

Why do they burn the 'bush'? Fire, rural livelihoods, and conservation in Zambia

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Despite the historical importance of fire as a savanna land management tool, much controversy still surrounds discussions on anthropogenic fire utilization and the sustainability of indigenous land management practices in African savannas. This controversy is arguably a result of a discord between official fire policies and actual indigenous fire practices – a discord based on a gap in existing knowledge of, and a lack of informed literature on, the importance of fire for socio-economic and environmental survival in savanna environments. Addressing a continuing lack of research on the political ecology of fire, this study investigates the historical and present day socio-economic, environmental and political frameworks that affect anthropogenic burning regimes and land management in the Kafinda Game Management Area and Kasanka National Park in Zambia. A series of participatory research activities revealed the continuing importance of fire to rural livelihoods, but that a mismatch in desired burning regimes exists between local stakeholders. The paper argues that local power relations are preventing the local communities from adopting burning regimes that would be more environmentally sustainable and more in line with present day farming systems.

KEY WORDS: Zambia, savanna, fire management, indigenous resource management, political ecology, participatory rural appraisal

Introduction

Savanna environments constitute the largest physical ecosystem in southern, central and western Africa (Solbrig and Young 1993; Mistry 2000). The high frequency of dry lightning storms over the African continent creates a unique fire climate and fire has had a long history in the evolution of African savanna ecosystems (Komarek 1971 in Stocks and Trollope 1993; Van Wilgen *et al.* 1990; Stott 1991). The prevalence of fire has over time created a degree of fire dependency for the growth, production, regeneration and co-existence of herbaceous and woody savanna vegetation (Werner 1991; Whelan 1995; Van Wilgen and Scholes 1997; Laris 2002).

Humans are believed to have altered the intensity and timing of fire over time, particularly in relation to increasing human demographics and changing power regimes, and anthropogenic activity is one of the main causes of fires in African

savannas today. The current distribution of *miombo* woodland, the principal vegetation type in the Zambebian savanna zone, is believed to reflect the history of anthropogenic fire utilization in the region (White 1983; Stott 1997; Mistry 2000 2002).

Despite the historical importance of fire as a savanna land management tool, much controversy surrounds anthropogenic fire utilization and the sustainability of indigenous land management practices in African savannas (see, for example, Mistry 1998; Baker 2000; Mistry *et al.* 2005; Kull 2002; Laris 2002 2003; McDaniel *et al.* 2005; Laris and Wardell 2006). This controversy is arguably a result of a discord between official fire policies and actual indigenous fire practices. There is little research or management knowledge of the importance of fire for socio-economic and environmental survival in savanna environments. As elsewhere, the literature on fire and savanna environments tends to focus on biophysical aspects of fire management and impact, and tends to take a top-down approach

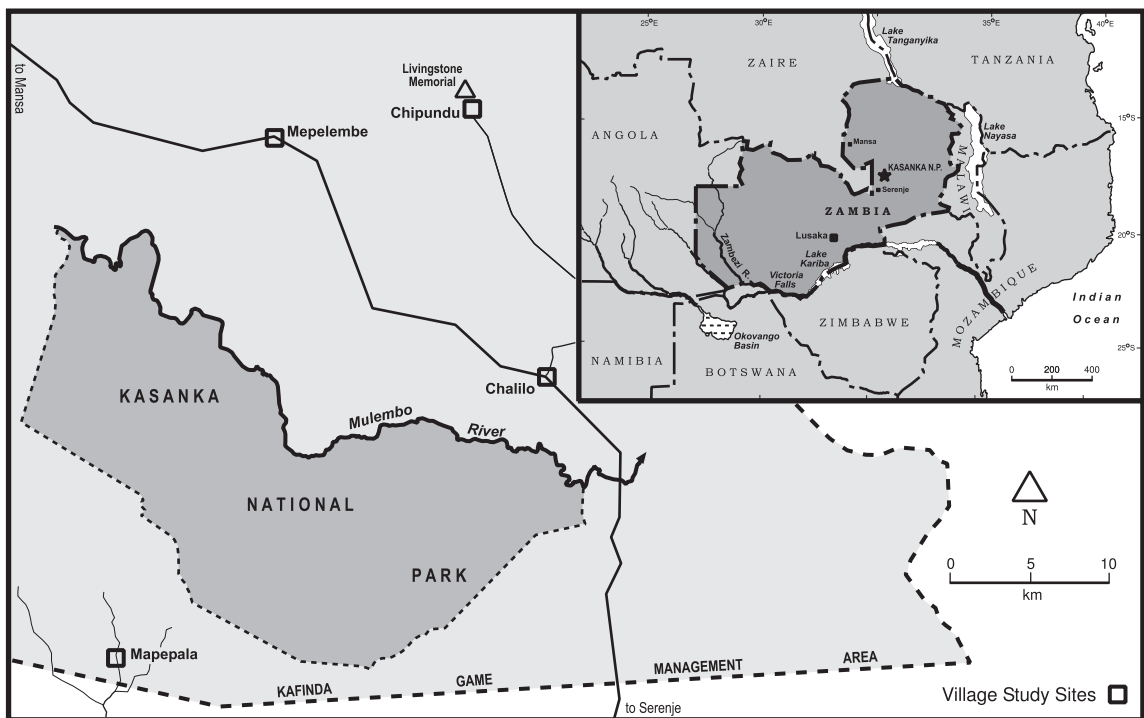


Figure 1 Kasanka National Park and the Kafinda Game Management Area, Zambia
 Source: Adapted from SD-36-1 Chilonga Map, Surveyor General, Lusaka; and Mistry (2002)

to land management. There is a lack of research on local actors' motivations behind their burning regimes in distinct socio-economic and political situations. This paper will address aspects of this gap in research. The study is based on fieldwork conducted in the Kafinda Game Management Area (KGMA) and Kasanka National Park (KNP) in Zambia (Figure 1).

The paper focuses on divergent perceptions and utilization of fire by various land managers and the impact these opinions and actions have on local livelihoods. It aims to contribute to the global understanding of the role of fire in savanna land management from a socio-economic and political ecology angle. It briefly outlines the history of fire policy in African savannas and examines the current socio-economic, environmental and political context of local knowledge, perceptions and practices in a specific regional case study of fire use. This analysis will assist conservation workers in savanna environments to improve interactions with local smallholder farmers, regarding burning practices, and so improve social and environmental outcomes.

Fire policy versus fire practice

During the colonial era, indigenous African land management was strange to the mindset of most Europeans. Limited European knowledge of the physical dynamics of tropical environments led to a dismissal of indigenous practice. Indigenous use of fire was seen as an 'evil' practice that led to forest degradation (Stebbing 1937; Aubreville 1947). The arrival of European colonists in many savanna regions consequently altered local fire regimes and imposed restrictions on burning. The nineteenth century colonial governments in the Zambezi region, for example, adopted land allocation and division policies that alienated the indigenous population. Indigenous early to late dry-season fire regimes were discouraged or prohibited, as such fires threatened both property and the social hierarchies of rigidly ordered colonial societies (Pyne 1990 1993; Mistry 2000; Suchet 2002). Colonial fire management either altered local fire regimes to one of exclusive late dry-season burning, or imposed fire-suppression policies based on the view that indigenous burning regimes were

environmentally degrading (Pyne 1990; Cline-Cole and Madge 2000; Pearce 2000; Laris 2002; Mistry 2002). Colonial rule also fundamentally altered the political and administrative ways in which many African states managed peoples and environments (Bryant and Bailey 1997; Suchet 2002). Post-colonial leaders were educated in rigid colonial government systems, and, as a result, many colonial policies and practices were retained, as newly independent states pursued economic development. Among those retained were colonial approaches to fire management (Mistry 2002).

The reproduction of colonial approaches to fire management has continued to the present via a growing emphasis on 'green conditionality' in the disbursement of aid and loans from the 'First World' to the 'Third World' (Bryant and Bailey 1997; Suchet 2002). In many savanna regions, policymakers are therefore using fire suppression policies encouraged by the developed world, rather than developing and adopting fire management strategies suited to regional or local environments. Case studies by Fairhead and Leach (1998), Baker (2000) and Laris (2002) on the environmental impact of indigenous burning practices in West Africa, research by Mistry (2000) on policy and politics surrounding indigenous fire management in savanna regions globally, research by Kull (2002) on Madagascar's persistent conflict over fire, insights by McDaniel *et al.* (2005) and Mistry *et al.* (2005) into government development programme pressure on indigenous fire management in South America, and studies by Gill (1994) and Whittaker and Mercer (2004) on bushfire management conflicts in Australia, have all concluded that conflicts between indigenous or rural communities and official bodies over fire management often stem from global (Eurocentric) perspectives on environment and natural resource management having replaced local standpoints. Suchet (2002, 149) argues that '[b]y applying universalised Eurocentric knowledge, other knowledges are rendered silent, are ignored, devalued and/or undermined so that Eurocentric knowledges only hear, see . . . and engage with themselves'. The consequences in many savanna environments have arguably been 'large-scale illegal burning, and the occurrence of catastrophic burns resulting in ecological and economic damage to land and property' (Mistry 2002, 308).

Fire and land management: controversial issues

Kauffman *et al.* (1993, 375) argue that '[h]umans are the principal force that shapes the size, frequency, and severity of fire on Earth . . . [as humans] . . . directly impact the biota by accelerat-

ing, modifying, or excluding fire from ecosystems'. This human ability to manipulate fire is a contested issue in discussions on sustainable land management because indigenous fire manipulation skills in tropical drylands remain in conflict with Western style land management, which tends to attempt to keep constant abiotic factors like fire. Dating back to colonial land management models, tropical drylands have, in general, been interpreted using a single-state equilibrium model of succession. However, recent studies by, for example, Laris and Wardell (2006), Parr and Andersen (2006), Laris (2002), Mistry (2000), Stott (1997), Van Wilgen and Scholes (1997), and Sullivan (1996) have established that fire, along with other disturbance factors, such as drought and grazing, makes possible the co-existence and co-dominance of herbaceous and woody savanna vegetation. Savannas are, therefore, increasingly perceived as heterogeneous ecosystems at different spatial and temporal scales, influenced by abiotic and biotic factors, and with fluctuating boundaries over the short as well as the long term (Stott 1991 1994 2000; Baker 2000; Higgins *et al.* 2000; Mistry 2000). This complex non-equilibrium and heterogeneous ecosystem rarely exhibits a stable state and this has historically generated land management conflicts and uncertainties, particularly when comparing official land and fire management policies with actual indigenous utilization of fire as a savanna land management tool.

Van Wilgen and Scholes (1997, 33) argue that ecologists in general would prefer to see 'the maintenance of a historical fire regime, including its natural variability in time and space'. However, historical fire regimes are unknown and tropical farmers and pastoralists around the world have long been accused of causing widespread environmental degradation through their burning regimes (see, e.g., Trapnell 1943; Lawton 1978; Blakie 1985; Rietbergen 1990; Goldammer 1993; Kaufman *et al.* 1993; Agnew 1995; Bullock *et al.* 1995; Badejo 1998; ITTO 2001). According to Laris (2002), this accusation has been channelled through an overemphasis on the ecologically detrimental aspects of fire in discourse on African savanna burning, whilst simultaneously neglecting the beneficial aspects of fire. Laris (2002, 155) argues that this overemphasis has resulted in 'misguided policy that poses a threat to human livelihood and savanna ecosystems'.

With the acceptance of the role of non-equilibrium theory in ecosystem management, these dominant views linking indigenous practice with land degradation are being questioned (Stott 1991 1994; Fairhead and Leach 1996; Stocking 1996; Sullivan 1996; Baker 2000; Stott and Sullivan 2000; Kull

2002; Laris and Wardell 2006). This shift away from perceiving savanna ecosystems as 'stable' is leading to a gradual change towards acknowledging the value of fire in, for example, indigenous shifting cultivation systems and wildfire protection schemes (Richards 1986; Werner 1991; Moore and Vaughan 1994; Whelan 1995; Fairhead and Leach 1996 1998; Baker 2000; Kull 2002; Laris 2002; Mistry 2002; Mistry *et al.* 2005; McDaniel *et al.* 2005; Parr and Andersen 2006). As a result, fire regime heterogeneity, particularly in the form of patch mosaic burning, instead of fire suppression, is increasingly being promoted in savannas. Still, as Parr and Andersen (2006, 1616) maintain, 'there is much work to be done to elucidate the intricacies of effective patch mosaic burning. Overcoming knowledge deficiencies and uncertainty... is a necessary challenge to both ecological researchers and to fire managers. Only then will good science and informed decisions ensure effective fire management'.

Dominant Western environmental views on trends in land degradation, nevertheless, still act as powerful narratives in the condemnation of indigenous land management practices. According to Laris (2003), Stocking (1996), Swift (1996), and Fairhead and Leach (1996), these powerful Western narratives prevail as they 'meet a need, and provide a useful discourse... for three main constituencies: national governments in Africa... international aid bureaucracies... and some groups of scientists' (Swift 1996, 86). Local subsistence land users, therefore, remain the losers, as their indigenous resource management often continues to be either ignored or labelled unsustainable, and therefore illegitimate in international land management, development and conservation frameworks. It seems that fire management frameworks, based on historical thinking on fire utilization, are being applied to distinct local settings by critics who arguably still adopt a 'colonial' mentality while also espousing a non-equilibrium view of ecosystem. This is referred to by Langton (1998 in Suchet 2002, 152) as a form of 'ecological imperialism' justified by an assumption of superiority of Western knowledge over indigenous knowledge systems'.

These frameworks are often applied without regard for local social or environmental circumstances. Mistry (2002, 305) argues that 'a common element of much development work in savannas has been a general lack of understanding of savanna ecology, as well as traditional ways of life and culture'. This links back to Eurocentric colonial discourses that devalue indigenous people, nature and wildlife. According to Suchet (2002, 147), such Eurocentric discourses construct indige-

nous people, nature, and wildlife as 'resources to be developed or conserved... [a process] often achieved through the illusion of removing control, intervention and management, [for example through establishing and picturing national parks] as exemplars of nature in all its glory, unspoilt and pristine'.

The result of much development and conservation work in Africa and globally has consequently often produced a distinct discord between official fire policies and actual indigenous fire practices. This is in accordance with recent research on land management conflicts over indigenous/rural fire management and land ownership in West Africa (Baker 2000; Laris 2002), Madagascar (Kull 2002), Southern Africa (Mistry 2000), South America (McDaniel *et al.* 2005; Mistry *et al.* 2005) and Australia (Gill 1994; Whittaker and Mercer 2004; Andersen *et al.* 2005; Parr and Andersen 2006). These bushfire management conflicts are embedded in institutionalized approaches to natural resource management and thinking, regarding the place of people in ecosystems and in unequal socio-economic and political power relations within international, national and regional contexts.

Methodology

Using a participatory rural appraisal methodology, this study is based on socio-economic and environmental data gathered on land management and burning regimes in the Kafinda Game Management Area (KGMA) and the Kasanka National Park (KNP) in Zambia from May to July 2004. The fieldwork combined the following main methods:

- 1 Socio-economic and ecological research via informal semi-structured interviews, focus groups and public meetings with local actors and local traditional leaders in the KGMA; representatives from non-governmental organizations [the Kasanka Trust, the Kafinda Community Resource Board, the US Peace Corps, and the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ)]; and state officials (from the Zambian Department of Forestry, the Zambian Wildlife Authority, and the National Parks & Wildlife Services, Zambia). A total of 75 individual interviews, 10 focus group meetings and four public meetings were conducted.
- 2 Field observation via systematic walk-throughs with farmers on individual fields/farms in the four KGMA study areas and with the KNP burning team within the park boundaries.
- 3 Participant observation of park and village life.

In the KNP, fieldwork and surveys were undertaken with the park management team and park staff.

Due to the large geographical scale of the KGMA and other study limitations, such as time, seasonality, lack of transport, culture and language, a sample consisting of four study areas was chosen: Mapepala, Mepelembe, Chalilo, and Chipundu (see Figure 1). Cluster sampling was used as the underlying random sampling framework (see Clegg 1990, ch. 14 for a useful description of cluster sampling). This framework relied on the existence of the natural grouping of the local communities into distinct areas, usually based around a market place (e.g. Chalilo market), a grinding mill (e.g. Mpelembe), a school (e.g. Mapepala), or a monument (e.g. the Livingstone Memorial in Chipundu). Subgroups for inclusion in the sample within each of the four study areas were easily identified, as extended families live together at individual homesteads (referred to as 'villages' by the local community; personal communication 2004) within walking distance to the particular gathering points mentioned above. The actual smallholders interviewed depended on family members being at home when homesteads were visited by the author.

Despite the study limitations encountered, no obvious bias is believed to have been created through the PRA methodologies used. Data collected during public meetings, individual interviews, focus groups, walk-throughs and observational data are compatible and thereby verify the sampling scheme. Thus, despite the KGMA study sample being restricted to four areas, the opinions and activities of villagers in these four study areas are believed to be representative of the KGMA as a whole.

Study areas

KNP is surrounded on all sides by the KMGA (Figure 1). Together, the two areas span over 4280 km² in the Serenje District of the Central Province of Zambia (Farmer 1992; Frater *et al.* 1995; IUCN Zambia 1995). Serenje District is located on a plateau 1200–1500 m above sea level and the climate is strongly seasonal, with 95% of the 1000–1500 mm annual precipitation falling during the summer season from November to April (Trapnell 1943; Mistry 2000).

The soils are predominantly infertile, comprising weathered and strongly leached oxisols and ultisols. The predominant vegetation type of the region is primary, secondary and tertiary *miombo* woodland. The *miombo* ecosystem also encompasses grassy and seasonally waterlogged depressions, *dambos*, as well as the fire-induced tall grass savanna called *chipya*. Both *miombo* woodland and *chipya* are strongly affected by fire. The mature *miombo* woodlands are dominated by

the mutondo (*Julbernardia paniculata*), mutobo (*Isoberlinia angolensis*) and *Brachystegia* species. However, where *miombo* woodland has been degraded by fire, secondary and tertiary *miombo* woodland tends to be dominated by broad-leaved trees, such as the musuku (*Uapaca kirkiana*) and mufuka (*Combretum collinum*) (Farmer 1992; Storrs 1995; Smith *et al.* 2000). *Chipya* vegetation is characterized by a tall graminoid layer, scattered with fire-tolerant trees (Storrs 1995; Smith *et al.* 2000). It is important to note the significance of fire in determining not only the degree of forest cover, but also the prevalence of individual tree species within local woodland, as particular tree species and trees in general are of great socio-economic importance for local livelihoods (Table 1).

Fire is used extensively as a land management tool both by the park management team in KNP and by indigenous people in the KGMA (Figure 2). The land management aims, the season of burning and the type of fire regimes, however, differ between the KGMA and KNP. The density of both vegetation and wildlife varies significantly between the two areas as a result. Whereas the early dry-season prescribed fires in KNP promote tree growth, the late dry-season bush burning in the KGMA tends to have a destructive effect on tree regeneration. Fire utilization and management is therefore a potential breeding ground of local conflict, as the quantity of trees and wildlife and the right to fell and hunt has an impact on local livelihoods. To understand the specifics of this mismatch in management regimes it is necessary to analyse not only the history of the two areas but also the aims and objectives related to individuals' or particular groups' utilization of fire as a land management tool.

Kafinda Game Management Area

The KGMA was established in 1941, along with the creation of the Kasanka Game Reserve (now the KNP). As a conservation measure, the then Northern Rhodesian Government in 1941 initiated the creation of Game Management Areas around all National Game Reserves in what today is Zambia. The scheme required all human inhabitants to move out of the designated game reserve areas and into the surrounding game management areas. Thus, apart from the park staff, no people live in KNP, which makes for a distinct boundary between the national park and the surrounding communal lands.

The KGMA is divided into two main parts: state lands and customary lands. State lands are under the management of the Zambian Department of

Table 1 Tree species with locally valued attributes in the KGMA, Zambia

| Tree species (Bemba) | Tree species (Latin) | Attributes |
|----------------------|------------------------------------|--|
| Mutondo | <i>Julbernardia paniculata</i> | Caterpillar breeding; charcoal; firewood; roofing poles |
| Mukwa (or Mulombwa) | <i>Pterocarpus angolensis</i> | Timber; medication from bark to cure bloody diarrhoea |
| Kayimbi | <i>Erythrophleum africanum</i> | Timber; charcoal; 'live' fence from cuttings |
| Mwanga | <i>Pericopsis angolensis</i> | Charcoal |
| Mufungo | <i>Anisophyllea boehmii</i> | Edible fruit |
| Mupundu | <i>Parinari curatellifolia</i> | Edible fruit; roots used for diarrhoea medicine |
| Mutobo | <i>Isoberlinia angolensis</i> | Caterpillar breeding; charcoal |
| Musamba | <i>Brachystegia boehmii</i> | Caterpillar breeding; charcoal; medication from roots to cure diarrhoea; bark used for beehives and suitable tree to create hang bark beehives in; bark and fibres used for clothing, blankets and roofing |
| Muwawa | <i>Strychnos Pungens</i> | Charcoal; firewood |
| Mwenye | <i>Syzygium cordatum</i> | Charcoal; building work |
| Matambula | ? (possibly <i>Uapaca nitida</i>) | Charcoal mixed with gun powder for hunting |
| All species | | Ash to fertilize fields; organic material for soil improvement; shade; furniture; 'keeps' water in the ground and attracts rain; suppresses grass growth; effective firebreak |

Source: Author (2004) with reference to Storrs (1995)

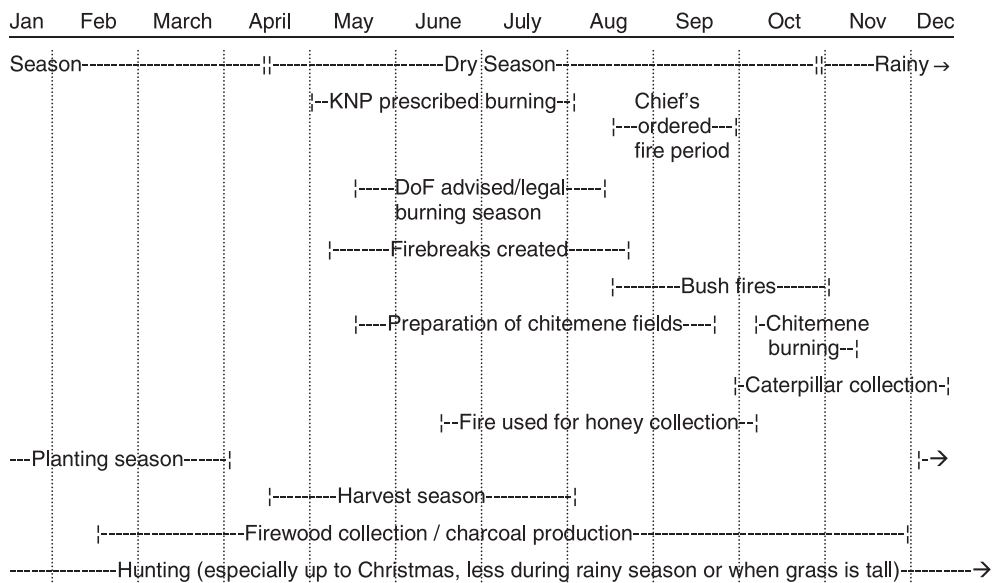


Figure 2 A seasonal land-management calendar with particular emphasis on anthropogenic fire utilization in the KGMA and KNP, Zambia
Source: Author (2004)

Forestry. Customary lands, on the other hand, are under customary tenure and under traditional authority in the form of a Chief. The majority of the KGMA is under the traditional authority of Chief

Chitambo IV. The Chief and the Chief's advisors – *chilolos* – allocate land for farming and settlements. Land users, however, have no title to land or forest resources that are communally managed

under a common property regime (Hanna *et al.* 1995). A prominent role of the Chief is therefore to manage common property and solve local land resource disputes. This role remains strong despite the introduction of democratic forms of local decision-making for land management in Zambia and the official role of state organizations such as the forestry department. There is little cooperation between the local Chief and state land management authorities currently. Land management, already complex due to these land tenure and decision-making issues, is made more difficult by relatively high population growth in the region (IUCN Zambia 1995; Central Statistical Office 1981 1991; KNP 2004). This has led to the capacity of the land to support its current population using the traditional system of shifting cultivation, *chitemene*, to be exceeded.

Chitemene farming is attractive to the local population, as it produces high finger millet yields. Cleared branches and fallow vegetation are piled together and dried during the months of September and October, and the area is burned just before the rains start in late October or early November. High yields are ensured as fire converts the organic plant materials into ash (Nye and Greenland 1960; Baker 2000). The argument against *chitemene* farming is that the practice only provides one to two cultivation seasons before the soil is too devoid of nutrients to sustain a viable crop yield. In the KGMA, the size of cultivated *chitemene* field tends to be 2–4 m wide and 6–10 m long. *Chitemene*, however, also often involves lopping and chopping of trees and branches from an area 8–10 times larger than the actual area of cultivation, to increase the amount of ash available post-burning to enrich the soil (personal communication with KGMA villagers 2004).

Chitemene farming has traditionally had a relatively speedy vegetation regeneration period, as only 30% of the above-ground woody biomass was extracted (Pingali *et al.* 1987; Mistry 2000). With the increase in population density during the twentieth and twenty-first centuries, however, the fallow period has decreased significantly, with a noticeable decline in woodland by the mid-twentieth century as a result (Peters 1950; Chidumayo 1987b 1998 2002). The combination of continual population growth, extensive late dry-season fire utilization and increasing farming intensity has resulted in great concerns being expressed about the spread of deforestation and environmental degradation in Zambia (Peters 1950; Trapnell 1959; Lawton 1982; Chidumayo 1987a 1998). At the same time, however, the decrease in *chitemene* yields, due to reduced fallow periods, has resulted in many KGMA smallholders shifting to *impunta* and *ifibunde* farming

methods during the past 10–20 years (personal communication with KGMA villagers 2004). Both *impunta* and *ifibunde* cultivation systems are more permanent, intensive and have a shorter fallow period compared with *chitemene*. The increased permanence and intensity of *impunta* and *ifibunde* farming is achieved by creating mounds of grass covered by soil. The grass acts as a fertilizer as it gradually rots and after the initial two to three seasons of cassava cultivation, the mound soil is scattered on the field and is incorporated into the fields' soil by tilling. This ensures a further three to four seasons of good soil for crop cultivation.

With the shift from *chitemene* to *ifibunde* and *impunta* farming, there has been a reduction of local deforestation and the need for fire in local farming has also changed (personal communication with KGMA villagers 2004). Whereas fire is a remarkably intricate and pervasive enabling device, without which *chitemene* farming would be futile, fire is not essential for *ifibunde* and *impunta* farming. It is, on the contrary, often important for KGMA smallholders to maintain firebreaks around their fields all year round, as the exposed *ifibunde* and *impunta* post-harvest soils become barren with frequent burning. For reasons discussed below, annual fires, nevertheless, continue to be ignited extensively in the KGMA during the late dry season, resulting in large uncontrollable fires. The local controversy over the role of fire in local land management, as well as the necessity of fire for socio-economic and environmental survival, has consequently been continually provoked with the gradual change in local farming techniques.

Kasanka National Park

Since 1987, KNP has been privately managed by the Kasanka Trust, a charitable organization with both a UK and a Zambian division. The ultimate goals of the Kasanka Trust are 'to secure the future of biodiversity in Kasanka National Park, funded through tourism revenue, and to sustain as well as stimulate the local economy through improved natural resource management' (KNP 2004). The environmental objectives of the park management are to preserve all the varied habitats found in Kasanka and to encourage tree growth. The main tool for achieving these objectives is controlled early dry-season burning which enables the park management to achieve goals such as:

- 1 creating firebreaks and minimizing the spread of fire into the Park from the KGMA;
- 2 preventing intense and destructive late dry-season fires;

- 3 producing new pastures for wild animals (a key for generating tourism revenues and thus a key economic resource for KNP);
- 4 creating mosaic vegetation growth patterns that maintain biodiversity and encourage tree growth.

Fire is perceived as an ecological resource management activity by the Kasanka park manager (personal communication 2004) and there is an exclusive emphasis on controlled early dry-season burning within the park boundaries. The park manager, however, underlines that during the late dry season, poachers will deliberately burn the bush on the KNP periphery, whilst fires ignited by the Chief and villagers in the KGMA also cross the park boundary. It is therefore impossible in practice to protect an area the size of KNP from all late dry-season fires, and it is apparent from this study that this is a clear source of conflict between local land users. A mismatch in fire management regimes exists between the two areas – a mismatch that has potentially detrimental environmental and economic consequences for both parties. However, the aspiration of the KNP management team for the local community to discontinue their current predominantly late dry-season fire regimes is arguably not realistic, as the approach does not fully take into account the continued dependence of the local community on their natural habitat and the benefits associated with late dry-season burning.

Results

The role of fire in the seasonal land management calendar

Fire is a major feature in the seasonal land management calendar of the KGMA and KNP (Figure 2). The local communities use fire to obtain desired natural resources and to shape the natural environment to further their agricultural and other objectives, such as bush clearance, firebreak creation, charcoal production, hunting, weed and disease control, caterpillar breeding, honey collection and pasture regeneration. There is also an acute local awareness of disadvantageous, as well as beneficial, outcomes of different fire regimes in the KGMA and KNP (Table 2).

The timing of burning is clearly linked to particular livelihood activities. In the KNP, fire is exclusively ignited during the early dry season to encourage tree growth and species biodiversity. The State Forestry Department and local NGOs, such as the Kasanka Trust and the Kafinda Community Resource Board (a fledgling local democratically based natural resource management institution), additionally cooperate locally to encourage patch

mosaic burning in the KGMA earlier in the dry season to reduce the intensity and thus destructiveness of late dry-season fires.

In the KGMA, by contrast, 79% of interviewees burn the bush from late August to early September on the Chief's order to encourage caterpillar breeding. Fifty-nine percent use fire in October to clear and fertilize *chitemene* fields. A further 5% burn the bush during the late dry season particularly to kill diseases, pests and weeds. Fire is used all year round to produce charcoal (31%), for hunting (26%) and to produce fresh pastures (9%). Eighty-five percent of KGMA interviewees burn during the late dry season to clear the bush, whereas 76% use fire early in the dry season to create fire breaks up to 50 m wide to protect property and fields.

In the KGMA, clearing of the bush late in the dry season, and the creation of firebreaks earlier in the dry season, are linked to the extensive growth of tall grass species in areas where woodland has been cleared for agriculture and settlements. Tall grass is valuable to local villagers, as it is used for roof thatching and mats. The height and density of the grass, however, creates problems as it dries, as it harbours pests and becomes unpalatable for livestock. It is also problematic, because this dry, tall and dense grass produces vast amounts of combustion material, which contributes to the late dry-season bushfires becoming so hot and intensive that they can become uncontrollable and 'burn with the wind for weeks at a time' (personal communication with KGMA villager 2004).

As mentioned above, the fires that clear the bush in the KGMA late in the dry season are often initiated with one particular aim in mind, namely caterpillar breeding. A variety of caterpillar species are consumed in Zambia and caterpillars are a highly valued source of income in the KGMA. Burning in late August and early September has traditionally been associated with shedding of tree leaves, which are replaced by a flush of new green leaves when caterpillars require such leaves for breeding. In the last decade, however, the emphasis on exclusive late dry-season burning has increasingly been associated locally with very intense fires that contribute to woodland degradation.

The local Chief receives a 'handsome share' (personal communication with KGMA villagers 2004) of each villager's income from caterpillars. The incentive for the Chief to encourage caterpillar breeding is therefore high, and the Chief accordingly orders his *chilolos* and village headmen to ignite bushfires during the last week of August each year (personal communication with Chief Chitambo IV 2004) despite the local, national and international concern over declining woodland in

Table 2 Reasons for and against early and late dry-season burning: local opinions in the KGMA and KNP, Zambia

| | KGMA | KNP |
|--|------|-----|
| Reasons for early dry-season burning – fire awareness in | | |
| To encourage tree growth/help vegetation regeneration | | * |
| To create firebreaks | * | * |
| To prevent intense/destructive late dry-season fires | | * |
| To produce new pastures for animals | | * |
| To create mosaic vegetation growth patterns that encourage plant biodiversity | | * |
| To kill pests, diseases and weeds | * | * |
| To protect valuable trees | * | * |
| Not to destroy firewood (i.e. high moist level after rain) | * | |
| Protect and encourage tree growth around villages, which will suppress grass growth and thereby decrease the intensity of late dry-season fires | * | * |
| Reasons not to burn during the early dry season – fire awareness in | | |
| The bush will not be cleared properly as the grass is still green | * | |
| The wind will blow the ash away before the rain arrives | * | |
| The leaves will be hard by September/October when new shoots would otherwise encourage caterpillar breeding | * | |
| The crops are still in the fields | * | |
| Reasons for late dry-season burning – fire awareness in | | |
| To clear the bush | * | |
| To clear, fertilize and sterilize arable fields | * | |
| Late August/September burning to encourage caterpillar breeding | * | |
| To collect honey | * | |
| For hunting | * | |
| To produce new pastures for animals | * | |
| Chief's order! | * | |
| In living memory late dry-season burning has been the standard local fire regime | * | |
| Arable crops have been harvested and the fields cleared | * | |
| Reasons not to burn during the late dry-season – fire awareness in | | |
| The top soil is washed away by the rain resulting in soil erosion and potential long-term land shortage | * | * |
| The intensity and high temperatures of late dry-season bush fires kills vegetation, animals and habitats | * | * |
| High fire temperatures destroy soil texture and structure, resulting in barren fields (better to leave leaves and plant debris to decompose on fields) | * | |
| Protect grass which is used for thatching | * | * |
| Increasingly scarce firewood is destroyed | * | |
| The increase in siltation levels of waterways can result in dried up rivers and lakes or can cause floods due to loss of soil structure | | * |
| Incontrollable nature of late dry-season bushfires often results in ecological and economic damage to land and property | * | * |

Source: Author (2004)

the area (personal communication with KGMA villagers and representatives from KNP, KCRB, and the Zambian Forestry Department; Van Wilgen and Scholes 1997; Mistry 2000; Chidumayo 1998; Mistry 2002). The Chief has, furthermore, put in place local laws that penalize villagers who initiate bushfires outside the Chief's burning order. These orders are not only highly influential on the pattern of fire utilization in the KGMA, but also highly controversial, as 36% of all villagers interviewed

would not burn in the late dry season if not for the chief's order to do so. Many locals do not support exclusive late dry-season burning, as they associate it with long-term declines in caterpillar numbers, due to the decline in tree cover linked to the intensity of late dry-season fires.

There is a general consensus in the local community that, although the harvest of caterpillars has always fluctuated on a yearly basis, the quantity of caterpillars generally has decreased over the past

decades. This is officially stated by local KGMA villagers to be 'God's will' (personal communication 2004). However, during personal interviews it was clear that local villagers correlate the reduction in caterpillar numbers to the decline in tree cover. Burning during August and September was furthermore stated to be a problem by 92% of KGMA interviewees, as the wind and the intensity of the bushfires often enable fire to jump over firebreaks. The dried vegetation on *chitemene* fields is therefore vulnerable to ignition, whilst the hot fires and the exposed nature of the soil in *ifibunde* and *impunta* fields have a tendency to make the soil of these fields barren. Burning of fields in August and September not only exposes the soil to the sun, but the vitally important ash on *chitemene* fields is blown away by the wind before the rain can incorporate the beneficial values of the ash into the soil when the rain arrives in November.

Despite the KGMA villagers' awareness of these adverse effects, the creation of more and wider firebreaks around homesteads and fields is difficult, as creating firebreaks is very time consuming and the manual labour needed to create firebreaks is often not available. There is therefore often little smallholders can do to prevent late dry-season bushfires from running through their fields. Similarly, the KNP management team and the Zambian State Forestry Department are helpless towards controlling the spread of late dry-season bushfires from the KGMA into the KNP and state forestry reserves, given the intensity of the fires, the geographical scale of these areas and limited resources for fire fighting.

Although the KNP management team maintain that fire is an ecological necessity for park management, 63% of KGMA interviewees maintain that fire is a necessity for field and bush management, and 23% of KGMA interviewees maintain that fire is a necessity for bush but not for field management; this 'necessity' is strongly linked to seasonal timings. The current emphasis on late dry-season burning in the KGMA, driven by the Chief's desire for more income from caterpillar 'tax', is clearly contradictory to the wishes of many stakeholders at both local and national levels.

Fire laws: contradictions and confusion

The controversy that surrounds the Chief's late August fire decree is grounded in the power relations that underpin land management of the KGMA. That fires are still predominantly ignited in late August, despite an awareness of the negative consequences outlined above, emphasizes that traditional authorities still possess great power.

Sixty-one percent of KGMA interviewees stated that they only receive fire advice from the Chief, as 'the Chief is the law' (personal communication 2004). Thirty-six percent maintained that they had been advised to burn the bush earlier in the dry season, either by forestry officers from the State Forestry Department, members of the Kafinda Community Resource Board or representatives from Kasanka Trust, but that they nevertheless burn the bush late in the dry season due to the Chief's order. Only 3% of KGMA interviewees maintained that they burn according to their own needs regardless of conflicting advice from other stakeholders. In addition to the traditional authority of the Chief, the Chief's power also appears to be interlinked with the continual belief in witchcraft – a practice ascribed to the Chief (personal communication with KGMA villagers 2004).

The findings from this study also underline that 'modern' state law on fire regimes still has not been implemented in many remote rural areas. Very few villagers in the KGMA are aware that by initiating the ignition of fires in late August, the Chief is breaking not only the 'Traditional Law' of 1962, but also the 'The Forests Act' of 1999 (Government of Zambia 1999), which states that ignition of bushfires and forest fires is illegal after mid August. Members of the Kafinda Community Resource Board are aware of the legal restrictions on bush burning but they simultaneously accept that the Chief's authority overrules the law (personal communication 2004). With only two state forestry officers in Serenje District, the implementation and control of official laws on the ground is too weak to challenge the position of the Chief, and they are unable to implement their preferred regime of early dry-season burning. Consequently, contradictory advice and orders on fire utilization and fire management are currently given by different authorities, and, although 61% of KGMA interviewees burn according to the Chief's orders, this inconsistency has produced variable burning activities by KGMA residents.

Discussion

As Table 2 demonstrates, the local communities in the KGMA are fully aware that, although fire is of major ecological importance to savanna ecosystems, it can also result in ecological damage, which has a significant impact on local livelihoods. Nonetheless KGMA villagers, the local Chief and the KNP management team have clear reasons for why, when and how they burn. These reasons are consistent with similar research on indigenous knowledge and burning practices in Bolivia (McDaniel *et al.* 2005), Brazil (Mistry 1998;

Mistry *et al.* 2005), Madagascar (Kull 2002) and Mali (Laris 2002), where scientists and fire managers have been proven wrong in their belief that local people use fire indiscriminately, and thereby degrade the environment on which they are dependant. Such findings highlight the importance of considering desired livelihood outcomes in an analysis of fire utilization and perceptions, as local needs often underlie the nature of causality, and the motivations underpinning activities and priorities. This emphasis correlates with Laris' (2002, 156) statement that there is a need to 'move beyond merely linking specific fire patterns with different land users to incorporating an understanding of the seasonal fire regime, which highlights the differences between early- and late-burning fires, and the reasons for them. [For] [t]hese fires affect the environment to varying degrees, and understanding the seasonal pattern of this burning has important implications for the research and policy-making communities'.

The Kasanka Trust perceives fire as an ecological resource management activity, and fire is therefore utilized exclusively to achieve desired ecological outcomes in KNP. In the KGMA, on the other hand, fire is perceived as an important land management tool, and it is therefore utilized as a means to improve socio-economic and environmental aspects of local livelihoods. This mismatch in desired outcomes of fire management adversely affects the ecological management aims of the KNP and the State Forestry Department by uncontrollable fires crossing the national park and state forest boundaries during the late dry season. At the same time the environmental protectionist policy of the KNP has excluded KGMA villagers from a part of their traditional hunting ground, while the increase in wildlife in the KNP has resulted in wildlife, such as elephants, raiding KGMA fields in the vicinity of the park boundary. A similar conflict over fire management, trees and game has been recorded by Mistry *et al.* (2005) in Brazil, where the government's development policies in Tocantins state have had significant implications for the livelihoods and fire management practices of the Kraho Indians. Conflict between different stakeholders over fire management in relation to desired outcomes of fire utilization has also been recorded by Laris (2002) in Mali, where different stakeholders generally understood the beneficial and detrimental aspects of fire, but these stakeholders simultaneously disagreed over how much fire to permit and how to prevent unwanted fire.

By emphasizing both the environmental and socio-economic costs of fire, and by placing local livelihood resources within contexts of environmental, socio-economic and political vulnerability,

it becomes apparent how access to, and influence over (or the lack of), different forms of resources can influence structures and processes, such as fire utilization and management. It is these structures and processes that shape livelihood strategies in order to achieve desired livelihood outcomes.

It is, for example, apparent in the Mapepala area of the KGMA that the community burn during the late dry season solely to follow the Chief's decree that prioritizes caterpillar breeding. Burning related to *chitemene* farming late in the dry season is insignificant in this area, as the only current woodland suitable for *chitemene* farming is located along the border to KNP where elephants raid the crops (personal communication with Mapepala farmers 2004). Caterpillars have long been a main source of cash income in Mapepala. The gradual decline in yields of caterpillar harvests during the past decade, however, has brought to the fore the importance of other alternative livelihood incomes. Cattle rearing is problematic due to tsetse flies. The distance to the nearest market in Serenje (75 km) and the lack of transport prohibits any potential local income from selling fruit and vegetables. Collection and sale of firewood has also been a traditional source of income, but firewood is becoming increasingly scarce due to the destructiveness of the late dry-season fires, as well as the impact of other livelihood activities, such as the significant increase in charcoal production and sale over the past decade (Mistry 2000; Chidumayo 2002). Such negative effects on alternative livelihood incomes have made the growing resentment towards the Chief's initiation of bushfires in late August apparent. However, the lack of access to markets, the lack of labour to protect property and fields from fires, and the general lack of opportunity for local level empowerment have so far prohibited the local community in the KGMA from rejecting the Chief's fire order and altering the timing of prescribed local fires. These findings correlate with the conclusions of Mistry (1998) and Kull (2002) on the main factors determining indigenous fire use in Brazil and Madagascar, namely money, labour and time.

Patch mosaic burning

Recent studies and historical analysis by, for example, Pyne (1990), Braithwaite (1996 in Laris 2002), Mistry (2000), Kull (2002), and Laris (2002) highlight that indigenous fire management practices in various savanna environments historically have used a mosaic burning pattern, which has prevented large conflagrations. Whereas local land-management practices in the KGMA have traditionally revolved around burning the bush in

such a mosaic pattern, whilst simultaneously evolving and changing as a survival strategy with changing conditions, current indigenous knowledge, agricultural practices and natural resource harvesting are arguably being undermined by the economic desires and political power of the local Chief. Whilst the local farming system has changed from a predominance of *chitemene* farming two decades ago, to the prevalence of *ifibunde* and *impunta* cultivation today, indigenous fire regimes have not been allowed to change accordingly due to the laws and penalties implemented by the Chief.

Although the Chief plays a significant role in shaping local fire regimes and livelihoods, the complexity and diversity of local livelihood vulnerabilities, assets, strategies and outcomes should not be forgotten. Results from this study demonstrate that local opinions reflect the gradual change in farming systems from *chitemene* to *ifibunde* and *impunta*. Farming techniques in the KGMA have evolved and changed as a survival strategy, at the same time as fire awareness has heightened with more heterogeneous fire regimes being promoted by different stakeholders, such as the State Forestry Department and outspoken NGOs such as the Kasanka Trust. Fire ignition solely in the late dry season nevertheless continues, mainly due to the Chief's orders, but also as a remnant from the colonial time. Mosaic burning at different times of the dry season seems an incomprehensible idea to smallholder farmers in the KGMA. It appears to be an ingrained local belief that burning of the land and the bush can only take place once a year. Reasoning behind fire regimes is thus based on an 'either/or' decision-making process. Villagers appear to believe that a choice must be made between burning early or late in the dry season, and, given these two options, villagers perceive there to be more benefits from late dry-season fires. The 'either/or' decision-making process may also be influenced by a local recognition of the need for a change in labour requirements with the more intricate management system needed for mosaic burning practices.

This study emphasizes that fire utilization remains critical in achieving desired socio-economic and environmental outcomes in the KGMA and KNP. The fieldwork data also underline that fire is 'a bad master but a good servant' (Gillon 1983, 636). A more holistic and balanced approach to burning should therefore arguably incorporate controlled early as well as late dry-season fire regimes.

The accumulation of combustion material, which results in the intensive and uncontrollable nature of current late dry-season bushfires, could be avoided by implementing prescribed patch mosaic burning.

By burning early in the dry season, the fires would be easier to control and thereby would reduce the incidence of fire damage to agricultural crops and property. If needs be, mosaic burning could be prescribed again in other areas later in the dry season without the present-day intensity. This fire system would ensure that the bush is kept clear and manageable for longer each year, whilst grassy areas could still be protected to ensure the supplies of grass for roof thatching and mats. The lower temperatures of the bushfires would additionally assist vegetation regeneration and encourage tree growth. The reproduction cycle of local caterpillar species would arguably also recover given time. Late dry-season burning of *chitemene* fields would still be possible. The likelihood of *chitemene* related fires getting out of control would be reduced by the early dry-season mosaic burning pattern. This early mosaic burning pattern would, furthermore, make it easier to protect *chitemene*, *ifibunde* and *impunta* fields from bushfires, as smaller fires are less likely to jump over firebreaks.

This more integrated approach to fire utilization would arguably improve both socio-economic and environmental aspects of local livelihoods. It would also improve the current fire management conflict between the KGMA, KNP and the State Forestry Department. Implementing a more balanced fire regime in the KGMA, however, is highly dependent on the empowerment of the local community to redress the unequal and conflicting power structures that currently restrain development in the KGMA and conservation in KNP.

Conclusions

This paper has emphasized the historical, socio-economic, environmental and political complexity that surrounds diverse utilization and perceptions of fire as a land management tool globally, and more specifically in the Central Province of Zambia. Fire is as dominant today in the present-day seasonal land management calendar in Zambia, as it has been through recorded history. The heightened local awareness of the impact of fire on environmental and socio-economic needs has furthermore resulted in fire being as controversial locally today as the use of fire for land management purposes has been in academic, scientific and official circles since the nineteenth century. The immediacy of the controversy to local livelihoods, however, results in the debate operating on a different level in local contexts. The mismatch in fire management regimes between the KGMA, KNP and the State Forestry Department, for example, amounts to a differentiation in desired livelihood outcomes in relation to caterpillars and trees.

This study demonstrates that making a clear distinction between indigenous knowledge and perceived 'outsider' knowledge does not by itself provide an adequate way to understand fire management issues and conflicts. Knowledges are instead both interwoven with, and divided across gaps in, daily resource politics at various scales – local, national and international. These interact in complicated ways with local land use practices, which are changing. Whittaker and Mercer (2004) emphasize the link between knowledge and social action and the important role this link plays in gaining a better understanding of the positions people take in debates over bushfire. Such an understanding inevitably needs to take into consideration both the continual alienation of indigenous fire management and the lack of involvement of stakeholders from grass roots levels, as well as from national and international institutions, in the shaping of official land management policies. However, such an understanding also needs to consider the 'growing and changing role of the state in [public and private] land management . . . the rise of modern environmentalism and fire ecology research and their influence on land use and management; and . . . changing [local] . . . econom[ies] with consequences for traditional patterns of land use' (Gill 1994, 232). These points are important from a global perspective of how fire management approaches have been developed and applied across time, as Western societies are currently experiencing the devastating effects of uncontrollable wildfires after decades of fire suppression policies in, for example, California in the USA, southeastern Australia and in some Mediterranean areas.

The real challenge for future management, conservation and development of public, customary, private and state land in savanna environments arguably lies in incorporating local knowledge and experience into globalized environmental policies and politics on fire management. This paper clearly shows, however, that it is not simply the ecology of fire, but rather the political ecology of fire utilization, which determines local utilization and perceptions of fire for land-management purposes. All aspects of local livelihoods – environmental, socio-economical and political – should therefore be taken into consideration to form a more informed and integrated global picture of why and how people continue to rely on fire as a savanna land management tool.

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