

## **Spatial and temporal distribution and utilisation of fallow land in south central Zimbabwe**

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### **Abstract**

The purpose of this study was to assess the spatial and temporal distribution of fallow land between 1984 and 2010 in Zimbabwe's communal areas and its utilisation. Chivi district, which is located in south central Zimbabwe, was used as a case study. Remote sensing techniques were used to map and determine the extent of spatial and temporal changes in fallow land. Factors influencing fallow land increase and the subsequent current utilisation were assessed using participatory and conventional methods. Vegetation characteristics and soil fertility analysis was done on fallow fields of different ages replicated five times. Soil fertility analysis and vegetation characterisation was undertaken using standard methods. The size of fallow land was found to increase by 18.23 % from 1984 to 2010 while the cultivated area decreased from 34.40% to 17.18%. Factors that caused increase in fallow land were mainly socio-economic driven rather than biophysical. Draught power shortage (34%) was ranked as the major reason of fallowing followed by labor shortage (24%) and lack of inputs (22%). Poor soil fertility (16%) and drought (4%) were ranked as least reasons for fallowing. Soil fertility was generally low with mineral N ranging between 12.67 ppm and 18.67 ppm. Available P ranged between 3.6 ppm and 4.4 ppm whilst soil pH values ranged between 4.2 and 4.6. Most fallow fields were dominated by grasses and herbaceous plants. Fallow fields over 10 years had sparse shrubs. No trees species were found in all the fallow fields. Dominant grass species in the fallows included *Cynodon dactylon* and *Perotis patens*, which had lower nutrient content compared to required quantities for livestock production. The study concluded that size of fallow land was increasing in Chivi communal areas mainly because of socio-economic and biophysical factors, and that fallow land is mainly used for livestock grazing although the quality of grazing pasture was poor. Effort should therefore be made to increase the

productivity of fallow land by, for example, introducing technologies that improve pastures.

Key words: Communal lands, fallow land, spatial and temporal distribution, Zimbabwe

## Résumé

Le but de cette étude était d'évaluer la distribution spatiale et temporelle de la terre en jachère entre 1984 et 2010 dans les zones communales du Zimbabwe et de son utilisation. Le district de Chivi, qui est situé dans le centre-sud du Zimbabwe, a été utilisé comme une étude de cas. Les techniques de télédétection ont été utilisées pour cartographier et déterminer l'ampleur des changements spatiaux et temporels dans les terres en jachère. Les facteurs influençant l'augmentation des terres en jachère et l'utilisation ultérieure en cours ont été évalués en utilisant des méthodes participatives et conventionnelles. Les caractéristiques de la végétation et l'analyse de la fertilité des sols ont été effectuées dans les champs en jachère d'âges différents répétés cinq fois. L'analyse de la fertilité du sol et la caractérisation de la végétation ont été réalisées en utilisant des méthodes standard. La superficie des terres en jachère a augmenté de 18,23% de 1984 à 2010 alors que celle des terres cultivées a diminué de 34,40% à 17,18%. Les facteurs qui ont causé l'augmentation des terres en jachère ont été principalement reconnus socio-économiques plutôt que biophysiques. La pénurie d'électricité en temps de sécheresse (34%) a été classée comme la principale raison de la mise en jachère suivie par le manque de travail (24%) et le manque d'intrants (22%). La pauvre fertilité des sols (16%) et la sécheresse (4%) ont été classées comme les moindres raisons pour la mise en jachère. La fertilité du sol est généralement faible avec l'azote minéral compris entre 12,67 ppm et 18,67 ppm. Le phosphore P disponible se situait entre 3,6 ppm et 4,4 ppm tandis que les valeurs de pH du sol variaient entre 4,2 et 4,6. La plupart des champs en jachère ont été dominés par des herbes et des plantes herbacées. Les champs en jachère de plus de 10 ans avaient des arbustes clairsemés. Aucune espèce d'arbres n'a été trouvée dans tous les champs en jachère. Les espèces d'herbes dominantes dans les jachères comprenaient les *patens* *Cynodondactylon* et *Perotis*, qui avaient une plus faible teneur en éléments nutritifs par rapport aux quantités requises pour la production animale. L'étude a conclu que la taille de la jachère a augmenté dans les zones communales de Chivi principalement à cause des facteurs socio-économiques et biophysiques, et que les terres en jachère sont principalement

utilisées comme pâturage du bétail, bien que la qualité des pâturages fût pauvre. Donc, l'effort devrait être fourni pour accroître la productivité des terres en jachère, par exemple, en introduisant les technologies qui améliorent les pâturages.

Mots clés: Terres communales, terres en jachère, distribution spatiale et temporelle, Zimbabwe

## **Background**

Zimbabwe, like all developing countries, struggles to increase the socio-economic welfare of its citizens particularly in the rural areas, which are characterised by widespread food insecurity. Seventy percent of the population is rural based (also known as communal lands) and are dependent on agriculture for its livelihood. Sustainable land utilization and management is one important challenge since land is a finite resource. Despite the widespread food security in communal areas, and the socio-economic importance of agriculture in these areas, there are reports of increasing amount of land being left fallow in many communal areas in Zimbabwe. This underlines the need to address the phenomenon of increasing hectares of fallow land in communal lands.

## **Literature Summary**

Most communal areas in Zimbabwe are located in NR IV and V the driest regions in the country (Moyo, 2004; Rukuni, 2006). High poverty levels in communal areas have their origins in the colonial administration that was responsible for partitioning the country into two agricultural sectors, namely commercial and communal. Communal lands, where 70% of the population resides, were/are characterised by a poor natural and agricultural resource base (Mehretu and Mutambirwa, 2006). The poor potential of the land base in communal lands, reinforced by colonial parliamentary acts of land apportionment, and rapid population growth interacted over years to exert pressure on soil, grassland and forest resources leading to land degradation and the need for resettlements (Muir-Lerseche, 2006). This explains the increasing phenomenon of agricultural land being left to fallow for indeterminate periods of time. Very few studies have investigated the spatial and temporal distribution of fallow land.

## **Study Description**

The study was undertaken in ward 28 in Chivi district, which lies some 400 km southeast of Harare, Zimbabwe's capital. Chivi district falls under natural region (NR) V and is one of the driest regions in the country. It receives average annual rainfall <450 mm. The recommended farming activity is mainly

livestock production, because of low and erratic rainfall. This is worsened by soils that are mainly sandy that are characterised by low fertility (Nyamapfene, 1991; Scoones *et al.*, 1996; Mapanda and Muvengahama, 2011).

Agriculture is the main source of livelihood. The major cereal crops grown in the area are maize and sorghum, and rice which is grown on wetlands (Chuma *et al.*, 2000). Crop production is mainly for subsistence. Livestock production includes cattle (mainly for draught power), goats and poultry.

Ward 28 is composed of six village development committees (VIDCO). Villages in VIDCO A were used for the field work because it was typical of all the other VIDCOs in this Ward in terms of social set up of livelihoods. In VIDCO A there were four villages in total, namely, Madziva, Mutsure, Tibha and Gororo, and all these villages participated in the study.

A completely randomised design (CRD) composed of five different fallow periods replicated 5 times was used. The different fallow periods included 0-2 years, 2-5 years, 5-10 years, 10-15 years, 15-30 years. Lands belonging to different fallow periods were identified with the help of village heads and the household heads of the four villages.

Landstate images were used to assess the spatial and temporal distribution of fallow land.

Soil sampling for fertility analysis and vegetation characterisation was undertaken using standard methods. Dominant grass species were collected from fallow fields and their nutritive quality was determined using standard methods. Participatory and conventional methods were both employed on all the four villages to identify and rank factors contributing to increase in fallow land.

## Research Application

**Spatial and temporal changes in fallow land.** The size of fallow land was found to increase in area. The area under cultivation was found to decrease by a similar proportion. Taking 1984 as the base year, fallow fields were shown to increase from 0 % to 18.23 % by 2010. Area under cultivation decreased by almost 50%. The decrease in cultivation activities could not be associated with shifting cultivation practices which are normally done to replenish soil fertility (Yemefeck, 2005). A recent study, using remote sensing techniques, showed the area

under maize crop was decreasing significantly throughout Zimbabwe (USDA, 2009) confirming that fallowing was becoming a common phenomenon in the country.

**Factors influencing increase in fallow land.** In literature the reasons that explain fallow land have been dominated by the theory of overpopulation (Chuma *et al.*, 2000, Scoones *et al.*, 1996). In this study it was observed that socio-economic factors were the main factors influencing increase in fallow fields followed by biophysical factors. Draught power shortages were ranked as the main reason of fallowing followed by labour shortages and lack of inputs. Poor soil fertility and drought were ranked as the least reasons of fallowing. However these factors were interlinked.

**Vegetation characteristics.** Species richness and diversity did not have any significant difference within different fallow period. Species richness diversity in fallow fields were significantly different from that in woodland ( $P < 0.05$ ). However, species richness was higher in woodland compared to all fallow fields and so was species diversity. Fallow fields were found to have mainly grasses and herbaceous plants dominating and shrubs were sparsely distributed in fallow fields from 10 years old, compared to woodland which had many shrubs and trees. This can be attributed to the fact that tree and shrub species were unable to compete for resources such as water and nutrients with grasses. In addition, the presence of herbivores in fallow fields which did not allow species to establish successfully was also a contributory factor (Holl *et al.*, 2000). Herbaceous plants were higher in woodland than in fallow fields mainly because they establish successfully under the woodland canopy where they are protected from the excessive heat from the sun (Holl *et al.*, 2000). More herbs present in the woodland may also be due to higher organic matter contents compared to the fallows.

No correlations were found between species richness and soil N, P, K and pH ( $p > 0.05$ ). The absence of any correlation between species richness and soil fertility could be because neither species richness variations nor soil fertility variations were observed across the different fallow periods. It can also mean that soil nutrients do not affect species richness but might affect individual species in a community.

**Nutrient quality of grazing pasture.** These grasses have low nutrient contents compared to the quantities required for livestock production. Grass species found in the area as the most dominant, *Cynodon dactylon*, *Perotis patens*, *Digitaria eriantha*, *Brachiaria brizantha* and *Hyperthelia dissoluta* had low crude protein levels which ranged between 2-5% whilst recommended rate is of 12%. These grasses also had high neutral detergent fiber and acid detergent fiber contents. The high acid detergent fiber (62% on average) and lignin content (10.4 % average) results in decreased total nutrient digestibility even though energy availability is high (results from acid detergent fiber). The low protein content in these grasses was reflective of the low soil nitrogen levels of the fallow fields which limit protein synthesis and the resultant nitrogen available for livestock uptake.

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### References

- Chikowo, R. 2004. Nitrogen cycling in agroforestry systems of sub-humid Zimbabwe: closing the loop. PhD thesis, Wageningen University, The Netherlands.
- Chikowo, R., Mapfumo, P., Nyamugafata, P. and Giller, K.E. 2003. Woody legume fallow productivity, biological N<sub>2</sub>-fixation and residual benefits to two successive maize crops in Zimbabwe. *Plant and Soil* 1: 1-13.
- Food and Agriculture Organization. 1997. State of the World's Forests. FAO, Rome, Italy.
- Government of Zimbabwe, 2004. Zimbabwe Millenium Develooment Goals: 2004 Progress Report. Harare, Government of Zimbabwe.
- Kusangaya, S, Manzungu, E and Mazvimavi, D. 2004. Analysis of land use and land cover changes in the lower Odzi sub-catchment. *Geographic Journal of Zimbabwe, University of Zimbabwe*.
- Manyawu, G.J. 1998. Stockbreeder set priorities at Grassland Research Station. Farming World.
- Mapfumo, P., Mutambanengwe, F., Giller, K.E. and Mpepereki, S. 2005. Tapping indigenous herbaceous legumes for soil fertility management by resource-poor farmers in Zimbabwe. *Agriculture, Ecosystems and Environment* 109.
- Mpofu, I.D.T. 2005. Nutritional biochemistry laboratory manual, Department of Animal Science. University of Zimbabwe, Zimbabwe

- Mukandiwa, L. 2006. Utilisation of Acacia to improve goat production in a semi-arid area of Zimbabwe. Unpublished MSc Thesis. University of Zimbabwe, Zimbabwe.
- Muir-Leresche, K. 2004. Agriculture in Zimbabwe. In: Rukuni, M. Tawonezwi, P. and Eicher, E. (Eds.) *Zimbabwe 's agricultural revolution*, Harare, University of Zimbabwe Publications.
- Nepstad, D.C., Uhl, C., Pereira, C.A. and Cardoso da Silva, J.M. 1996. A comparative study of tree establishment in pasture and mature forest of Eastern Amazonia. *Oikos* 76.
- Nyamadzawo, G., Nyamugafata, P., Chokowo, R. and Giller, K.E. 2003. Partitioning of simulated rainfall in kaolinitic soils under improved fallow-maize rotation in Zimbabwe. *Agroforestry Systems* 59.
- Nyampfene, K.W. 1991. Soils of Zimbabwe. Nehanda Publishers (Pvt) Ltd, Harare. Zimbabwe.
- UNEP. 2003. Africa Environment Outlook. United Nations Environment Programme, Nairobi, Kenya.
- Zingore, S., Murwira, H.K., Delve, R.J. and Giller, K.E. 2007. Influence of nutrient management strategies on variability of soil fertility, crop yields and nutrient balances on smallholder farms in Zimbabwe. *Agriculture, Ecosystems and Environment* 119.