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Jinhua Wang
Ningxia Grassland Station, China

Binyu Zhang
Ningxia Grassland Station, China

Chengjiang Dai
Ningxia Grassland Station, China

Shouding Shi
Ningxia Grassland Station, China

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Suitable grazing methods for the *Stipa bungeana* grassland in Southern Ningxia foothills

Wang Jin-hua ,Zhang bin-yu ,Dai Chengjiang ,Shi Shouding

Ningxia Grassland Station ,Yinchuan 750001 ,China ,E-mail :nxwang7905@126 .com

Key words : pasture utilized ,grazing intensity ,grazing ban ,grazing uncontrolled ,rotation grazing on an area basis

Introduction After a grazing ban on a hilly mountain pasture in Southern Ningxia for 3 years ,improvements were shown to have occurred in the ecology of the local environment . However in order to utilize grassland resources ,long-term grazing bans are not a preferable option . Guyuan City in Ningxia has many hills and mountains and grazing has always been an important part of agriculture in the area [1 ,2] . Additionally ,it is questioned whether a grazing ban can be more beneficial to the ecology of a grassland than reasonable grazing . Investigation is required to highlight potentially better grazing management methods for grassland ecology whilst increasing farmer income .

Materials and methods An experimental area covering 521 .7 hm² was set up in pasture hills in Yuanzhou district ,Guyuan city . The experimental area was divided into eight plots by a fence . The grazing treatments included a grazing ban throughout the entire year ,no grazing during the warm season and grazing in cold season ,grazing uncontrolled throughout the year ,and rotational grazing on an area basis throughout the year . Three grazing intensities (0 .53 ,0 .87 ,1 .2 hm² / sheep unit) were set up . The ratio of sheep placed into each treatment plot was designed to match that of a standard grazing sheep flock . Rams were put into the sheep flock at a male : female ratio of 1 :15 . Grassland ground coverage and the existing volume of grass ,and the mass ratio of high-quality and low-quality forage were measured in the middle of March and August (Wang Shiping ,etal . , 1998) . Ten ewes with markers were weighed every 45d . The number of ewes annual estrus ,pregnancy rate ,the lambing rate and the rate of twins were recorded . Lambs were weighed when they were born and again at 1-month of age . A cost-benefit analysis was done at the end of the year .

Results During the grazing period ,the average weight gain for the treatment which allowed sheep to graze over the whole year was 1 .9 ~ 4 .2 times the weight gain for the treatment in which sheep grazing only in cold season . The rate of estrus hybridization ,lambing rate and the rate of twins of sheep grazing in whole year was 34 .2% ,100 .8% and 46 .7% higher , respectively ,than that of sheep grazing in pen . The average annual net income per sheep grazing over the whole year was 7 .53 times of that of sheep which were reared in a pen . Average existing pasture volume and good pasture of meadow for rotation grazing on three plots were 46 .71% and 43 .19% higher than that of meadow for free grazing in autumn . Under different grazing intensities ,all pasture capacity and existing good pasture capacity of meadows in autumn was 0 .53 and 0 .87 hm² /sheep unit ,respectively ,in 2005 . This shows that a low grazing intensity is beneficial for pasture vegetation growth . In late grazing period (June 1-Aug 31) ,total weight gain and daily weight gain of sheep under low grazing intensity (1 .2 hm² /sheep unit) and high grazing intensity (0 .53 hm² /sheep unit) was 6 .45 kg ,70 .88g and 3 .4kg ,37 .36g respectively . This shows that low-intensity grazing can be more beneficial to sheep than high-grazing intensity . The regression equation between different grazing intensities and the existing mass of autumn pasture : $y = 556 .1 + 38 .3x$, $r = 0 .96$. The regression equation between different grazing intensity and number of grazing sheep per hectare : $y = 2 .642 - 0 .10417x$, $r = -0 .976$. For the purpose of protecting grassland vegetation and improving stockbreeding production efficiency ,it's concluded through the intersection of dual linear regression ,that the suitable grazing intensity of grassland is 0 .76 hm² /sheep unit . Compared with grazing uncontrolled ,the average existing masses of all pasture and fine pasture on autumn grassland for rotation grazing were 46 .71% and 43 .19% higher respectively ; the average height and coverage rates of main pasture was 11 .11% and 7 .69% higher respectively ; during the grazing period ,weight gain ,lamb birth rate and twin lamb birth rate were 1 .55kg ,12 .5% ,16 .67% higher ,respectively .

Conclusions By comprehensive analysis it's concluded that rotation grazing on an area basis is currently the most suitable grazing practice for mountain pastures near Guyuan City . In this region 3-4 summary rotation grazing system can be implemented .