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VELD FIRE RISK ASSESSMENT AND COMMUNITY BASED CONTROL STRATEGY IN NORTON FARMING AREA OF ZIMBABWE

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Abstract

Fire has caused destruction of property and loss of life around the world causing disturbance to the natural balance of the ecosystem. Farms are more vulnerable than any other species because among other things, they are isolated and crop residue act as fuel. Veld fire risk was assessed in the Norton farming community of Zimbabwe in order to develop a community based fire control strategy. Rural appraisals, field observations, interviews and a questionnaire were used on 50 sampled farms. Fire risk was high in grazing and residential properties. Fire frequency increased in the last five years from the year 1999. Hunters, farmers, smokers and children started most recorded fires. The Norton community lacked capacity to fight veld fires. Chiefs, village heads, police force, extension staff and the farmers should form a committee that coordinates fire control activities in relationship to community based control calendars.

Key Words: Fire risk, fire frequency, fire fighting capacity, control calendar

Introduction

Fire has caused destruction of property and loss of life around the world. It disturbs the natural balance of the ecosystem. Fire subjects the soil to high temperatures, causing loss of organic matter and drying out of the topsoil. Many classes of organisms are burned and the soil becomes barren. Fire ashes the above ground biomass and litter and may impair the reproductive potential of plants by reducing the seed bank in the soil. Damage may also be caused to belowground roots and tubers. Patterns of seed production, seed germination and seedling establishment of most annual plants is lowered. The woody vegetation resists fire, but the grass and herbaceous components can be eliminated. Veld carrying capacity resultantly becomes low because of

changes in vegetation species composition and long-term reduction in herbage production Anderson, (1997).

Farms are more vulnerable than any other species because among other things, they are isolated and crop residue act as fuel. In addition hay bales stored for feeding livestock during the dry season add to the fire hazard. Vast expanses of forested lands act as fuel and give a great potential of veld fire outbreaks on the farms. It was observed that in Mashonaland West Province as a whole, fire frequency was higher in resettled area of Zimbabwe than in communal farming areas during the 2005 dry season (Svotwa et al, 2006). The lower frequency in the latter community could be a result of absence of fuel, effect of traditional taboos and the enforcement of traditional by laws by local leadership.

Svotwa et al (2006) put forward various causes of fire outbreak, especially in the resettled farming communities of Zimbabwe. Former commercial farm workers suspected of starting fires in acts of sabotage to resist loss of land and employment during the land reform process implemented by the Government of Zimbabwe from 1999. Illegal hunters also use fire to flush out wild animals and when extracting honey. On the other hand the newly resettled farmers use fire to clear bush in preparation for planting crops. In most cases such fires run wild due to lack of contingency plans and precautionary fire control measures. Adventurous young boys herding cattle in the veld are also sources of forest fires in the communities, while other forest fires in the past have been linked to grass cutting contractors who leave fires unattended after cooking when they are clearing grass along highways. Natural causes such as lightning strikes also have a potential to ignite fire in the forest (Elias, 1993).

When forest fires are not properly managed, they may result in death and injury to the people who can not escape its smoke, gases and heat, destruction of buildings, their contents and other tangible property, temporary or permanent closure of business, loss of income and possible bankruptcy and destruction of irreplaceable reminders of human heritage (Waugh, 2002). The social and economic problems that is associated with forest fires are so great and in most cases irreversible. The veld fires have caused serious and significant damage to the environment, property and human life in Zimbabwe in recent years (Herald, 9 September, 2006). Forest fires can also result in political and social conflicts when such fires traverse across international and social boundaries, hence the need to ensure regular, proper and accurate fire risk assessment all the time with a view of evaluating the hazard to determine the level of action required to reduce the risk to an acceptable level.

Of late, there has been an increase in veld fires in the resettled areas in Zimbabwe, including the area around Norton. The persistence of veld fires year after year is suggesting that the reaction to fires to date needs to be reviewed and calls for a community based veld fire control strategy. Furthermore, fires seem to occur more frequently in the newly resettled areas where there is

plenty of fuel material and the apparent relaxation in the enforcement of the existing legal instruments under the Forestry Act That stipulate what measures to follow to control outbreaks of fires. It is against this background that this project was carried out to assess the risk of veld fires in the farming area around Norton in Mashonaland West Province of Zimbabwe. The project sought among other things to assess the risk of veld fire on farm property and determine the extent and frequency of veld fire in the area. The information from the research was used to develop a community based veld fire control strategy model for the farmers. In this regard raising awareness among Government officials and non-Governmental organizations in managing fire risk in different parts of the country particularly in A1 and A2 farms.

The study area characteristics

Norton farming area is located in Chegutu District in Mashonaland West Province of Zimbabwe. The study area has an altitude of 1200m above sea level and is generally flat. The level surfaces promote high wind speeds due to lack of physical barriers thus increasing the risk of veld fires (Goudie, 1984).

The vegetation in the area is of the savanna type characterised by extensive areas of grasslands and forested areas. Large concentrations of vegetation are observed along streams and within pockets and sections of the area that experienced minimum disturbances in recent years. The forest is mainly the indigenous B*rachystegia sp* and the exotic *Eucalyptus spp*. The soils vary from red clay and sand soils and the area falls in the natural Region II of Zimbabwe, with rainfall ranging between 750-1000mm. These conditions promote rapid vegetation growth with grasses growing to a height of about 2.5m.

The climate is that of hot wet summers and cool dry winters, typical of the Savanna. Wet conditions are experienced from November to about March. Cool dry conditions start from around April to about end of July, the period which trees in the area lose their leaves in response to winter. Very high temperatures ranging between 24 ^{o}C to 30 ^{o}C are experienced after mid August, with strong dry winds blowing generally from the eastern direction. These weather conditions, especially between July and October, are conducive for veld fire outbreaks in the study area.

The study area was formerly owned by white commercial farmers and treated as private properties and as such fuel was still in abundance during the time of the study. With the advent of the Land Reform program, the population in the area had significantly increased leading to a change in settlement pattern. The ownership of natural resources also changed from private ownership to communal, especially in the villagised communities known as A1 farms.

Methodology

Data Collection

Rapid Rural Appraisal (RRA) to ensure wider coverage of the area and participation of research subjects to increase information base on veld fire risk, previous damage, cause and control strategy to address the noted limitations was used (Pratt and Loizos, 1992). This ensured the participation of the community in the identification of fire causes, its damage to the environment and how this could be mitigated so as to achieve ecological sustainability for the A1 and A2 farms in Norton. RRA provided the opportunity to gather data in a short space of time of about two weeks and formed the basis for survey sampling, in-depth interviews, field observations and Focus Group discussions.

Since the community was still new in the area it was important that an interactive community platform is designed with a view to map out appropriate data collection protocols as well as identifying the gaps that exist between the participatory approaches and the conventional academic approaches. RRA formed part of an awareness programmes aimed at educating the farmers on the importance of minimising the use of fire as a management tool in areas where there is high potential for fire damage.

RRA was then triangulated with key informant in -depth interviews with one local chief, six village heads, a police officer, an Environmental Management Authority, Forestry Commission and an agricultural extension officer. Interviews were used to extract information of veld fire risk, previous damage suffered, veld fire frequency, existing methods of veld fire control and fire fighting capacity as well as the community's suggested fire control strategy. Key informants were targeted because they provided technical, scholarly and informed analysis of the causes of veld fire and related matters.

A random questionnaire sample survey, 10% split of the A1 and A2 farmers was used to select 50 respondents to provide responses on property exposed to veld fire risk, causes of fire, previous damage suffered, fire fighting capacity and suggestions on the control strategy.

The collected data were synthesized and sequenced through tabulation of community fire risk, fire damage, causes, frequency and suggested solutions to fire problems. Data were pruned to check on trends, similarities, differences, exaggerations and recurrences. Data collected through questionnaires were summed up calculating frequencies and percentages on all the questions asked. Summaries were drawn up for all the data that was gathered through field observations and that collected through secondary data collection techniques. After pruning and sequencing of information, it was then presented in the form of visual formats such as pie charts, graphs and tables to make meaning of the large volumes of raw data.

Results

Grazing land and residential properties were most affected by fire, with affected area estimated at 70% and 40% respectively. Sixty-four (64%) of the farmer acknowledged having suffered damage

to the property in the previous episodes of veld fires while 36% are yet to experience damage to property (Table 1). The frequency of veld fires increased from 2001-2005. The year 2005 recorded the highest frequency of 15 times with the lowest recorded in the year 2001.

Table 1: Percentage veld fire risk and damage to property on farms around Norton

FARM PROPERTY	PERCENTAGE RISK	PERCENTAGE DAMAGE
Grazing land	60	70
Residential	54	40
Storage structures	50	20
Cattle kraals	30	15
Animals	15	10
Farm equipment	25	6

Veld fire broke out 23 times from the year 2001 to 2005 from the Eastern direction with the Northern direction and the Southern direction recorded 7 and 13 times respectively. The western direction recorded the least frequency (6). During the whole period 2001-2005, fire broke out 49 times. In 2001 fire broke out 5 times with the highest frequency of 3 recorded from the east. The following year 2002 had a fire outbreak of 8 times, with the highest frequency recorded from the eastern direction again. The year 2005 recorded the highest frequency of 15 with 10 veld fire events being experienced from the east. The western direction had the lowest frequency followed by the northern direction.

Hunters caused 52% (26) followed by farmers who caused 34% (17) of the fires recorded in the area in the last five years. Natural causes contributed only 2 %. Cop production was practiced by 84% of the farmers Norton area while only 10% had cattle. Other farmers (6%) were into horticulture, poultry and piggery.

Table 2: Direction and frequency of veld fires from 2001-2005

Direction	2001	2002	2003	2004	2005	Totals
East	3	3	3	4	10	**23**
North	0	2	2	1	2	**7**
South	1	1	3	6	2	**13**
West	1	2	2	0	1	**6**
Totals	**5**	**8**	**10**	**11**	**15**	**49**

A variety of lands clearing methods were used in the project area. Fire was used for land clearing by 78% of the farmers. Few farmers (2%) had modern equipment to use for agricultural land clearance. Sixteen percent (16%) of the farmers acknowledged the use of slash and burn

method. Five percent (5%) had access to telephones while 3% had cell phones. Ninety two percent had no means of communication.

Farmers proposed various methods of fire control as shown in Figure 1. Only 2 and 3 percent respectively were in possession of water bourses and fire extinguishers. The rest of the farmers (95%) resorted to traditional methods of fire control such as use of tree branches, soil and water buckets.
Fire outbreaks were reported to be common in the period July-August each year. Vegetation in the area would be dry providing conducive environment for fire outbreaks.

Farmers proposed various methods in veld fire control to include firebreaks, back burning, fire beating and educational campaigns. Such methods, with full cooperation of every farmer and technical support could reduce the veld fire risk and damage.

Sixty six percent (66%) of the farmers rated their neighbourhood fire fighting capacity below 50%, while twenty percent rated the community's capacity between 50 and 60 percent. Ten percent (10%) rated the capacity of the community between 60 and 80 percent. Eighty-eight percent (88%) of the research subjects advocated for a community based veld fire control strategy.

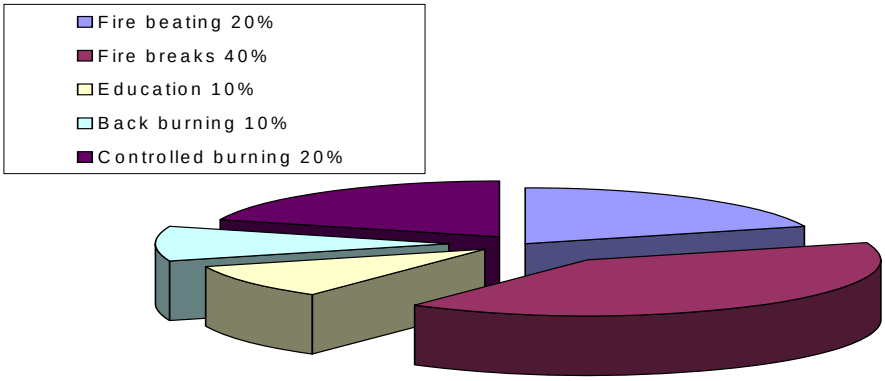

Figure 1: proposed methods of veld fire control by farmers around Norton

The farmers proposed the roles that could be played by the community leadership in veld fire control.

Varied information was gathered on the veld fire risk, causes (Figure 2), past damage, veld fire frequency and possible solutions during the RRA, interviews, field observations and responses from questionnaires. From the gather information it was evident that control of veld fires require participation of the whole vulnerable community. The research subjects suggested various

methods, which they thought, were suitable for the control of veld fires in the area. From the information that was gathered from the research subjects a veld fire control and prevention strategy was formulated, (Table 3)

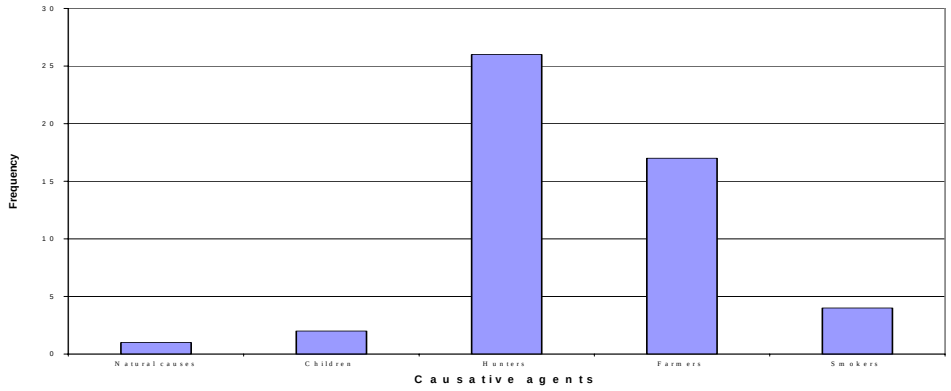

Figure 2: Causative agents of veld fires in A1 and A2 farms around Norton

Farmers suggested that the period between January to March had very limited fire outbreaks and that there was no danger even if the fire was to break out due to environmental and weather conditions hence no fire control activity was suggested. However, they suggested that constant reminders for fire prevention were needed and conducted at intervals at social gatherings. Much of the activity was suggested in April in preparation for the dry season where veld fires were reported to be common. The period between July to October was described as the 'red zone' due to dry environmental and weather conditions which are usually characterized by low humidity, high temperatures and strong winds providing conditions for uncontrollable veld fires. It was suggested that no burning should take place. For an effective community based fire control strategy the farmers suggested key personnel that should be consulted outside the boundaries of the community. There was a general positive perception on the need wide based community involvement and preparedness in the management of fires.

Table 3: Calendar of Fire Prevention Activities

Month	Fire control activity	Awareness action by the Community	Remarks
January February March	Non	Reminder for fire prevention in social gatherings.	Farmers committed to crop management in the field
April	Fire break construction, clearing of farm boundaries, paddock and field boundaries. Clearing of grass around crop storage, animal housing and fuel storage facilities	Awareness on fire prevention.	Soil still wet and fire breaks easy to construct.
June	• Fire break construction, clearing of farm boundaries, paddock and field boundaries. • Clearing of grass around crop storage, animal housing and fuel storage facilities • Controlled burning		Grass is partially dry
July August September October	No burning	Campaign on complete avoidance of fire	If controlled burning is unavoidable, the n it must be done up to 9 am and after 5 pm on calm days.
November December	Controlled burning after the first rains.	Awareness campaign on controlled burning	Controlled burning done to control insect pests and rodents in crop fields

Discussion

Grazing land and residential properties were the most vulnerable to fire damage. Crop production and animal production dominated the agricultural activities in Norton area. Grasses are deliberately left in the grazing areas for animal grazing. In some sections of the veld the grass is deliberately left as standing hay for later use during the dry season and this acts a fuel for veld fires. Southern Africa actually suffered veld fire damages in the past to annual or periodic burns with effects manifesting in the land degradation and forest reduction.

Fire is known to eliminate the woody component of the veld and leave the grass component dominant. In the long term, there is a fall in the herbage yield due to an overall change in grass and woody species composition. Hirji, et-al (2002) argued that areas affected by veld fire are difficult to estimate but however, pointed out that global estimates indicate that 440-505 million hectares of African Savanna are burnt annually. Continuous research was required to quantify the damage caused on the grazing area and wildlife habitats in Zimbabwe.

Majority of the farmers in the area once experienced property damage in the last 5 years. Press reports on fire damage to property and even human life is quite common in Zimbabwe (Herald

reporter. 9 September 2006). Where environmental conditions are more favourable forest fires can be very wild and uncontrollable. In Zimbabwe veld fires have caused untold suffering to farmers countrywide and its frequency was reported to be high in the 2005 dry season (Svotwa et al, 2006). The losses caused by the fires were estimated at Z$ 3 million with the cost of fire fighting put at Z$ 500,000 in 1993 (Elias, 1993). Even one hot season fire, with an adequate weight and depth of fuel, may destroy perhaps 100 to 200 years' accumulated growth in commercial terms: not the forest vegetation as such, for most of this will coppice, and in a century or two will be restored (Swink, F and Gerould W. 1994 and Calvert, 1993).

In the year 2000, raging fire engulfed three-quarters of the central part of the 43,000-hectare Hwange National Park and forced hundreds of wild animals to flee the flames (BBC News, 2000). In Manicaland province alone, billions of dollars were reported to have been lost in fire in the Boarder Timbers, Wattle Company and Forestry commission Estates in both Nyanga and Chimanimani. It was estimated that 10-year timber supply was lost flames, with foreign currency loss estimated at billions of dollars (The Herald, 1 March, 2006). In Zimbabwe however some of the tragedies could have gone unreported due to lack of communication and remoteness of the farming community.

With 64% of the farmers having experienced damage to property in the project area, the desire to cooperate in formulating and participating community based fire control strategy was high in the Norton area. The same spirit could be harnessed in other related communities so that the problem of fire that is almost becoming a national disaster could be a thing of the past.
The frequency of veld fires increased from 2001-2005, with the highest frequency recorded in 2005.The frequency of fires from the year 2001 to 2005 have been found to be high with a phenomenal highest frequency of 23 recorded from the eastern direction. The general increase of veld fires from 2001 to 2005 could be related to the existence of fuel and changes in demographic patterns in the area. Ndangana (2006) observed a higher frequency in A1 and A2 farms where 80% of land in Mashonaland west was burnt than Communal areas having only 20% of land burnt.

Lack of fuel and ability Traditional chiefs ability to enforce traditional by laws and to give punitive measures to perpetrators of the crime could possibly be attributed to the low frequency in communal areas. It was estimated that a total of 1657989 hectares (80 %) was burnt in Mashonaland West Province in 2005. Much of the burning occurred in the large-scale commercial farming areas (A1 and A2) and small scale farming areas, with the communal areas having only 20 % of land burnt (Ndangana, 2006). Such observations could be very important in the formulation of a community based approach, in which traditional leaders, who are generally command a lot of respect in Zimbabwe, could supervise.

Fire is considered an important land-clearing tool in the farming community causing the problem of possible conflict over the interpretation of “fire”. Farmers have ever considered fire as a tool to prepare agricultural land for thousand of years, (West, 1996). This could be the reason why farmers contributed significantly to veld fires in the study area (34%). In Indonesia, fire has long been used a quick and cheap method of land clearance by farmers, forestry, concession and plantation owners, (Waugh, 2002). A similar study by Hartnett, and Olenbusch, (2000) also considered fire as an indispensable land management tool for valuable grasses. However, without coordination the risk of fire spread is high, thus exposing property in farms to veld fire risk and damage. A carefully managed fire control strategy is needed to produce desired results.

The direction of fire outbreak was more or less the same for five years in the Norton farming area. Hunters and farmers caused most of the fires. This trend could be linked to the location of Lake Chivero South Bank National Park, which shares its western boundary with the study area. Information gathered during Rapid Rural Appraisals and interviews suggested that hunters set fire to trap game animals, which crosses the Park boundary fence into the study area. An equally high frequency, which was recorded from the southern side, was linked to communal people from Mhondoro, which is adjacent to the study area on the southern direction. With the direction of fires almost predictable, it becomes necessary to concentrate the effort of environmental education in communities in the concerned area. Follow up studies were necessary in the fire vulnerable areas in order to identify communities to which fire awareness campaign could be targeted most.

With farmers identified as the other group that cause fires in the Norton area, the danger of fire outbreak becomes high in Zimbabwe, considering some newly resettle individuals were given land in areas bordering national parks and forestry areas. Of late the Government of Zimbabwe has removed illegal settlers in areas bordering timber estates in the eastern districts of Zimbabwe, as these are widely believed to have caused fire that destroyed the estates in 2005. Another strategy had been to engage legally settled farmers around timber estates into forestry so as to make them participate in fire prevention (The Herald, 1 March 2006).

Apart from farmers, other culprits were identified in the research and also by other researchers on the subject. Howe, (1994a and Howe, 1994b) wrote of discarded of cigarettes and broken glasses on which the sun’s rays focus resulting in veld fire. Panzer, and Schwartz. 2000singled out hunters as major culprits in starting forest fires. In Zimbabwe, it has been alleged that in acts of sabotage, former commercial farm workers resisting loss of land and employment respectively has deliberately set fire on the land. Adventurous young boys herding cattle in the veld and grass cutting contractors who leave fires unattended after cooking when they are clearing grass along highways were cited as other causes of veld fires (Calvert 1993). With the suspects known it becomes easy to design environmental education programme and to allocate time and methods

of delivery. For Norton fire awareness campaign could be easy since the community it self seems to know the major culprits who start fires in their area

With crop production as one of the important agricultural activities, the availability of trash where dry season incorporation of residue has not been done was high. Crop residue naturally acted a fuel for fire during risk times. Farms are considered more vulnerable areas with respect to veld fires not only because of crop trash, but also due to grass that farmers leave for animals to graze. The presence of haystacks and crop storage structures all add to the fire risk. As a risk reduction measure, the proper location of such structure on the fire, and the isolation of these from unauthorized visitors by way of guarding and fireguards became a necessity for far safety (Svotwa, Ndangana and Manyanhaire 2006). Other structures that would needed proper location and guarding were fuel tanks and tobacco drying facilities.

Lack of access to telephones and other means of communication were quite alarming considering the importance of such facilities in alerting the neighborhood. This could be the reason for none existence of a coordinated veld fire management strategy. Svotwa, Ndangana and Manyanhaire (2006) observed a proportion of 50% of the farms located 10 or more kilometres away from urban or rural service centres while studying safety in A1 and A2 farms in Makonde District in Mashonaland West province, a situation similar to the study area. The cell phone technology that was fast growing in Zimbabwe could be adopted in farming communities as a necessary means of communication. However, there could be problems of recharging batteries in some farms where electricity is yet to be installed.

Traditional methods of fire control methods were still dominant in fire fighting. Other methods like use of water browsers could be limited by lack of capital. In some cases the distance to a water source could make such methods ineffective. On the other hand the use tree branches could result in serous destruction of trees that farmers could be trying to protect from fire damage. As one used branches, one was exposed to radiant heat and smoke inhalation, making fire control as opposed to fighting a safer option.

Farmers proposed various methods that include included firebreak construction, back burning, fire beating and educational campaigns in veld fire control. Such methods, with full cooperation of every farmer and technical support could reduce the veld fire risk and damage, but need cooperation of the whole community to succeed.

With a neighbourhood fire-fighting capacity rated below 50% the Norton community needs a strong campaign programme that would improve their fire fighting capacity. However the major strength of the community was advocating for a community based veld fire control strategy.

The farmers proposed the roles that could be played by the community leadership in veld fire control. The period from January to March had very limited fire outbreaks due to environmental and weather conditions; hence no fire control activity was suggested. Such factors as high relative humidity rather depressed temperatures, low wind speed, high precipitation and the green condition of vegetation contribute to low fire risk during this period (Hartnett, and Olenbusch, 2000.). A set of fire control activities was suggested, and a community based fire control calendar (Table 3) was constructed.

The farmers indicated that need for outside help in the formulation of an effective veld fire control strategy. Control of fire actually required participation of the whole vulnerable community. All stakeholders with interest in the challenge of fire risk control were included in strategies that were mapped out against fires. These included Agricultural Extension staff, Department of livestock, Forestry Company, Insurance companies, Zimbabwe Republic Police, Schools and farmers. Education materials were to be easily accessed by the communities, schools and social gatherings.

Conclusions

All farmers in the Norton area were once affected by fire either directly or indirectly. Grazing areas, crop fields, grain storage structures and forests were at risk in Norton. For the past five years the direction from which fire came from was almost the same and the culprits were identified as farmers, hunters, herd boys, road construction contractor and saboteurs. Fire control methods ranged from use of fire beaters to use of browsers. Fire outbreak was most frequent during the period August to October when weather conditions are conducive. Because most of the answers to the question on who, did what, where, when, how and why as related to fire risk were answered in this research, a community based control strategy was easily formulated for the Norton and other farming areas. A fire control calendar was constructed from the answers to the above six questions, and this could guide the community in their effort to reduce fire risk. Involvement of such outsiders like agricultural extension staff, departments of livestock, Forestry Company, insurance companies, Zimbabwe Republic Police, schools and farmers is necessary. The whole community could easily access educational materials. These should raise awareness and even warn communities of the damage that is associated with uncontrolled fires. Fire outbreaks have become a perennial problem in the area and there is a danger to lose valuable vegetation and animal species. Whilst the participants new the min causes to this near catastrophic environmental scenario there is little will at individual level to control the spread of these fires.

There seem to be some sought of a blame game as residents of these areas have no strong cultural roots to impose sanctions on the management of fires. In communal areas the ideal situation would be for the village head to impose sanctions and strict controls on the use of fires

and specific penalties in the form of a herd of cattle or other types of livestock would be paid to the chief by the offenders. Such an ideal situation would provide the basis for a strong community based fire control strategy. However, if there is no strong rock and soil to stand on but only the atmosphere and waters everywhere, the ideal thing to do is not to lament that you are to perish but to learn how to shift with the moving material. In this vein, there should be a strong campaign for the inculcation of positive traditional practices that enhance the positive management of fires not the present scenario where with the onset of the dry season everyone is goes hunting with little regard for the environmental consequences of the fires that are used to flash wild animals. The tragedy of the commons scenario that is build within the A1 and A2 farms has far reaching environmental consequences and the ideal situation is to not enforce laws and central government policies but to build on the indigenous knowledge that exist within the communities as illustrated by the information used to build a fire control strategy. If in the simplest form of negligence the authorities ignore the rich information within the community evidence based on the frequency of the fire outbreaks (extensive in nature) point to the conclusion that there could be massive changes in species composition and the emergence of wood species that are tolerant to the fires. There is amble evidence that savanna vegetation has been natured by fire but this could be misguided line of thought from a policy perspective as it impinges on biodiversity and possibly the reduction in livestock and crop productivity.

Recommendations

Farmers should clean contour channels and ridges and use the grass to feed livestock. Long grasses around crop storage areas, cattle pens, crop fields, homestead and along roads leading to the farm should be cut to reduce quantity of fuel that generates fire. Fireguard, 4-10 m wide on either side of the boundary fences should be developed around every paddock and crop filed. All activities could be timed as suggested in the calendar (Table 3).

The adoption of a bottom up approach can easily capture community dynamics, risk perception and needs taking into account the potential of local resources and capacities. It is at community level that physical, social and economic risks can adequately be assessed and managed. The community-based approach emphasises activities that strengthen capacity to cope with fires and improve on livelihood security. It is clear that problems of fire are integrated with sustainable and social development and at the community stage, assessment provides answers to questions like why, where, when, who, what and how?

An understanding of why fire fires are started helps in designing learning materials for environmental education. It is also important to determine vulnerable area where there is abundance of fuel. Attention should be focussed in these areas so that any fire outbreak can be put out before considerable damage to the environment has been caused. The crafting of the national fire strategy by the Environmental Management Agency is a step in the right direction.

However, adequate funding must be provided so that the programmes are put into action at the lowest levels and do not end as workshops discussion issues in urban areas far away from the beneficiaries.

There are also periods when fire out breaks is quite common and most destructive. Such an understanding can help in the making of specific fire control calendars for a community. The age, economic and social groups that normally cause fire must always be made targets for environmental education, while it also important to identify groups in the community who can take parts in community fire risk reduction activities. After taking stock of physical fire fighting capacity the community has, the intervention becomes necessary at this stage.

Mapping communities is important because trends, hot spots and infrastructure that are under threat can be assessed. The use of a seasonal calendar is important to establish when, what and how as the solution and one has to be sensitive to gender roles and activities. The community also has to agree on measures that reduce the frequency of deadly fires and traditional leaders should enforce by laws that can easily minimise uncontrolled fires. There is great need to educate settlers in areas bordering estates and commercial farms, as these are widely believed to have caused fires that destroyed the estates in 2005. Prevention must be the central focus in fire strategy. Warning systems are very important and must come from the community for ownership reasons. Some of the warnings could be in the form of stickers, posters, fire hazard indices just to mention a few.

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