



Effectiveness of the Forest Fire Management Frame in Togo

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Authors' contributions

This work was carried out in collaboration between all authors. Author BA designed the study, wrote the protocol and interpreted the data. Authors BA and PK anchored the field study, gathered the initial data and performed preliminary data analysis. While authors PK and KK managed the literature searches and produced the initial draft. All authors read and approved the final manuscript.

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ABSTRACT

Aims: The aim of this study is to analyze the framework of dialogue and management of fires for a better involvement and sense of ownership of the actors in general and the local communities in particular. Specifically, this study seeks to (i) analyze the efficiency of the national framework of regulation and management of fires, (ii) analyze the effectiveness and the state of owning the legal provisions by the actors (iii) assess the perceptions of the actors, precisely local communities from the buffer zones of protected areas, on the prevention and management of forest fires.

Place and Duration of Study: Sample: Botany and Plant Ecology Laboratory, University of Lomé. Ecological site LAMTO, Ivory Coast, CRC Sophia, Antipolis France, between September 2011 and April 2015.

Methodology: The present study took place in the buffer zone localities of the national park Oti-Keran-Mandouri (OKM), the wildlife reserve of Abdoulaye (ABD) and the natural resources reserve

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of Togodo (TGD). Qualitative and quantitative methods were exploited on a complementary basis. The qualitative method was based on the techniques of collection and analysis of stakeholders' perception of the legal fire regulation. The survey was dedicated to the local populations and the discussion topics concerned the knowledge and the understanding of the legal requirements of fires management and ecological consciousness of fire impacts. The quantitative method allowed to quantify the data collected to measure the frequencies and establish regularities between the answers. It was about the sample question techniques. A percentage of 1/1000th was applied to the resident populations and the index cards of inquiries revealed.

Results: The results show an ineffectiveness of the fire management frame as the interventions of several institutions are not coordinated. The majority of the inquired population (> 93 %) have an insufficient knowledge and understanding of the legal requirements of regulations of fires. Indeed, they are little informed (8%) about the existence of the regulations in force about fires and particularly of the deadline of the early fires (6%). The actors are mainly from the informal sector (70%) with a low rate of literacy and generally in areas where the rate of poverty is high. Even the qualified actors have little knowledge about the regulations on fires (5%) and women are more disadvantaged compared with men in terms of target for the sensitization and the capacity building of the population. The local leaders, who represent the relays of the administration at the local level, have a low level of knowledge (3%) to assure an effective spreading of information. This context explains the low level of participation of the actors to the implementation of the regulations on fires. However, the majority (78%) are well informed about the impacts of fires on the development of their land. So, awareness campaigns, which begun since 1980s seem to become a routine and approaches of solutions are more and more far away from the realities and the concerns of the local communities. Indeed, for the local fire management stakeholders, every fire regimes has its advantages and inconveniences. The early or late fires are not only temporal references to be fixed, but are dependent on the local ecological context and especially the burning objectives expected.

Conclusion: The national sensitization deserves to be supported by a wide restitution at the local level up to the hamlets where live the majority of the real local actors of fire management. The state of owning legal requirements seems to correlate to the level of elimination of illiteracy and poverty at the local level, hence the necessity, in the medium and long term, of an integrated approach of the management of fires and of the complete human development at the local level.

Keywords: Fire regulation; burning deadline; early fire; local stakeholders.

1. INTRODUCTION

In Togo, burning vegetation is very common as farming and cultural practice. But, beyond some standards, fires escape from human control and become harmful to forest ecosystems and the whole environment [1]. The use of fire reduces costs of the clearing, of sowing and that of the territorial planning [2]. The occurrence of fires strengthens the renewal and the feed quality for the fauna and favors the preservation of the biotopes of many wildlife and cynegetic species and thus contributes to the dynamics of forest ecosystems [3,4]. For these useful aspects, the burning of vegetation has become rooted in the habits and techniques of conquest of space and in the production and consumption of human societies since time [5,6].

As a result, it has been noted that, fires essentially of anthropological origin [7], can contribute to attain a useful goal. But the fire

regulation's owning by the stakeholders and the legal requirements and appropriate techniques of prescribed burning are prerequisites for an effective management of forest fires. Therefore the useful fires require a regulated management and the prevention and the fight against the uncontrolled fires are challenges to be won in the protection of the vulnerable ecosystems. Particularly in tropical zone, the high vulnerability of the biodiversity and the resources of the protected areas to fires are established [7-14].

Given that, a systematic ban on fire is impossible, the forestry administration of Togo has introduced a practice of early fires to prevent the most catastrophic late fires. Indeed, every year, at the approach of the dry season, awareness campaigns are organized by the forest administration to mobilize the actors and arouse their appropriation of the prevention measures and fight against the uncontrolled fires. Resources are then mobilized to organize and

support structures and organizations involved in the fire management at the national and local level. Every year, forest authorities set a legal dead line for practicing early fires, according to the local climate and ecological context [15,16]. This legal practice is led to the objective of late fires prevention. The fire which occurs in the transition period between the late fires and the early one are qualified as middle season fires [17-19]. The knowledge and pertinence of this dead line by all the actors is very important for the effectiveness of the fire framework implementation.

But, since the 1980s when the sensitization campaigns and the preventive practice of the early fires were legally established in Togo, every year late fires are recorded on about 60% of the territory, particularly in the protected areas [15,16].

Facing the persistence of uncontrolled fires, it has become urgent to question the effectiveness of the national regulations framework and management of the fires. This can be done through the analysis of the framework and its level of local appropriation as well as the diagnosis of the perception by the local population of the problem of forest fire management. This approach will help to better analyze the concepts of early fire, late fire, prescribed fire in the context of the local realities and the perception of the actors.

Thus, this study has as target to analyze the framework of dialogue and management of fires for a better involvement and appropriation of the actors in general and the local communities in particular. Specifically, it seeks to (i) analyze the efficiency of the national framework of regulation and management of fires, (ii) analyze the effectiveness and the appropriation by the actors of legal provisions and (iii) assess the perceptions of the actors, precisely protected areas buffer zones residents, on the problem of prevention and management of fires.

2. MATERIALS AND METHODS

2.1 Areas of the Study

The study took place in the resident villages of the buffer zones of three protected areas in Togo, the national park of Oti-Keran-Mandouri (OKM), the wildlife reserve of Abdoulaye (ABD) and the natural resources reserve of Togodo (TGD).

OKM is situated in the northern region of Togo, between latitude 9°55 ' and 10°20 ' North and longitude 0°25 ' and 1°00 ' East. It is made up of two blocks (Oti-Mandouri and Oti-Keran) and set up as a national park and hunting reserve by the decree N 77-117 of April 25th, 1971. With 180.000 ha of reserve surface, the resident populations of OKM consists of an ethnic diversity of which the most represented are Lamba, Tamberma, Mossi, Moba, Tchokossi and Fulani. The extensive agriculture based on the fallow and fires constitute the main activities of these populations. The cattle breeding is quite important and concerns sheeps, goats and cattle. The traditional hunting, the harvesting of fruits of *Vitellaria paradoxa* (C. F Gaertn) and *Parkia biglobosa* (Jacq. G. Don) and fishing are secondary activities of resident populations [20]. In the dry season most of the water sources dry out leading to illegal intrusion of populations from the buffer zone into the reserve, looking for water, plant resources and even ores. The exploitation of the forest resources is important and concerns timber and firewood and put a real pressure on the park's resources and is as well the cause of the intrusions and offences recorded in the park [21]. For practical reasons the study limited itself to Oti-Keran (Fig. 1).

ABD is classified by decree N 39-51/EF of June the 07th, 1951 and has a surface of 30.000 ha. It is located between the latitudes 8°33 ' and 8°47 ' north and longitudes 1°15 ' and 1°27 ' east (Fig.1). The buffer zone resident population is of diverse ethnic groups of which essentially Tchamba, Kotocoli, Kamboli, Kousountou, Bago, Kabye and Losso dominate [22]. The peripheral zones are occupied by farming in the form of itinerant crops on slash-and-burn field. They also engage in hunting, which is one of the causes of uncontrolled fires. The exploitation of forest resources (firewood, timber and diverse non-timber products) constitute the major secondary activity in this zone [20].

TGD is situated in the southeast of the country between longitude 1°20 ' and 1°40 ' east and latitude 6°40 ' and 6°50 ' north. TGD is situated between two administrative regions and its oriental limit goes along the Benin border (Fig. 1). It covers a surface of 25.500 ha and consists of the classified forest of Togodo Sud and the classified forest of Togodo Nord. In terms of population density, this zone is one of the highest in Togo and is about 312 inhabitants / km² [23], the main cause of the anthropological pressure on the protected area. The population

there is also of many ethnic groups. They are: Adja-Tado, Ewé, Kabyè and Losso. The extensive slash-and-burn farming is the main activity practiced by about 80% of the population. The carbonization stands the major source of revenue for farmers. Most of the streams of the zone being located inside the AP, the fishing activities incite to intrusions in the AP. The harvesting of non-timber forest products is less practiced and concern especially medicinal plants [24].

2.2 Methodology of the Study

In the present study, the qualitative and quantitative methods were used on a complementary basis. The qualitative method is

based on the techniques of collection and analysis stakeholders' perception [25,26]. Several ways of investigation was used. They are, the documentary analysis, the simple observation, the conversations sessions in organized groups and individual interviews (Fig. 2). Focus groups and groups of contradictory discussion helped to explore and confront the advantages and disadvantages of the various fire regimes with the statements of the actors and their perception of the legal fire regulation [27]. Individual interviews were conducted with the local leaders. The index forms of inquiries were filled from the information obtained with the actors. Audiovisual recordings were exploited in addition.

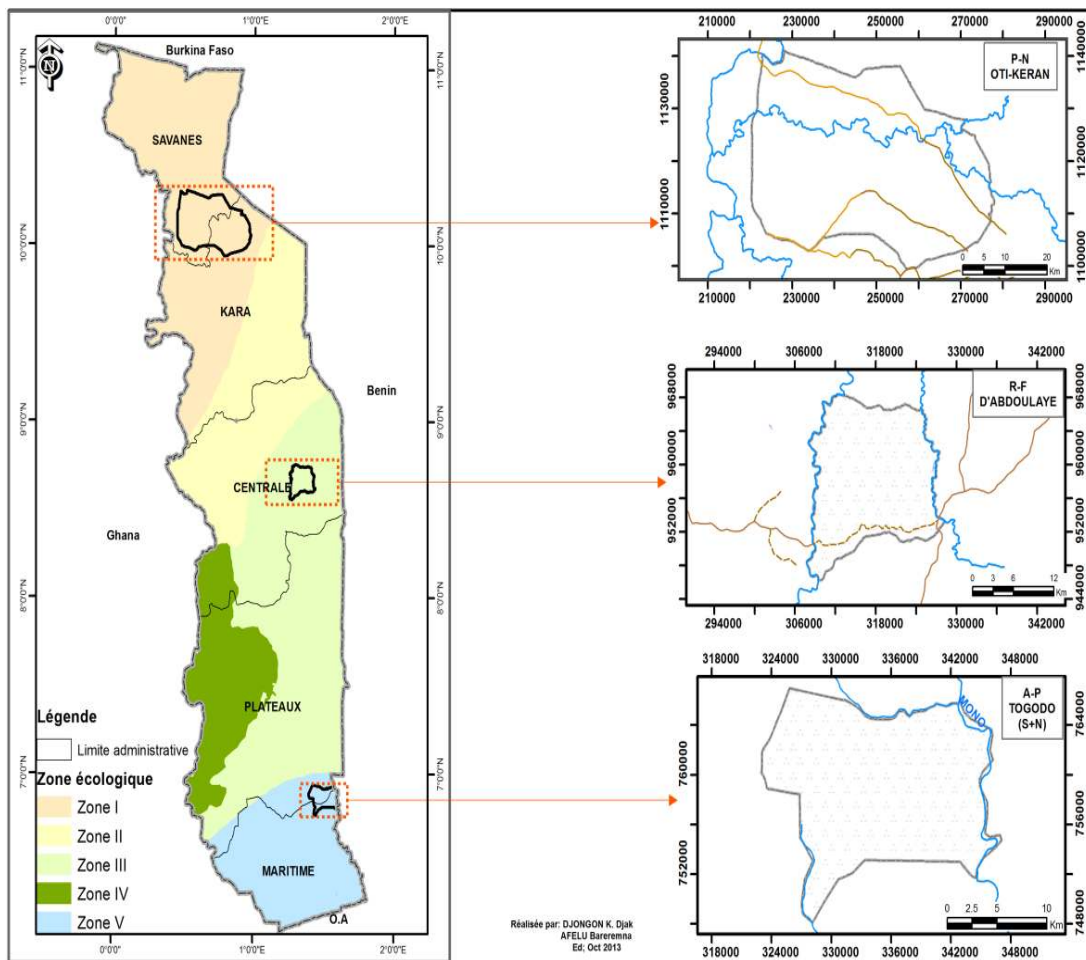


Fig. 1. Location of the study areas

Legend : Zone I : soudanian savannas of north plains, Zone II : mosaic of dry dense forests and savannas of north-east mountains, Zone III : guinean wooded savannas of the central plain, Zone IV : semi-deciduous dense forests of south-west mountains, Zone V : savannas strewed with forest islets of the coast plain, OA: Atlantic Ocean, PN: national reserve, RF: wildlife reserve, AP: protected area

The survey was dedicated to the active rural populations, agents of the decentralized institutions and traditional authorities of the zone of study. The targeting of the persons liable to present helpful interest for this research was realized and the sample established. The quantitative method allowed us to quantify the data collected, to measure the frequencies and establish regularities between the answers.

The fire management framework is all of institutions, laws, rules and groups of stakeholders, with regard to the planning and implementation of the forest fires regulation and management at national and local level.

Discussion topics concerned the knowledge and the understanding of the legal requirements of fires management and ecological consciousness (Table 1). A rate of 1/1000th was applied to the buffer zone populations (Table 2) and the index cards of inquiries were revealed [26]. The knowledge level of the people approached during the survey was followed up before and after the campaigns of fires. Indeed, the second phase of survey helped to estimate the effective incidence of the official sensitization campaigns on the local capacities of prevention and management of fires.

In the level of every protected areas, the sessions of dialogue had been organized in focus group, such as group of carbonization women, hunters, herdsmen, breeders and transhumants, farmers, the local forest authorities and land owners. The discussions in small focus group (not more than five persons) had consisted in sessions of dialogue who have got additional information. These both methods allowed the analysis of forces, weakness and potentialities to a future improvement of the forest fires prevention and sustainable management [27]. The direct observation was the attitude of interviewed persons and the manifestations of fires at the local level and on the everyday life of the population. By protected areas, it had been organized two groups of contradictory discussion in order to get the advantages and inconveniencies of each fire regimes according to the local realities.

Local actors are the local comities, associations and organization which occurred in the management of protected areas and in the prevention and fight against forest fires. The fire management framework is all of institutions, laws, rules and groups of stakeholders, with regard to the planning and implementation of the forest fires regulation and management at national and local level.



Fig. 2. Group and individual conversations

Table 1. Topics addressed during inquiries

Locality:.....		Geographical coordinates.....			Date					
N°	Name* (optional)	Age, Sex, Profession	Knowledge of the deadline of allowed early fires	Level of knowledge and comprehension of the national regulations on fires			Awareness level upon occurrence and fire impacts of at local level			
Response			Yes	No	1	2	3	Weak	Fair	Acc
Early fires (FP)			Latest fires (FT)							
Advantages		Inconveniences		Advantages			Inconveniences			
Response		-		-			-			

*Legend: * name and identity are optional; not informed 1; barely kept informed but don't know exactly the contents of the statutory texts 2; know, understand and enough able of explaining to others some terms of the national fire regulations 3; Weak level Weak; fair level Fair; acceptable or high level Acc.*

Table 2. Sampling of the population from the protected areas buffer zones

AP	Buffer zone population	Inquired sample (1/1000 ^e)	Organized groups	Focus groups
OKM	224.000	224	07	05
ABD	79.000	79	03	05
TGD	245.600	246	04	05
Total	548.600	549	14	15

2.3 Analysis and Data Processing

The index cards of inquiries are revealed and uploaded to MySQL (via EasyPHP) software for data base. The XIStat software served to the statistical analysis and management to build graphs. The obtained information was analyzed with regard to the socioeconomic data of national reference on the level of adult literacy and local poverty [23].

3. RESULTS

3.1 Current Situation of the National and Local Framework of the Management of Fires

It appears two types of fire management framework, a general one and a framework of reference. The second one is the technical orientation of the fires regulation in Togo. Indeed, there are many institutions concerned by the management of fires other than the Ministry in charge of the environment. They are among others, the ministries in charge of agriculture, security and civil protection, town planning, landscape management, social action, local development and health, NGOs, civil and local organizations. These institutions develop within themselves strategies and action plans which can integrate measures of prevention or fight against wildfires.

But, the only one national reference framework and technical orientation is the elaborated texts and measures planned by the department in charge of the national environment policy. It is the law n° 2008-005 of May 30th, 2008 concerning the framework law on environment in Togo, and the law n° 2008-009 concerning Forest Code, and the Decree n° 2009-302 / PR of December 30th, 2009 regulating the useful fires, and the national strategy of forest fires management adopted in 2010 and the annual action plans of fire campaign by the technical services of the Ministry in charge of forest resources. The documents and texts of national

reference identify the actors but especially in the form of group of actors (sectorial and institutional actors). Actors have been divided up into groups according to the geographical position of their residence with regard to the AP and according to their degree of influence on the sustainable management of the AP. It is mainly about residents of the protected areas' buffer zones sector (decree n° 2003 / 237 / PR of July 27th, 2003) who authorized the creation of these associations and groupings. This shape of local governance is taken back by the law n° 2008-005 of May 30th, 2008 concerning the framework law on environment and the law n° 2008-009 of June 19th, 2008 concerning forest code which establishes a new forest legal regime in Togo and which places the local governance in the center of the responsibility and the taking part in forest resources and landscape management.

Unfortunately, the reality at the local level shows that most of the local committees of the protected areas management are neither organized, nor operational. It is noticed at the national and local that actions of the various institutions often remain isolated and limited on the scale of their sphere of influence. The current approach tackles in a transverse way the management of forest fires without any effective coordination and complementarity. Also, it is noted that since 2010, the declination of the national fires management strategy in regional, local and specific plans and their wide diffusion to the local population are still ineffective.

Besides, the decree regulating the fires considered as an application text is previous to the both national forestry law and the national fire management strategy. The two latest texts, supposed to be the national and inter sectorial directive of fires management, incite in particular to a review of the aforementioned decree.

Finally, it brings out an ineffectiveness of the national and local fire management frame with uncoordinated interventions of several institutions. Therefore, in order to improve the institutionalization and implement community-

based forest management, the integrated approach aims to insuffle the coordination of the interventions of all the stakeholders at the both local and national level.

3.2 Efficiency and Level of Appropriation of Fire Regulation

Among all the 549 people interviewed, 148 were women (27% of the sample), respectively 35 in OKM, 18 in ABD and 95 in TGD, while 73% were men.

The investigated stakeholders come from several professional sectors, essentially from informal sector (67%), public authorities and central

power representatives (3%), local authorities (5%), herdsman and breeders (11%), hunters and track men (5%), local organizations (4%) and students (5%) (Fig. 3).

Generally, at the level of the three study zones, hardly 6% of the investigated actors have knowledge of the deadline of early fires against 94% which have no idea of it (Fig. 4). Indeed, 7.82% of the men answered favorably to this question against 0.91% of the women. The portion of the investigated persons who do not know this basic date of reference is so strongly dominant; that is 92.18% of men and 99.09% of the women in the entire sample.

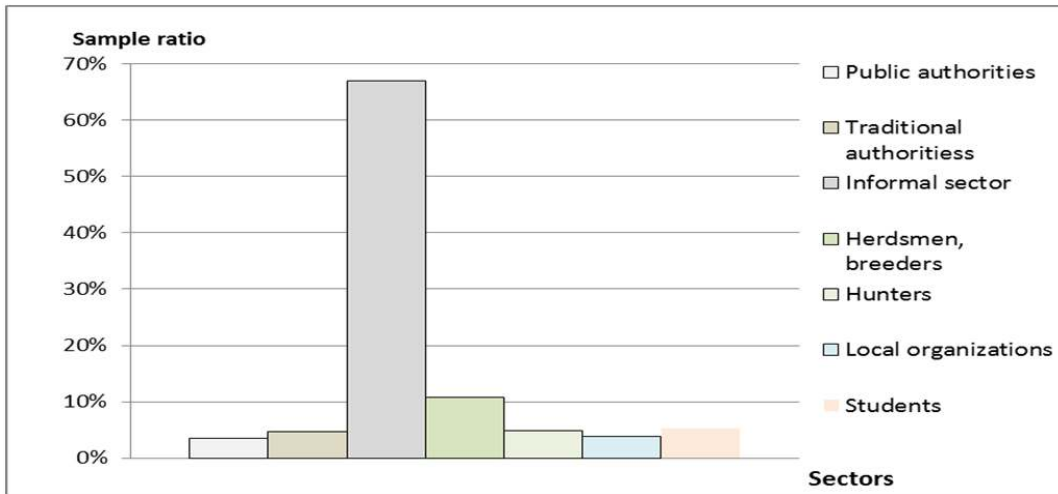


Fig. 3. Professional sectors of investigated actors

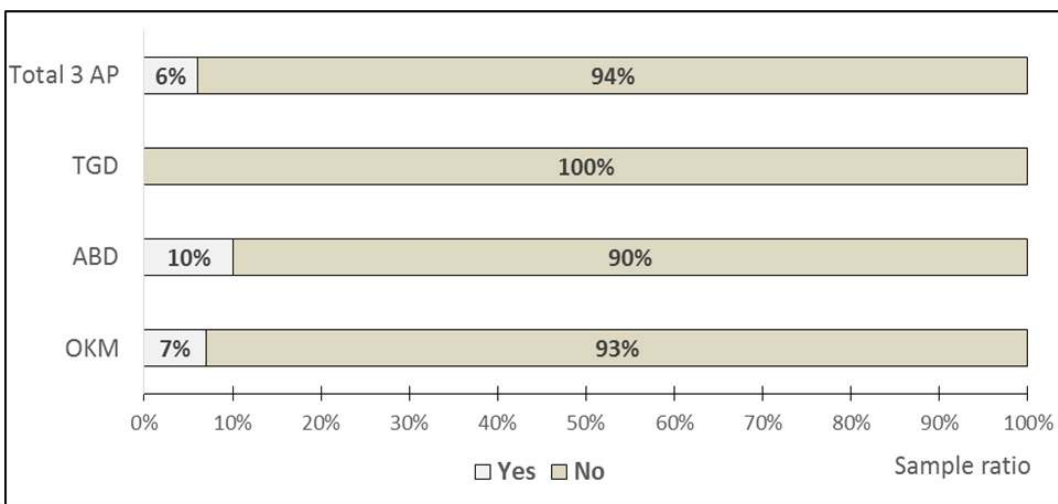


Fig. 4. Early fires deadline knowledge ratio

Legend: AP: protected area, ABD: wildlife fauna reserve of Abdoulaye, OKM: national reserve of Oti-Kéran-Mandouri, TGD: protected area of Togodo

In reference to the perception of the regulatory framework of fires management, the acceptable level is globally less represented and moves from 23% at the level of TGD, 3% in OKM and hardly 1% in ABD. The average level, which does not allow somebody to explain or to serve local relay in the distribution of the contents of the regulations is strongly represented at the level of the sample to TGD (96%) than in the peripheries of ABD (65%) and that of OKM (15%). The low level, which is on average 42% for all the samples, is significantly higher at the level of the people investigated in peripheries of OKM (82%) than at the level of the two others AP.

In total, for each sample, hardly 7% of the investigated people have a level of acceptable understanding; a majority of 51% has an average level and 42 % have a low understanding of the national regulations on fires (Fig. 5).

However, about 78% of the sample has a sufficient level of consciousness (average and good) of the occurrence of the fires and the

negative impacts of the uncontrolled fires on the development of their locality (Table 3). This situation shows that local communities are enough aware and have an acceptable ecological consciousness of the fires and their impacts and that it is especially at the level of their capacity to translate this consciousness into operational approaches of prevention and fight against uncontrolled fires that efforts need to be strengthened.

By correlating, the knowledge of deadline and the rate of the burned surface at the level of the peripheral zones of the AP, we can see that at the level of ABD the relative high level of knowledge of the prescribed early fires deadline (10%) goes hand in hand with a low rate of burned surface (5,4%) in the peripheral zone of the AP. On the one hand at the level of TGD, the low rate of the recorded fires coincides with a very low level of knowledge of deadline, on the other hand, at the level of OKM the situation is mitigated (Fig. 6).

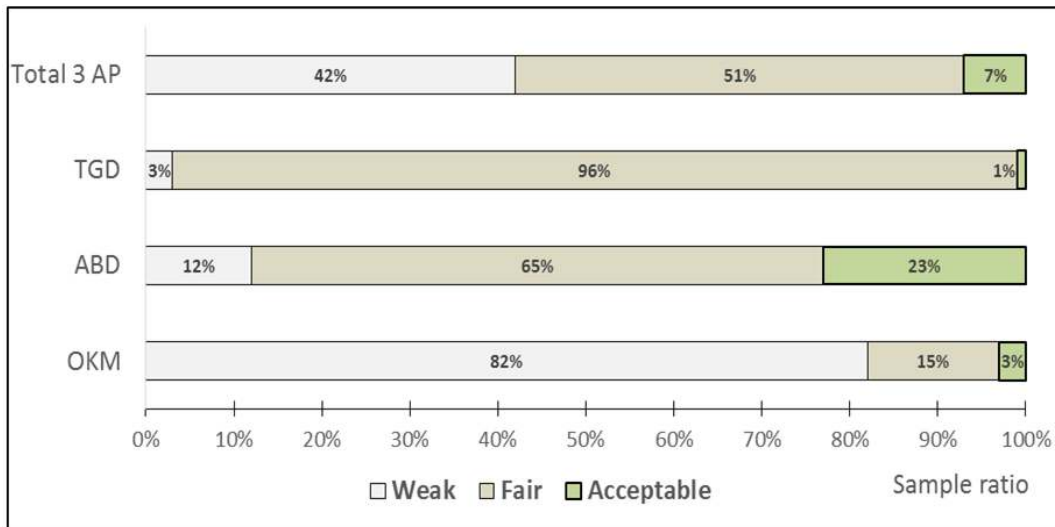


Fig. 5. Level of understanding texts and regulatory measures

Legend: AP: protected area, ABD: wild life fauna reserve of Abdoulaye, OKM: national reserve of Oti-Kéran-Mandouri, TGD: protected area of Togodo

Table 3. Distribution of the respondents according to their level of consciousness of the fires

AP buffer zone	Level of consciousness of the impacts of the local fires		
	Fair	Average	Acceptable
OKM	7%	29%	64%
ABD	48%	27%	26%
TGD	26%	8%	66%
Average	22%	23%	55%

Both parameters were significantly different, which means that the knowledge or not of the deadline has no obvious influence on the occurrence of the uncontrolled fires at the level of the peripheral zone of the AP. Therefore, sensitization campaigns and mobilization of the local actors for the prevention and the management of fires not only have to focus on the choice and the diffusion of the deadline of setting of fires but also be interested in other forms of operational and organizational capacities of the resident populations.

In fact, by respectively comparing the level of understanding of legal regulations with the

literacy rate of the adults, the index of poverty at the local level with the rate of the burned surface in the peripheral zones, a correlation seems to come out. Indeed, the more the level of understanding is low, the more the rate of the burned surface is high (Fig. 7). On the other hand, the rate of burned surface is inversely proportional to the literacy rate of the adults of the target locality (Fig. 8) and proportional at the level of local poverty (Fig. 9). Consequently, the level of perception of the regulation framework of the management of fires is proportional to the adults' literacy rate (Fig. 10).

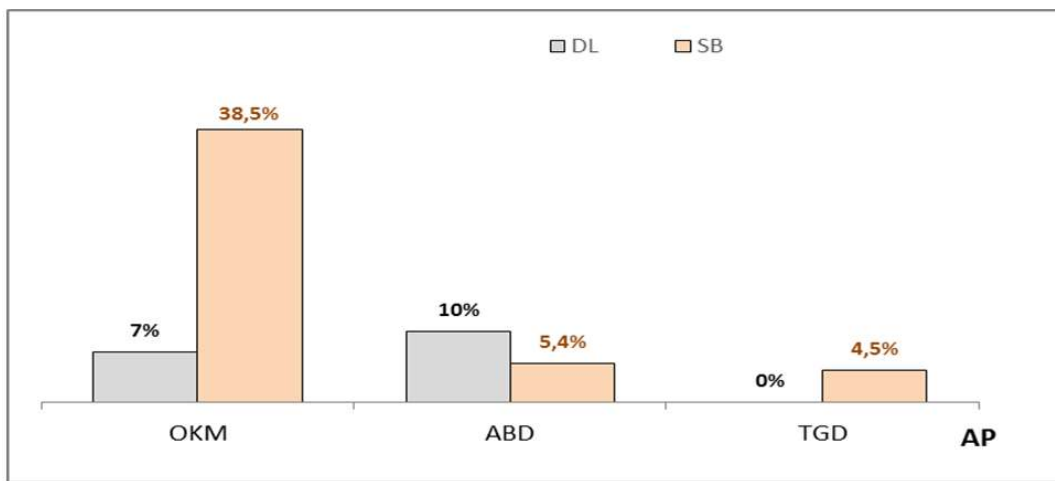


Fig. 6. Crossing of the rate of burned surface and the knowledge of deadline

Legend: AP: protected area, ABD: wild life fauna reserve of Abdoulaye, OKM: national reserve of Oti-Kéran-Mandouri, TGD: protected area of Togodo, histogram SB: burned area rate, histogram DL: knowledge of prescribed early fire deadline rate

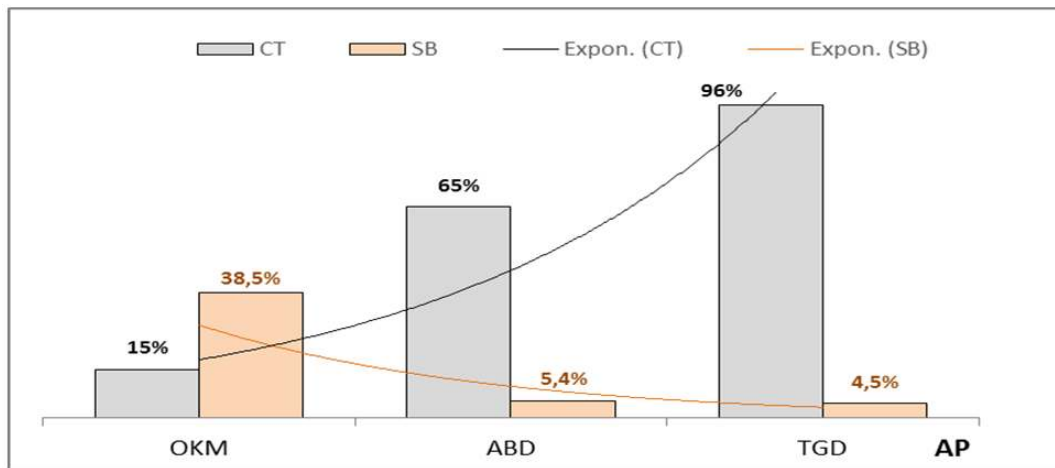


Fig. 7. Correlation between rates of burned surface and the level of law comprehension

Legend: AP: Protected area, histogram SB: Burned area rate, histogram CT: Level of text and fire regulation laws comprehension

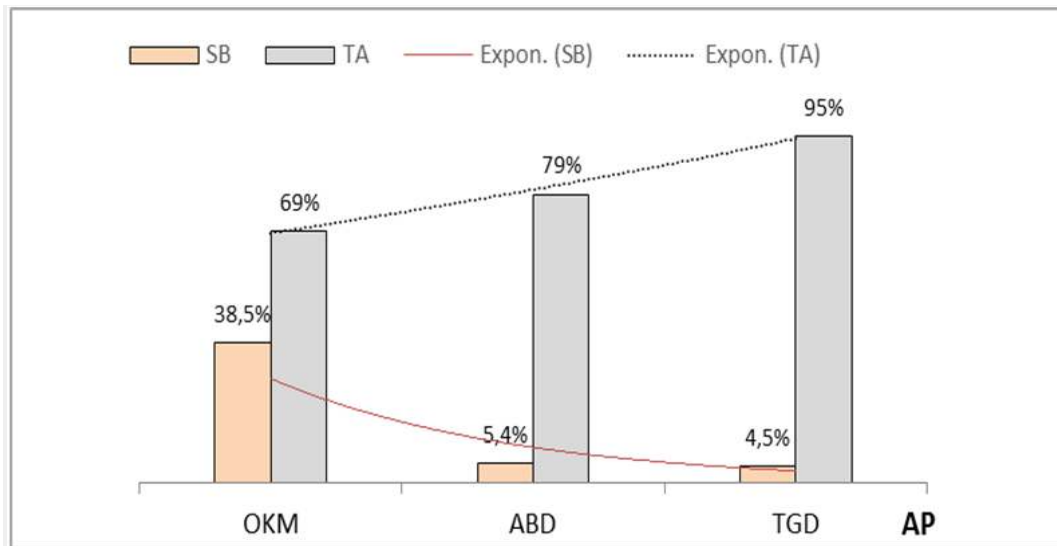


Fig. 8. Correlation between rates of burned surface and the literacy rate
 Legend: AP: Protected area, histogram SB: Burned area rate, histogram TA: Adult literacy rate

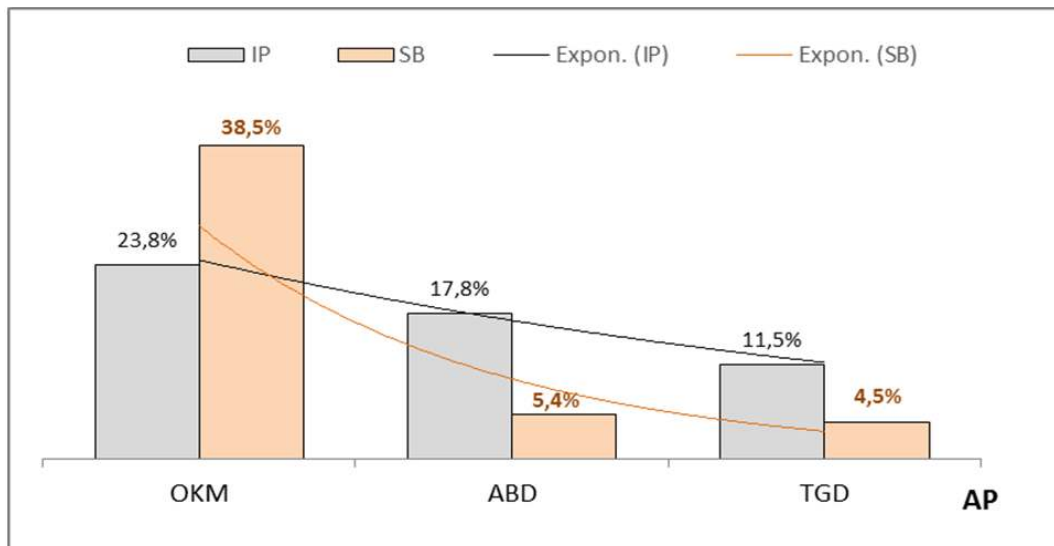


Fig. 9. Trend between the rate of burned surface and the level of poverty
 Legend: AP: protected area, histogram SB: burned area rate, histogram IP: level of local poverty

In the second phase of the survey, hardly 13% of the pooled actors, essentially traditional authorities, executives and local state civil servants, improved their level of information and knowledge on the regulations of fires in moving from a lower level to an upper one. But for the 87% of the other actors, especially women, farmers, breeders and local craftsmen, the level of information and knowledge did not evolve.

These resultants show that the official sensitizations campaigns of information and

capacity buildings mobilize few of the local communities that are far from urban and administrative areas. The high level of adult illiteracy and the local poverty seem to strengthen the vicious circle of the low participation capacity of the resident of the protected areas' buffer zones in the prevention and in the fight against the uncontrolled fires. Indeed, the management of the forest fires is linked to a successful approach of sensitization and of a targeted, interactive and regular capacity building (Fig. 11).

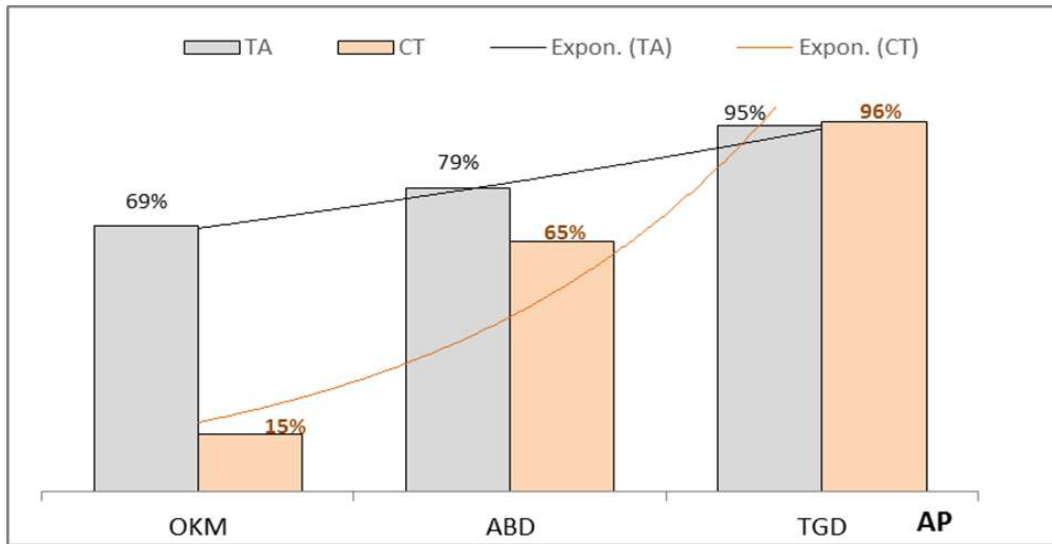


Fig. 10. Literacy rates of the adults and comprehension of the statutory texts
 Legend: AP: protected area, histogram CT: comprehension of the statutory texts rate, histogram TA: adult literacy rate

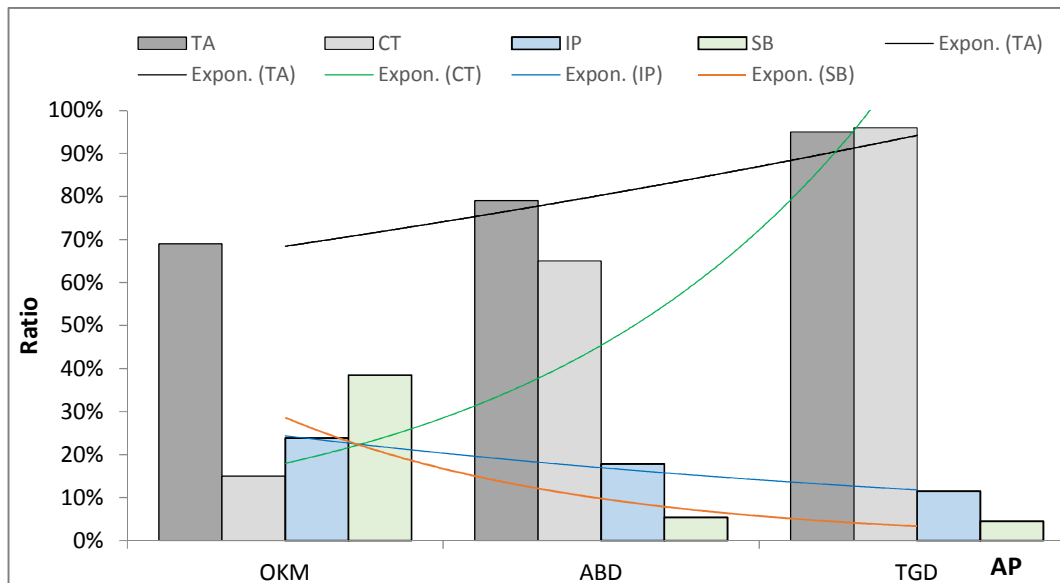


Fig. 11. Trend between adults' literacy, comprehension of fires regulations, local poverty and burned surface levels

Legend: AP: Protected area, histogram CT: comprehension of the statutory texts rate, histogram TA: adult literacy rate; histogram SB: burned surface; histogram IP: local poverty level

The appropriation and the local participation in the management of the environment and particularly in the prevention and management of forest fires are favored by the fight against poverty and a better education level of the local populations. The sustainable approach in improving local stakeholders' understanding of

forest fires regulation and management created links between forest projects and poverty reduction. By professional categories, civil servants and the technical decentralized services, local executives are relatively better informed and made sensitive to the detriment of the farmers, the craftsmen and those of the

informal sector. Yet the latter are by far the most important in terms of number and generally the ones who more interact with the plant resources and the protected areas, thus key players in the prevention and the management of bush fires.

3.3 Local Communities' Perception of Fires

The complementarity methods has been illustrated by the verbatim (Table 4) which confirmed the results obtained from discussions groups by the analysis of individual opinion brought from the survey.

Inquiries and collected informations show that for the local stakeholders, early fires (FP) or late ones (FT) have comparative advantages and negative impacts. Every regime of fire is understood and preferred according to the burning objectives that actor is looking for. However, it can be deducted from actors responses that, early fires have relatively more advantages and less inconvenience compared to late fires (Table 5).

These results bring together the local perception of fires regimes and the ecological and environmental considerations on which the national fires regulations are based.

Table 4. Verbatim of some interviewed persons

«The origin of the vegetation fires in general is diversified. The buffer zones of the protected areas are occupied by farming in the form of itinerant crops on slash-and-burn field, the hunting and poaching, carbonization, the increasing of the dry period due to the climate irregularity, the pyromania caused by mental patient, the fire from the exhaust of cars, the fires of children and pastimes. Forest fire is a threat for the environment; we must all together pay attention for its best management so that the incoming generations will get benefit. » Talk of the forest officer of Mango.
«Every year, we register lots of destruction cases of harvest and houses. This phenomenon is present and observable in our area. Just last time we registered a case of house fired in the localities of Tchamba (Alibi 1 and Goubi) with destruction of harvest and goods. » Talk of the regional director of the social affairs of the central region.
«During the dry season 2009, and more particularly in November, my plantation of mango trees had been fired due to a bush fire to whom we don't know the authors and the origin. I admit that if one want to estimate the loss registered are nearly estimated to 35000F CFA. This due to the envy of people facing goods or patrimony of others and these people put fire clandestinely in the night. » Talk of the headmaster of the consortium of village protected area management organization of Oti-Keran.
«The late fires destroyed the flowers of wild trees and pasture, This is why the schea tree for example and other wild trees do not produce as more as before. » Talk of a farmer, president of the village protected area management organization of Ossacre.

Table 5. Advantages and inconveniences of the various fire regimes

Fire regimes	Advantages and inconveniences
Advantages of early fires (FP)	<ol style="list-style-type: none"> 1. Tree stumps do not burn and easily shoot at the slightest humidity 2. The organic matter of the soil is not very destroyed and the ground keeps its fertility 3. Some grasses are still green and the fire of low intensity cannot set ablaze, so it cannot penetrate into the forest, and this limits the damages. 4. Grasses regain grow very fast after a fire improving the availability of fodder. Certain medicinal and edible herbs grow better after the soft passage of fires (ex of <i>Launaea taraxacifolia</i> (Willd.) Amin ex C.Jeffrey) 5. Earthworms and centipedes which fertilize the soil are barely destroyed because they bury themselves in the ground and so escape the heat of the fire. But if the fire is strong, it can kill them even underground. 6. FP does not affect the top and the terminal buds of plants and they continue their growth after it. 7. Bird's nests are barely affected 8. The low intensity of the fire is bearable by the small games which comes back on sites after the passage fires

Fire regimes	Advantages and inconveniences
	<ol style="list-style-type: none"> 9. The surroundings of houses are cleaned and protected from snakes 10. Grasses burn and leave firewood that women collect 11. Fruits and tree flowers are less destroyed by the fire which burned grasses on soil surface 12. FFP help to clear the surroundings of farms and zones of houses against grasses and reptiles 13. Damages are minor. The fire is slow and low. Often attics and the poultry are on the farms and given that the fire does not move fast, and even if the owner of a farm is not on the scene, his close neighbors or friends have time to hurry there to protect his properties 14. Palm groves resist better to the FP, the apical twig is neither affected by flames, nor by the heat 15. FP is used to protect corn peanut farms, and young teak plantations and palm trees are used to protect them against savage fires 16. FP facilitates the clearing of old teak plantations 17. Fires intensity stop the dormancy of the seeds of locust tree and teak 18. After FP, grasses resume growth for the pasture of the domestic and wild fauna 19. FP do not destroy forests galleries which protect sources and water sources against the drying 20. It is easier to master the FP when they take out boundaries of burned zone 21. FP reduces the spending for clearing and hoeing. After a fire we recruit few sharecroppers for the works of preparation of the plots of land to be sown.
Inconveniences of early fires (FP)	<ol style="list-style-type: none"> 1. Selective clearing, only grasses and the adventitious burn, lianas and undergrowth do not burn and are difficult to uproot during the works of clearing and of sowing 2. After FP tiny creatures (reptiles, locusts, ants ...) among which many escape the FP invade the inhabited zones and become harmful 3. The realization of the FP with all its security measures needs time and technical or financial support 4. After the FP the rural runways are blocked by thatch and by badly burned fragments 5. The FP burns the couch grass (<i>Imperata cylindrica</i>) which dries out early and makes difficult the search for thatch for the brooding of roofs 6. The FP opens natural tracks of access and plundering of the fields of culture by animals
Advantages of latest fires (FT)	<ol style="list-style-type: none"> 1. FT dislodges game animals for the hunting 2. The clearing is intensive, fast and better made 3. After the FT adventitious unwanted invade little fields 4. The FT gives a good visibility to the landscape of the country 5. The populations of pests and parasites are widely decimated by the FT 6. The FT is easy to execute and practically without costs
Inconveniences of latest fires (FT)	<ol style="list-style-type: none"> 1. Big threat to farms , corn lofts 2. Firewood of the undergrowth are not spared and burn with herbs and reduce the availability of biomass energy 3. Late fires are difficult to master. A sudden blow of wind brings them houses corn lofts and teak and palm tree plantations which are vulnerable to fires, 4. Cases of dead persons caused by smoke and heat of savage fires are mentioned in Sendome (near Tomety Kondji, Togodo) 5. Some yearly medicinal plant no more grow after the passage of intense fires which only leave lots of ashes behind them, 6. Small games flee and go in other places for the benefit of the resident populations of these areas

Fire regimes	Advantages and inconveniences
	<p>7. Years after intense fires, games are rare and adults that have been able to flee breed elsewhere, whereas little ones not strong enough perish in the fire. This endangers the availability of the species in the area years after the fire,</p> <p>8. When these intense fires are occur repeatedly within 3 and 4 years, the animal recolonization becomes difficult (situation depicted by many resident hunters of the three studied AP),</p> <p>9. In the first year, farming on the burned surface seems to give good results, but the following years show the contrary,</p> <p>10. The organic matter of the soil is thoroughly destroyed and the soil loses its fertility especially for crops with no deep roots Stumps and trees' shoots are dramatically destroyed and their shoot and development after the fire is difficult.</p> <p>11. Gallery forests are wide open and the big solar intensity dry up ponds and water resources</p> <p>12. Earthworms and micro fauna are also destroyed.</p> <p>13. The burned black aspect of the landscape does not offer attractive living environment</p> <p>14. Some medicinal plants lose their efficiency goes pass them when they are drying out</p> <p>15. Repeated FT destroy the shape and the vigor of trees</p> <p>16. Fire and Ebola propagation risks: Theories on Ebola suggest that bats' habitats and shelters being destroyed by fire especially the late ones that relatively reach closed forests. These bats would be taking shelter in the bushes and forest relics near houses, which liable to augment the contact man and wildlife,</p> <p>17. This sort of mammals bat being a natural reserve of the Ebola virus and being part of populations' occasional habit diet with a cutting up technique that put man in contact with the animal waters, the risk of contamination from animal to man is high and from there on the contamination chain man/animal and man/man</p> <p><i>The two latest hypothesis coming from the collective consciousness are justified by the fact that the investigation has been carried out in a period when the Ebola virus threat was given a lot of media coverage in Togo and in west African sub-region.</i></p>

4. DISCUSSION

The difficulty of local appropriation of the fire regulation tools seems to be the main cause of the local feeble participation in the prevention and management of forest fires. This low level of capacity of the local actors highlights the need to making the regulation framework and it's owning by all the stakeholders from local to national level as a key strategy. This remark confirms the conclusions [6,7,26] on the responsibility of the local communities in the prevention and management of fires. Generally, local actors have very little knowledge about the regulations on fires in force, but they are very aware of the impacts of fires on their landscape and on the livelihoods of their environment. The sensitization campaigns seem not to meet the real expectations of rural populations.

Likewise, the profile analysis of the investigated persons shows that women represent the least informed social layer, but the most aware of the of the fires' occurrence at the local level. In fact, from several studies results [2,6,7,27-30], the analysis of the daily business schedule of men and women and the seasonal uncertainty schedule confirm that women are less available (14 to 16 hours of occupation per day against 8 to 10 h for men). This situation reduces their involvement and their appropriation of local development issues. On the other hand, negative consequences of fires on land (lost of crops, dead and firewood fire etc) seem to have more impacts on women who more talk about it during the exchanges. And in the order of effects on community resources, fires and afforestation are more targeted. This situation confirms that local populations are aware of fire and risks they are exposed to, but on the other hand the

configuration of the current national framework of regulation and management of fires does not make it easy in the mobilization and the participation of the local communities. In addition, the local communities have techniques of prevention and fight against uncontrolled fires adapted to the local context and they only need a technical support to spread them.

Masahiro et al. [28] confirm the practical advantage to use the local techniques in the elaboration and the implementation of formal techniques of prevention and fight against fires and the spreading of the regulations. In the same vein it has shown in a study carried out in New Caledonia [7], the existing gap between the elaboration of tools by managers and technical services and the real appropriation of these tools by actors, especially the rural ones. In fact they have observed that in the discourse of the technicians during sensitization campaigns, a more negative conception is being made concerning fires and their impacts on the local biodiversity. This language from technicians is likely to stop the effective mobilization of the local stakeholders in the prevention and management of forest fires.

Some investigation carried out in Ivory-Coast [12, 18], Guinea [29], Benin [30], Zambia [27], Gabon [31,32], and in Burkina-Faso [33] have shown that early or late fires are not necessary temporal references to set, but also depend on the ecological context and particularly on the burning objectives the actors carrying them out are looking for. Institutional fires seem to be inadequate with realities on the local fields (in terms the chosen period). Some local practices are opposed to that regulation which is still difficult to implement and does not help to significantly reduce late fires. For local actors, every fire regime has its inherent advantages and disadvantages. So the choice of the type of fire depends on the pursued objectives by the actors and a systematic imposed choice is not the best thing to do for its local appropriation by the actors. The global analysis of the advantages and disadvantages of each type of fire shows that it is preferable to opt for early fire if the fire cannot be prevented and that before making early fires we need to identify stakes to be protected. However, the burning of the vegetation, even useful ones, which take place in fields neighboring to forest or protected areas need to be confined to the chosen site and measures need to be taken in order to reduce and control its propagation. Indeed, results

obtained in Burkina Faso, in Guinea and in Côte d'Ivoire on fires' influence on local socio-cultural context [12,18,29,33] have shown that every burning must be planned so as to optimize advantages and reduce inconveniences. Early fires are not compulsory; they have only to be prescribed in case of utility or prevention of disastrous fires like late and wild uncontrolled fires.

Whatever, about the chosen of the better fire regime to be prescribed, the operator must be conscious that this choice has advantages and disadvantages which need to be taken into account in the preliminary studies beforehand to minimize the negative impacts. In the same vein, for some ethnic groups from north Togo [5] and Zambian farmers [27], the practice of fires has an integrated function into cultural value and land and country planning. Therefore, to the triptych interactions [18,19,27,33,36] comes the fourth dimension which is the socio-cultural dimension among the three pillars of the system pasture/fauna/ecology management in the wildfire context.

From another view, some authors [2,12,14,26,28] noted that the fundamental needs of local populations (cultivable soil, agricultural yields), the degradation of crops by the wild fauna and the nearness of the activities fields increase the human pressure on the protected areas. They realized that, over the last ten years, criminal fires are among the most recorded offences and any activity that strengthens the interactions between man/forest is to be regulated to reduce the risk of fire. Therefore, an integrated approach has been recommended in the management of fires. Also, it was confirmed that, besides campaigns against wildfires offences, resident populations are still little informed and equipped about legal provision of fire regulation and natural resources management and the importance of involvement and the organization of the local actors is an inescapable obvious fact [12,27,28,34,35]. According to this situation, a large diffusion at local level of the forest text and the regulations on fire management and forest planning is of utmost importance to help the understanding and appropriation by the targeted actors.

Since the successful fire management requires participatory approaches, the landholders, the fire services and communities of interest need to improve their knowledge and collaboration. The fire and local resources management in natural

or protected reserves, fire awareness education, the early warning systems building are some of high points to be considered in the capacity building for the effectiveness of communities' partnership in local and national fire management [2,12,14,26,28,20,30,32,33]. In order to minimize the occurrence of uncontrolled and unwanted human-caused fires, to link the fire regulation to the landscape management objectives such as safety, biodiversity, population well-being, environmental bets, cross-sectorial participation and a coordinate approach is major in its implementation. However, the land problems and conflicts of demarcation of the protected areas and communities' domains and the clarification of rights of usage are aspects often mentioned by the actors and which determine the effectiveness of the fight against fires. This approach is summarized by some authors [26,27] who mentioned the difficulty to regulate the practice of the fires without taking the local practices and the land problems into account.

Besides the transversal, inter institutional and special feature of fires management, the national forest administration has the responsibility to institute it through the planning documents and to coordinate its implementation [2,9]. The capacity building of the resident communities of the AP as well as their level of knowledge and perception of legal requirements underlie their effective participation in the management of fires [19,24,25,26]. Then, it becomes necessary to overlook some challenges like the poverty among local forest-dependent communities in order to reduce pressure on existing natural forest resources and reasons of forest fires.

5. CONCLUSION

The legal institution of the early fires has not yet allowed preventing the occurrence and local practice of the late fires, the latter moving through the country even after the legal deadline. The current context of the organization and the capacity of communities do not facilitate the implementation and the local participation in the prevention and in the management of fires. Few actors have a real knowledge of legal requirements, and this situation confirms the gap which always exists between the designers of policies and strategies and the local communities supposed to implement the conceptual framework. The majority of the local actors are not informed about the existence of the regulations on fires and about a forest code. Very

few understand the spirit and the importance of these measures, and are not capable of appropriate in them. The wide diffusion at the local level of the forest code and the regulations regarding management of fires and forest planning is of capital importance to develop the perception of the actors. For the local stakeholders, every regime of fire has its advantages and inconveniences. The choice and the practice of a type of fire depend on the pursued objectives and cannot be posed or systematic. Indeed, early or late fires are not a temporal references to be fixed, but are especially dependent on objectives aimed by the actor who practices it. The legal institution of the practice of the early fires would succeed in its implementation at the local level in taking into account the socio cultural context of the land. The ideal thing is to protect the vulnerable items to fires without forbidding the potential usefulness or prescribed fires planned in the time and space. Any statutory approach for its efficiency and its owning by the population, would win in taking this multi-stakeholders approach and multi-objective since its conception to its implementation. The regulations on fires have to be part of an integrated approach with the translation into mother tongues of the summaries of the main texts of regulations on fires under schematic and illustrated formats understandable for less alphabetized layers with an emphasis on the gender. Any time, even if in a context of climate change and REDD+, the protection of forest against wildfires becomes a key issue in addressing climate change, delivering sustainable forest management and conserving biodiversity.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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