Potential Good Practice Note

Management of Rangelands Through Controlled Shrub Burning

Introduction

The bio-diversity of Bhutan can be best demonstrated by the mixture of rangelands and livestock of the country. The rangelands[1] in Bhutan comprise of alpine grasslands, temperate shrub-lands and sub-tropical forests. Each of these categories contains within it a wide diversity of livestock ranging from water buffaloes in the southern foothills to yaks in the alpine meadows. Several species of cattle, sheep and equine are distributed throughout the different agro-ecological zones. These livestock play an important role in the agrarian economy of the country by not only providing milk, meat and fibre, but also by supporting agriculture through draught power and manure supply.

Rangelands[2] have been described as those areas of land, which by reason of physical limitations, low and erratic precipitation, rough topography, poor drainage or extreme temperatures are unsuited for cultivation, and which are a source of forage for free ranging native and domestic animals as well as a source of wood products, water and wildlife (Stoddart et. al. 1975). In Bhutan, it is known as *ri* which literally means a range shed, when used in the context of a source of grazing, collection of firewood and non-edible products, medicinal or incense plants. Hence the term *rikha* means 'on the range' and *rikhaley* means 'from the range'. The term *tsamdrog* is nearly synonymous with rangelands, and it means grasslands.

[1] *Source*: 'Rangeland and Livestock Management in Bhutan' – Tshering Gyaltsen: http://www.fao.org/Ag/AGP/agpc/doc/TAPAFON/TAP_11.PDF

[2] *Source*: 'Condition and Potential for improvement of High Altitude Rangelands' – Pema Gyamtsho: http://www.bhutanstudies.org.bt/admin/pubFiles/v7-4.pdf

In Bhutan the sub-alpine and alpine zones comprise rangelands and lie approximately between 3,000 – 5,000 m altitudes. A survey conducted by the renewable natural resources sector of the Royal Government for the 7th Plan, this region is home to 9,182 nomadic and semi-nomadic households deriving a livelihood from an area of 62,000 ha registered rangeland which supports some 37,000 heads of yaks and 32,000 sheep (Livestock Census 1994). In monetary terms, this area contributes an estimated Nu 110 million to the GNP as the value of milk and milk products, manure, draught and wool (MoA/ISNAR, 1991)[1].

The major production constraints in these areas are poor productivity of rangelands due to overgrazing by both domestic animals and wild ungulates, poor management practices, inbreeding of yaks, difficult transport, communication and marketing, poor literacy rate and poor entrepreneur skills of the herders. The transhumant migratory system which is dictated by climatic limitations and socio-economic needs further compounds the problem. While all the above constraints have hardly been addressed, the solution to the constraints detected by the agronomic and management practices could go a long way towards enhancing the productivity of the system.

From the limited experience obtained, it can be seen that by improving winter pastures alone and using them as standing hay fields, the calving interval of female yaks can be reduced from 2-3 years to 1 year, and milk yield can be increased from 300 ml a day to 1 litre a day (Gyamtsho 1992). This would mean that there would be an increase in milk production on two fronts:

- increased number of female yaks in milk production, and
- increase in milk yield per animal.

Source: Rangeland and Livestock Management in Bhutan, Tshering Gyaltsen

The main causes of deterioration of rangelands can be attributed to **erosion**, which is a natural cause, due to flash floods, landslides etc. Other causes are excessive or **over grazing, poor nutrient cycling, shrub encroachment, and to some extent the herding systems**.

Controlled Shrub Burning Trials

In Bhutan, most of the rangelands are generally located within the park and protected areas. The enforcement of the first Forest Act (1969) banned the traditional rangeland management practice via burning with a view to improve the habitat for wildlife. However, while the act was enacted with all well-intended vision to protect the environment, it might have succeeded in increasing vegetation cover to some extent but on the other hand large number of good grazing land got covered by unwanted shrubs resulting in grazing competition between domestic and wildlife in small open areas of the meadows.

Soe Yaksa[3] area is located in Paro in western Bhutan at an altitude of 3,900 to 4,200 m, consisting of 9 villages with 19 households. The inhabitants are wholly dependent on Yak herding for their livelihood and have their permanent homes in the lower areas and move to higher altitudes (up to 5,000 m) in summer. The transhumance[4] is vertical and relatively short (1 – 2 days travel). Winter mortality of young and weak animals due to malnutrition is a major problem; hay meadows do not produce enough to meet demand during the winter. Improved pasture forages can be grown on the better soils but have to be protected from grazing animals. The lack of fencing is yet another problem.

This note showcases a study, undertaken by the Livestock Sector of Paro Dzongkhag, of controlled shrubs burning in the alpine area of Soe Yaksa which was conducted to see its effect on rangeland regeneration. The trial was initially started in 2004 but the burning could be implemented only in February 2006 due to unfavourable weather conditions.

3 *Source:* Transhumance grazing systems in temperate Asia, Bhutan case study 2: yak herders in Soe Yaksa, Chentok geog, Bhutan, in 1999-2000 - Gyaltsen, T., Bhattarai, B. N.

4 Transfer of Livestock from one grazing ground to another, as from lowlands to highlands, with the changing of seasons.

The preliminary findings reveal that the burning trials led to an increase of 26% of edible species of vegetation. After five to six month of burning trials, an excellent ground cover of edible grasses, sedges and broadleaf was observed in the area.

Objectives of the Study

- Assess the regeneration of grasses, forbs, broadleaf and shrubs species after prescribe burning in high altitude grassland.
- Develop guidelines and document an appropriate rangeland management practice in alpine areas for sustainable use of the resources.

Materials and Method

A total of four trial sites were selected at Soe Yaksa where the grasslands were affected by the unwanted shrubs and other vegetation. The trial sites were at varying elevations of 4,160 to 4300 m above snow line (See Table 1)

Table 1: Prescribed Burning Trial Sites

Grazing Land	Altitude (m)	Aspect	Tsamdrog Owner
Sutena	4,300	West	Norzagem
Taklung	4,300	West	Rhada Lham
Shebjidenkha	4,160	North West	Keasang Om
Balung	4,200	South West	Tshewang Lham

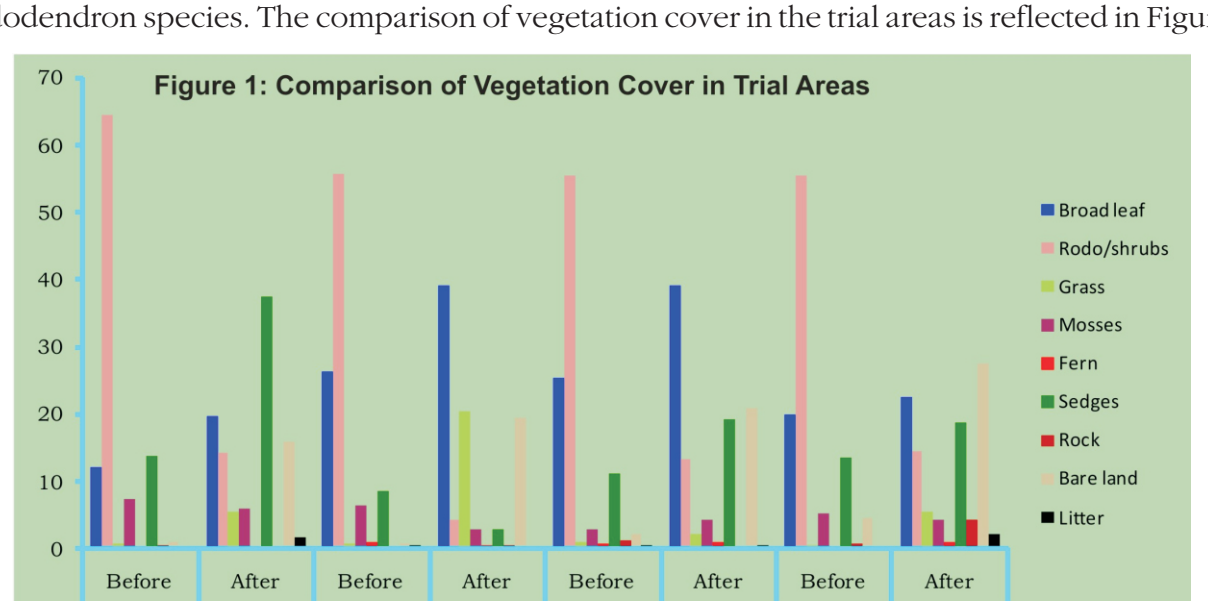
The following materials / methods / tools have been used while conducting the study:

- ***GIS & Remote Sensing*** (Landsat TM Mao of 1998) to estimate the dominance of various vegetation in the area.
- ***Randomised Complete Block Design*** (RCBD) with three replications in each site. Plot size from each treatment was 100 m2 (900 m2/ location).
- ***Iron cages for assessment of biomass*** - Nine-iron cages of base dimension (0.8 m x 0.48 m) and top dimension (0.7 m x 0.4 m) with height (0.3 m) per location were installed. Annual biomass yield from iron cages area were harvested and assessed the forage yield. Forage is separated into edible and non-edible types.
- ***Transect line*** to estimate the species composition and individual species abundance. The point analysis was carried out along a transect line of 2 m. For this, 40 points at regular interval of 5 cm were recorded. 18 Transects at random per site were read giving a total of 240 points per site.
- ***Soil samples from the trial area*** were collected for analysis at the National Soil Science Centre, Simtokha. A total of thirty such soil samples from depth of 0 – 10 cm, 10 – 20 cm and 20 – 30 cm were analysed.
- The ***roots and seeds from burned area*** were collected to find out which survived under such extreme burning condition. Live root and buried seed count were carried out six months after burning. The collected samples mixed with soil were washed in the running water using tea strainer for the recovery of live seeds and roots from the trial areas.

The Trial design consists of - (a) Prescribed burning (b) Slashing of vegetation and (c) Natural vegetation as control. In the burnt area the standard temperate grass mixture seeds - *lolium multiflorum, Dactylis glomerata and Fescua arundincea* - were broadcasted in August 2006 to see whether the over-sowing of improved fodder species, in combination with existing native species, could help the fodder development in the area.

Results and discussion

The GIS / remote sensing indicated that about 1,830 ha of grasslands had already been dominated by Rhododendron species. The comparison of vegetation cover in the trial areas is reflected in Figure 1.

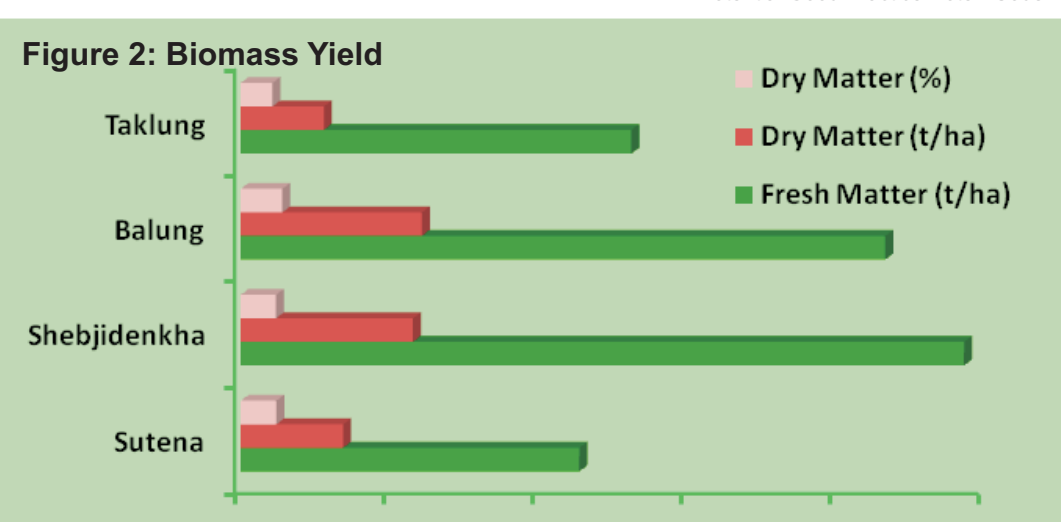


The rhododendron species was found to be the most problematic vegetation in the area. Further, the study revealed that even with extreme burning the survival rate of roots of rhododendron is almost 100%. However, no live seeds of any species had been recovered in the trial areas after burning. The details of live roots and buried seeds recovered in the trail area are presented in Table 2.

Table 2: Live Roots and Buried Seed Count

Trial Sites	Live Buried Root Count (Nos)			Live Buried Seed Count (Nos)			Weight of Live Root (gms)		
	RI	RII	RIII	RI	RII	RIII	RI	RII	RIII
Sutena	69	41	49	-	-	-	-	-	-
Shebjidenkha	63	67	75	-	2	-	-	-	-
Balung	81	71	45	-	-	3	94	84	33
Taklung	58	57	58	-	-	2	42	35	33

The burning trials revealed that the growth of unwanted vegetation under *Rhododendron aeruginosum* locally known as *"Khemp"*, even after 6 months of burning is visibly nil. It, therefore, is advisable that re-burning be carried out after certain intervals to overcome the species. Nevertheless, the growth of palatable forage species was observed to have increased by a considerable amount. The biomass yield, of edible forage types, harvested from the iron cages area of 0.38 m^2 is shown in the Figure 2.



The soil test results obtained show that the pH of soil is generally acidic at all trial sites till the depth of 0 – 10 cm. However, changes in soil pH are expected in time to come, and, therefore, needs to be monitored every alternate year.

Average dry matter production of prescribed burning treatment varied from, site to site. The highest dry matter yield recorded 1,069 kg/ha at Shebjidenkha and lowest of 626.6 kg/ha at Taklung site. There was significant difference ($P<0.05$) of dry matter production between different study sites particularly Sutena and Taklung when compared to Shebjidenkha and Balung. Although the growing season extends from May to October, significant herbage production does not occur until the beginning of the rains, usually in June. Thus, it was possible to harvest fodder only once in a year.

Dry matter production from slashed treatment was recorded and varied from maximum of 500 kg to minimum 117 kg dry matter/ha. However, the fodder was not harvestable from 3rd year as re-growth of shrub has dominated palatable fodder species. The percentage of edible fodder species in the control treatment was recorded with significant differences ($P<0.001$) in regeneration of palatable fodder species between treatments. In the burnt treatment, the palatable fodder species increased by 79.2% over the period of 3 years. In control treatment, the edible fodder species recorded <10% on average and >90% shrub cover of *Rhododendron anthopogen* and *Rhododendron setosum*. The palatable fodder species mentioned above are those that are found during transects and these species are actually not accessible to animal due to growth habit of shrubs. 37 broadleaf species, 4 sedge sp, 4 grass sp, 4 rhododendron sp, and 2 fern sp were identified. Of the 37 different broadleaf sp, 9 are non palatable including rhododendron sp, shrub/bush sp and fern sp. The re-growth rate of rhododendron was 2-3cm after 3 years of burning.

Conclusion

The 3 year findings of the prescribed shrubs dominated grassland indicate an increase in regeneration of palatable forage species from < 10% to 79.2%, therefore, validating that prescribed burning can be used as a tool to manage shrub dominated grasslands in high altitude rangelands. Changes in species composition, soil properties and other parameters will be repeatedly observed over a period of 5 -10 years if necessary. This particular study is to generate some information on rangeland management in alpine areas. For further monitoring and to

collect relevant information on shrubs dominance in the alpine grassland another trial need be conducted in some other areas of Bhutan.

Success of burning depends on willingness of resource managers to understand and appreciate the importance of fire in maintaining a desired ecosystem. Pre-burn vegetative composition, soil moisture and fertility, fire intensity, precipitation and grazing following burning, and other factors are likely to contribute to variations in vegetative response among studies (Wright, 1985). Burning generally increases the production of herbaceous species. In one study in the United States, the total herbaceous current year's production averaged 2.2 times higher on the burns compared to controls until third year (Cook et al. 1994). Shrub survival varied among species and the type of burns. However, shrub cover declined between 35 to 50% of pre-burn levels. Burning significantly increased crude protein of herbs in all years and sites sampled, the protein content on the burns averaging 60% higher than on control.

When considering prescribed burning as a means to improve habitats for ungulates the short and long-term effects of fire on dietary and habitat needs of ungulates should be considered. In the United States repeated burning at frequent intervals (e.g. 5 years) is recommended to maintain high forage quality, and herbaceous productivity in general is unknown.[5]

[5] *Source*: 'Condition and Potential for improvement of High Altitude Rangelands' – Pema Gyamtsho: http://www.bhutanstudies.org.bt/admin/pubFiles/v7-4.pdf

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Authors & Contributors: Tshering Gyaltsen, Deputy Fodder Officer, Mr. Herilal Nerula, Assistant Research Officer, Yonten Dorji, Assistant Research Officer, Gyem Thinley, Assistant Research Officer (RNRRC, Yusipang), Nidup Tshering, Assistant Livestock Officer, Dzongkhag Administration, Paro, Community of Soeyaksa, SA PPLPP Regional Coordination Team
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SOUTH ASIA Pro Poor Livestock Policy Programme
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Regional Office:
NDDB House (6th Floor) PB 4906, Safdarjang Enclave
New Delhi - 110029, INDIA
Tel: +91 (0) 11 2619 7851 / 7649 • Fax: +91 (0) 11 2618 9122
E-mail: sapplpp@sapplpp.org • Website: www.sapplpp.org

Partnering Institutions

BRAC
BRAC Centre
75 Mohakhali, Dhaka 1212
BANGLADESH
Tel: +880 2 8824180-7 Extn: 2311
Fax: +880 2 8823542, 8826448
E-mail: saleque@sapplpp.org
saleque.ma@brac.net

Department of Livestock
Ministry of Agriculture
Thimpu
BHUTAN
Tel: +975 (0) 2 351102
Fax: +975 (0) 2 322094, 351222
E-mail: tshering@sapplpp.org
naip@druknet.bt

BAIF Development Research Foundation
Dr. Manibhai Desai Nagar, NH 4
Warje, Pune 411058, INDIA
Tel: +91 (0) 20 25231661
Fax: +91 (0) 20 25231662
E-mail: sepawar@sapplpp.org
sepawar@baif.org.in

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