

INSTITUTIONAL ARRANGEMENTS FOR FIRE MANAGEMENT IN THE BRAZILIAN  
AMAZON

By

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To my family, friends, professors and to all those who love the Amazon, and understand that we,  
humans, are just part of nature

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Fire is a very important element in the agricultural production systems used all over the world. It is through the use of fire that large areas of tropical forests are burned each year, opening space for the establishment of new pasture and agricultural fields. In the Brazilian Amazon, more than 15,000 km<sup>2</sup> per year of forest biomass have been burned and converted into crop fields and pastures in the last decade. In spite of its importance as an accessible landscape transformation tool, sometimes farmers lose control of the fire, causing losses, which have ecological, economic and social consequences. To avoid the losses associated with accidental fires, government and civil society have been carrying out different actions such as new legislation, as well as regional and local programs.

In this study I analyzed some of those experiences developed in the Amazon that tried to decrease the numbers of accidental fires within rural regions. Specifically, the research focused on the contributions of institutional arrangements for fire management based on a project carried out at Flona-Tapajós. The analyses indicate that institutional arrangements can contribute to cope with the problem of accidental fires by increasing the numbers of techniques and recommendations farmers apply to avoid accidental fires, and by increasing the number of farmers applying each technique. However, the process of building institutional arrangements

needs to be both participatory, requiring strong involvement of the users of fire, and adaptive, so that farmers can try to improve the use of techniques from year to year, and they can modify the rules of the arrangements when they understand it to be necessary. The process of building institutional change needs to empower local people so that they can decide year-to-year what techniques and recommendations are important to be applied, considering the changes that might occur within the communities.

## CHAPTER 1 INTRODUCTION

Fire is the most reliable and least expensive means of converting forest biomass to agriculture and pasture fields. Because of that, fire is a universal tool in rural Amazonia, extensively used by small, medium and large farmers throughout the region. Although its benefits are very important for the land uses that are part of the regional economy, much research has called attention to the problems associated with this practice. One of these problems is escaped fire. In Brazil, every year, cattle ranching and swidden agriculture are sources of ignition to forest fires (Ray, Nepstad and Moutinho 2005) that generate economic, environmental and social damages.

After the accidental fire that occurred in the Brazilian state of Roraima in 1998, significant actions were implemented in the region focusing on the problem and risks of large accidental fires. These actions were carried out by the federal and state governments and by other organizations of civil society. At the federal government level, one important action was the regulation of fire use for agricultural activities through decree No 2661. Besides new legislation, other projects and programs were carried out in Amazon with the goal of decreasing accidental fires such as PROTEGER, PDA/PADEQ and *Roça Sem Queimar* project. According to Nepstad et al. (2001), long-term reduction of Amazon fire, and thus its substantial costs to society, can happen through investments and policies that stimulate permanent agriculture and forest production. However, they are needed in rural regions at the local level, in communities of small farmers, but also for medium and larger producers who still use fire to manage their properties.

### **Research Objectives**

This thesis discusses the contributions of institutional arrangements for fire management in the Amazon through an analysis of an action research project for fire management developed in

at Tapajós National Forest (Flona-Tapajós), a protected area located in Pará, Brazil. This project contributed to the establishment of fire management agreements to avoid accidental fires. This thesis had two main objectives:

to understand the contributions of institutional arrangements for fire management in the Amazon, based on a analysis of the project carried out within Flona-Tapajós; and

to discuss the importance of local participation and partnerships to build an action research project, as well as the effectiveness of the institutional arrangements for fire management.

### **Research Site**

This research was carried out at the Tapajós National Forest, a 600,000 hectares protected area located in the State of Pará, Brazil, where a project was developed through a partnership between an NGO and rural communities of Flona-Tapajós with the ultimate goal of decreasing accidental fires within the protected area.

### **Research Methodology**

In 2007, a survey was carried out within the protected area to analyze the level of compliance with the rules established in the fire agreements, and how the communities were using the agreements. To do this analysis, two sources of data were used: (a) an assessment carried out in 2001 within 11 communities of Flona-Tapajós, where 71 families were interviewed at the beginning of the project; and (b) surveys carried out in 2007 in 4 communities, where 53 families were interviewed. The communities interviewed were Prainha II, Paraíso, Chibé and Piquiatuba. I also used my experience as part of the NGO's staff that carried out the project within Flona-Tapajós, discuss the partnerships and local participation in the research project.

### **Organization of the thesis**

The thesis has four main chapters. Chapter Two reviews and discusses the use of fire in the Amazon together with the problems associated with this practice. In addition, it presents attempts by governments and civil society to decrease the number of accidental fires in the Amazon. At

the federal government level, one important action was the establishment of fire legislation. It was established in 1998, after the big accidental fires in Roraima. Although the legislation meant that the federal government recognized accidental fires as a problem in the Amazon, it recommended procedures very difficult to be put into practice by farmers. The need to obtain authorization to burn is one example. Other regional programs carried out by NGOs were effective in increasing the concerns of rural leaders for environmental issues, and in promoting the exchange of information among farmers in the Amazon, but there is no clear information about the contribution of those programs to an actual decrease in accidental fires.

Chapter Three discusses the contributions of institutional arrangements for fire management in the Brazilian Amazon by analyzing the rules established by the families, and the farmers' compliance with those rules, in a fire management program. The case of Flona-Tapajós shows that institutional arrangements can positively contribute to addressing the problems of accidental fires. However, the process of building institutional arrangements needs to be adaptive so that farmers can improve the use of techniques from year to year, and change the rules when they deem it necessary.

Chapter Four discusses the importance of local participation and partnerships in building an action research project and ultimately, the effectiveness of the institutional arrangements that were developed during the fire management project at Tapajós National Forest. The case of Tapajós National Forest shows that the engagement of many different stakeholders present several challenges. It takes time, resources, continuous debate of interests and goals and constant adaptation, but the openness to participation by different stakeholders ultimately resulted not only in the execution of the action research project, but more importantly, in the achievement of the main goal of the partnership itself: the reduction of accidental fires at Flona-Tapajós.

Secondly, the chapter analyzes the relationship between the number of people participating in the process of formulating local agreements at Tapajós National Forest and the level of compliance with the fire management agreement rules. The results indicate that there is no significant difference in the average number of rules applied by the families of communities with high level of attendance in comparison to the communities that had lower levels of attendance at the meetings to formulate fire agreements. However, while at the community level, numbers did not seem to be decisive for the success of the initiative, the engagement of different stakeholders and their participation in different moments, seems to have contributed to legitimating the project and thus, contributing to the achievement of the partnership's main goal, which was the reduction of accidental fires.

Finally, Chapter Five presents the conclusions of this research. It indicates that the attempts to build the participatory action research not only contributed to the execution of the project, but were also fundamental to the effectiveness of the institutional arrangements for fire management that were developed during the project at Tapajós National Forest. Thus, the case of Tapajós National Forest shows that a partnership between an outsider organization and the families increased the concern of the people regarding fire, and that local participation is not just simply desirable for fire management, but rather is a requirement. Without involving the users of fire in the processes of looking for solutions to accidental fires, desirable results cannot be achieved, because the farmers are the ones that ultimately are going to use fire, deciding which techniques and recommendations to use to avoid accidental fires. Just as important, the results of this research indicate that it is possible to develop partnerships that involve both outsiders and locals and thus to contribute to conservation initiatives in ways that do not ignore the needs of the local people.

CHAPTER 2  
THE USE OF FIRE IN THE AMAZON: IMPORTANCE, PROBLEMS AND ATTEMPTS TO  
DECREASE ACCIDENTAL FIRES

**Introduction**

Fire is a very important element in the agricultural production system used all over the world. It is through the use of fire that large areas of tropical forests are burned each year opening space for the establishment of new pasture and agricultural fields (Conklin 1954; Nepstad, Moreira and Alencar 1999; Ickowitz 2006; Vayda 2006). In the Brazilian Amazon, which holds the largest tropical forest of the world, about 18,000 km<sup>2</sup> per year of forest biomass have been burned and converted into crop fields and pastures in the last decade (INPE 2008). The distribution of fire in the region follows the spatial pattern of the roads and deforestation, defining the area where the agriculture frontier is being established (Wood 2001). This area known as the Arc of deforestation or Arc of fire (Figure 2-1) has been a major focus of government and non-government intervention in relation to fire prevention and control.

The high occurrence and frequency of fire hot pixels in the Brazilian Amazon indicate that it is a tool being widely used by small, medium and large farmers and producers in the region. The popularity of fire in the Amazon production system is associated with the relative low cost of burning and short terms benefits associated with it. In spite of its popularity and benefits to rural producers, there are several risks associated with the use of fire in the Amazon. Fire can easily spread and escape from its intended area, affecting neighboring areas and land uses. Accidental fires can promote damage and loss of infrastructure, agricultural systems, pasture fields and forests resources, which can stimulate more extensive and unsustainable land use practices (Nepstad, Moreira, and Alencar 1999).

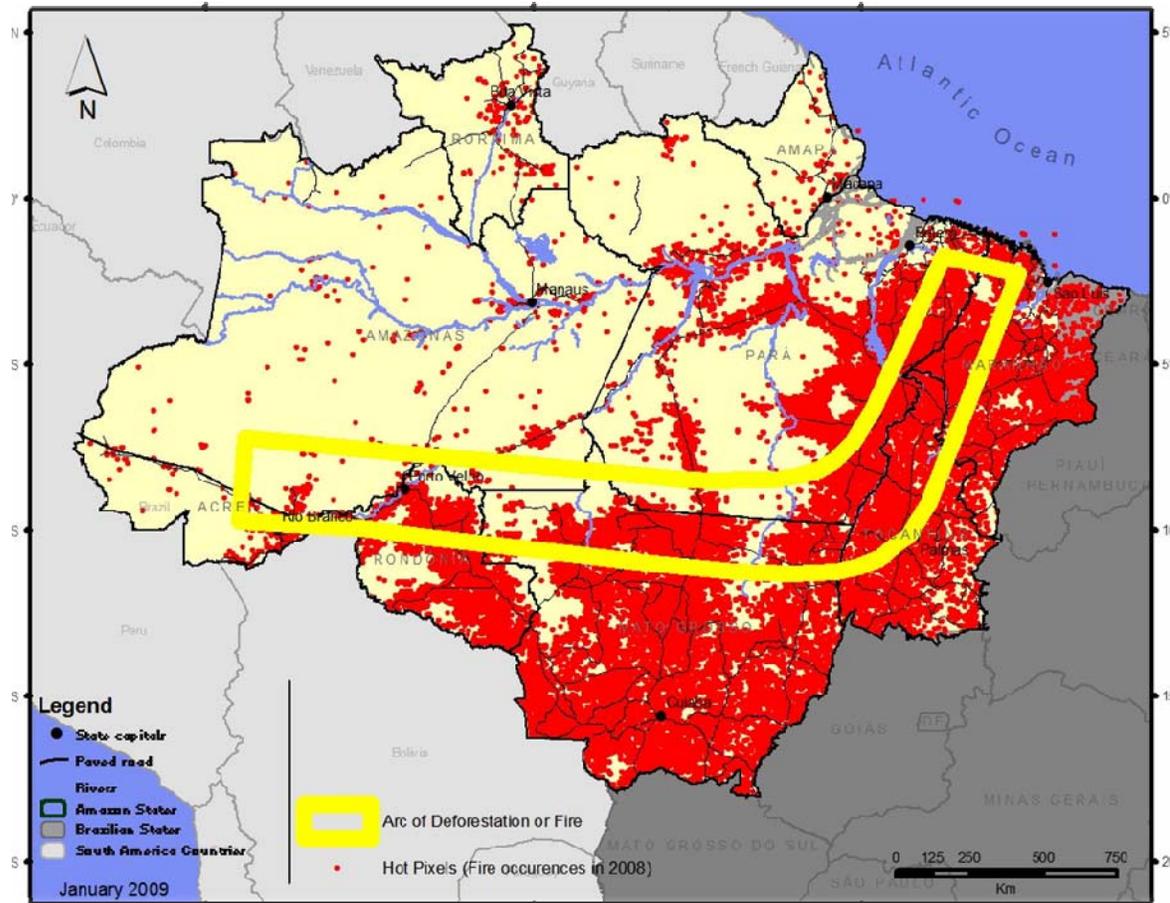


Figure 2-1. Distribution of fire hot pixels in 2008 in relation to the Amazon Arc of Deforestation and Fire.

The risks of escaped or accidental fires are likely to increase in a future of warmer climate and population growth. These two elements are expected to affect the flammability of the vegetation and increase the sources of ignition, respectively, causing more accidental and recurrent fires (Cochrane 2003). In fact, there is already an indication that dense forest is losing its resistance to fire due to the disturbances promoted by human activities in forest areas (Alencar, Nepstad and Diaz 2006; Nepstad et al. 1999). These disturbances associated with extreme drought events have caused large-scale burns (Alencar et al. 2004; Aragão et al. 2008). In the last two decades alone the Amazon suffered large-scale accidental fires such as the one in 1998 in the state of Roraima and the one in Acre in 2005 (Aragão et al. 2008; Barbosa and

Fearnside 1999). Both events represented a benchmark that called the attention to the issue of fire in the Amazon. Both government entities and other organizations started several reactions and initiatives to decrease fire use, and to prevent and control accidental fires in the region.

In this chapter I discuss the use of fire in the Amazon together with the problems associated with this practice. In addition, I present some of the attempts by governments and civil society to decrease the number of accidental fires in Amazon. The chapter is organized in two parts. In the first I focus on the importance of fire for agriculture, and the problems associated with this practice. In the second part I discuss some attempts by the government and other organizations, at different scales, to decrease accidental fires within the region. The most important Brazilian legislation about fire was established in 1998, after the big accidental fires in Roraima. Although the legislation meant that the federal government recognized accidental fires as a problem in the Amazon, it recommended procedures that are difficult to be put into practice by farmers. The need to obtain authorization to burn is one example. Other regional programs carried out by NGOs are effective in increasing the concerns of rural leaders for environmental issues, and in promoting exchange of information among farmers in Amazon, but there is no clear information about the effect of those programs to decreasing incidence of accidental fires.

### **The Importance and Problems Associated with the Use of Fire in Amazon**

Fire is part of the system of production of four million rural people in Amazonia (Nepstad et al. 2001). One of the main economic actors in the region that uses fire as an important agricultural tool is the small farmer. According to data from the *Instituto Brasileiro de Geografia e Estatística* – IBGE (Brazilian Geographical and Statistical Institute) there are more than 600,000 small farmers in the Amazon (Almeida, Souza, and Rodrigues 2006:155). These farmers own land parcels smaller than 100 hectares, and have production systems based on the family labor force. The average size of their fields is around 1 to 3 hectares per year (Walker and

Homma 1996). They represent 70% of the total rural population of Amazon, and are responsible for 36% of the agricultural Gross Domestic Product of the region (IBGE 1998; Vosti, Witcover, and Carpentier 2002). These families use fire as an agricultural tool to prepare and manage fields for crops and grazing. In general, farmers consider fire practical, cheap, and quick. In fact, almost none of them have the economic means and/or knowledge to use alternative techniques or to implement alternative agricultural systems that do not need fire for maintenance. Besides, most of these farmers live in areas of poor soils, where forest is still abundant and land is usually cheap. The labor available is from their family and they have little capital to start alternative systems of production. In such conditions, fire represents the most viable alternative to provide nutrients to the soil through the combustion of forest biomass in ash-fertilized fields, being the perfect substitute for fertilizers, pesticides and machinery (Nepstad et al. 2001: 395). Following this logic of fire use in the Amazon, there are several benefits and costs associated with this practice that can directly or indirectly affect farmers. These benefits include: conversion of forest biomass to nutrients, decrease in the costs of production, control of diseases and weeds, and use of available technology and knowledge. The costs, known as impacts, include: soil impoverishment, CO<sub>2</sub> emissions, air pollution through smoke, and the risk of accidental fires (Table 2-1). These impacts vary in the scale and in the way they affect users of fire, as well as the time frame in which they feel the consequences of this activity. In general, most of the positive impacts directly affect the fire user, in a very short time period (Table 2-1). On the other hand, most of the negative impacts or costs associated with fire do not necessarily affect the fire user, and when they do, the effects of the practice of using fire are felt in the medium to long term. These relationships help explain why fire is such an important tool in the rural Amazon context, and why it is very difficult to exclude it from the farming system.

Table 2-1. Positive and negative impacts of the use of fire in the Amazon in relation to the scale of influence and time.

Impacts of fire	Type of benefits and costs		Scale of influence		Time to detect		
	Positive <sup>1</sup>	Negative <sup>2</sup>	Direct	Indirect	Short term	Medium term	Long term
Conversion of biomass to nutrients	x		x		x		
Decrease in costs of production	x		x		x		
Control of diseases and weeds	x		x		x		
Use of available technology	x		x		x		
Soil impoverishment		x		x		x	x
CO2 emissions		x		x			x
Smoke		x	x	x		x	
Risk of accidental fires		x	x	x	x	x	

1 Positive impacts represent the benefits of using fire for a rural producer

2 Negative impacts represent the costs or problems of using fire for a rural producer

From this list of benefits and costs, the one of greatest policy concern is the risk of accidental fires. In many cases, when farmers burn their fields, they lose control of fires and inadvertently burn forest, agricultural systems, pasture, and other kinds of vegetation, such as secondary forest. Accidental fires are responsible for 50% of the area burned every year in the Amazon (Nepstad, Moreira, and Alencar 1999) and can cause many losses (Figure 2-2). The magnitude of unwanted fires in the Amazon has generated government and societal concern about the risk of large-scale forest fire events and has transformed fire into the main environmental problem in the region.

### **Increasing Risk of Forest Fires**

Forest fires in the Amazon dense forest used to be rare, and associated with Mega-El Nino events in pre-Colombian times (Meggers 1994, Sandford et al. 1985). This infrequent natural fire regime has been disrupted by the expansion of anthropogenic activities such as logging,

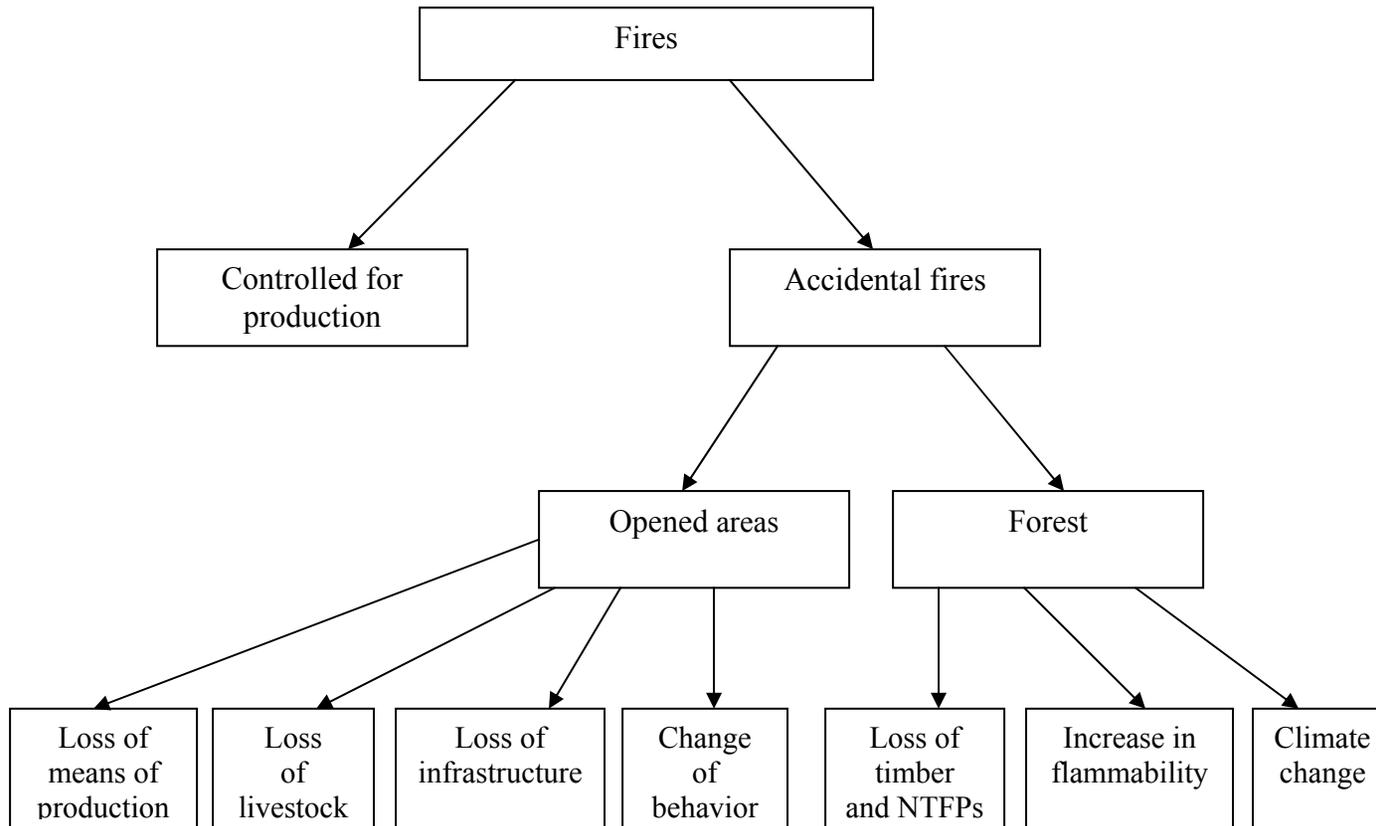


Figure 2-2. Representation of main losses caused by accidental fires in the Amazon

cattle ranching and large and small-scale agriculture and road infrastructure (Alencar et al. 2004; Cochrane 2003; Nepstad et al. 2001; Uhl and Kauffmann 1990). These activities are responsible for increasing forest flammability by promoting changes in the forest microclimate, through the increase of edge effect caused by fragmentation and deforestation, and the increase of canopy openness promoted by logging (Cochrane 2001; Ferreira. and Laurence 1997; Holdsworth and Uhl 1997; Ray, Nepstad and Moutinho 2005; Uhl and Kauffman 1990).

The large number of families using fire every year combined with the increased flammability of Amazon forests during El Niño-Southern Oscillation (ENSO) events, results in increased probability of accidental fires (Alencar et al. 2004) such as those that occurred in the Brazilian states of Roraima in 1998 or Acre in 2005 (Barbosa and Fearnside 1999; Aragão et al. 2008). The total area burned in Roraima was 38,144 - 40,678 km<sup>2</sup>, where about 55% of the fire affected primary forest (Barbosa and Fearnside 1999). The area of forest fires in the Amazon is estimated to vary from 200,000 to 1.600,000 ha in years of non-ENSO and ENSO, respectively (Alencar, Nepstad and Diaz 2006:10). Besides accidental forest fires, the area burned after deforestation to establishment to agricultural fields has averaged 1.800,000 ha in the last two decades (INPE 2008).

### **Ecological Losses**

Accidental fires can provoke ecological, economic and social damages. The effects of fires in the Amazon region have global effects on the Earth's system because they alter the chemical composition of the atmosphere and the Earth's reflectance (Artaxo et al. 2005). Among them, the most important changes are alterations in the dynamics of nutrients and biomass, changes in the hydrological cycle, and reductions in the number of local plants and animals (Barlow, Haugaasen and Peres 2002; Gerwing 2002; Haugaasen, Barlow and Peres 2003; Holdsworth and Uhl 1997; Nepstad et al. 1999; Ray, Nepstad and Moutinho 2005).

Fires can damage the structure and composition of the forest (Alencar et al. 2005; Barbosa and Fearnside 1999; Cochrane and Schulze 1999; Gerwing 2002; Haugaasen, Barlow and Peres 2003). Cochrane and Schulze (1999:2) found that about 50% of trees die after a forest fire. This number increases and varies depending on the intensity and frequency of the fire. Thus forest structure is expected to change dramatically after fire since large trees have an inverse relationship with fire intensity and frequency, while pioneers tend to increase with burn intensity, generating an area dominated by pioneers (Cochrane and Schulze 1999).

Further, once a forest burns, the probability of another accidental fire increases. Fires increases the flammability of the Amazon landscape and initiates a positive feedback under which tropical forests are gradually substituted by species more prone to fire (Nepstad, Moreira and Alencar 1999). Once a forest is burned, trees are killed and start to shed their leaves, opening the canopy, increasing the amount of solar radiation and the amount of fuel material on the forest floor. The insulation changes the internal air humidity and temperature of the forest, drying the leaves and dead woody biomass on the forest floor.

### **Economic and Social Losses**

In addition to the ecological damage provoked by accidental forest fires, there are also economic and social impacts of fire in the Amazon region. Every year farmers lose wood, pasture, fences, other investments and productive systems that are worth millions of dollars. Economic damages of having pasture fields and fences burned alone vary between US\$12 to \$97 million per year (Diaz et al. 2002). The annual economic losses associated with burned timber inside the forest vary between US\$ 1 and 13 million. Scaling up, these losses represent 0.1% and 2% of the GDP of the Amazon, and 0.2% and 1.6% of GDP of the agricultural production of the Amazon region.

Within rural communities families accumulate damage when they lose pastures and crops by accidental fires. In 1998, a survey carried out in Del Rei, a community in northeastern Pará, Brazil, showed that 98 percent of the families had one or more accidental fires on their properties during the six-year period covered in the study. In most cases, the study showed that accidental fires started within the community where the damage occurred, where in 1997, ninety-eight percent of the accidental fires began in the community fields, where families lost timber, animals, productive agricultural systems and pastures. Because of the pasture losses, some farmers had to rent pasture from their neighbors. Also in some cases, the accidental fires burned fields that were not prepared to burn. Because of that some families could not produce adequately, since the competition between plants increases when fields do not burn well.

There are also social damages associated with accidental fires. They include conflict between farmers, and an increase in poverty levels due to the constant risk of accidental fires that stimulate extensive forms of land use. Farmers are not always inclined to invest in more sustainable forms of land use (Nepstad et al. 2001:399) when the constant risk of accidental fires can destroy years of work and investments.

Respiratory problems are also among the negative impacts of fire. Every year the local hospitals in the rural areas of the Amazon receive hundreds of people with respiratory problems due to the constant effect of smoke inhalation promoted by burnings. These costs represent around 0.2% of the region's GDP during the 1996-1999 period (Diaz et al. 2002; Mendonça et al. 2004:89)

### **Looking for Solutions: the Attempts to Decrease Accidental Fires in the Brazilian Amazon**

In spite of the importance of fire in the Amazon, only in the last decades did government and society start to pay attention to the problem that this practice may cause. The debate arose in the beginning of the 1990s about increasing deforestation, with the release of the first annual

deforestation statistics for the Amazon by the Instituto Nacional de Pesquisas Espaciais (INPE). The issue of deforestation and fire use gained political force during the ECO 92 Summit in Rio and became one of the main foci in the agenda of the Pilot Program to Conserve the Brazilian Rain Forest (PPG7). In 1996 the World Bank, worried about increasing of deforestation and fire in the Amazon, hired a research team to understand and quantify fire in the region. This study generated a book that brought public attention to the fact that about half of the area had burned in the region had burned accidentally (Nepstad, Moreira and Alencar 1999).

The Amazon Environmental Research Institute (IPAM), an NGO based in Belém, Pará, conducted this study. At that time this NGO was the main protagonist in promoting the discussion of fire. After the study was concluded, IPAM organized two workshops, one in Brasília and another in Belém, to present to the government the concerns of many scholars about the probability of widespread accidental fires in the Amazon forest. The increasing concern about fire issues gained force when much of the state of Roraima burned in 1998. After the publication of the study results and the accidental fires of Roraima, many activities took place in the region, and different actors started looking for solutions.

### **Legal Attempts to Decrease Fire**

The federal government has been creating and changing laws and programs to approach fire use in Amazon, and to create a legal framework to regulate this practice. Brazilian attempts to regulate fire use are not new. In the XVII Century there was a law in Brazil that forbade the use of fire in areas where pau brazil (*Caesalpinia echinata*) could be found, through the regulation of December 12<sup>th</sup> 1605 (Ramos 1998:4). In 1934, decree No 23.793 established the Brazilian Forest Code; it forbade the use of fire without previous permission of the forestry authorities (Ramos 1998). In 1965 the federal government created Law No 004771 that regulated the use and protection of forests in Brazil. In that law fire appears in four articles (11, 25, 26 and

27) in very general terms. This law was the first that made the setting of fire in forests or other vegetation types without precautions a crime, and clearly forbade the use of fire. However, in its unique paragraph, it says that if local and regional aspects justify the use of fire, then, the government can permit its use with norms of precaution which were left undefined.

From 1965 to 1979 there were other federal actions regarding the environment, but none specifically addressed the issue of fire use. However, some of these actions were important to forest conservation and control of deforestation, such as the creation of the Instituto Brasileiro de Desenvolvimento Florestal (IBDF), and the creation of the Brazilian Environmental Secretariat.

In 1979, through decree No 84.017, the federal government regulated national parks, and forbade any activity that could provoke fire within national parks. In 1981, the government created a set of institutions to deal with environmental issues, among them the National Environmental Policy (PNMA), the National Environmental System (SISNAMA), and the National Environmental Council (CONAMA) and instituted the Environmental Defense Register. In 1983, the government instituted a national campaign to prevent agricultural and forest fires (regulation No 000326 of 1983), probably in response to the ENSO of 1981-1982. The Brazilian Constitution of 1988 brought in an entire section about environment, but without any consideration of a specific problem or practice. In 1988, the IBDF through regulation No 000231, required authorization for the use of controlled burns, as was established in the Brazilian Forest Code of 1934. Still in 1988, the IBDF, created the National Commission of Prevention and Control of Forest Fires (CONACIF), with the objective of coordinating and regulating the use and control of fire through regulation No. 000254. In 1989, decree No 97.635 regulated article 27 of the Forest Code, and created the National System of Prevention and Control of Forest Fires (PREVFOGO). In 1991, through cooperative agreements, the government created an

emergency program to control deforestation and fire in Legal Amazon, establishing agreements with the Amazon State Environmental Agencies (OEMAs). In 1993, a regulation of the Environmental Ministry (MMA) promoted a campaign called “Live Amazon” to control illegal practices of burning and deforestation in the region. During 1996 and 1997, a multilateral agreement between MMA, the German Agency for Technical Cooperation (GTZ), the United Kingdom Department for International Development (DFID), and the World Bank created the Pilot Program for the Protection of Tropical Forests in Brazil (PPG-7), which later would support many other different programs regarding to fire monitoring systems and fire prevention. In 1998 decree No 2661 redefined the attributes of PREVFOGO, and established specific rules for the use of fire. Still in 1998, decree No 2662 created the Program for Prevention and Control of Fires in the Brazilian Amazon Forest (PROARCO) as a response to the Roraima fires and international pressure. The law No 9605, of 1998, established the Law of Environmental Crimes. Its article 41 makes a crime to set fire in forests. In 1998, the Brazilian Institute of Environment and Renewable Natural Resources (IBAMA) published a regulation regarding controlled burning and its procedures, and also established the practice of “solidarity burning” in which rural communities could organize themselves to get one collective authorization to burn their fields, instead of many different authorizations for many different families within a community. In 2000, decree No 3420 created the National Forest Program (PNF), in which the FLORESCER Program was specifically established to work with prevention and combat of deforestation, burning and forest fires. In 2003, the federal government created the Plan of Action to Prevent and Control Deforestation, Burning and Illegal Logging in the Brazilian Amazon.

The review of fire legislation shows that the use of fire appeared in some laws before 1998, such as the Brazilian Forest Code of 1934, and the decree No 97.635 of 1989 that created

the PREVFOGO. However, although fire was noted, it did not appear in specific regulations before 1998. It seems that the federal government only responded to the problem after Roraima's accidental fires in 1998. This event had national and international repercussions, and in that year, the federal government created decree No 2661 redefining the attributions of PREVFOGO, and establishing specific rules for the use of fire. This was the first regulation that went to the level of defining procedures to be used by farmers during burning of their fields.

## **Governmental Programs and Other Initiatives to Decrease Fire**

### **Regional level**

Besides laws and regulations there are two programs of federal government that require more attention. The first, called PROARCO, developed emergency actions in partnership with many state and local governments. The second one called Demonstrative Projects (PDA) had a very practical configuration to decrease accidental fires.

PROARCO was created in the context of the dry season of 1998, and the consequent risk of repetition of accidental forest fires such the one that happened in Roraima state at the beginning of that year. The project was carried out by IBAMA with financial support from the World Bank, and started its activities in 2000 (Sauer et al. 2004). The main goal of the project was to prevent and/or control large-scale wildfires in the Brazilian Amazon during the dry season of 1998, and generate lessons to ensure conditions were created to prevent large fires in the mid-term (MMA 2009). According to the Environmental Ministry (2009), there were five benefits expected to be achieved with the project. They were:

- a) Reduce occurrence of large-scale fires and potential economic and social losses to residents of the Amazon;
- b) Enhance protection of the Amazon rain forest and the environmental services it provides;
- c) Improve knowledge of how to prevent escaped fire in this region;

- d) Foster sustainable partnerships among federal, state and civil society organizations in an emergency setting; and
- e) Develop a system of rapid response to fires which could be used in future emergencies, including other recurrent natural disasters and accidents.

The program had 4 main components:

- a) Risk assessment and monitoring of critical areas;
- b) Forest fire prevention;
- c) Forest fire suppression; and
- d) Project coordination, monitoring and evaluation, and studies (World Bank 2005).

The project aimed to work with rural populations living along of the Deforestation Arc, urban populations of the Amazon, state and regional electric power generation and distribution companies and their users, indigenous people, and society in general.

Established in 1995, the PDA was developed by the Environmental Ministry (MMA), and started its activities in 1996. This program, a result of the international cooperation that created the PPG-7, was a sub-program of the PPG-7. Its main goals were (a) to support local organizations to develop innovative experiences to promote sustainable development; and (b) to promote the registration, diffusion and incorporation of those experiences to other rural communities, organizations and governmental institutions. In its first period, the PDA supported 147 projects within the Amazon region (MMA 2009). In 2004, the PDA started a new period with three new components. One of these, the Alternatives to Deforestation and Burning Project (PADEQ), promoted the sustainability of rural properties, reducing or eliminating the use of fire through the implementation of alternative systems of production. PADEQ has supported 49 projects within the Amazon (MMA 2009).

The state governments of the Amazon also have been looking for solutions to the problem of accidental fires. One example of state government action is the case of the government of Roraima to the accidental fire in 1998. In response that fire, the state government, in partnership

with IBAMA, created the State Committee for Prevention and Control of Burning and Combat of Forest Fires. This committee instituted groups of fire fighters within some municipalities, trained to combat fires, and also to support local rural communities in carrying out controlled burnings. The state committee established partnerships with state government secretaries, IBAMA, Military Police, National Institute for Colonization and Agrarian Reform (INCRA), National Institute of Amazonian Research (INPA) and Civil Defense. In general this committee had the goal of coordinating actions to avoid accidental fires within Roraima (Souza Jr. 2006). However, although the Roraima government was involved in the committee, at the local level the structure created to implement actions had no financial support, nor adequate training and materials. IBAMA acts mostly in emergency situations, and there is no institutional plan to avoid and control accidental fires for Roraima. Likewise, the other organizations involved in the committee did not carry out structured and continued actions to prevent and combat accidental fires. The state government did not support the committee to consolidate itself and act, and also did not have a plan to change the agricultural system in order to decrease the need for fire use as an agricultural tool (Souza Jr. 2006).

### **From regional to local level**

There were also regional level experiences trying to decrease accidental fires number. The Mobilization and Training of Family Farmers for the Prevention of Accidental Fires in the Brazilian Amazon Project (PROTEGER) is one example of a regional-scale project which started in 1998. It was a result of a partnership between Grupo de Trabalho Amazônico (GTA), with Amazonian farmers' unions through PPG7 and PROARCO. The project had the financial support of USAID (U.S. Agency for International Development), and was developed in two distinct periods. The first period, in 1998 and 1999, had an emergency character (Sauer 2005), and tried to develop activities to sensitize Amazonian farmers to the use of methods that could

control fires. PROTEGER also stimulated the organization of community groups of people called *brigadas comunitárias*, to work locally within their own communities to decrease accidental fires. The Project collected information about systems of production that could be alternatives to fire use. At the end of two years, PROTEGER had worked in 322 municipalities in the nine Amazon states. It organized 400 training courses and workshops in which 200 local leaders participated. Those local leaders, called *monitores* and *monitoras*, were responsible to disseminate the information within their communities. Between 2001 and 2004, based on the learning experience of PROTEGER in its first period, the GTA coordinated PROTEGER II. In its second period, the general goals of the project were to contribute to the preservation of the Amazonian ecosystem and to the improvement of life quality of the local population, and to prevent forest fires set by family farmers in Amazon. The specific goals were:

- a) increase the level of burning control by family farmers;
- b) promote forms of sustainable production without fire use;
- c) stimulate recovery of deforested areas;
- d) strengthen local organizations for environmental management; and
- e) influence public policies that could contribute to the reduction of accidental forest fires in the Amazon (Lins 2005).

A group of consultants analyzed the many results of PROTEGER (Sauer et al. 2004). Some of those results were (a) the establishment of a channel to think about, debate and increase the concerns of rural union leaders with environmental problems within the Amazon; (b) the exchange of information about alternative systems of production, between farmers of different regions; and (c) the formation of local groups to mobilize families within communities. Consultants concluded that the challenge of decreasing accidental fires was difficult to verify

because there were no data available about numbers of fires and their origins, but they noted that at least there was more engagement among farmers to avoid accidental fires.

### **Local level**

Many local projects in the Amazon have tried to decrease accidental fires and/or diminish fire use within rural properties. An example of such local level action is case of the *Roça Sem Queimar* Project. This project was carried out in 11 municipalities of the Transamazon region, state of Pará. With support from the Secretaria de Coordenação da Amazônia (SCA) and MMA, it was carried out by Fundação Viver, Produzir e Preservar (FVPP), a local non-governmental organization. The goal of the project was to experiment with crop production without using fire to prepare the fields. The project was carried out in partnership with 150 participating farmers, and with rural labor unions of the municipalities. Each farmer got a fund of US 500.00 per year to experiment with producing on one hectare without using fire. In addition the farmers got training and technical support (Sauer et al. 2004). The farmers involved in the project could not use fire on that one hectare, nor could they use external inputs to manage the system. They had to follow agro-ecological principles such as:

- a) conservation of biodiversity by keeping trees with economic value;
- b) maintenance of soil cover by planting species to produce biomass and organic matter for the soil; and
- c) planting diversified plants in the same area (Sauer et al. 2004).

In an analysis of the project in 2004, one of the principal problems cited was the fact that it was necessary to wait one year between the initial preparation of the field and the planting process, because it takes time for the organic matter to decompose (Sauer et al. 2004). Another problem was that some farmers found it difficult to believe in agro-ecological principles.

Another difficulty was the presence of many branches and trunks in the field, which impede

farmers' movements while working. Despite these difficulties, there were positive points, such as the fact that the farmers were directly involved in the planning and actions of the project.

According to Sauer et al. (2004), farmers' experiences were valued, and they learned from the training opportunities, but more importantly from trying to produce without the use of fire.

Although more research is necessary, the project demonstrated efficiency in producing crops such as cocoa, a very important crop in that region, as well as bananas (Sauer et al. 2004).

### **Some Thoughts on Fire in the Amazon and the Experiences Carried Out**

In 1998, the scientific community knew that the Amazon forest could suffer large accidental fires, and had tried to call the attention of the government to that, however, only after the case of Roraima, in 1998, did significant actions take place in the region focused on the problem and risks of large accidental fires. These actions were carried out by the federal and state governments and by other organizations of civil society. At the federal government level, one important action was the regulation of fire uses for agricultural activities through decree No 2661. It was important, first, because it meant recognition by the government of the problem. Also the laws gave accidental fires the character of a crime and specified who could use fire and under what conditions. However, the structure of the government in Amazon is too weak to guarantee the enforcement of the laws, and secondly fire laws created by the federal government are distant from those who actually use fire to produce. In my experience working in more than 30 rural communities in different municipalities of different states in the Amazon, I never found one farmer who was aware of federal legislation about fire. For those reasons, laws and regulations alone are not enough to decrease the number of accidental fires in Amazon.

Fire is still going to be part of the agricultural system in the Amazon for the next decades. There are two basic important things that need to be done to effectively decrease accidental fire in Amazon. First, educational program such as PROTEGER are important, because as pointed

out by Sauer et al. (2004), educational activities promote local responsibility by people for environmental issues. Second, a massive investment is needed in alternative systems of production that can help to decrease the need to burn every year, and/or to exclude fire completely from the system of production, such as the PDA/PADEQ and *Roça Sem Queimar* projects. According to Nepstad et al (2001), long-term reduction of Amazon fire, and its substantial costs to society, can happen through investments and policies that stimulate permanent agriculture and forest production. However, they are needed in rural regions at the local level, in communities of small farmers, but also for medium and larger producers who still use fire to manage their properties. As pointed out by Souto (2003) in an analysis of the government program PREVFOGO, those programs need to work directly within rural communities.

### **Conclusions**

In this chapter I reviewed and discussed the use of fire in the Amazon together with the problems associated with this practice, and presented some attempts by government and civil society to decrease the number of accidental fires in the region. The analysis indicates that changes in the use of fire in Amazon are not going to happen from one year to another. Fire is so important in the agricultural system of the region that important changes need to be carried out through initiatives that engage directly the users of fire locally, and that are established through adaptive process where people can experience new models, evaluate it, and adapt according to emerging conditions. Although the fire legislation of 1998 is important as federal government recognition of accidental fires as a problem in the Amazon, it recommends procedures that are difficult to be put into practice by the farmers. There are some examples of the difficulties faced by the farmers to follow the law: the bureaucratic procedures that a farmer has to go through to obtain authorization to burn, and also the size of fire break required by law, that according to the

farmers is too large and requires lots of labor. Other regional programs carried out by NGOs are effective in increasing the concerns of people about environmental issues in general, but not specifically about fire management.

In the next chapter I discuss a project developed at the local level in eighteen rural communities of a protected area in the north region of Brazil. Through a partnership between an Amazonian NGO, IBAMA, the Rural Labor Union of Belterra municipality, and rural community organizations, the project was carried out with the clear goal of reducing accidental fires. The experience was based on the assumption that effective fire management requires direct involvement of fire users, and a continuous process to promote changes. Institutional arrangements for fire management were established and they were:

- a) elaborated by the users of fires;
- b) adequate to their reality;
- c) experimented and adapted by them through the years, and
- d) required a strong level of partnership and participation among the people and organizations involved.

CHAPTER 3  
INSTITUTIONAL ARRANGEMENTS FOR FIRE MANAGEMENT: THE CASE OF  
TAPAJÓS NATIONAL FOREST – PARÁ – BRAZIL

**Introduction**

There are many important factors contribute to the occurrences of accidental fires in the Amazon. Climatic conditions such as extreme drought events, the characteristics of the vegetation surrounding the area to be burned, and the fragmentation status of this vegetation are some of the elements that can contribute to the occurrence of accidental fires (Alencar et al. 2004). However, there are techniques used by the farmers to prepare their fields for the burn that are very important to avoid accidental fires. The decision of using one or more of these techniques is taken by the farmer at the individual level. Even though the decision is individual, the consequences of an escaped or accidental fire can be shared, and affect every family in one community or even in neighboring communities. Because of this risk, some communities in the Amazon have been trying to reduce the risk of accidental fires through institutional arrangements where rules of how to use fire were established by the families living within each community.

In this chapter I discuss the contributions of institutional arrangements for fire management in the Brazilian Amazon by analyzing the rules established by the families, and the farmers' compliance with those rules, in a fire management project. The case of Flona-Tapajós shows that institutional arrangements are effective in the short and medium terms in coping with the problem of accidental fires. However, the process of building institutional arrangements needs to be adaptive so that farmers themselves can try to improve the use of techniques from year to year, and change it when necessary.

The chapter is organized in three parts. In the first part I present the literature about governance of the commons, and how institutional arrangements have been used by different groups in different parts of the world as a way to avoid destruction of their natural resources and

of their source of livelihood. In the second part, I present the experience of fire management in the Tapajós National Forest where institutional arrangements were developed as a solution for accidental fires. Finally, I draw upon the common property principles designed by Elinor Ostrom to analyze institutional arrangements developed at the Tapajós National Forest.

### **Institutional Arrangements to Avoid the Tragedy of the Commons**

In 1968 Garret Hardin published an article called the Tragedy of the Commons. The tragedy of the commons refers to people's tendency to destroy natural resources when they are not privately held. According to Hardin, individuals will always exploit public resources to maximize profits. He gave an example of a common pasture where every herdsman can place as many cattle as possible because "as a rational being, each herdsman seeks to maximize his gain" (Hardin 1968: 1244). The result is tragedy, because overgrazing will ruin the resource and everybody will have problems. To Hardin, freedom in commons systems brings ruin to all.

Another important aspect of the commons is the tendency to share losses and damages. "Here is not a question of taking something out of the commons, but of putting something in" (Hardin 1986: 1245), but the rationality is similar to the cases of taking something out, according to the author. Using an example of the use of water as a common resource, Hardin explained that "the rational man finds that his share of the cost of the wastes he discharges in the commons is less than the cost of purifying his waster before releasing them" (1986: 1245). The result, again, is the tragedy by "fouling our own nest so long as we behave only as independent, rational, free-enterprisers" (1245). To avoid the tragedy of the commons and the destruction of the common resources, Hardin proposed privatization or state control, as the two possible alternatives. In his view, the appeal to conscience or to people's sense of responsibility would not work without a system of sanctions and coercion mutually defined by those people affected.

Other scholars have challenged Hardin's theory. The principal argument is that Hardin did not recognize the capacity of individuals involved in situations where resources are common properties to use their knowledge to create rules and to change problems they face (Gautam 2005). Many recent scholars have written about the use of common-pool resources and the ways communities and other users have organized themselves to create institutional arrangements that avoid the tragedy of commons. To Agrawal (2001:1649), scholars working with the commons have shown that resource users organize themselves to establish systems and regimes where they allocate benefits of resource use equitably, for long periods of time. Ostrom (1990) discusses the best ways to limit the use of natural resources so they will not be completely exploited and can be continuously used by people over time. The principal point she makes is that individuals develop strategies to govern and manage their common resources and avoid the tragedy.

#### Common-pool resources (CRPs)

refer to a natural or man-made resource system that is sufficiently large as to make it costly (but not impossible) to exclude potential beneficiaries from obtaining benefits from its use (Ostrom 1990: 30).

To study cases in which people developed strategies to avoid environmental destruction, Ostrom limited her research to situations where renewable resources were scarce, and where users could harm one another. After analyzing many cases of long-enduring, self-organized, and self-governed CRPs, Ostrom (1990) presented a list of principles (Table 2-1) that are indicators of a successful collective process of management.

Based on this list, principle 1 refers to the importance of clear defined boundaries, so that it is clearly established who has rights to withdraw and use the resources in question, and also to define the limits of the resource. According to Ostrom (1990), the definition of boundaries should be the first step in organizing for collective action. Just the defining of boundaries, users

and not authorized users, can give a certain level of guarantee that the efforts of those involved in collective action will be worth it.

Table 3-1. Design principles illustrated by long-enduring common-pool resources institutions

Principles	Characteristics
1. Clearly defined boundaries:	Individuals or households who have rights to withdraw resources units from the CRP must be clearly defined, as must the boundaries of the CRP itself
2. Congruence between appropriation and provision rules and local conditions :	Appropriation rules restricting time, place, technology, and; or quantity of resources units are related to local conditions and to provision rules requiring labor, material, and; or money.
3. Collective-choice arrangements	Most individuals affected by the operational rules can participate in modifying the operational rules
4. Monitoring	Monitors, who actively audit CPR conditions and appropriator behavior, are accountable to the appropriators or are the appropriators.
5. Graduated sanctions	Appropriators who violate operational rules are likely to be assessed graduated sanctions (depending on the seriousness and context of the offense) by other appropriators, by officials accountable to these appropriators, or by both.
6. Conflict-resolution mechanisms	Appropriators and their officials have rapid access to low-cost local arenas to resolve conflicts among appropriators or between appropriators and officials.
7. Minimal recognition of rights to organize	The rights of appropriators to devise their own institutions are not challenged by external governmental authorities.
8. Nested enterprises (For CRPs that are part of larger systems)	Appropriation, provision, monitoring, enforcement, conflict resolution, and governance activities are organized in multiple layers of nested enterprises.

Source: Adapted from Ostrom 1990 page 90.

Principle 2 refers to the need for congruence between appropriation rules, provision rules, and local conditions. Local particularities can make it necessary to have different rules for

different places even when the rules are set up to govern the same kind of resource in a way that consider proportional equivalence between costs and benefits (Ostrom 1990; 2005).

Principle 3 refers to the possibility that individuals directly affected by the institutional arrangements and its rules can modify them when necessary. When there are clear boundaries, there is congruence between appropriation, provision and rules, and when the users can contribute to the creation of the rules and change them, there is a greater likelihood that the rules will be appropriate to the case to which they. However, it does not necessarily mean that the users will follow the rules. It is easier to agree with rules, than to follow them after they are elaborated (Ostrom 1990).

Principle 4 refers to the need for a monitoring system. Trust and reciprocity among users to avoid breaking rules are characteristics of only a few long-surviving regimes (Ostrom 2005). A monitoring system is therefore needed that can identify those who are and are not following the rules.

Principle 5 refers to the need for a sanction system for those who violate established rules. In the analyses of successful cases, Ostrom (1990) found that it was local people, instead of external authorities, carried out monitoring and sanctions, and that initial sanctions were very low considering the expected benefit-cost ratio of breaking the rules. It seems that the initial sanctions were more to inform the one breaking the rules. According to Ostrom, the sanction system is more like a “quasi-voluntary” cooperation system than coerced cooperation.

The monitoring and sanctioning system has to be understood together with the other initial principles, because the level of commitment of participants is not related to the possibility that someone is monitoring them or that they might be punished. The level of commitment was also related to the fact that people were able to choose their own rules that were appropriate to their

reality. Success was also enhanced when it was clear who could participate, and when there were incentives for people to do so (Ostrom 1990).

Principle 6 refers to the importance of rapid, low-cost, local spaces to solve conflicts. There is always a possibility that someone will understand a rule in a different way from others, or break a rule. However, in long term regimes participants need a place to debate their problems and find solutions.

Principle 7 refers to the freedom of participants to devise their own rules, and the importance of governmental recognition of those rules. Local users' ability to develop more effective regimes over time is influenced by the national or local government recognition that those people can, themselves, decide their own rules. Official recognition of local rules gives more power to the locals in the monitoring process.

Principle 8 refers to the importance of having an organization based on different scales, for more complex and larger systems. Nested enterprises can help to overcome the weakness of one scale or another. According to Ostrom (2005), in a polycentric system the users of a common-pool resource have some authority to make some rules; however, they can count on other authority levels to cope with problems such as local tyrannies and inappropriate discrimination. Polycentric systems are ones in which people are "able to organize not just one, but multiple governing authorities at different scales" (Ostrom 2005, 283).

Although the design principles can predict the level of success of a common property regime, there are also other factors that can threaten its success. According to Ostrom (2005, 272) these threats are:

1. rapid exogenous change;
2. transmission failures from one generation to the next of the operational principle on which community governance is based;

3. programs relying on blueprint thinking and easy access to external funds;
4. corruption and other forms of opportunistic behavior;
5. lack of large-scale institutional arrangements related to reliable information collection, aggregation, and dissemination;
6. fair and low cost conflict-resolution mechanisms; and
7. educational and extension facilities; and facilities for helping when natural disasters or other major problems occur at the local level.

However, according to the author there are ways to address these threats. The establishment of community-governance entities to provide continuous support to the communities, besides research on self-governing systems, and the development of better curricula on local governance, are actions that may cope with threats to sustainable systems of governing common resources (Ostrom 2005).

### **Building Institutional Arrangements for Fire Management: Tapajós National Forest**

In this section I analyze the case study of a fire management project within a protected area in the Brazilian Amazon carried out by a regional NGO, with direct participation of local communities, local organizations, and the Brazilian Environmental Agency (IBAMA - Instituto Brasileiro de Meio Ambiente e dos Recursos Naturais Renováveis). At Flona-Tapajós, IPAM stimulated and supported the development of institutional arrangements as an attempt to increase the number of techniques used by the families during the burning process of their fields, and consequently decrease the number of accidental fires. The arrangements were composed of a list of techniques and recommendations that each family within the communities should apply when burning. The process was developed in an adaptive way in which families established rules, tried to apply them, evaluated the results, changed the rules, tried to apply them and evaluated them again.

The general research question of this section is: do institutional arrangements contribute to fire management? Specifically, the questions are:

1. Are institutional arrangements effective in decreasing accidental fires?
2. What are the basic principles for building institutional arrangements for fire management?

### **History of the Project**

In the beginning of the 1990's a rural community in the northwest part of Pará state called Del Rei asked its Rural Labor Union to help them solve the problems of accidental fires. During the drought of 1991 and 1992, many families suffered damages caused by accidental fires. From that time to 1996, the community in partnership with IPAM (Amazon Institute of Environmental Research) a regional NGO based in Belém, Pará, carried out research and organized many meetings to discuss issues related to accidental fires and how the families could decrease their losses caused by them. These meetings were seen as an opportunity for knowledge sharing about the use of techniques that could help keep fire within the borders of their agricultural fields. Even though several people attended the meetings, the community continued to have problems in the following years. It was in 1996 that they decided, with the help of IPAM, to create a local law with clear rules about how to use fire within the community. The experience within Del Rei community indicated that institutional arrangements could contribute to fire management in the Amazon. However, more research was necessary regarding this subject, and IPAM had interest in carrying out this research.

In 2000, IBAMA and a group of local volunteer environmental agents working with in national forest located in another region of the same state, carried out a meeting to evaluate the environmental problems of the protected area. During this meeting, accidental fires were pointed out as an important problem, and because of that IPAM was invited to develop a project within the communities to establish local agreements for fire management to decrease accidental fires.

## **The Tapajós National Forest**

The Flona-Tapajós is located in the north of Brazil, northwest region of Pará State (Figure 3-1) in the municipalities of Belterra, Aveiro, Rurópolis and Placas. Created by the federal government in 1974 through decree No 73.684, the Flona-Tapajós is a protected area for sustainable use (SNUC 2000). This means that such areas should integrate conservation of natural resources with the sustainable use of parcel of its natural resources. At the time of creation, there were many conflicts between the government and the families living there because there were some families who were not originally from the region (IBAMA/ProManejo 2005), and because at that time people were not allowed to live within National Forests (FLONAS).

The Tapajós National Forest (Flona-Tapajós) is a 600,000 hectare protected area nowadays under management responsibility of the Instituto Chico Mendes de Conservação da Biodiversidade (ICMBio). When the fire management project started, IBAMA (Instituto Brasileiro de Meio Ambiente e dos Recursos Naturais Renováveis) was the agency responsible for the management of the area. The area has more than 7,000 families living in an urban area and 30 different rural communities. The rural communities have more than 2,000 families that have their livelihood based mainly on agricultural production. The use of fire is one of the traditional agricultural tools for all these families.

The Flona-Tapajós has families of traditional people, indigenous and *colonos*. These families have limited land use rights that include the use of forest resources to produce crops, extract timber and non-timber products, although they do not officially own the land. The use of fire is one of the traditional agricultural tools for all these families.

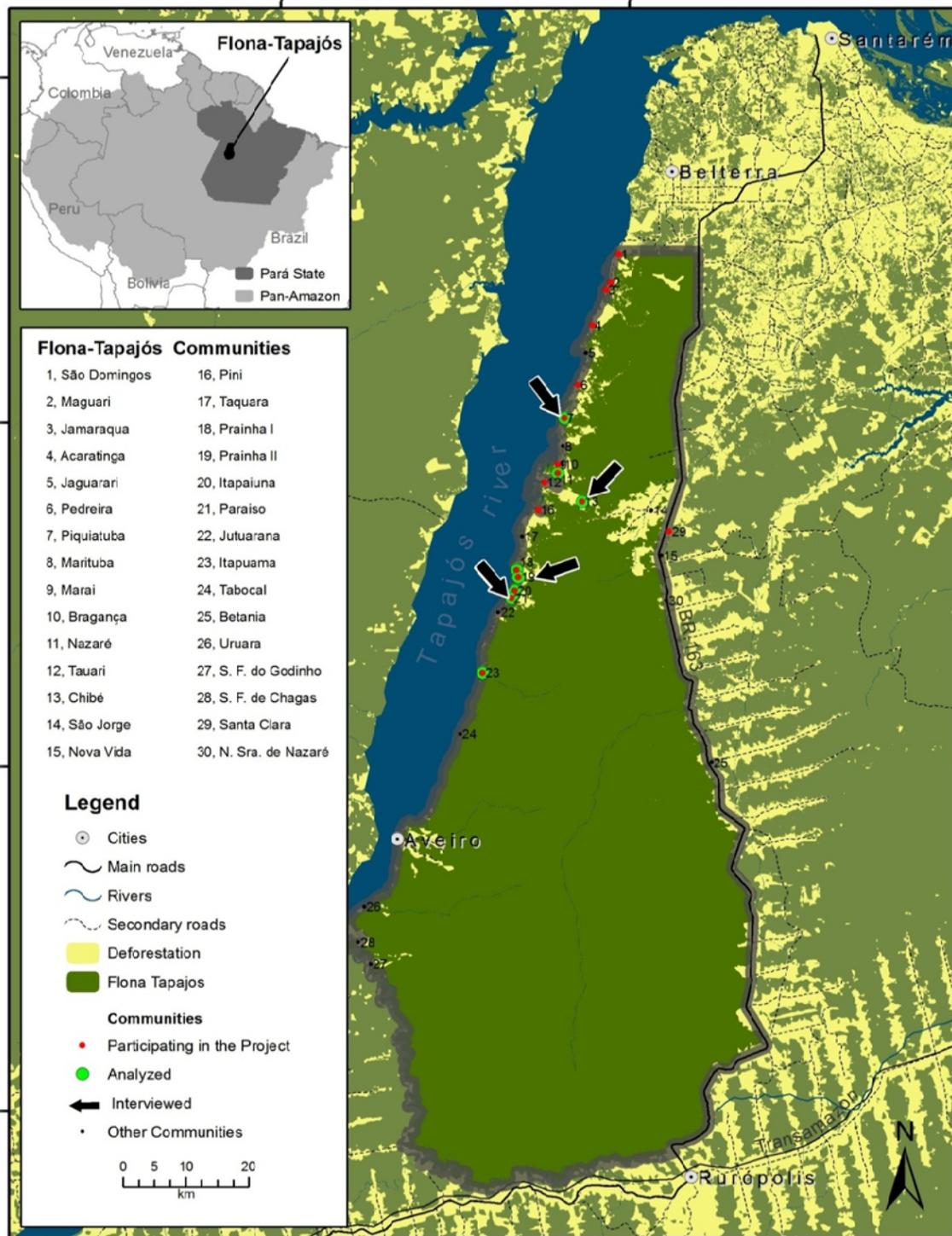


Figure 3-1. Location of the communities and municipalities of Flona-Tapajós, communities participating in the fire management project since 2001, and the communities interviewed in 2007.

The Flona-Tapajós communities in 2001 were externally represented by local leaders, in some cases chosen through a formal election process, but most of the communities did not have a formal association. Besides the local leaders of each community they had four inter-communitarian associations that were formal organizations, each one representing part of the communities. The Rural Labor Union of Belterra (STR-Bel) was another grass-root organization that could represent most of the communities, but also not all of them because the Flona-Tapajós has part of its territory in other municipalities such as Aveiro and Placas. In 2001, the communities of Flona-Tapajós were involved in many different projects with different goals. There were projects to support the inter-community associations. There were projects supporting alternative systems of production such as the use of rubber to produce handcrafts, the production of oils, the establishment of agroforestry systems, the raising of small animals, and so forth. Most of them had financial support from IBAMA/ProManejo. Currently, 12 communities are involved in a timber project coordinated by the Cooperativa Mista Flona Tapajós Verde (COOMFLONA). The COOMFLONA was created to manage Ambé Project, a demand of the local people of Flona-Tapajós, after the federal government, through IBAMA, started a process of timber exploitation in partnership with an international timber company. The families questioned the government, on the grounds that they should be the ones to exploit the timber and get the benefits. It was a long process of negotiation until the families started the Ambé Project (COOMFLONA 2009).

Regarding fire management, there were other actions carried out within Flona-Tapajós that had the goal of decreasing problems with fire, directly and indirectly. In 2002 the PREVFOGO, an IBAMA program, started a partnership with the communities to form the *Brigada de Fogo*. The *Brigada* is a temporary group of local people trained by IBAMA/PREVFOGO to control

escaped fires within the protected area. The communities, through an election process, select the local people who make up the *Brigada*. After that they are trained by IBAMA/PREVFOGO and the Fire Fighters, and have to take an exam that selects the ones who will compose the *Brigada* for a period of six months of the burning season. From 2002 to 2008, the *Brigada* had to fight two accidental fires within Flona-Tapajós. However, other accidental fires were registered by IBAMA in the years of 2004, 2006 and 2007. Another important action of IBAMA that contributed to the process of fire management within the protected area was an initiative to control deforestation. In 2002, IBAMA invited the leaders of all the communities to establish a process to control deforestation. During those meetings, it was decided that each family could cut down the vegetation, burn and produce in a maximum two hectares per year. The decision of producing in forest or secondary forest was to be negotiated with IBAMA by each community. Those areas would also be monitored by IBAMA year to year through a random process involving all the communities.

### **The Fire Management Project at Flona-Tapajós**

The fire management project was carried out at Flona-Tapajós. It started in 2001 and finished in 2004. The project was carried out by IPAM in partnership with the local people from within the communities, the Rural Labor Union of Belterra and IBAMA/ProManejo. The main goal of the project was to decrease accidental fires within the protected area. To IPAM, the main goal of the project was test the efficiency of institutional arrangements for fire management, as a way to decrease the risks of accidental fires.

Before the project started, the idea of formulating local institutional arrangements within each community of Flona-Tapajós was presented and evaluated by the leaders and other local organization representatives in two different meetings of three days each. In those meetings the leaders of all the communities helped IPAM to define activities, a calendar and indicated the

communities with more problems of accidental fires, where the project should start working. After that, the project was submitted to IBAMA/ProManejo, and once approved the activities started within the communities. The process within communities to formulate the fire agreements followed many steps (Figure 3-2). First, each community was invited to discuss their fire use practices and later to formulate fire agreements. Each community had the opportunity to debate internally and then to respond to IPAM if they wanted to participate in the project or not. Sixteen communities were pointed out by the leaders as the ones where the project should be carried out. Those were invited to participate in 2001, but four declined the invitation, including some with a history of accidental fires. The communities that declined the invitation, during the meetings said that they were not interested in regulations about fire. In their view, fire is a practice that they know how to use, and they did not want to change anything regarding that point. So, IPAM started working only within the communities that accepted the invitation. In the following years, other communities invited IPAM to work with them: In 2002, four communities started participating, and in 2003 another two communities.

The second activity of the project was a fire use assessment within each participant communities'. The assessment was carried out through interviews with families of the communities. The interviews were carried out at the household level, and all the questions were related to the system of production, fire practices, cases of accidental fires, and losses caused by accidental fires. The information was organized by IPAM and was used in many ways: first to create a base line to see if there was change in the families' practices during future years. Second, in each meeting within the communities, the information was used to debate past cases of accidental fires, and good practices identified by the families. Third, annual information was

organized in a way that enabled participants to evaluate the effectiveness of the management system, and to make changes accordingly.

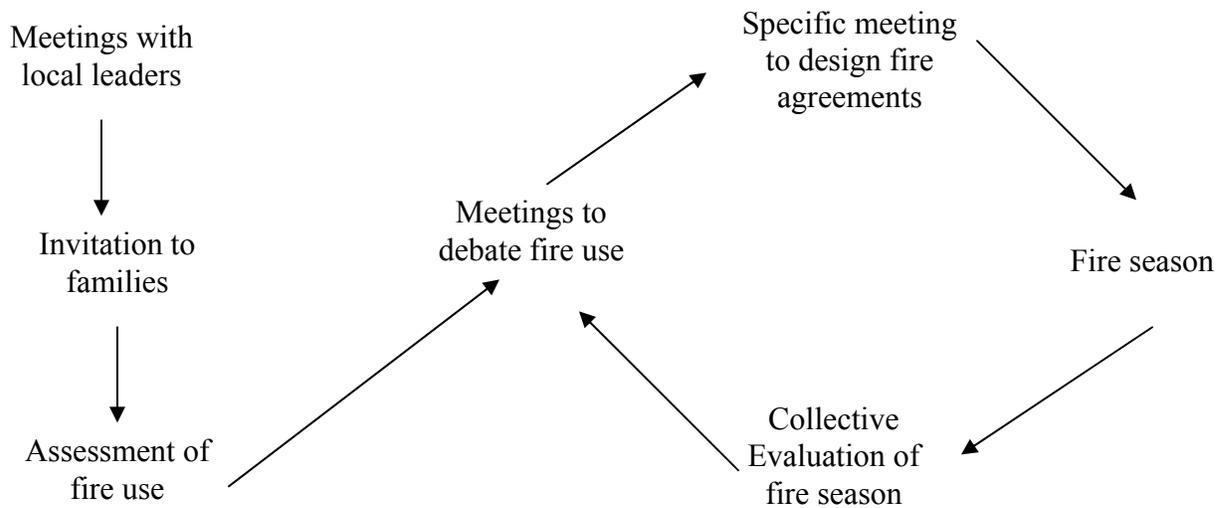


Figure 3-2. Fire management main activities carried out within the communities.

The third activity was the organization of one to three-day meetings within each community, in which families and IPAM discussed practices of fire use; the benefits of fire management for communities; the problems associated with fire use for the local, regional, national and international environment; and ways to avoid accidental fires. Alternative systems of production were also discussed, as well as the responsibilities of Amazonian farmers for responsible fire use. The communities then had meetings to discuss specific practices and methods used to prepare fields to burn. IPAM suggested techniques they could start using or changes that could more effectively control accidental fires. In these meetings the communities formulated temporary agreements that they would try to implement in the next burning season. The meetings were organized in two different moments. The meetings to debate practices and to formulate the agreements were carried out just before the families began to prepare their fields for the year, generally around June and July.

After the burning seasons in which families were to try to apply the rules of the temporary agreements, there was one meeting in which the families evaluated the burning season, the rules they tried to use, and whether they needed to change the agreements to make them more feasible. These evaluations were carried out in two ways. First IPAM technicians would visit a sample of fields to interview the owners of the fields regarding the use of the techniques. Then a meeting with all the farmers was carried out, and each farmer had the opportunity to talk about his or her attempt to use the rules, the difficulties they encountered, and their opinion about each rule, and the changes they thought were necessary. Based on information produced by the families, and also by IPAM, all the communities reformulated the agreements every year. The idea was to develop realistic rules that they could follow, and at the same time, that could result in control of accidental fires. By the end of the project the communities established definitive fire agreements. The meetings to evaluate the use of the rules established in agreements were carried out after the burning season, during the months of January and February. An average of four meetings was carried out within each community each year. These meetings were open to all the families within each community. In general there were more men than women participating, and there were also participation by teenagers.

Besides the process within the communities, the project developed three other main activities. The first was the training of two people chosen by the families from within each community, who were responsible for keeping up the debate about fire management in other opportunities besides the activities organized with the presence of IPAM. Throughout the project, these individuals, called fire management facilitators were engaged in planning, giving inputs to the project and helping to carry out the activities within their communities. This group was voluntarily involved in the project. Most of the volunteers were young people, not traditional

leaders of the communities. The training process therefore focused not only on the debate over fire and alternative systems of production for fire management, but the group also demanded training in techniques of how to present ideas, how to speak in public, and how to organize and write proposals. The facilitators faced some challenges. The most important was that some families attributed to them responsibilities that they had not initially accepted, such as being present and assisting at every burning event. The agreement in the meeting at which they were selected established that the facilitators were there to talk with people, not to work for them.

The second activity was a process involving teachers and students of some schools at Flona-Tapajós in an attempt to introduce fire use in the curriculum of the schools. This process was difficult because any change in the schools had to enlist the interest of the local government. In the case of Belterra, the local government was not interested in fire control. The third activity was the creation of a group of local leaders and organizations (Forum for Fire Management of Flona-Tapajós) to discuss fire use, to ensure the continuity of the project, and other possible projects for Flona-Tapajós that could help to decrease the use of fire. Although the Forum started with the participation of many local organizations, by the end of the project, only two local grass-roots organizations remained interested in collaborating with IPAM and the communities. When IPAM began to work within Flona-Tapajós, the idea was that, at the end, the communities would formulate and abide by definitive agreements. However, it did not take long for them to say that continued support was necessary to keep the discussion alive, and also to promote the introduction of alternative systems of production that could, in the long term, diminish the use of fire. Those ideas were discussed within each community and their local leaders, and also within the Forum. Within the communities, the leaders guaranteed that they would address the issue in their meetings with the support of the facilitators, and would remember and discuss the rules they

established. Also by the end IPAM helped two local grass-roots organizations (Sindicato dos Trabalhadores Rurais de Belterra and Federação das Comunidades Tradicionais da Floresta Nacional do Tapajós) wrote proposals for funds to keep the work going within the communities already involved in the process. Funds were also requested to incorporate other communities that asked for the project in the following years, and to work within the communities living along the borders of the protected area.

During the process, some people living within Flona-Tapajós had different concerns and reactions to the project, especially in the first year (Table 3-2). During the first meetings the participants were afraid that at the end of the process they were going to be forbidden to use fire in agriculture. In fact this was never the goal for IPAM, for the leaders involved in the planning of the project, or for IBAMA, since everybody was aware that the families had no alternative technologies. IPAM repeatedly affirmed that the prohibition of fire use was not the goal of the project. Some people would ask why they were debating an old practice that they learned how to use from their ancestors. The responses of IPAM were that the idea was not going of teaching anybody how to burn, but instead helping with the improvement of the practices where they were not working, to avoid more accidents in the future. Some families often answered this point by reminding each other of the accidental fires they had before, and the losses they had in the past.

During the meetings, in which the debate was about their local practices and the impacts of fire use at different scales, the communities in general were very open and curious to participate in the debate about climate change and the connections between what happens in their fields and people all around the globe. In the specific meetings to formulate fire agreements, some families expressed that fire could not be controlled, that only agricultural mechanization could prevent accidental fires. IPAM tried to highlight the experience of those families who never started

Table 3-2. Concerns expressed by some families during the fire management project and the steps or arguments used to overcome those concerns.

Concerns	Arguments from IPAM, and other families to overcome the concerns
1 Concern about a possible prohibition of fire use	Fire would not be prohibited in the end of the process but only controlled
2 Fire was an old known practice. There was nothing new to learn	The process was not about teaching new methods, but of how to improve the use of known techniques, and to guarantee that everybody used the known techniques.
3 Curiosity about global relationship of environmental issues	More exchange of information.
4 Need for better technology (mechanization)	Valorize the experiences and techniques used by families that did not have accidental fires. Discussion of agricultural mechanization benefits and cost, alternative systems of production, sources of financial support, organization necessary for them to access those resources.

accidental fires within the communities, and tried to emphasize the techniques they used, and explore the possibility of other families following those examples. Families that had never caused accidental fires within the communities often responded to this point saying that if people would use the techniques they knew, they were not going to have problems in the future. Because in many situations, the topic of mechanization as the best solution to accidental fires would be brought to the meetings, IPAM did exercises to analyze economic and social aspects of mechanization, its benefits and costs, and the debate of how they could use it. Mechanization of agriculture was pointed out as the best solution for fire, because at the time the project started, a strong process of mechanization for the production of soybeans was going on outside the protected area through the movement of agribusiness to the region. Besides this, the discussion of alternative systems of production, and sources of financial support that the families could get to start those systems was always part of the debate in the meetings. In later years, the debate

was more related with their experiences in trying to use the techniques they had selected, and changes that needed to be made to their agreements.

The initiative at Flona-Tapajós was based on dialogue between families of each community and researchers, jointly trying to identify good techniques to avoid accidental fires. During those years, each community involved in the process formulated agreements in which they tried to regulate the use of agricultural fires to avoid accidents. The agreements were composed of rules to be followed by each farm during the preparation of the productive field. All of the rules were techniques and procedures to control fire and to avoid physical damage to the farmers.

### **Changes in Fire Management Practices at Flona-Tapajós**

The project carried out by IPAM finished in 2004. The project that was written for the Federation to continue to work within the communities of Flona-Tapajós was not funded. The Federation was not a formal organization at the time and this made it impossible for them to apply for other additional support. The project presented by STR-Bel was approved, though, and they are carrying out activities to promote fire management and alternative systems of production within some communities on the border of Flona-Tapajós.

In 2007, I carried out research within the protected area to analyze the level of compliance with the rules established in the agreements, and how the communities were using the agreements. To do this analysis, I used two sources of data: (a) an assessment carried out in 2001 within 11 communities of Flona-Tapajós, where 71 families were interviewed at the beginning of the project; and (b) surveys carried out in 2007 in 4 communities, where 53 families were interviewed. To select the four communities I built an index of participation that considered the number of people participating from 2001 to 2004 in the meetings where the agreements were formulated within the communities; in chapter 3 the construction of this index is better

explained. The communities interviewed were Prainha II and Paraíso with the highest level of participation and Chibé and Piquiatuba with the lowest level of participation (Table 3-1). The surveys were conducted in July of 2007, and in most cases the couples were interviewed together.

The results from the early assessment indicated that, before the project started, the use of techniques to avoid accidental fires by families living in the protected area was minimal (Table 3-3). According to Assunção (2001), most of the families used on average four techniques. Carvalho et al. (2007) listed 18 techniques or recommendations that can be used to avoid accidental fires. The list is composed by techniques and recommendation that farmers need to apply months before the burning day, such as the definition of the place to start a new field, or the plan to work in partnership with neighbors. There are also techniques and recommendations specific to the day of burning such as time, number of people or starting the fire against the wind. The list is a result of action research carried out in more than 20 rural communities of Pará. The knowledge of the rural families was tested to analyze the effectiveness of each technique in helping to control accidental fires.

In 2001, at Flona-Tapajós, less than 20 percent of the families used to build a firebreak around the field before burning; almost fifty percent of the farmers burned their fields at noon (the hottest hour); and less than 20 percent of them remained to watch the fire until the burning process finished (Assunção 2001). The result of these practices was a history of accidental fires throughout the years, but especially in 1997/1998. The 11 communities involved in the assessment carried out in 2001 had accidental fire in their areas, resulting in losses of forest, pasture and productive systems (Assunção 2001). During the years of the project, all the

communities involved described accidental fires in their areas, although they were not precise about the years they occurred.

Table 3-3. Percentage of the families using techniques and recommendations for the years of 2001 and 2007.

Techniques or recommendations	Years	
	2001 n=71	2007 n=53**
1 Distance from rivers	*	100.0
2 Bring tools to the field	*	100.0
3 Wear adequate clothes	*	100.0
4 Authorization from IBAMA	*	98.1
5 Watch the field until the fire finishes***∞	13.0	96.2
6 Month of burn	*	95.3
7 Burn some days after raining	38	92.3
8 Distance from roads	*	88.4
9 Plan the burning day	*	87.1
10 Prepare source of ignition before	*	83.3
11 Time to burn***∞	6.0	83.0
12 Cut the trees towards the field	*	70.8
13 Start the fire against the wind***∞	31.0	69.2
14 Lower the fuel load	*	66.0
15 Inform neighbors of the day to burn	*	63.6
16 Clean the fire break before burning	*	62.5
17 Water***	20.0	56.6
18 Build fire break around the field***∞	18.0	52.8
19 Cut dead trees	8.0	52.3
20 Number of people***∞	19.0	47.2
21 Talk to neighbors to work together	*	14.2

\* Information not available in the database of 2001.

\*\* Percentage calculated based on valid responses, because there are rules that do not apply for all the communities and it was not asked in the survey.

\*\*\* Techniques or recommendations indicated by the families as the important ones.

∞ Techniques or recommendations indicated by the technicians as the important ones.

The results from 2007 indicated that the number of techniques used by each family, and also the number of families using each technique, had increased. Most of the families living at Flona-Tapajós in 2007 used at least 11 techniques. For the technicians involved in the project, the five most important techniques are: build a firebreak around the field, time to burn (avoiding

the hottest time of the day), number of people participating during the fire, starting the fire against the wind, and watching the field until the fire finishes. For the families interviewed in 2007, the most important techniques were the same ones pointed out by the technicians, plus bringing water to the field. Building a firebreak increased from around 20 percent of use to 52 percent. Preferred time to burn increased from 6 percent of the families, to 83 percent. In 2001 31 percent of the families used to start the fire against the wind, and in 2007 this recommendation was used by 69 percent of the families. Watching the field until it finished burning increased from less than 20 percent to more than 95% (table 3-3). The five techniques pointed out by the technicians were the same ones pointed out by the families interviewed as the most important to avoid accidental fires. But the families also considered that it was very important to have water available to help with small accidental fires. In 2001, 20 percent of the families said they used to bring water to the field during the burning day. In 2007, 56.6 percent of the families asserted they were following this recommendation.

The process of requiring official authorization to burn started during the years of the project. While IPAM talked with the communities about the importance of keeping their fields legal, IBAMA developed a system in which they would visit each community to give families the authorization for cutting and burning their fields every year. This explains the high level of compliance with this rule (98 percent).

Family labor force is considered an important element that guides the decisions made by small farmers in Amazon regarding their land uses strategies (Perz and Walker 2002; Perz 2004). During the elaboration of the fire agreements, technicians and families were concerned not to introduce solutions to accidental fires that would increase labor demands, and consequently the costs of production for the farmers. Considering that the requirement of labor can be one factor

influencing the decision of families to use a specific technique or not, I classified the techniques used by the families in 2007 in 4 categories (Figure 3-3). There are techniques that:

- a) depend on family labor;
- b) depend on family labor and technology (chainsaw);
- c) depend on family and neighbor's interest and labor;
- d) no family labor required.

An average of the compliance with the techniques and recommendations using these categories indicated that families followed more the techniques and recommendations that do not require hard labor (81.2 percent), and applied less the ones that required partnership with neighbors (49.5 percent). Of the six most important techniques pointed out by the families (watch the field until the fire finishes, start the fire against the wind, water, build fire break around the field, time to burn, number of people), three that depend more on planning than on hard family labor (watch the field until the fire finishes, start the fire against the wind, and time to burn) were used by more than sixty percent of the families.

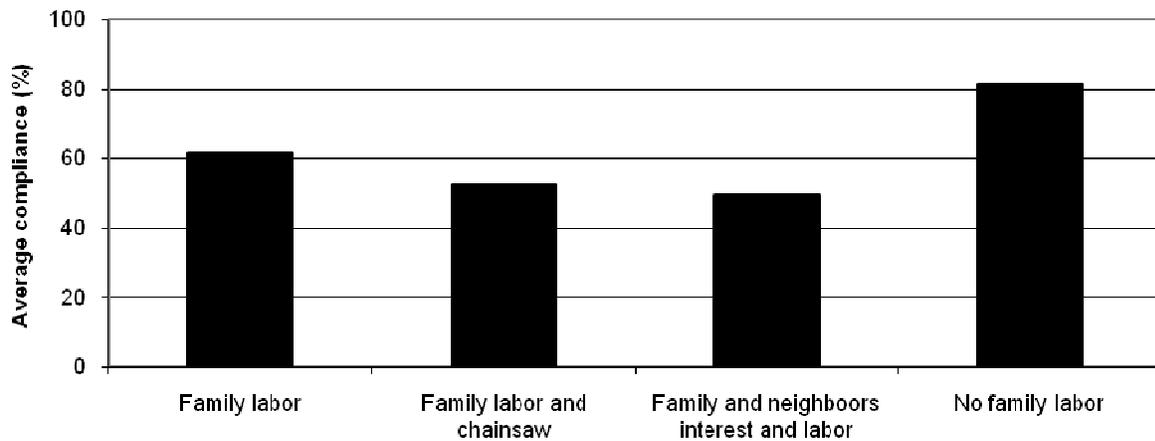


Figure 3-3. Average of families' compliance with techniques and recommendations based on a labor classification for the year of 2007.

In 2007, almost 95 percent of the families knew that the community had fire agreement. Those that did not know were new couples, families that were not living in the area and old people that did not participate in the process during the years of the project. Most of the people thought that the agreements still needed changes. More than 50 percent said that they kept discussing fire use and the techniques; however, almost 50 percent said that they only do it when IBAMA comes to the community to give the authorizations to burn.

The analyzes of the techniques applied in 2001, before the project started, and in 2007, two years after the project ended, show that not only did people use more techniques, but also the number of people using each of them increased for all the techniques. Although the changes were considerable, 83 percent of the families interviewed recognized that there was still a risk of accidental fires. They also recognized that the risks were lower in 2007 than in the past (97 percent). During the interviews, some families asserted that in 2005 they had a severe drought in the region and that no big accidental fires occurred within the protected area because families are more worried and more careful now, than they were in the past. In 2007, fires escaped in the field of 5.6 percent of the families interviewed, but none of them spread to huge areas.

### **Institutional Arrangements for Fire Management - Avoiding the Tragedy of Commons**

Fire is an agricultural tool used today by almost all small, medium and big farmers in the Amazon. The practice and problems of using fire as an agricultural tool have three aspects of the commons:

1. Accidental fires can cause damages to every farm in a community and sometimes in neighboring communities.
2. The decision of decreasing the risks of accidental fires needs to be taken by the community, and not just by one farmer. Even if one individual manages fire in a way to avoid accidents, his property or productive system still has the risk of being burned by an accidental fire provoked by his neighbor, or by someone living in another community. This means that the more people involved in the process of controlling accidental fires, the greater the chances that the effort will be successful; and

3. Some techniques of controlled burns require or are easier to put in practice through collective work.

Hardin (1968), presented situations in which the consequences of one practice could provoke problems for many other individuals, and those situations could also be identified as tragedies. He cites pollution as one example. In the case of agricultural fire, it does not matter if the system is private property or communal; accidental fire is an element that will not respect boundaries, and can provoke indiscriminate damages in all the properties of a community. The solution to this problem also requires a certain level of collective organization. During a meeting involving many farmers in the Del Rei community, many years ago, after they tried different strategies to avoid accidental fire without too much success, one farmer said that to control fire effectively they should create a local law. He understood that together they needed to create local rules, and follow them, in order to control agricultural fires. The community of Del Rei established the first fire agreement of the region. This event showed an understanding that the strategy of fire control necessarily had to have components of collective action. Just one farmer (A) isolated in his property using the correct techniques to control fire in his field is not enough. His neighbor (B) can provoke a fire accident and this fire can burn forests and systems of production of farmer A. To have an efficient system, they need to work together, and use as many techniques as they can, as well as communicating effectively, even forging collective management strategies.

The experience developed at Flona-Tapajós was thought out based upon those considerations, and institutional arrangements were developed in 18 communities, as an attempt to increase the number of techniques used by the families during the burning process of their fields, and consequently decrease the number of accidental fires. The arrangements, in most of the cases were composed of a list of techniques and recommendations that each family within the

communities should apply when burning. The process was developed in an adaptive way in which families established rules, tried to apply them, evaluated the results, changed the rules, tried to apply them and evaluate them again. The analysis carried out in this research indicated that this process contributed to an increase in the number of techniques used by the families, and also in the percentage of the families using each technique.

A later analysis of that experience drawing upon the principles designed by Ostrom (1990) (table 3-4) shows that fire management agreements at Flona-Tapajós had clear boundaries, the rules were thought out considering cost/benefits analyses, the process was adaptive and families could modify the agreements anytime, and external agencies recognized the rights of the communities to take their decisions. However during the years of the project, communities did not establish a monitoring and sanction system, most of the communities did not set up arenas to solve conflicts, and the interaction among other organizations to support fire agreements was only indirect.

Regarding the definition of boundaries, it was easy in the case of the Flona-Tapajós agreements due to two factors. First, each community already had their own boundaries, and clear definitions were already established regarding of which families were part of the community and which ones were not. Also, the use of fire within each community was only for agricultural purposes, and the right of farmers to burn for agricultural purposes was guaranteed in law. During the meetings the families just emphasized that the rules created were applied to everybody who would burn a field.

Regarding the congruence between benefits and costs of following the agreements, there was a concern not just among the technicians, but also among the families not to propose rules that would increase the costs of production for the families. This concern was based on the fact

that the use of techniques and recommendations for fire management does not increase the profits of a farmer. It can decrease damages, but accidental fires are a possibility. Burning fields does not always result in accidental fire. And not all accidental fires mean damages in the view of farmers. It is therefore complicated to increase labor when there is no consequent increase in benefits. The results of this study show that the families were more likely to follow the rules that required less labor.

Table 3-4. Analysis of Flona-Tapajós experience using the principles designed by Ostrom (1990)

Design principles illustrated by long-enduring common-pool resources institutions	Analyses for Flona-Tapajós
Clearly defined boundaries	All the agreements were clear regarding the rights to use fire, and for what purpose
Congruence between appropriation and provision rules and local conditions	The rules set up were based on the farmers' practices, and there was an effort to think of rules that were not going to increase the labor required, because the use of techniques for fire management does not increase the profits of a farmer. It can decrease damages, but accidental fires are a possibility. Not all the time a farmer burns his field is there is an accidental fire. And not all accidental fires mean damages in the view of farmers.
Collective-choice arrangements	The agreements can be modified any time by the families, however, although they have suggestions for changing it, they are not bringing the ideas to the communities' meetings
Monitoring	There is no formal system of monitoring who is doing what within any of the communities.
Graduated sanctions	From the 8 communities involved in the project from the beginning to the end, four have defined that people would be responsible for damages caused, but no sanction have been applied
Conflict-resolution mechanisms	Three communities decided that community' meetings were their space to solve conflicts, In one community they defined if they could not solve it, IBAMA was going to be invited to intervene.
Minimal recognition of rights to organize	Communities were free to decide their own rules, and even now IBAMA is not interfering with fire agreements.
Nested enterprises (For CRPs that are part of larger systems)	There is not any other organization responsible for helping the communities, despite attempts. ICMbio is currently the organization that can support communities regarding fire management.

Regarding the possibility of the participants to change the rules, during the years of the project there were special meetings designed just to change the rules, and the communities did change their agreements many times. Nowadays, the agreements can be modified any time by the families; however, although they have some suggestions for change they do not always bring them to the communities' meetings. While the agreements were being developed, many times the communities were asked to think of a system of monitoring, and sanctions for those who didn't follow the rules. Although some communities did create procedures, most of them did not want to do it. When I went back to the field in 2007, the son of one family caused an accidental fire that burned the productive system of his parents. The parents did not want to discuss the case even with the leaders of the community, as was established in their agreements; the main reason was because the person that had caused the accidental fire was their own son, and they were the only family that had damages in the case. The strong kinship level within the communities in that region may be one explanation for why families did not want to establish a system of punishment and sanction. However ICMBio has a strong presence within the communities and they can always report problems to that governmental organization, although there is no evidence of families doing that. Also, IBAMA monitors fields within each community every year as part of a process established in agreement with families of Flona-Tapajós to control deforestation. This monitoring activity carried out by IBAMA is the only action of its kind, and maybe it plays the role of monitoring the system. The families interviewed in 2007 said that they only know what their neighbors are doing because they sometimes work together or they go hunting, and they go through neighbors' fields and can see what they are doing.

Regarding the solution of conflicts, some of the communities decided that the community meetings were their space to resolve conflicts, but there were no cases after the agreements were established in which the community had to interfere in a conflict situation.

While the project was going on, IBAMA left the communities free to participate and decide their own rules, and even now they are not interfering with fire agreements. However, they helped the communities many times by providing information about each technique and the importance of using them, leaving the decision about including the techniques or not in the agreement to the farmers participating in the meetings.

Because the project had an ending date, there were many attempts to build a network of organizations that could keep the debate about fire management alive better described in the chapter four. However, it was not possible due to three factors:

- a) most of the organizations were not able to work within all the communities of Flona-Tapajós;
- b) some organizations were not interested in working with fire management; and
- c) the only organization that was interested in keeping the project was not able to apply for financial support because it was a new organization that had no formal status.

Every year just before the burning season, IBAMA goes to the communities to authorize the deforestation and burning of the fields. The families indicated this visit as the moment when the fire agreements were remembered. This could be a great opportunity to review the rules and re-enforce the process, but this is not occurring.

The lack of continuous discussion of the fire agreements is one of the biggest threats to their continuing to function. In 2006 there was one case of accidental fire that was provoked by a young couple that did not participate in the project activities. Also, there were a few families who moved to the community after 2004 who do not know that there was a fire agreement in the community. If the community or the IBAMA/ICMBio or the local organizations do not continue

to promote the discussion of fire management, there is a chance that those communities will decrease the number of techniques and recommendations being used, and consequently increase the of accidental fire in the future.

### **Conclusions**

The case of Flona-Tapajós shows that institutional arrangements can contribute to coping with the problem of accidental fires, even when the process is stimulated by an external agent. At Flona-Tapajós four years of open discussion about techniques and recommendations available to avoid accidental fires, and a process of promoting dialogue among families where farmers could express their interests and opinions and by themselves decide which techniques and recommendations to use to control accidental fires, evaluate them and change them according to their opinions and debates, resulted in a increase in the number of techniques used, and also in the number of people using them. Thus, the risk of accidental fires decreased, as pointed out by all the families.

What are the basic principles to build institutional arrangements for fire management? The experience of Tapajós National Forest indicates that the effectiveness of institutions for fire management depends on some important principles such as the ones pointed out: congruence between costs and benefits to put the rules in practice, or clear definition of boundaries (Ostrom 1990). However, based in the case of Flona-Tapajós it is possible to say the effectiveness of the initiative also relied on the facts that:

1. The initiative took place at the very local level, with strong participation and engagement of the farmers using fire;
2. To build institutional arrangements, the techniques and recommendations to be used were chosen by the farmers who would use them. It does not matter what external agents think, because in the end, the farmers' decisions will be implemented during the burning of their fields;

3. The decision power in the hands of the families was to be clearly stated. All communities and families need to know that they could decide to participate or not, to stop the process anytime they wanted, and the decisions regarding the techniques were truly in the hand of the families. In the case of Flona-Tapajós some communities were never involved in the project and there was no penalty for that. Maybe because of it, during the following years the number of participating communities increased.
4. The process was adaptive so that all those involved could learn from successful activities and also from mistakes, improving the understanding of the process, and changing course of actions when necessary (Mulder and Coppolillo 2005). In the case of fire agreements, evaluations were carried out year from year to analyze the attempts to use the techniques and recommendations, and to decide what was necessary to change.
5. The process was focused and continuous, with different kind of activities, allowing long-term debates on fire. Otherwise, it is not possible to guarantee any change in the behavior of people through a lecture on good techniques and recommendations of how to burn fields for agriculture.

When the project for fire management started within Flona-Tapajós, technicians thought that after some years of adaptive changes, the families could define a permanent set of rules that could be applied for long time. However, it did not take long for us to understand that institutional arrangements can always change, and that the families need to control the process of organizing and changing it from year to year if it is necessary. A change in the weather can make a difference in the set of rules necessary to control accidental fires, and the communities internally need to be able to work out the necessary changes. In the case of Flona-Tapajós, families keep taking the decision at the individual level, and although the number of techniques and the number of families using them increased, for fire management, it would be better if the decisions for using the techniques or recommendations were debated among all the families year to year, as a way to stimulate constant concern and also to avoid the failure of transmitting this concern to new generations.

The case of Flona-Tapajós also indicates that through the process of building institutional arrangements for fire management, farmers start thinking and debating about alternative systems of production to fire, and in this way, the process of discussing fire management creates an

environment for the introduction of more important changes in their agricultural systems, that could ultimately diminish or even exclude fire from the system of production

CHAPTER 4  
PARTNERSHIP IN AN ACTION RESEARCH PROJECT: BUILDING AND ANALYZING  
PARTICIPATION

**Introduction**

Participatory approaches started to gain acceptance in development projects and also within the environmental field due to the failure of many top-down initiatives in achieving the goals established, and when externally imposed models often proved to be ineffective (Chambers 1992; Guijt and Shah 1998). After decades of debate, the importance of having local people participating actively in decision-making processes is now a consensus among scholars and practitioners working in development initiatives and environment. Agencies and foundations started requiring strategies and activities that would guarantee local participation in proposals supported by them, as a way to empower local people to analyze their own situation and take action and improve their livelihoods (Guijt and Shah 1998). However, there is still the challenge of putting into practice the consensus about importance of participatory process. The term participation has often been used to describe very rudimentary levels of participation where agencies' staff just consults community members (Guijt and Shah 1998). The analysis of participatory processes have not yet resulted in a theory about local participation, but ranges and frameworks to analyze the subject have been proposed to identify if a process is locally participatory or not (Adams and Hulme 2001; Cohen and Uphoff 1980; Stone 2003).

The discussion about local participation is not specific to development and environmental projects. Participation can also be discussed in the context of research projects. According to Ferreyra (2006:577) in the last few decades, there has been an emerging debate in participatory action research (PAR) in the context of environmental governance involving multiple stakeholders.

In this study, I discuss the importance of local participation and partnerships in building an action research project, and ultimately, to the effectiveness of the institutional arrangements that were developed during the fire management project at Tapajós National Forest. The project was developed through a partnership between an NGO, rural communities of a protected area and many other stakeholders. The project aimed to build institutional arrangements for fire management through a participatory process, as a way to decrease accidental fires within the protected area. I used my experience as part of the NGO's staff, to discuss the attempts to make it a participatory process during the years. This analysis suggests that it is complex to define what is local in a process, in which more than one community and more than one organization is involved. The engagement of many different stakeholders is not easy. It takes time, human and financial resources, continuous debate of interests and goals and constant adaption. In the case of Flona-Tapajós, the openness to participation by different stakeholders contributed not only to the execution of the action research project, but more importantly, to the achievement of the main goal of the partnership itself: the reduction of accidental fires at Flona-Tapajós.

Secondly in this study, I examine how numbers of people participating during the formulation of local agreements at Tapajós National Forest are related with levels of compliance with the fire management agreements rules the families follow nowadays. I decided to investigate this question because during the years of the project, the group of technicians carrying out the activities and the people coming to the meetings were always worried about the number of families present in the meetings. The concern was motivated by many reasons:

- a) part of the community was going to take decisions in the name of other community members that were not participating in the meetings;
- b) those who were not coming to the meetings might not follow the decisions made. Farmers used to bring up the subject of the importance to guaranteeing that the neighbors were going to make the same effort to avoid accidental fires as these people attending the meetings. Otherwise, their own effort would not avail, because a single accidental fire

could damage all the farmers. This point was debated in all the meetings within the communities.

- c) Finally, the number of people involved in the activities we were developing was one evaluation criterion used by the funding agencies.

These were the reasons for the concern about the number of families in each community participating in the meetings. However, during four years working at Tapajós National Forest, I observed that the number of people that were participating in the meeting varied by community. Some communities had higher levels of participation with many people coming to each meeting, while others had less people participating in the meetings.

To understand how different levels of participation during the process of local agreements formulation at Flona-Tapajós were related with levels of compliance with the rules, I carried out a survey in four communities of Flona-Tapajós. Two of those had the highest levels of adult participation in the meetings carried out there, while the other two had the lowest levels of participation. In July of 2007 I carried out 53 interviews with families of the four communities. I calculated frequencies of the degree to which people used the agreements rules' to compare the communities. My findings indicate that at Flona-Tapajós, there is no significant difference in the average number of rules applied by the families of communities with higher level of attendance in comparison with the communities that had lower levels of attendance at the meetings to formulate fire agreements. Because there is no important distinction between the two communities, the findings suggest that in communities in which families have long-term interactions and where the level of kinship is also strong, the number of people participating in the meetings is not a determinant of the actions the families will take.

This chapter is organized in four parts. In the first, I discuss the importance of local participation to manage natural resources, and the importance of local participation in the specific case of building institutional arrangements to avoid natural resources depletion. Then, I

discuss the experience of fire management in the Tapajós National Forest within the context of participation. The third part brings an analysis of the relationship between number of people participating in meetings and compliance with rules they established during those meetings. Finally, I draw some conclusions regarding the two goals of this research.

### **Background**

Local governance and local participation in environmental issues are widely supported by many scholars as a way to guarantee sustainability and development. Despite the current interest in participatory methods, the involvement of local people in decision-making processes is not new. In 1930 there were initiatives in India trying to stress participation as a way to empower and promote collective local actions (Guijt and Shah 1998:3). However, in the past, participatory approaches sometimes were actually discouraged in development projects and programs (Stone 2003). During the 1960's within the growing environmental movement, participatory approaches did not have the global space and importance that they get nowadays. As an example, at that period and before, many protected areas were created in many different places without any consideration of local interests, and local people, and primarily by decisions of outsiders (Mulder and Coppolillo 2005). Only during the 1970s, after the failure of many top-down the initiatives and when ineffective of externally imposed models became clear, did participatory approaches start to gain more serious consideration (Chambers 1992; Guijt and Shah 1998). Bottom up development projects, started to gain more acceptance when conservationists embraced the idea, as a way to avoid the large-scale and expensive failures to top-down models (Mulder and Coppolillo 2005). In the early 1990s participation started to be used as synonym for good or sustainable development (Guijt and Shah 1998:4). Participation requirements by agencies and foundations, were based on the assumption that "participatory approaches empower local people with the skills and confidence to analyze their situation, reach consensus, make decisions and

take action, so as to improve their circumstances, and promote more equitable and sustainable development” (Guijt and Shah 1998:1). In that period participatory development “emphasized not only the need for local input in projects... but also the decentralization of and access to decision-making processes” (Stone 2003:28). Nowadays, even in the governmental sphere the importance of participatory processes is gaining space. There is a shift going on in state environment governance program to promote more participatory approach involving local stakeholders and the private sector. Thus, “many actors, decision makers, and partnerships have come to play increasingly important roles in what happens” to the environment (Agrawal and Lemos 2007:38). The current advocates of participatory approaches “emphasize not only voice but agency, the capacity and power for local people to define development according to their aspirations... and to negotiate vis-à-vis other actors, the conditions of their participation in all aspects of a development project” (Stone 2003:32). Thus, the term co-participation appears to define a process of collaborative participation where local communities and other actors form partnerships to define and implement development initiatives, as a more recent approach (Stone 2003).

But what does local participation mean or what is a participatory approach? “Participation has often been used to describe very rudimentary levels of consultation between agency staff and community members” and sometimes it has been used to manipulate people “under a cloak of social palatability”... but it seems that scholars are accepting that “genuine participation should embody some form of empowerment of the population, especially participation in decision making” processes where people should be involved in the whole project or program cycle (Guijt and Shah 1998:9). Mere consultation, and limited involvement in activities, should not be considered to be a genuine participation process (Schneider and Libercier 1995:10). For Cohen

and Uphoff (1980:214), participation is a single phenomenon that by general definition is “the involvement of a significant number of persons in situations or actions which enhance their well-being”. To some, participation is an end in itself: a human right. In conservation and development initiatives, community supporters and activists argue that local people have the right to participate in any decision process that could influence their lives (Weigand Jr. 2003:1).

Although it seems that nowadays there is agreement among academics and practitioners that engagement of local people, groups and communities foster more effective environmental governance, there is also criticism of participatory approaches and the way “outsiders” work with rural communities and groups regarding to the level of participation local people have in the projects and programs in which they are involved. Adams and Hulme (2001) say that there are two polar forms of community conservation. On one side there is centralized or top-down protected area management that does not make efforts to include local opinions and views, and on the other side, there are initiatives that aim to promote a complete devolution of resource management to local authorities. Stone (2003) also proposes a range of participatory development initiatives that go from little participation, in which projects and programs are defined externally and local people are just providers of resources such as labor and information, to full participation in which projects are locally driven since their conceptualization, and the involvement of outsiders is minimal (Figure 4-1).

Cohen and Uphoff (1980:214) designed a framework to analyze participation. The authors say that it is important to think of participation in three dimensions: what kind of participation is under consideration, how participation is occurring, and who participates at which level (Cohen and Uphoff 1980; White 1996). Besides these three dimensions, the context of a participatory

process needs close consideration too, because the situations in which participatory actions take place may vary widely (Cohen and Uphoff 1980).

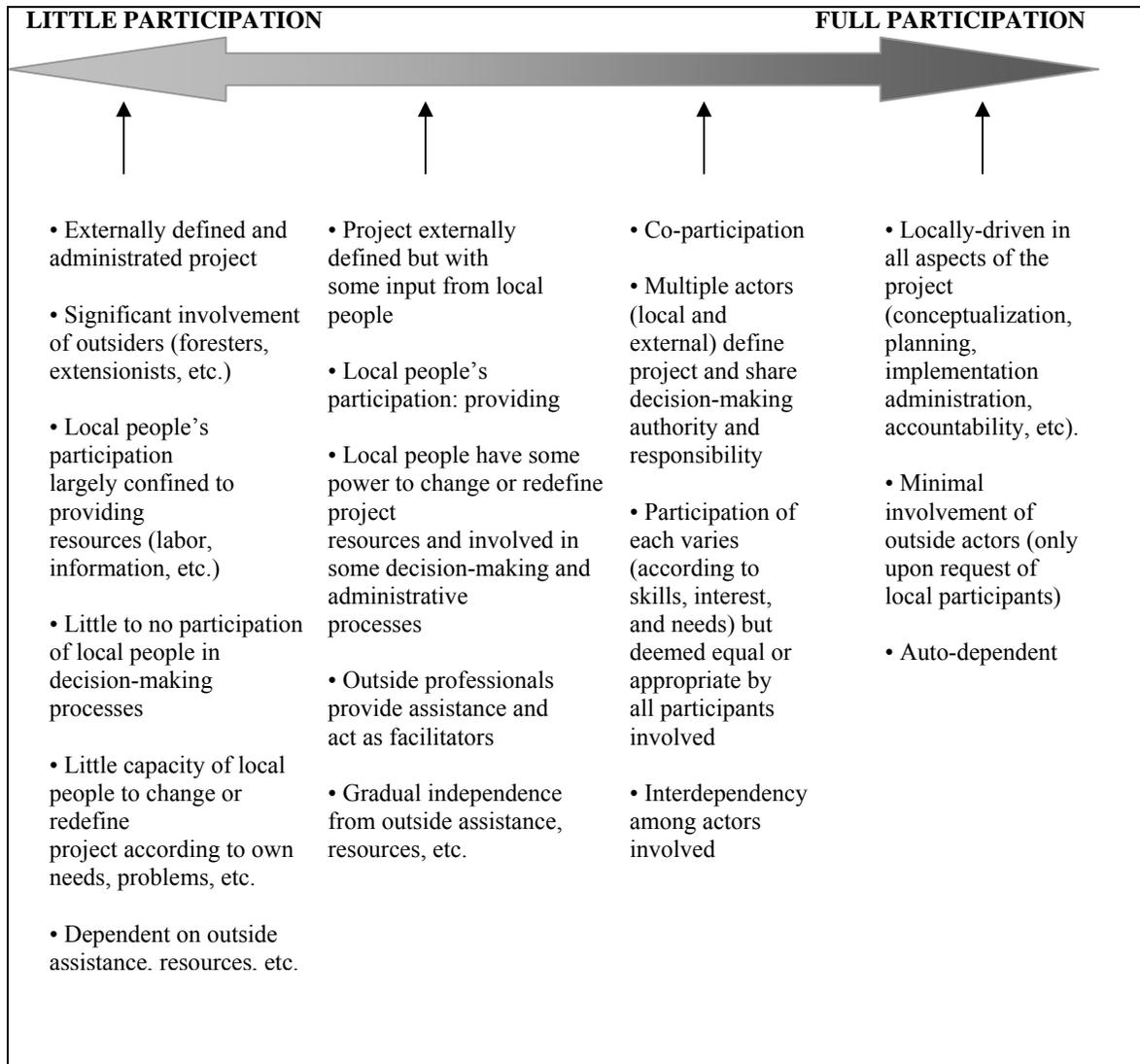


Figure 4-1. Range of participatory development initiatives. Source: Stone 2003:36

Regarding the kind of participation possible, the authors list four types:

- a) participation in decision-making processes;
- b) participation in implementation;
- c) participation in benefits; and
- d) participation in evaluation.

Decision-making participation refers to the “generation of ideas, formulation and assessment of options, and making choices about them, as well as the formulation of plans for putting selected options into effect” (Cohen and Uphoff 1980:220). Three different moments are involved: initial decisions related to the identification of local needs; ongoing decisions taken during the execution of the project or program; and operational decisions that mean specific arrangements or partnerships established by the project as an effort to involve people.

Implementation participation refers to people’s participation in the implementation aspects of a project. Cohen and Uphoff (1980) conceptualized it in three ways: resource contribution can mean provision of labor, cash, material goods and information; administration and co-ordination refers to the possibility of people’s participation as employees or as members of project advisory or decision-making boards, which helps increase self-reliance. The last form of participation regarding implementation is enlistment in projects or programs.

Benefits of participation refer to the material, social or personal gains someone can obtain for participating in a project. Material benefits refer to private goods, and social benefits refer to public goods such as schools or water systems. Personal benefits refer to the possibility of a group member acquiring political or social power through the execution of the project or program, as well as self-esteem and sense of efficacy. Besides the study of what are the benefits of participation in a project and who acquires the benefits, for Cohen and Uphoff (1980:221) it is also important to understand possible harmful consequences of participation, and who participates in adverse outcomes.

Evaluation participation refers to the ways people participate in evaluating a project or program. In the project context, evaluations can happen through formal review processes or informal consultation, and it is important to know who participates in it, how continuously and

what power people have to, based on the evaluation, change the course of the actions within the project.

Regarding who participates, the authors state that this depends on the characteristics of a project or program, and the distinction of the participants. In rural development programs it is possible to distinguish possible participants in four groups, but within each group other kinds of distinction are possible. The groups are: local people, local leaders, government personnel and foreign personnel.

How participation occurs is another important point, and it adds a qualitative aspect to the analysis of participatory processes. According to Cohen and Uphoff (1980:224) the important points to consider are: the initiative of participation comes from above or from below; the inducements for participation are more volunteer or coercive; the structure of participation and the channels of participation (individual/collective, direct/indirect) over time; the duration, and the scope of participation; and finally the empowerment of people to obtain results through participation. To the authors, the processes which are initiated from below and are voluntary, organized, direct, continuous, broad in scope and empowered are considered to be the most participatory (Cohen and Uphoff 1980:225).

The context of participation, according to Cohen and Uphoff (1980) also deserves important consideration. The authors distinguish context in two forms: (1) the characteristics of the project that refers to technological complexity, resource requirements, tangibility, probability, immediacy and divisibility of benefits, program linkages and flexibility, administrative accessibility and coverage; and (2) the task environment that refers to physical and biological, economic, political, social, cultural and historical factors.

Finally, it is important to consider the purposes of participation. According to Cohen and Uphoff (1980), in one project or program the purposes can be seen different by depending on whose perspective is taken into consideration. However, there are two important things to consider: whether the purpose of one group of participants differs from the purpose of other groups, and who gets the benefits of participation.

Within communities there are many different aspects that contribute to the process of participation in a given project. However, no single theory is able to explain all those aspects, and each author seems to make separate contributions. Guijt and Shah talk about differences within communities that interfere in the participation of people. There is a naïve view of community as a unit that is “an harmonious and internally equitable collective” (Guijt and Shah 1998:1). However it is important to understand the complexity of community differences in participatory processes. “Age, economic, religious caste, ethnic and in particular, gender” are some of these differences that need consideration (Guijt and Shah 1998:1). Besides internal differences, participation is also influenced by other aspects such as dissatisfaction with a project. In one case of a participatory rural appraisal in Bahia, Brazil, some people refused to participate in the process as a silent protest against the government for the creation of an extractive reserve in the area, and as a rejection of the group that was conducting the process (Weigand Jr. 2003). This example shows that families within communities consider a variety of issues in participating or not in any process.

Issues related to local participation are also relevant to participatory research action projects. According to Ferreyra (2006:577) in the last few decades, there has been an emerging debate in participatory research action (PAR) in the context of environmental governance that involves multiple stakeholders. The assumption of participatory action research (PAR),

according to Wadsworth (1998) represent a new paradigm of science that considers the importance of social and collective processes in obtaining conclusions about a specific question or subject. Most of the participatory action research involves those who share concerns, experiences and interests: those that have a problematic situation; those trying to assist to change it and those who provides material resources necessary to change the situation (Wadsworth 1998).

In this study, I first discuss the importance of local participation and partnerships to build an action research project, and the effectiveness of the institutional arrangements for fire management at Tapajós National Forest, considering the frameworks of local participation in the context of a participatory action research project. Secondly, I look to how numbers of people participating during the process of local agreements formulation at Tapajós National Forest are related to levels of compliance with the fire management agreements rules the families follow. This was an attempt to measure local participation, and test its relationship to management results. According to Guijt and Shah 1998:10 “feasibility of 100 percent of participation is a myth. The local participation context will strongly influence the degree and form of participation”. But if 100 percent is a myth, what proportion is necessary? What percentage of people participating in processes within a community is sufficient to guarantee that results will be achieved? This is the question that this study attempts to answer. For that, I test the hypothesis that the greater the number of community participants, the greater the degree of compliance with the rules of fire management agreements.

### **Attempts to Build a Participatory Action Research at Tapajós National Forest**

The fire management project was developed within Tapajós National Forest (Flona-Tapajós), a 600,000 hectares protected area located in the State of Pará, north part of Brazil. The area is celebrating 35 years of creation. Flona-Tapajós was established in 1974 through federal

decree No 73.684, and its creation was part of a federal government strategy to integrate the region to the other parts of the country (IBAMA-ProManejo 2005). The many communities living within the area just learned of the protected area's creation in 1975, when the Instituto Brasileiro de Desenvolvimento Florestal (IBDF – Brazilian Institute for Forest Development) started doing an assessment in the area to identify the number of families that were going to be driven out. IBDF was the government agency responsible for the management of the area at that time. From the year of creation until the end of the 1990's, conflicts marked the relationship between communities, other groups living within the Flona-Tapajós and IBDF (IBAMA-ProManejo 2005). The main points of conflict were: (a) IBDF was extremely authoritarian towards the families (Faria 2003; IBAMA-ProManejo 2005); and (b) the limits established by the federal government included areas in which families were living, and the legislation of that time did not allow people to live within national forests. Because of that, a long period of conflict and resistance by the families, supported by local organizations, took place in the region (IBAMA-ProManejo 2005). In 1994, through decree No 1.298, the government recognized the presence of the families living within the area, and their rights to be there. However, among the families there was a strong debate about the possibility of having their areas excluded from the protected area limits. In 1996, 62 percent of the families voted to have their areas excluded from the Flona-Tapajós. In 2003, a new voting process was carried out and 95 percent of the families decided the opposite (IBAMA-ProManejo 2005). Through development projects and a more democratic model of relationship between the government agency and communities, the relationship between government and communities has changed in the last decade. Many partnerships were established for the management of the area, and also to promote alternative systems of production for the families living within Flona-Tapajós. Projeto de Apoio ao Manejo

Florestal Sustentável na Amazônia (ProManejo) is a project funded by PPG-7, and managed by IBAMA. This project at Flona-Tapajós supported activities regarding community management of natural resources, control and monitoring of the protected area, ecotourism and environmental education (IBAMA-ProManejo 2005).

### **The Fire Management Project at Flona-Tapajós**

IBAMA had developed a partnership with communities within Flona-Tapajós and established a group of volunteer environmental agents composed by local people trained to work in their communities regarding environmental issues. In 2000, IBAMA/ProManejo promoted a meeting with the participation of local leaders representatives of inter-communitarian associations of Flona-Tapajós, the Rural Labor Union of Belterra, the volunteer environmental agents (AVV's), research institutions and other local organizations, to discuss environmental problems of Flona-Tapajós. IPAM was invited to participate and present the experience working with fire management in other regions of Pará state. Because of that experience, and because one of the problems debated in the meeting was the number of accidental fires that occurred at Flona-Tapajós during 1997 and 1998, IPAM was invited to write a project to work at Flona-Tapajós.

The previous experiences of IPAM group working with fire management had shown some important lessons that helped to guide the process at Tapajós National Forest. One important lesson was that fire management could not be improved without a strong engagement of local people. Because of that and after deciding to propose a project, the first action of the IPAM group was to organize two meetings with representatives from all the communities within Flona-Tapajós, and some other local organizations to discuss if the idea was important to the region or not, the activities to be carried out, the communities to be involved, the time of the project, and the necessary partnerships. At that time, most of the communities did not have formal

organizations to represent them. Their representation at the meetings happened in three different levels:

- a) the presidents of the communities (leaders choose by the families to coordinate the communities),
- b) the presidents of the inter-communitarian associations (formal organizations representing communities, and also able to propose projects; Flona-Tapajós had four inter-communitarian associations and each represented part of the communities), and
- c) the Rural Labor Union of Belterra (the organization that at the time represented all the communities of Flona-Tapajós located within Belterra municipality).

There are some communities of Flona-Tapajós that are located in the municipality of Aveiro, but the Rural Labor Union of this city never participated in the activities of the project, although they were invited many times.

Based on the debate carried out in those meetings, a one-year project was proposed to IBAMA/ProManejo. The common goal of the project was to decrease accidental fires at Flona-Tapajós (Figure 4-2). The partners at the beginning of the project were IPAM as the research proponent, the communities as the research participants, IBAMA/ProManejo as the financial support and also as the federal government agency responsible for the management of the area, and the Rural Labor Union of Belterra (STR-Bel) as local representative of the communities, and a reference group. Each partner had its own goal.

In the case of IPAM, a research institute, we had the goal of studying the effectiveness of local agreements in decreasing the number of accidental fires within protected areas. This goal was clearly expressed all the time of the partnership, and it brought a constraint in the sense that the communities involved in the process by definition were those ones that wanted to try to formulate agreements and value them. Because of that, during the conception of the project, the decision-making power was strong for IPAM that was the proponent of the project and the manager of the financial resources, followed of IBAMA/ProManejo, the Rural Labor Union and

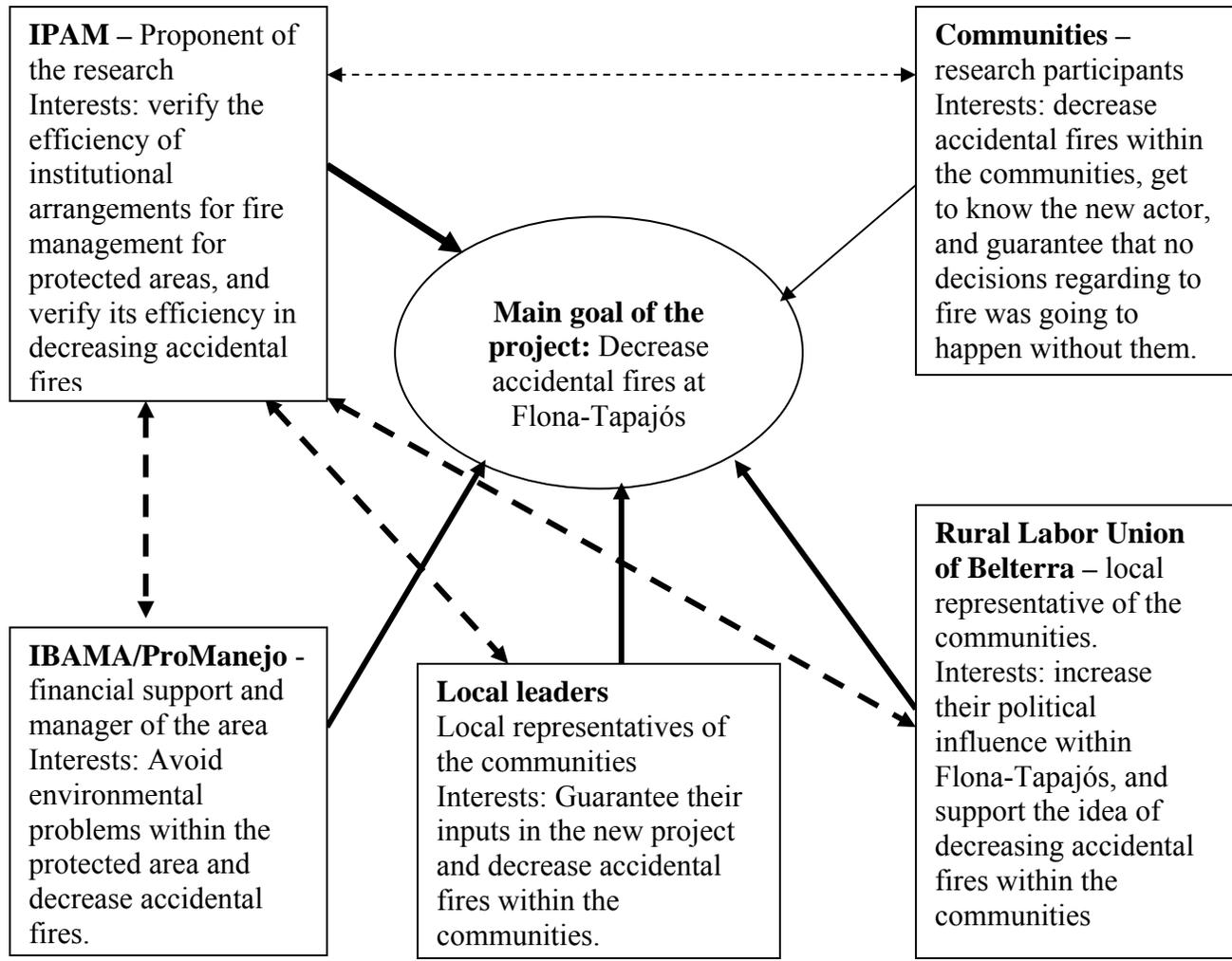


Figure 4-2. Partners at the beginning of the project, their position, their interests, their power regarding to the project and their level of interaction direct with IPAM. Straight lines and their denseness indicate the level of power for each partner in the project. The dashed lines and their denseness indicate the relationship of IPAM with each partner

the representatives of the communities that participated in the meeting where the ideas for the project formulation were discussed. In the Figure 4-2 the straight lines and their denseness indicate the level of power for each partner in the project. The dashed lines and their denseness indicate the relationship of IPAM with each partner. The direct power of the families within the communities only started to exist after the first activity carried out within each community. Through this partnership the project was conceived, and the local leaders and IPAM were the ones that contributed most with definition of activities to be developed within the communities, and defining the areas of priority to the project to start. All those partners had other interests and other partnerships not related to the fire management project, and not represented here in the diagram.

After the approval of the project, the first activity was a visit to each community indicated by the local leaders of Flona-Tapajós as the ones with more problems with accidental fires. The trip to the communities had the goal of explaining the project, its objectives, and activities, and to invite the communities to be part of the process. The families in the communities alone could decide to participate in it or not. Sixteen communities were invited based on the decision of the leaders of Flona-Tapajós; 12 accepted, at first, others said that the project was not interesting for them, and some communities invited IPAM to start the project in future years. The acceptance by the communities was the basic condition for the project to happen, considering the IPAM, IBAMA or the Labor Union were not users of fire. It was not the first communication within the communities. The leaders that participated in the formulation of the project had already discussed it internally. However, the main goal of the partnership, the construction of it, and also the goal of it to each partner were topics carefully discussed within the communities. It was important to clarify goals of each one, because IPAM was interested in

testing a specific instrument that was the formulation of fire agreements, hence, the communities that accepted the project knew precisely that it was a proposal to discuss their fire practices, and they were going to try to formulate rules to burn fields. The idea of bringing out the debate about rules to burn to within the communities was an attempt to let the families to establish their own rules of how to burn. That was based in two basic assumptions. First, the federal fire law had no influence in the practice of local families. Although the law was specific at the level of establishing procedures of what to do during a burning, some of the procedures needed adaption, considering farmers' reality. Second, there was the assumption that simply discussing techniques of how to burn with the families, without an instrument for organizing them, would not be effective. This assumption was based on the experience in communities where IPAM worked before. The process was a discussion about families' experiences and practices, technical knowledge introduced by IPAM and other agencies, and the current Brazilian legislation about fire. It was a process of talking about the families' practices, the benefits and problems with them and the possible local solutions. It was not a teaching process about the fire federal law, and what it says farmers should do. It was a process of considering the federal law, considering technical knowledge, and discussing what was possible to be carried out or not. Based on that, year-to-year the families were setting up a set of rules, trying to apply them, and them evaluations carried out by families and IPAM would indicate possible changes in the rules, in an adaptive process. This process was repeated until the communities were able to elaborate a list of rules that was feasible to be applied, and efficient to control accidental fires.

The first meetings with the communities gave us, the practitioners, the first lesson regarding participation and participatory processes. Because the project was conceived based on a demand from the volunteer environmental agents, and because we had discussed its details

with most of the leaders of the communities, the IPAM group supposed it was an idea accepted by most of the people. However, there were a number of communities, and families within the communities, that were not interested in the discussion of fire management. It is important here to question: which level is local? For us, as practitioners or outsiders, the local leaders and the AVV's were local, and because we were working with them, the project was based in a local demand. However, the practice when we were within the communities showed that even the decisions made by a group of local leaders, people from within the communities, did not always represent the demand of the communities, and even when a community agreed with the project there were still the family level to be considered, and not the families agreed with it. To design the project, we did not have financial support to go to each community and have the same interaction we had with the leaders, but because of that it was important to start the process all over within each community, to explain all the ideas, the objectives, how it was conceived, to be open to new inputs, criticisms, and to change ideas, activities and plans based on that.

During the first year of the project and the beginning of the second, the main activities were the meetings within the communities to discuss fire practices and techniques implemented by the families to avoid accidental fires, the experimental testing of the efficiency of the techniques available to control fire, and the training of the facilitators. All these activities were carried out within the communities that accepted to participate of the project. For each community the actions were:

- a) an assessment of the fire practices for agriculture;
- b) experimentation with the efficiency of the techniques (demonstrative burnings where all the techniques indicated by the families were applied, and analyzed after burning); and
- c) the selection of two people who were trained to carry out some activities locally called the facilitators of fire management.

The communities indicated them, and to promote the participation of women in the fire management debate, the communities were asked by IPAM to indicate one man and one woman to represent the communities. At the end, from the 18 communities involved in the project during the years, six indicated women. The responsibilities of the facilitators were to mobilize the communities for the meetings, to discuss and plan the activities with IPAM, and to help IPAM with the facilitation of the meetings within their communities. With the involvement of the facilitators, the project had a different configuration of partnership because this group of local people was dialoging with IPAM, planning the next steps of the project and evaluating it (Figure 4-3). The direct interaction of IPAM with community leaders changed once the facilitators started getting involved in the project. The decision of involving facilitators in the project was based on the fact that the leaders had many other responsibilities in representing the communities in other initiatives going on in the region, so we discussed together the possibility of new people participating in the fire project. Most of the communities indicated new people, but for some of them, the facilitators were the traditional leaders. Besides, the families were the other group contributing, participating, and evaluating. IBAMA and STR-Bel had less influence. In the case of IBAMA, it was thought that because the goal was to leave the communities free to take decisions, and although IBAMA was in a process of building a more democratic relationship with families, IBAMA was the federal government agency responsible for the management of the area. In the case of STR-Bel, at that time it was going through a political transition, and there were no representatives directly involved with the project actions. When the new board was elected, IPAM had to start all the negotiations with STR-Bel again, and the new leaders showed more interest in the project.

By the end of the second year of the project, IPAM decided to invite some organizations that were involved in activities or projects at Flona-Tapajós to create a discussion group about fire use at the protected area. The main interests of IPAM with this activity were:

- a) to open the project to be discussed formally by other organizations;
- b) to identify common interests of working within the protected area; and
- c) to guarantee the continuity of the fire management actions within the protected area after the end of the project.

The Forum for Good Fire Management was composed by IBAMA/ProManejo, representatives of the communities through the inter-communitarian associations and Rural Labor Union of Belterra, IPAM, Federal University of Pará (UFPA), Projeto Saúde e Alegria (PSA), CEFTBAM-Proteger Project, GCI, and later the Federation (Federação das Comunidades Tradicionais da Floresta Nacional do Tapajós) (Figure 4-4). In this Forum activity plans, agendas and budget were discussed among the organizations that were already working at the protected area, but also new ideas were discussed and some of the organizations participating had not worked at Flona-Tapajós, but had interests in starting to work there.

Within the Forum, IPAM started discussing about the continuation of the activities within the protected area. The most important question was: which organization could take over the project? There were some difficulties to transfer the project to a local organization. The first attempt was to find an organization interested in working with fire management. Second, that organization had to be able to work within all the communities involved in the project, but also be able to start it in other communities that had showed interest. It was a problem for the inter-communitarian associations because each of them was representative of just a number of communities, and political issues would not allow them to work in all of them. Third, after identifying that organization it was necessary to train that organization to use the adaptive

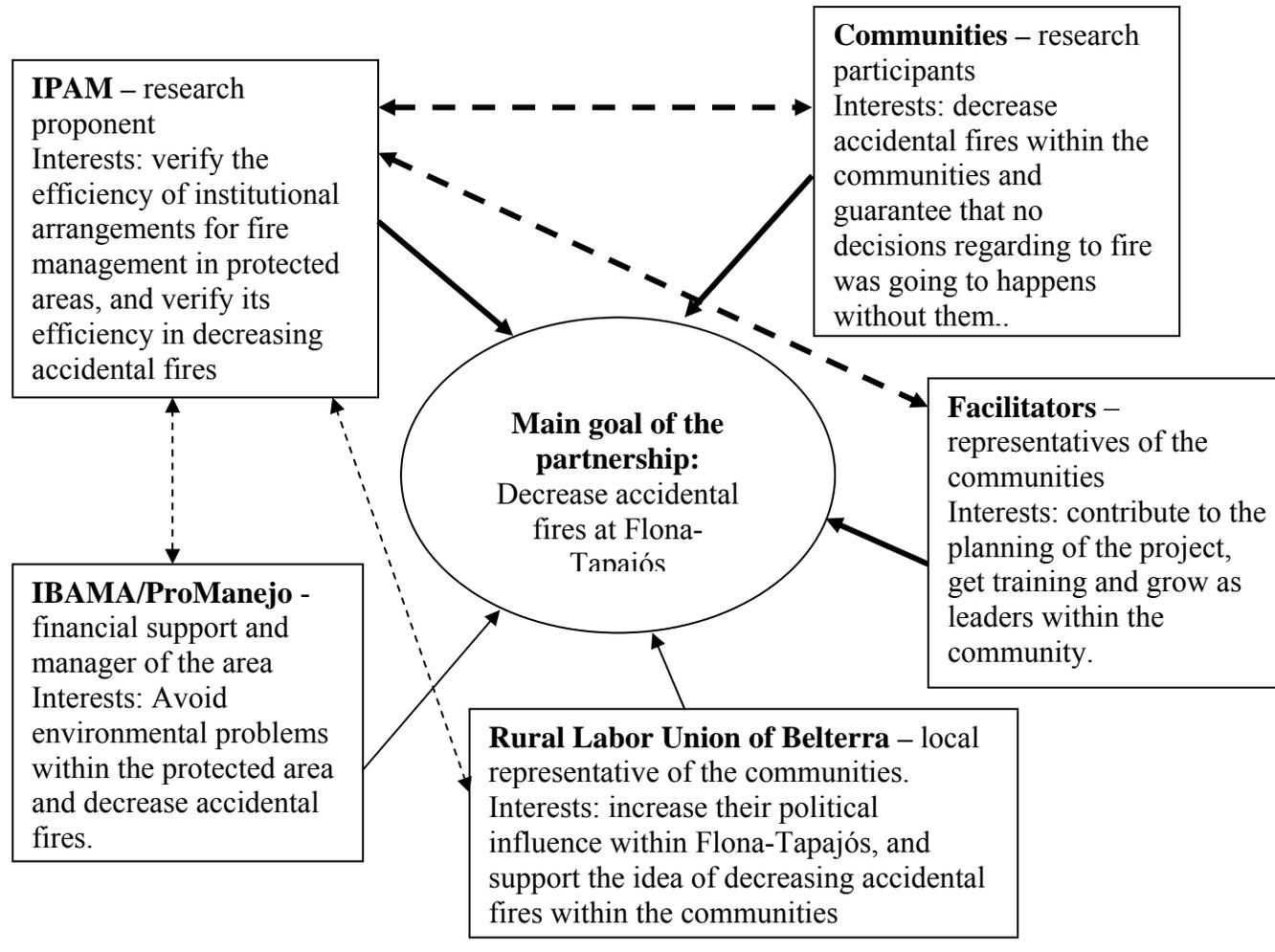


Figure 4-3. Partners after the project started, their position, their interests, their power regarding to the project and their level of interaction direct with IPAM.

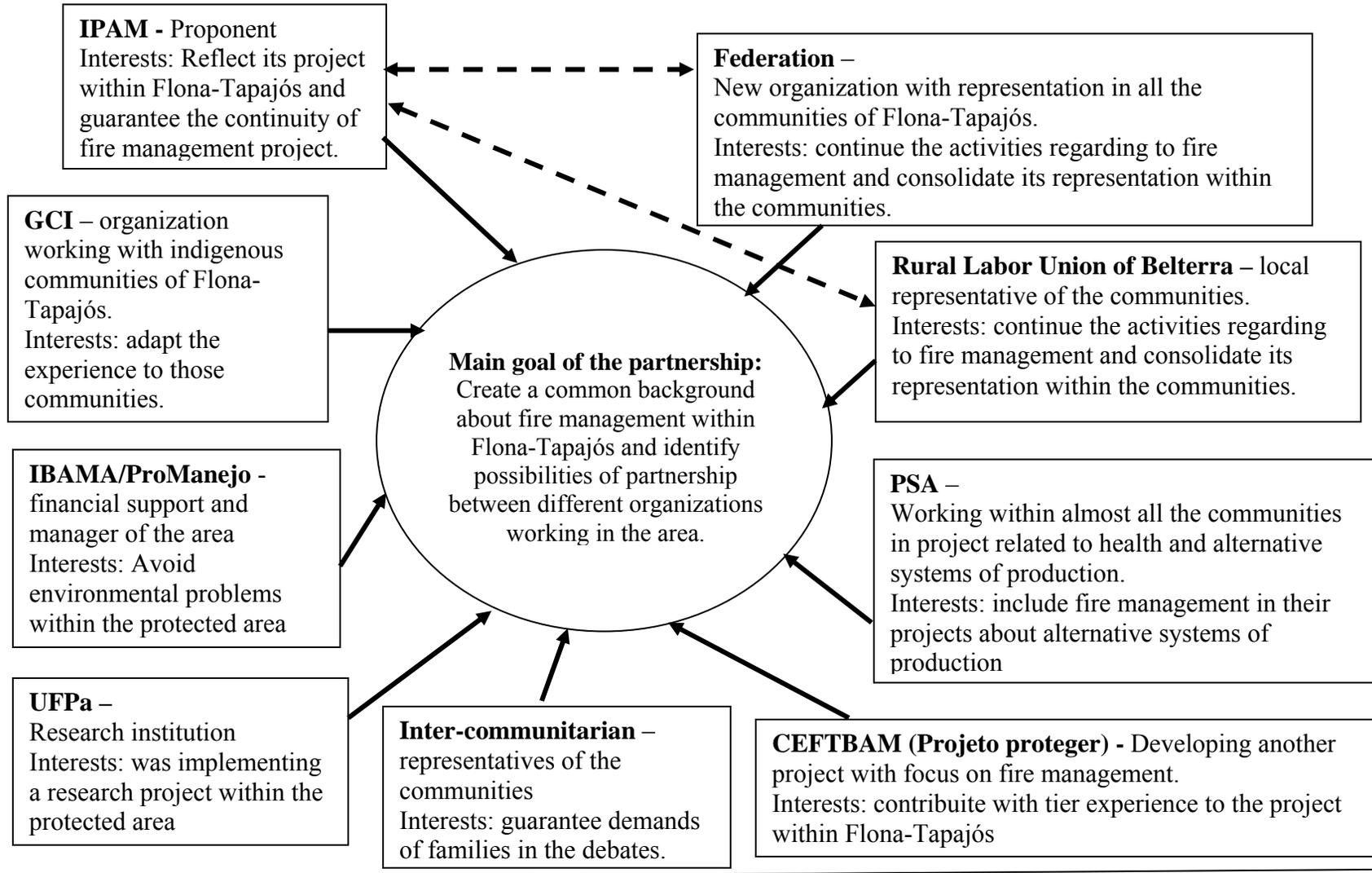


Figure 4-4. Partners in the third and fourth year, their interests and their power of decision-making in the project.

methodology that was initiated within the communities, and finally to find financial support for that organization to keep the activities going. While the fire management project was going on, a commission involving all the communities of Flona-Tapajós was formed to discuss with IBAMA the agrarian situation of the protected area. This commission later formed the Federation (Federação das Comunidades Tradicionais da Floresta Nacional do Tapajós), and the leaders were interested in IPAM activities within the area. A partnership was established between IPAM, the Federation and the Rural Labor Union of Belterra. IPAM was going to train these two organizations and support them to write projects to work within, and on the border of Flona-Tapajós.

With the Forum, the number of partners increased, but after some meetings just some of them kept interested in discussing fire and planning activities together. Thus, by the end those still more involved were the communities, the facilitators, IPAM, the STR-Bel, after the political transition, and the Federation. Before the project was finished, the Federation and the STR-Bel were the organizations trained and with projects submitted to funders to develop activities within and along the border of Flona-Tapajós, to work with fire management and also alternative systems of production that could decrease not only the accidental fires, but also the need to burn every year. One of the projects was approved, and the STR/Bel is implementing it in the border of Flona-Tapajós. The project of the Federation was not approved, mainly because the organization was not formal at that time, and all the funders available asked for formal organizations with the legal requirements to submit proposals. IPAM, IBAMA and the Federation are still discussing a way to keep the work with fire management within the communities of Flona-Tapajós.

## **Reflections on the Process of Partnering for Action Research Project**

Based on Stone's schematic range of participation, the fire management project could be classified as a co-participation initiative, because the project was coordinated by IPAM, but had many other actors involved such as local families, local representatives (facilitators and leaders), other local organizations such as associations, labor unions, NGO's and some government organizations/institutions such IBAMA/ProManejo, and the university. At different moments, and at different levels, all those organizations contributed to project and had power to change its activities and plans. The project was a local demand, if we consider leaders as legitimate representatives of local people. It may not be located at the end of the line, as a full participatory process, because the financial administration of the project was done by IPAM, it was not a family level demand that brought the necessity of a project to discuss fire management, and it was not a community project, but a regional action involving many different communities. Besides, at least among the main partners (IPAM, facilitators and communities), there was a strong level of dependency. In all the conversations it was stated the project would continue only if the communities were still interested in discussing their fire management practices. During the four years of the project three communities opted for stopping the activities. In two of them, one that was on the boarder of the protected area, and the second one that had half of its territory inside the protected are, and the other half outside, many families were selling their lands to the soybean producers that were moving from central Brazil to the north region. This process resulted in a low level of interests of the remaining families regarding the fire management project. The third community had internal political problems, and after a community board transition, the new leaders were not interested in organizing the meetings for fire management, mainly because it was an activity that started in partnership with the other group of leaders. From

2001 to 2004, five new communities started involved in the activities, and in the last year, other invited IPAM to visit them, but by that time the project was being concluded.

Regarding Cohen and Uphoff's (1980) contributions to the analyses of participatory processes, the fire management project could not be characterized strictly in any of the kinds of participation described by the authors. There were situations during the process that most of the actors involved participated in decision-making processes. At the beginning of the project, its conceptualization, all the actors involved (IPAM, IBAMA, local leaders, and STR-Bel) had important role in defining the project, its goals and activities. After the conceptualization moment, when the project went to the communities, the families had the opportunity to make decisions regarding first: to participate or not in the initiative, the activities of the project, the rules in the agreements, and whether to use the rules or not. The moments of implementation were basically carried out by IPAM and facilitators, organizing the trainings and the meetings within the communities, and by the families, who were the ones to try to apply the rules of their agreements. The evaluation processes happened in many different levels. First, a sample of fields was selected and visited by IPAM technicians to analyze the use of the rules. Besides that, a meeting with all the families was carried out within each community, every year, to discuss the use of the rules, to analyze their efficiency and difficulties, and based on that evaluation, to change the rules for the next burning period. Evaluation of each activity was also carried out in each community, and that was the opportunity for families to express their concerns, propositions, and ideas. During the trainings, the facilitator also had the opportunity to evaluate each activity and plan future actions. The participation was voluntary for all the partners, and the communities that decided not to participate had not suffered any kind of pressure for that decision. The invitation was always open for them to reconsider. Considering the goals of the

project to reduce accidental fires, but also considering the interests of each partner, the benefits of the project were many. The numbers of accidental fire decreased the establishment of fire agreements through an adaptive process showed to be effective for protected areas and it was a benefit to all the partners.

One important point regarding the project was that IPAM made clear to all the communities, that despite the goal of decreasing accidental fires, for IPAM it was a research project. That clarification of goals created a demand within the communities to understand the usefulness of research projects in general, not only this one. There were other projects being developed at Flona-Tapajós, thus when IPAM started the action research, we faced a need to explain to the communities what is research, why is that important, for whom, and how it is done. That clarification was necessary because the communities had complaint about research. In their words, researchers were people who would come to then, ask many questions, and leave. In the case of fire management, in each evaluation, we would bring the information produced in each year to be used in the meeting to support the decisions.

The attempts to build participatory action research at Flona-Tapajós show that the engagement of many different stakeholders is not an easy task. It takes time, human and financial resources, continuous debate of interests and goals and constant adaptation, but the openness to participation of different stakeholders contributed not only to the execution of the action research project, but more importantly to the achievement of the main goal of the partnership itself: the reduction of accidental fires at Flona-Tapajós.

### **Do Numbers of People Count? Participation and Compliance with Rules**

The main goal of this part of the study is to understand if different numbers of people participating during the process of fire agreements formulation would result in different levels of compliance with the rules established by the families for their fire management agreements.

The concept of community used in this study is that community is a geographic collective, “a group of people who live (full and/or part time) in a locality and are connected by a web of emotional, economic and/or relational bonds and a culture, and share a set of values, norms, and meanings” (Guijt and Shah 1998:268).

The hypothesis I tested in this study was:

Communities with higher level of participation during the process of formulation of the agreements follow the rules more than communities with lower levels of participation.

The first step of this research was the identification, for each community, of the level of communities’ adult participation in the meetings where the fire management agreements were elaborated or reviewed. Because communities started the project in different years, I decided to work only with the communities that were part of the project from 2001 to 2004. From 18 communities involved in the project, 8 were participating all the four years since the beginning. To analyze the level of participation I used the attendance lists for each of the 8 communities to see what percentage of the population above 16 years old living in each community was participating in the meetings carried out during the years of the project. The age of 16 was taken based on the fact that the teenagers around that age used to come to the meetings sometimes, in most of the communities. During the project, the communities held many meetings related with fire management, but some of those meetings were not directly related with the formulation or reformulation of the agreements. Therefore, I used only the attendance lists from the meetings in which the families formulated and reviewed the agreements, as there were very important moments in the process of formulation and adaptation of the agreements. The list of attendance had only the name of the person participating in the meeting, and I was interested in knowing the proportion of the adult population those people in the lists represented to each community. To

find this information I first listed the number of families in each community in each year of the project. Then I used the average number of adult population using census data from IBAMA to estimate what percentage of that population was present in the meetings for the four years of the project. Communities were ranked according to the level of participation in the meetings carried out during the period between 2001 and 2004 (table 4-1).

Table 4-1. Average number of adults participating in the meetings as a percent of the adult population of each community for the years of the project.

Communities	Average for all the years (%)
1 Prainha II	64
2 Paraíso	49
3 Itapuama	37
4 Itapaiuna	34
5 Prainha I	30
6 Nazare	27
7 Chibé	25
8 Piquiatuba	15

Using this ranking I selected four communities in which to interview families. The first community selected was Prainha II, which had the highest percentage of participating in the meetings. It means that for the meetings I analyzed, in the community of Prainha II, an average of 64% of the adult population came to the meetings. However, at the time the project was carried out, Prainha II was not yet recognized by IBAMA as a community. In order to avoid bias, I also selected the community of Paraíso, which had the second highest level of participation in the meetings. Finally, I selected Chibé and Piquiatuba, which had the two lowest level of participation in the meetings during the four years of the project.

After this selection I traveled to each community to interview the families. My goal was to interview all the families of each community, but in the end, because of time constraints, I interviewed as many families as possible for each community. In Prainha II, I interviewed twelve

of nineteen families. In Paraíso, I interviewed ten of the eleven families. In Chibé I interviewed twelve of 43 families, and in Piquiatuba I interviewed nineteen of fifty-six families living within the community at the time I carried out the surveys. The families were selected randomly at first. However, beyond the families selected randomly, I did a second selection to interview only families who had burnt fields during the summer of 2006 or 2005, and families in which the interviewed people were actually in the field on the day it was burnt. These criteria were necessary because I was interested in the use of fire management techniques, and only those who had burned their fields could give me that information. The interviews were conducted at the families' homes with male and female heads present in almost all the interviews. There were a few cases in which the woman was not at home at the time of the interview, and some cases of a single member family. The interviews were conducted during June of 2007.

I used a structured survey to interview all the families. The survey was organized in different sections. The first section had questions related to the identification of the household heads (male and female) such as their names, time living within the community, and if they had lived in other regions before coming to the area. The second section had questions related to their last crop, and how they burned their fields, which techniques they used, and if they had accidental fires. In this section the people interviewed were asked to draw their plots and show where they built break fires, in which position they started the fire, the vegetation surrounding the field, and the direction of the wind. This information was necessary to evaluate if they had followed some techniques previously established in their fire agreements. The third section was related with their fire management agreements. In this section I asked questions about their opinions regarding their fire agreements, if they knew the community had a fire agreement, if they participated during the process of fire agreements formulation, if they remembered the rules

of the agreements, their opinion regarding the rules, and the current process of discussion of fire management within the communities. The last part of the survey had questions related with their participation in community organizations such as associations, religious organizations, labor unions, and so on.

For this study, I had one unit of analysis, which was the community, one dependent variable and one independent variable. To test the hypothesis the dependent variable was compliance with the rules, and the independent variable was the level of participation.

## **Communities Studied**

### **Piquiatuba community**

There is no clear information on when Piquiatuba community was founded. However, according to Faria (2003) in 1912 there were already some families in the area. By 1956 there were 14 families living in the area. Today, Piquiatuba has 70 families living in three different clusters of houses. Even though this community has strong family ties, nowadays there are many different family nuclei. The community has a total population of 370 people.

Piquiatuba has many different forms of organization. One is the Associação dos Moradores e Produtores Rurais e Extrativistas da Comunidade de Piquiatuba that represents the community externally, and organizes internal activities such as monthly meetings, parties, games and other collective activities. The community members elect the association council for a two-year term. Piquiatuba is also represented by ASMIPRUT (Associação Intercomunitária de Mini e Pequenos Produtores Rurais e Extrativistas da Margem Direita do Rio Tapajós de Piquiatuba a Revolta). The ASMIPRUT is an intercommunity association that represents eight neighbor communities. The families of Piquiatuba are associated to the Rural Labor Union of Belterra. There is also one youth group responsible for a collective radio, and for organizing the youngest people of the community. Piquiatuba has a women's group, and four soccer teams. Although most of the

families are Catholics, there is also a Protestant church within the community. Piquiatuba has a school that offers classes from the first grade to high school. For that reason students from other communities attended there.

The families living at Piquiatuba practice subsistence agriculture, and have an economy based on crop production, extractivism and government benefits. The main products are cassava flour and cattle. Also families collect some non-timber forest products such as açaí and Brazil nuts. There are more than 50 people in the community that work for the government, private companies, or receive money through government programs and retirement. Fishing is an important source of protein to this community, but is not a commercial activity.

Piquiatuba has been involved in many different projects. The Projeto Saúde e Alegria (Health and Happiness Project), a local NGO located in Santarem city, carried out different initiatives involving communities at Flona-Tapajós. Alternative systems of production, organizational strengthening and activities regarding to health care were some of the projects in which Piquiatuba community was involved. The community is currently involved in the Ambé Project, an initiative carried out by the Cooperativa Mista Flona Tapajós Verde (COOMFLONA). The project exploits forest products to the benefit of the families living within the communities. Regarding the fire management project Piquiatuba was involved since the first activities in 2001. During the four years of the fire management project activities, Piquiatuba was the community with the lowest level of participation.

### **Chibé community**

The families that nowadays are the community of Chibé were part of the neighbor community of Tauari. Political problems and also the distance between the clusters of families resulted in the separation of the one group of people that in 2000 started the community of

Chibé. Chibé has 43 families and approximately 180 people. Although there are extended families living in Chibé, this community has a variety of different families.

Chibé is organized in a formal association called the Associação Comunitária de Produtores Rurais e Extrativistas da Área do Planalto do Chibé (ASCPREC). The association represents the community externally, and organizes internal activities. The community members elect the association council for a two-year term. Chibé is also represented by AITA (Associação Intercomunitária do Tapajós de Itapuama a Marituba). The families of Chibé are associated to the Rural Labor Union of Belterra. Chibé has Catholic and Protestant members, but they only have a Protestant church. The local school offers classes from the first to the fourth grade.

The families living at Chibé practice subsistence agriculture, and have an economy based on crop production, extractivism and government benefits. The main products are cassava flour and cattle. Some years ago through the local association, around 15 families of the community got involved in a project to plant *cumarú* (*Dipteryx odorata*) and *curauá* (*Ananas erectifolius*). The plan is to produce and commercialize the cumarú seeds and curauá fiber. The project had support of state and federal government through the local technical assistance agency and banks.

Besides the cumarú-curauá project, Chibé has been involved in the activities carried out by Saúde e Alegria Project. Regarding to fire management project Chibé was involved since the first activities in 2001. During the four years of the fire management project activities, Chibé had a low to medium level of participation.

### **Paraíso community**

The first families living in Paraíso were in the area since the 1930's (Faria 2003). At that time they were three brothers and sisters who moved to the area and started the community. Strong kinship is a very important characteristic of Paraíso. Almost all the families are relatives.

According to Faria (2003) only in 1991, did the families living in the area recognize themselves as a community. The community has a total population of 75 people divided in 11 families.

Paraíso does not have a formal organization. The community has an informal council that represents them and organizes internal activities. The community members elect this council for a two-year term. Formally, Paraíso is represented by AITA (Associação Intercomunitária do Tapajós). The AITA is an intercommunity association that represents the neighbor communities. The families of Paraíso are associated to the Rural Labor Union of Aveiro. Most of the families are Catholics, but the community does not have a church. Paraíso has a school that offers classes from the first grade to the fourth grade. Some teenagers of the community have to go everyday to a neighbor community that offers higher levels of education.

The families living at Paraíso practice subsistence agriculture. The economy of the families living at Paraíso is based on crop production, cattle and government benefits such as retirement, and the Bolsa Família Program. There are two people who work in the local school, and are government employees.

Paraíso was involved with the activities developed by the Projeto Saúde e Alegria. Currently the community is involved in the Ambé Project. Regarding to the fire management project, Paraíso was involved since the first activities in 2001. During the four years of the project activities, Paraíso had always around fifty percent of the families participating in the meetings.

### **Prainha II community**

Prainha II was founded in 1998. The families living in Prainha II previously were part of the neighbor community of Prainha. Because of political issues, one part of the community moved to another area and started Prainha II. Siblings mostly formed the group that moved in 1998, and their father was an important leader in Prainha, who moved with his sons and

daughters and created the new community. Prainha II has 15 families and approximately 112 people.

The community has a formal organization called ASNUTA (Associação Intercomunitária Nova União do Tapajós) that organizes internal activities and represents the community externally. The community members elect the board of the ASNUTA. The families of Prainha II are associated to the Rural Labor Union of Belterra. Most of the families are Protestants, and they have a church that is also a training base for the region. The children and teenagers of Prainha II attend the school at Prainha, the neighbor community that offers classes from the first grade to high school.

The families living at Prainha II practice subsistence agriculture. The economy of the families living at Prainha II also is based on crop production, cattle and government benefits such as retirement, and Bolsa Família Program. Most of the families received credit finance to produce *urucum* (*Bixa orellana L.*) and *curauá* (*Ananas erectifolius*). The families sell the seeds of *urucum* and fiber of *curauá*. Cattle is also a important activity in Prainha II, but most of the families get income through the production of cassava flour, *urucum* and *curauá*.

Prainha II has been involved in many different projects. The Projeto Saúde e Alegria is one of the NGOs that worked within this community carrying out health activities such as vaccines and preventive programs. The community members through ASNUTA got involved in a project to produce *urucum* (*Bixa orellana L.*) and *curauá* (*Ananas erectifolius*). The community is currently involved in the Ambé Project. Regarding the fire management project Prainha II was involved since the first activities in 2001. During the four years of the fire management project activities, Prainha II always had the highest level of family's participation.

## Results

This part of the study I aimed to understand if different numbers of people participating during the process of fire agreements formulation would result in different levels of compliance with the rules established by the families for their fire management agreements. For the four communities I analyzed, there are seven fire management rules common in all the agreements. These include: Authorization from IBAMA, cut dead trees, build fire break around the field, time to burn, number of people, start the fire against the wind and watch the field until the fire finish (Table 4-3). However this is not the total number of rules that each community has. Piquiatuba has a total of 12 rules; Chibé and Paraíso have each 15 rules, while Prainha II has 16 rules in its agreement. Thus the communities with higher levels of participation in rule-setting meeting also had higher number of techniques included in the agreements.

Using the data from the four communities about the techniques each family used to burn their field during the summer of 2006 or 2005, and using the list of techniques previously defined in each fire agreement of the four communities, I analyzed the frequency of people in each community following the rules in their agreements. Piquiatuba has 12 rules. The minimum of rules people use is 5, and the maximum is 12 rules. The majority of them (68.4 percent) follow 7 rules or more. Chibé has 15 rules in its agreement. The minimum of rules people follow is 7 and the maximum is 15. The majority (91 percent) follows 10 rules or more. Paraíso agreement has 15 rules. People follow the minimum of 5 rules and the maximum of 10 rules. People follow from five to 10 rules. The majority (80 percent) follow 7 rules or more. Prainha II agreement has 16 rules. The minimum rules people use is 8 rules and the maximum is 15. The majority (91 percent) follows 10 rules (Table 4-3).

I found that from those 7 rules, most of the families (77.3 percent) follow four or more seven rules (Table 4-4). Twenty-two percent of the families use only two or three of the seven common rules.

Table 4-2. Fire management techniques in the communities' agreements, and rules in common

Rules	Column A	Column B	Column C	Column D	Column E
	Communities				Rules in common
	Piquiatuba	Chibé	Paraíso	Prainha II	
Authorization from IBAMA	X	X	X	X	X
Cut the trees towards the field	X	-	X	X	-
Lower the fuel load	-	-	X	X	-
Cut dead trees	X	X	X	X	X
Talk to neighbors to work together	X	-	X	X	-
Build fire break around the field	X	X	X	X	X
Clean the fire break before burning	-	X	-	X	-
Time to burn	X	X	X	X	X
Number of people	X	X	X	X	X
Plan the burn day	X	-	*X	X	-
Start the fire against the wind	X	X	X	X	X
Watch the field until the fire finish	X	X	X	X	X
Wear adequate clothes	-	X	-	-	-
Prepare source of ignition before	-	X	*X	-	-
Month of burn	X	X	-	X	-
Inform neighbors of the day to burn	-	X	X	-	-
Water	-	X	X	X	-
Bring tools to the field	-	X	X	-	-
Distance from rivers	-	X	-	X	-
Distance from roads	X	-	-	X	-
Total rules in each community	12	15	15	16	7

Table 4-3. Number of rules in each community agreement, and minimum and maximum of rules followed.

Communities	# of rules in the agreement	Minimum of rules followed	Maximum of rules followed
Piquiatuba	12	5	12
Chibé	15	7	15
Paraíso	15	5	10
Prainha II	16	8	15

Table 4-4. Frequency of people using the 7 rules in common in the four communities.

	Frequency	Percent	Valid Percent	Cumulative Percent
2,00	5	9,4	9,4	9,4
3,00	7	13,2	13,2	22,6
4,00	12	22,6	22,6	45,3
5,00	11	20,8	20,8	66,0
6,00	13	24,5	24,5	90,6
7,00	5	9,4	9,4	100,0
Total	53	100,0	100,0	

Analyzing the communities separately considering each category of participation (higher and lower) and the seven rules all of them have in common, I found that in Prainha II and Paraíso (higher participation) 81 percent of the families use four to seven of those common rules. In Piquiatuba and Chibé, 74.1 percent of the families use four or more of the common rules.

Separating the analyses of common rules for the community with high and low level of participation, I found that Prainha II and Paraíso (high participation) have 11 rules in common, and 81 percent of the families follow six rules or more. The communities with low participation (Piquiatuba II and Chibé) have eight common rules, and 51.5 percent of the families follow six rules or more.

In Prainha 87.5 percent of the rules of their agreements are followed by more than 50 percent of the families. In Paraíso 60 percent of the rules are followed by more than 50 percent

of the families. In Chibé, 100 percent of the rules are followed by more than 50 percent of the families, and in Piquiatuba 67 percent of the rules are followed by 50 percent of the families.

All the analyses suggest that different number of people participating in the meetings is not an indicator of how people will proceed with rules compliance. Although a comparison between Prainha II (higher level) and Piquiatuba (lower level) indicate differences in the number of rules they set up in their agreements (Table 3-4), and also in the percentage of the rules followed by most of the people, this is not the case for the comparison between Paraíso (higher level), and Chibé (lower level) where the number of rules are the same and the percentage of people following the rules is higher in Chibé. Looking at the common rules (Table 4-5) there are rules that Prainha and Paraíso follow more than Piquiatuba and Chibé, but there are also rules that Piquiatuba or Chibé follow more.

## **Discussion**

Regarding to the analyses of the difference in number of people participating in the meetings and possible differences in levels of compliance with rules, in this study, in the four communities where I carried out the research, the analyses suggest that there are no differences in the behavior of the families regarding compliance with the rules. One possible explanation for that is the fact that at Flona-Tapajós the communities are stable, the families living there are known by each other for a very long time, in most of the cases since they were born. The fact that there were not new families moving to the communities, and that they are usually relatives, can result in a strong level of communication between them that might be more important than their presence in the meetings.

Participation, according to Ostrom (1990) is just one part of the process of having strong common rules to manage natural resources. There are other important elements such as a monitoring system and sanction system for those that do not follow the rules. At Tapajós

National Forest these two important elements are weak. This could explain why there are not large differences between the communities with high or low levels of participation in meetings, and in the percentage of families in each community following the rules of the fire agreements.

Table 4-5. Percentage of the population by community following the rules

	Column A	Column B	Column C	Column D	Column E
Rules	Piquiatuba	Chibé	Paraíso	Prainha II	Rules in common
Authorization from IBAMA	94.7	100.0	100.0	100.0	X
Cut the trees towards the field	78.9	-	60.0	58.3	-
Lower the fuel load	-	-	50.0	91.7	-
Cut dead trees	10.5	50.0	10.0	16.7	X
Talk to neighbors to work together	21.1	-	20.0	0.0	-
Build fire break around the field	42.1	75.0	50.0	50.0	X
Clean the fire break before burning	-	50.0	-	75.0	-
Time to burn	84.2	100.0	70.0	75.0	X
Number of people	31.6	75.0	30.0	58.3	X
Plan the burn day	84.2	-	-	91.7	-
Start the fire against the wind	52.6	58.3	80.0	91.7	X
Watch the field until the fire finish	100.0	91.7	100.0	91.7	X
Wear adequate clothes	-	100.0	-	-	-
Prepare source of ignition before	-	66.7	-	-	-
Month of burn	89.5	100.0	-	100.0	-
Inform neighbors of the day to burn	-	66.7	60.0	-	-
Water	-	75.0	30.0	58.3	-
Bring tools to the field	-	100.0	90.0	-	-
Distance from rivers	-	83.3	-	100.0	-
Distance from roads	63.2	-	-	91.7	-
Total rules	12	15	15	16	7

There are other points to consider in the discussion of the results. In the case of Flona-Tapajós, the number of families living within the communities suffers a year-to-year variation. Some families leave the communities to work in temporary jobs. Those families continue to be counted as families living within the communities and this fact can have influenced the construction of the index of participation. If one community had only 50 families at the

community when the project was carried out, but the leaders said they were 60 families counting the absent, it would mean that inaccurate information was used to build the index.

More research is necessary to define the variables that explain why communities have a very similar pattern regarding to the application of the rules established in their agreements. One possibility is that the number of adult people, that was the information I used to create the index of participation, is not the best measure to quantify participation. Maybe the numbers of families represented in each meeting could give a better idea of which household was represented or not in the meetings. Nevertheless, in the case of this research this information was not available. Quality of participation is also another kind of information that could be used to compare communities, but again there were not systematized information about the quality of participation for the communities involved in the project.

### **Conclusions**

The construction of partnerships to guarantee the involvement of local people and local organizations in a research project is a complex process, and for that reason it is difficult to capture all the aspects that contribute to it or not. However, the descriptions of experiences are helpful to bring an understanding of how it occurs in the field. The case of Tapajós National Forest presented here shows some important lessons and reflections pointed out.

1. In a process involving many different communities and different organization, the definition of local is complex and has different levels. If we consider as local, only the families within each community, then all the strategies of projects and programs that consider local leaders as representative of the communities need to change. The case of the fire management project at Flona-Tapajós showed that locals have many different levels, such as local leaders, the community level, family level, but also other organizations that work in the region and are considered to be local organizations. In the case of the fire management project at Flona-Tapajós, an experience involving more than one community, to say that the process was participatory and included local people, it is necessary to consider all these levels.
2. Even when the leaders of a region are involved in the construction of a project, it does not mean that their ideas are representative of all the communities and families within a region.

However, even a process that did not start with the acknowledgement of all the families can change during its execution in a way to guarantee more effective participation of locals in different scales. In the case of Flona-Tapajós, it reflected in a challenge for IPAM during the first year of the project. Families were concerned with the real intentions of the project, and it took time and dialog until the families understood that no decisions regarding fire management were going to be made without their involvement, and felt more comfortable to participate and contribute in the debate of fire management strategies. Considering that, practitioners have to be aware of the importance, once within the communities, of dialoging with families, and that most of the time it is going to be necessary to start the process all over again, re-discuss everything, including the goals of the project and activities planned. It also requires a level of flexibility of the practitioners, to change plans as needed.

3. An initiative that was not conceived or directly administrated by the communities can still have a high level of sharing power, if outsiders are willing and able to change initial plans and to see local people' inputs as contributions and not as criticisms. The agencies funding the projects also have to be open to changes in what was previously determined
4. Just because the work is being developed closely involving representatives of the communities, it does not mean that the information is going to be distributed to most of the families. Again, sometimes topics needed to be discussed again and again.
5. Finally, in the case of Flona-Tapajós, the fact that IPAM had been working in the region with other projects before, and that there were a local technician responsible for the project helped to build the necessary alliances to guarantee more involvement of local organizations and even of the families within the communities.

In the case of fire management at Flona-Tapajós, although at the community level this study showed that numbers of people participating in the meetings was not decisive to their compliance with the rules, the qualitative analysis showed that only with clear dialog between the research organization, the communities and many other partners working in the region could the action research process be carried out. The attempts to build different levels of partnership meant more time, resources, continuous debate of interests and goals and many changes during the process, but it was fundamental to the legitimacy of the project, and ultimately, to the effectiveness of the institutional arrangements for fire management that were developed during the fire management project, and that was main goal of the partnership itself at Tapajós National Forest.

## CHAPTER 5 CONCLUSIONS

Fire is a very important element in the agricultural production system used all over the world. In the Brazilian Amazon, which holds the largest tropical forest of the world, about 18,000 km<sup>2</sup> per year of forest biomass has been burned and converted into crop fields and pastures in the last decade (INPE 2008). Although its benefits are very important for the land uses that are part of the regional economy, much research has called attention to the problems associated with this practice. Fire can easily spread and escape from its intended burning area, affecting neighboring areas and productive systems. In spite of its problems, fire will remain a part of the agricultural system in the Amazon in the coming decades.

The analyses of the use of fire in the Amazon along with the problems associated with this practice, and the attempts by government and civil society to decrease the number of accidental fires in the region all indicate that changes in the use of fire in Amazon are not likely to take place from one year to the next. Fire is so important in the agricultural system of the region that important changes need to be carried out through initiatives that directly engage the users of fire locally, and that are established through an adaptive process where people can experience new models, evaluate and adapt them according to their conditions. Although the fire legislation of 1998 is an important gain marking federal government recognition of accidental fires as problem in the Amazon, it recommends procedures that are very difficult for farmers to implement. The need of authorization to burn, and the size of fire breaks are example of those procedures. Other regional programs carried out by NGOs are effective in increasing the concerns of people about environmental issues in general, but not specifically about fire management.

This study analyzed the contributions of institutional arrangements for fire management based on the project carried out at Flona-Tapajós. The analyses indicate that institutional

arrangements can contribute to cope with the problem of accidental fires, even when the process is stimulated by an external agent.

At Flona-Tapajós, four years of participatory process to establish fire management rules resulted in a increase in the number of techniques used, and also in the number of people using them. Thus, the risk of accidental fires decreased, as pointed out by all the families. However, developing successful institutional arrangements for fire management depends on several basic principles. Examples include the congruence between costs and benefits to implement the rules, and clear definition of boundaries (Ostrom 1990). The case of Flona-Tapajós showed that it is also important that the initiative take place at the local level, with strong participation and engagement of the farmers who use fire and also chose the techniques and recommendations to be applied. It also showed that the decision power that is in the hands of families needs to be clearly stated. All communities and families need to know that they can choose to participate or not, and can stop the process at anytime. The decisions regarding the techniques also have to be truly in the hand of the families. The process needs to be adaptive so that all those involved learn from success and mistakes, and adapt accordingly (Mulder and Coppolillo 2005). It needs to happen through a focused and a continuous process with different kinds of activities. Finally, it is necessary to design ways, at the community level, for families to debate fire management agreements year to year. This stimulates a continued concern and awareness of the topic, which transmits this concern to subsequent generations and creates an environment to the introduction of other changes in the agricultural systems, which could ultimately diminish or even exclude fire from the system of production.

Finally, this study aimed to discuss the fire management project developed through a partnership between an NGO and rural communities of Flona- Tapajós. The study explored the

relationship between the number of community participants and the level of compliance with the fire management agreements rules that families follow. In the four communities I carried out the research, the analyses suggest that there were no significant differences in the behavior of the families regarding compliance with the rules. One possible explanation for that is the fact that, at Flona-Tapajós, the communities are stable and the families living there know each other for a very long time, in most cases since they were born. The fact that there are not new families moving to the communities, and that often they are relatives may result in a strong level of communication between them that can be more important than their presence in the meetings. The results of this research suggest that, at the community level, perhaps there is no need to have full community participation in their meetings. However, in the case of Flona-Tapajós, higher rates of participation generated more debate during the meetings, and greater confidence that the decisions were representative of the community.

The construction of partnerships that guarantee the involvement of local people and local organization in a project is a complex process. It is therefore difficult to capture all the aspects that contribute to the success of it. Although community level results suggested that the number of people participating in the meetings was not decisive to their compliance with the rules, the qualitative analysis showed that the action research process depended on a dialog between the research organization, the communities and other local stakeholders. The process involved more time, resources, continuous debate of interests and goals, as well as, many changes during the process, but these investments were fundamental to the legitimacy of the project. They were similarly important to the effectiveness of the institutional arrangements for fire management that were developed during the fire management project, which was the main goal of the partnership itself at Tapajós National Forest. Thus, the case of Tapajós National Forest indicates

that a partnership between an outsider organization and the families increased the concern of the people regarding fire, and that local participation is required if successful fire management is to be achieved. Without the users of fire involved in the process no results can be achieved.

Ultimately, farmers are the ones who are going to use fire, and decide they are the ones who which techniques and recommendations they will use to avoid accidental fires.

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## BIOGRAPHICAL SKETCH

Maria Lucimar de Lima Souza was born in 1976, in Altamira, state of Pará, Brazil. Daughter of farmers that moved from Northeast of Brazil to the Amazon during the colonization period, she always had an interest in the human aspects of environmental field. She attended the Federal University of Pará where she graduated as a Psychologist in 2003. While at Federal University of Pará, she started working as a trainee at Amazon Institute for Environmental Research (IPAM) where she worked for 8 years with rural communities from different regions in the Amazon in projects related to environmental education and partnerships for fire management. After 8 years, she decided to come back to school and rethink her experience as practitioner. This major decision on her life brought her to the University of Florida where she was part of the Amazon Leadership Initiative Program, and where she pursued her Master of Arts in the Center for Latin American Studies. She pursued a minor in tropical conservation and development. She did her field work in 2007, in Santarém region, within a protected area called Tapajós National Forest. Her research was related to the effectiveness of institutional arrangements for fire management in the Amazon region.