Floresta Social; iii) Bolsa Floresta Association; and iv) Bolsa Floresta Sustainable Income Generation. These programs deliver concrete and direct benefits to some of the most marginalized and vulnerable local populations, who are dependent on the forest for their survival (p.42).

The communities net benefits were estimated based on the Sustainability Matrix (SDS, 2006) designed by the State Secretariat for the Environment and Sustainable Development of Amazonas. It consists of 27 different socio-economic indicators considered of great importance in community development. Through the matrix, the local population identifies the actual conditions of the community for each one of the issues, such as education, housing, health, energy, trash collection, water, sewage, environmental monitoring, etc. – on an evolving line of development, moving from a critical situation to a desired condition, and all the necessary measures to improve on every line (p. 93).

The following table describes how the project is designed to operate regarding the different issues of community development, based on the Sustainability Matrix model, showing how the net community benefit is expected to be positive (pp.95-97).

Area	Situation without the project	Program/Activity	Budget US$	Organization
Education	Access to school (1^{st} to 4^{th} grades)	Creation of 3 schools according to the communities' needs, development of pedagogic materials, and support for teachers	398,176	FAS
Housing	Precarious houses	**Bolsa Floresta Social / Bolsa Floresta Family** The families will have more resources to invest in their houses	522,353	FAS
Health	No access to basic health treatment	Medical support, capacity building and support for health agents	68,824	FAS
Energy	No access to energy	Investment in solar energy system technology in the new schools	23,471	FAS
Water	No water treatment	Pro-chuva program will improve rain water storage and treatment	70,588	CEUC
Personal Documentation	People have a birth certificate	The Bolsa Floresta Program will provide the lacking personal documentation	11,765	FAS
Social Organization	Informal groups and community organizations	**Bolsa Floresta Association** The Program stimulates social organization	44,471	FAS
Communication	Isolated	Creation of Communication Bases	88,235	FAS
Networking	Inter-communities networking	**Bolsa Floresta Association** Strengthening of grassroots organizations and cooperatives	47,059	FAS
Lake Management	Lack of lake management rules	**Management Plan** Investment in community development, as well as ProBUC biodiversity monitoring in lakes	32,941	FAS/ProBUC
Aquiculture	Inexistent aquiculture	**Bolsa Floresta Renda** Fish Farming Kits	35,294	FAS
Family-based Agriculture	Subsistence/Harvest surplus done with low level technologies	Increase of productivity by developing new techniques, through technical assistance	16,518	FAS

Emissions and removals with and without project

Based on the baseline scenario for the project area, the project expects to prevent the deforestation of about 329,483 ha of tropical forests that would release 189.767 MtCO2 (p. 6).

Current carbon stocks at the project site(s)

The sources used to define the carbon stocks in the vegetation classes of the project are derived from MCT

(2006) and Nogueira *et al.* (2008), based on the RADAMBRASIL Project (1978) (p. 17).

The RADAMBRASIL Project was a government program carried out between 1973 and 1983, which installed 2,719 sample plots in the Brazilian Legal Amazon for biomass inventories. Of these plots, 13 were located inside the Juma Project boundaries. The measurements that were taken in each plot to calculate the biomass of the different forest phyto-physiognomies included all trees with a Circumference at Chest Height (CCH) greater than 100 cm (i.e., a Diameter at Chest Height (DCH) greater than or equal to 31.83 cm). The composition and structure of the forest inventories of the sampled plots are described in RADAMBRASIL, which details (i) all the *taxa* at least up to *General* level; (ii) the bole volume per class of CCH of trees > 100 cm; (iii) the frequency and abundance of each *taxon*; and (iv) a phyto-sociological analysis (p. 17).

Although there is consensus for using RADAMBRASIL phyto-physiognomy classification for the Amazon forests, there exist differing opinions about the estimates for the biomass stocks that should be used to calculate the total amount of carbon existing in the Brazilian Amazon. Until recently, the values provided by the First Brazilian Inventory of Anthropogenic Greenhouse Gases Emissions (*Primeiro Inventário Brasileiro de Emissões Antrópicas de Gases de Efeito Estufa*) (MCT, 2006) were considered the most reliable data. However, since the publication of the Brazilian Inventory in 2006, the scientific community has made significant advances to improve the carbon stock estimates for biomass and for carbon in the Amazonian forest. Among this work, it is worth mentioning NOGUEIRA *et al.* (2005, 2006, 2007, 2008a,b, c), which inventoried 602 additional trees for Central Amazonia (Nogueira *et al.,* 2005) and Southern Amazonia (Nogueira *et al.,* 2007), and in which details of the study area and correction procedures are described. The estimates of Nogueira *et al.* (nd, p. 8) and MCT (2004, p. 23) both used the allometric equation from Higuchi *et al.* (1998) from the Central Amazon, to calculate bole biomass of tree datasets from the RADAMBRASIL Project (the trees inventoried had a CCH > 100 cm, or 31.7 cm DCH), as follows (p. 19):

$$5 < DCH \geq 20 \text{ cm}$$

$$\textbf{ln(fresh mass)} = -1.754 + 2.665 \times \ln(\text{diameter})$$

$$DCH > 20 \text{ cm}$$

$$\textbf{ln(fresh mass)} = -0.151 + 2.17 \times \ln(\text{diameter})$$

However, the carbon stocks considered in the biomass estimates of Nogueira *et al.* (nd) combined allometric equations and inventoried wood volume in order to adjust the biomass estimates for different types of Amazonian forests. A new biomass equation was developed from trees harvested on relatively fertile soils in the Southern Amazon and new bole-volume equations were developed from trees in dense and open forests. These allometric relationships were used to assess uncertainties in previous estimates of wood volume and biomass.

In the case of the usual biomass model, based on inventoried wood volume, the study evaluated whether the factors currently used to add the bole volume of small trees (volume expansion factor) and the crown biomass (biomass expansion factor) are adequate for the biomass conversion. To assess the performance of the equations developed in the study as compared to previously published models, Nogueira and colleagues used the deviation (%) between the directly measured sum of the mass of the trees and the mass as estimated by each of the previous equations, both for sampled trees and as an extrapolation per hectare. Finally, all corrections were applied to generate a new biomass map for forests in the Brazilian Amazon from the RADAMBRASIL plots, and the biomass stocks by forest type were calculated for each of the nine states in the Brazilian Legal Amazon.

For the MCT (2006) biomass and carbon estimates, the sum of the carbon from all trees was divided by the area of the sample plot. Then, a correction was applied for the carbon content to include the trees with a DCH less than 31.7 cm, according to a Meira-Filho personal communication of a circumference histogram. For the below ground biomass, an expansion factor of 21% was then applied, as suggested by the authors. (pp. 18-19).

The table below provides the different carbon stocks estimates according to the various published sources, and comparing with the default values for tropical forests provided by the IPCC GPG for LULUCF. The carbon pools considered for the project are the same used by the studies of MCT (2006) and Nogueira et al.

(2008), as described in the table below: (i) above ground live biomass, (ii) dead wood, (iii) litter, and (iv) belowground biomass. (pp. 19-20).

Author	Forest type	Above Ground Biomass		*Below Ground Biomass Tons of C/ha*	*Total Biomass Tons Author Forest type of C/ha***
		Live Biomass Tons of C/ha	Dead Biomass Tons of C/ ha*		
Nogueira et al	Ombrophyllous Dense Alluvial Forest	127.71	15.69	29.55	**172.95**
	Lowland Ombrophyllous Dense Forest	136.09	16.72	31.49	**184.30**
	Submontane Ombrophyllous Dense Forest	136.39	16.76	31.56	**184.71**
MCT	Ombrophyllous Dense Alluvial Forest	115.28	0.00	24.21	**139.49**
	Lowland Ombrophyllous Dense Forest	115.28	0.00	24.21	**139.49**
	Submontane Ombrophyllous Dense Forest	112.21	0.00	23.56	**135.77**
IPCC Default Value for Tropical Forests		**131.00**			

** Dead biomass includes both dead wood and litter*
*** Except Organic Soils Carbon*

Although the IPCC can be considered the most conservative data among the three compared sources, these values underestimate the carbon stock values for the Amazon forests as they were generated through an average of different tropical forests in many regions of the world. Thus, as Nogueira et al. (2008) and MCT (2006) provide credible and "onsite specific" values for the existing types of vegetation in the project area, they were preferred rather than the IPCC default values. As a conservative approach, a mean average from both sources to estimate the carbon stocks in the forest classes present in the project area is used (p. 20).

The Lowland and Submontane Dense Forest classes were grouped into a single category of carbon density, defined only as "Dense Forest." This value was obtained by the arithmetic mean of both values (Lowland and Submontane carbon stocks), resulting in the final value per author. This procedure was done on both the Nogueira and the MCT values.

Afterwards, to define the final carbon stocks by vegetation types inside the Juma project boundaries, an arithmetic mean was calculated for each carbon estimate from the different authors. The values are shown in the following table (p. 21).

Forest type	Above Ground Biomass		*Below Ground Biomass* Tons of C/ha	*Total Biomass* Tons Author Forest type of C/ha**
	Live Biomass Tons of C/ha	Dead Biomass Tons of C/ ha*		
Alluvial Forest	121.50	7.84	26.88	**156.22**
Dense Forest	124.99	8.37	27.70	**161.06**

** Dead biomass includes both dead wood and litter*
*** Except Organic Soils Carbon*

It is important to mention that these values are "ex-ante" carbon estimates, and will be validated and adjusted "post-facto" through the forest inventories that will be carried out as part of the monitoring plan before the first project verification (p. 21).

The calculation of the carbon stocks of the Juma Reserve by vegetation type inside the project boundaries is presented in the table below (p.21):

Type of Forest	Carbon Stocks(tC/ha)	Area(hectares)	Total(tons of C)
Alluvial Forest	156,22	3,603	562,860.66
Dense Forest	161,06	469,074	75,549,058.44
Total		**472,677**	**76,111,919.1**

Business as usual (BAU) scenario

The most advanced simulation models indicate that in the coming decades the State of Amazonas will see a rapid increase in its deforestation rates. SimAmazonia I, a deforestation simulation model developed by a consortium of research institutions and published in *Nature*, indicates that in the coming decades the State of Amazonas could lose up to 30% of its forest cover by the year 2050 (BAU scenario). This will emit more than 3.5 billion tCO2.

According to the SimAmazonia I model, the region located in the municipality of Novo Aripuanã is extremely vulnerable to deforestation. The paving of highways could cause the complete loss of large extensions of forest by the year 2050 under BAU. The lack of roads connecting Amazonas to other regions of Brazil is one of the major reasons for the State's low deforestation rates (STONE, 2007). However, the dynamics of an expanding deforestation frontier, a low supply of timber for exploitation, and the consolidation of agriculture and cattle production in other states in the Amazon increases migration and, consequently, the conversion of its forests. Year after year, the areas with historically high rates of deforestation are advancing towards the State of Amazonas.

The projections of SimAmazonia I forecast eight scenarios for the entire Amazon in 2050, including the BAU scenario. The BAU scenario, with low government intervention, projects deforestation trends across the Amazon basin. It is based on historical deforestation rates, and adjusts for the effect of macroeconomic drivers such as the planned paving of roads, growth in cattle and agricultural production, population growth and other similar factors.

The other seven scenarios include an increase in governmental activity. These scenarios are more optimistic and consider the paving of roads as also leading to a gradual increase in the government's influence and law enforcement in the region. In the BAU scenario, the paving of roads follows a pre-determined program and the resulting deforestation effects are empirically estimated using data analyzed at the municipality level from PRODES (INPE, 2008b) (SOARES-FILHO et al., 2006). Specifically, the southern region of Amazonas and the municipality of Novo Aripuanã, and the pavement of highways BR- 230 (Trans-Amazonian Highway) and BR-319 (between Manaus and Porto Velho) will have a large role in determining the incursion of deforestation into the Juma RED project area (p. 31).

In the absence of the project, the most likely scenario for the Project area would be the deforestation of 62% (366,151 ha) of the Reserve, resulting in the release of 210,885,604 tCO2 by 2050 (p. 33).

Leakage

Recent studies on deforestation dynamics indicate that the single measure of creating a Protected Area promotes reduction of deforestation in the surrounding areas. This effect was observed in the great majority of the protected areas created in the Brazilian Amazon, and the offsite "reduction of deforestation" that was generated varied from 1 to 3% of the size of the PA (IPAM, 2008). For this reason, it is considered that the implementation of the Juma RED Project will not result in negative leakage, but rather a "positive leakage" since there will be a reduction in deforestation rates outside of the Reserve (p. 84).

Monitoring

1. Baseline monitoring

The baseline scenario will be monitored through an assessment of the driver variables and assumptions of SimAmazonia I to project deforestation under BAU. The parameters will be re-validated after each *crediting period* (every 10 years), based on the calculation of the verified *post facto baseline deforestation* of the past 10 year period – in comparison with other locations not affected by the project activities. If deforestation is verified as 10% lower or 10% higher than originally predicted, the *post facto carbon baseline* shall be re-adjusted using the observed values of the driver variables.

2. Project monitoring

The monitoring of the project involves 4 tasks:

2.1 Monitoring of project implementation

The implementation of the project activities and programs will be monitored by FAS and the Government of Amazonas, based on annual reports that will be made available by FAS as the main implementing institution (p.185).

2.2 Monitoring of land-use and land-cover change

The monitoring of land-use and land cover change will be made through the integration of (1) remote sensing analysis for identification of deforestation locations and pressures (based on PRODES, INPE), and (2) *in situ* actions to enforce the law and prevent deforestation and illegal logging inside the project area. This strategy will be made through cooperation between FAS, the Amazonas State Institute for Environmental Protection (*Instituto de Proteção Ambiental do Estado do Amazonas* – IPAAM) and its Special Group for Combat Against Illegal Crimes (GECAM) (p.186).

2.3 Monitoring of carbon stocks and non-CO2 emissions

The overall monitoring strategy comprises the following four components (pp. 86-87):

a) **Monitoring by satellite by the National Institute for Space Research (INPE).** INPE has developed the most advanced deforestation monitoring system in the world (with a resolution of 812 m2). INPE makes its images available to the public, and, through the use of this system, FAS, in addition to any interested citizen, is able to monitor deforestation using the data available on the INPE website. (http://www.obt.inpe.br/prodes/index.html)

b) **Monitoring of the carbon dynamic and forest carbon stocks.** A partnership between FAS/SDS and the National Institute for Amazon Research (*Instituto Nacional de Pesquisa da Amazônia*, INPA) will be established. This partnership will involve the development of analytical studies to quantify the carbon flux and carbon stocks of the different reservoirs of biomass in the forest, including aboveground and belowground biomass, leaf litter, fine woody debris, coarse wood debris and soil carbon.

c) **Participatory Monitoring "in loco" (SDS-ProBUC/IPAAM):** ProBUC is a system for monitoring natural resources and biodiversity that is being implemented in the State protected areas. The premise of this program is to involve local communities in monitoring as a way to increase local conservation awareness and to make monitoring more efficient. It also serves to give local communities a sense of responsibility for maintaining the integrity of local ecosystems upon which their livelihoods depend. This program will be implemented in the Juma Reserve starting in 2009.

d) **Surveillance Program**: The surveillance program aims to involve the communities in mapping the threatened areas, identifying the risks which they are exposed to and identifying which risks are the most aggressive. Then, control measures will be implemented by the managing institution to guarantee the control and protection of these areas, with the support of the IPAAM.

2.4 Monitoring of large natural disturbances

The monitoring of natural disturbances will be made through the analysis of PRODES satellite images and also directly in the field (p.188).

3. Leakage monitoring

Although leakage from the project implementation is not expected, deforestation will be monitored in all the surrounding zone of the project (leakage belt) (p.188).

Reporting

In order to avoid the loss of information, FAS will adopt a project implementation process in which annual reports will be prepared by every monitoring program and any corrective actions (i.e., to resolve conflicts or apply suggestions) taken by the team will be documented immediately following the execution. Every member of the project will be aware of how to document the actions taken in the project and how to forward

it to the Project Coordinator, who will keep track of this information and use it when necessary (p. 72).

All the activities developed by FAS and SDS/CEUC related to the Protected Areas in the State of Amazonas are documented through written reports, including activities such as awareness raising, expeditions for inventories, community meetings, training workshops, zoning workshops, management planning workshops and land use mapping workshops. This documentation method will also be applied to all the activities to be implemented within the scope of the Juma RED Project. All of these reports will be made available on the Internet on both the SDS and FAS websites.

The dissemination of general information provided by the project will be achieved through the participation of team members in scientific and general events, both nationally and internationally, related to environmental conservation, climate, and sustainable development. The team will also publish articles in scientific journals and in the popular media. Furthermore, the project will develop a series of pamphlets, brochures and reports to document and disseminate the lessons learned by the project inside and outside the project boundaries. Other dissemination activities include making presentations at schools, universities and promotional events. The team will also be involved in exchange programs in which communities and local stakeholders participate, allowing the successful replication of project activities elsewhere (p. 75).

Verification

Throughout the crediting period there will be periodic certifications performed by an accredited Climate Community and Biodiversity certifying organization. These certifications will verify that the carbon remaining in the Reserve is in keeping with the values expected at the start of the project. These certifications will be performed one year after obtaining the initial validation and every two years thereafter (p.52).

Baseline verification

The corresponding emissions and stocks are subject to change on two occasions:

1. After the first verification period and the new vegetation carbon stocks are defined;
2. In 2016, ten years after the start of the project, when the baseline will be revised.

Even though the baseline estimation is considered robust and conservative (CAR 09), there are uncertainties that can affect the generation of carbon credits. As a measure to deal with the model's uncertainties the baseline will be re-validated at the end of each "baseline assessing period" (10 years). At this time, if the baseline deforestation is verified as different than predicted (based on parameters defined by the model, as described in Annex XIII), the emission reductions for the previous period shall be recalculated.

If baseline deforestation is verified as lower than the originally predicted, the project shall discount the respective amount of Verifed Emissions Reductions (VERs) from the next "baseline assessing period". If baseline deforestation is verified as higher than the originally predicted, the project will be able to issue the respective amount of VERs for this period (p. 81).

Risks and risk management

Risks to the Juma Sustainable Development Reserve Project and Risk Mitigation Plan (p.53)

Type	Risk Category	Risk	Consequences	Mitigation
Climate	Short Term	Increase in deforestation rate	• risks for forests, biodiversity, community and climate • project carbon accounting will be decreased, affecting the project funding structure • investors can lose interest in the project, risking contracts	• introduce early capacity building and training for local environmental agents • increase deforestation monitoring and control activities • maintain 10% of carbon stocks in the project area as a

				buffer
Climate	Long term	Extreme natural events (such as heavy droughts, fires, etc.)	• forests are more susceptible to fires, many forest species are vulnerable to increases in temperature and decreases in humidity and other changes in microclimatic conditions	• invest in scientific research of forest dynamics • monitor local climate features, hydrological and forest dynamics, and biodiversity • keep 10% of carbon stocks as non-permanent buffer in the project area • keep a portfolio of other projects that reduce emissions from deforestation as reserve "buffer"
Community	Short term	Diseases affecting the population	• e.g., a malaria outbreak can cause people in the communities to leave the area	• invest in prevention (health clinics, health agents, medicine, mosquito nets, mosquito control)

As a mitigation measure to guarantee that the offsite carbon stocks will not decrease, the project will commit to an investment of at least 10% of the annual budget generated through the sales of RED credits (p.84).

The project is not expected to have negative social impacts on the communities outside of the Juma Reserve. However, the implementation of the Juma RED Project includes mapping the local stakeholders who have some relationship with the Reserve, such as the proximity of their villages to the Reserve, commercial relationships with the Reserve's inhabitants or the use of the Reserve's natural resources. This process seeks to understand such relationships, in addition to understanding relationships between the local inhabitants and the outside areas, municipalities, surrounding environment, etc. This mapping process will be associated with the same monitoring and surveillance programs applied to the Reserve area to generate critical input to avoid and manage negative impacts to offsite communities, such as illegal logging, deforestation etc.

If a negative impact is identified, the Reserve management team and the Deliberative Council, in which the offsite communities also have representation, will address such problems with fast and effective solutions. It is also worth reiterating that the areas and communities adjacent to the Juma Reserve will benefit from the conservation and sustainable use of natural resources that will be promoted by the project to avoid potential negative impacts. There will be 12 communities outside the Reserve limits also included in the Bolsa Floresta Program. Since it promotes development within the communities through all the benefits offered by the program, it avoids negative impacts such as immigration, leakage of deforestation or any grievance with other communities (p.101).

The only negative impacts that could be caused by the project implementation can be summarized as loss of productive plantation area caused by the limitation of deforestation to shifting agricultures, as a part of the Bolsa Floresta Program implementation. To manage that issue, the Bolsa Floresta Program has three other sub-programs in order to increase productivity and effectiveness and diversify the activities based on sustainable development. The Bolsa Floresta monitoring program will also annually monitor this issue (p.102).

Progress and plans

- Management plan

In March 2010, the management plan of the Juma reserve was approved after the council deliberated on the matter and consulted the public (Juma's Rainforest Report April, 2010).

- Communities benefits

A large electrification project is being finalized in April 2010 in 29 different communities of the Juma Reserve (Juma's Rainforest Report April, 2010).

The two other schools that were planned in the Project Design document were finished at the end of March

(Juma's Rainforest Report April, 2010).

- Bolsa Floresta Program

The Bolsa Floresta Program is up and running in Juma as well as 13 different Conservation Units (Protected Areas) and has 4 components: income, social, family and association (Juma's Rainforest Report September, 2009).

- CCB Status

PDD Submitted to CCB(Sep 29,08)

Validation Approved - CCB Standards First Edition Gold Level (Sep 30, 08)

Links:

Project-related documents

CCB-Validation Report (2008, September 30)

FAS website

About Juma: Marriot Newsletter

Juma's Rainforest Report August 2009

Others

· *REDD-Monitor 20th May 2010,Chris Lang, New Frontline video: 'The Carbon Hunters'*

· *PLANET ARK Nov. 25 2009, S.Grudgings, 'Amazon Forest Schemes Await Strong Climate Pact*