PRODUCTION FROM FINE WOOL SHEEP IN THREE AREAS IN NORTHERN CHINA

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Summary

The seasonal changes in production, the systems of management and the seasonal climatic and feeding conditions are described for three farms representative of the major areas for growing fine-wool sheep in northern China. At all farms, summer and autumn were seasons of rapid liveweight gain and wool growth. In the winter and spring, during lactation, liveweight declined wool growth decreased by approximately 70%, and fibre diameter by 4 to 8 microns. The wool produced was characterised by a very low clean wool yield (39-51%). Greasy fleece weights ranged from 4.5 to 8.0 kg and average diameter of wool fibres from 20.5 to 23 microns. The number of lambs born per 100 ewes mated ranged from 79 to 95, lamb weights ranged from 3.8 to 4.5 kg, and weaning weights ranged from 17 to 25 kg. Overall, the patterns of sheep production were similar to those found in seasonally arid environments (such as in the mediterranean climatic zone). Yield of clean wool and therefore clean fleece weights were far below those in most other fine-wool producing areas of the world.
(Key Words: China, Wool, Sheep)

Introduction

It is currently estimated that there are 95 100 million sheep in China. Approximately 25-30 million of these are classified as fine-wool sheep (Copland, 1987; Wong, 1988). The breeds used for fine-wool production have resulted from crossing native sheep with imported breeds. They are usually dual purpose sheep reared for both meat and wool production (Ch'ang, 1979; Cheng, 1984). Sheep are traditionally reared in areas not suitable for production of crops where climatic conditions are severe. The majority of fine-wool sheep are in northern China (Cheng, 1984) where the north-west is characterised by extensive mountain ranges, while in the north east sheep graze undulating grasslands. Rainfall in these areas is low, winter temperatures are low and strong winds may both exacerbate the low temperatures and cause problems with dust. The rainfall is seasonal with most precipitation in the summer months.

Sheep in these areas depend on pastures for most of their nutritional requirements with variable amounts of supplements fed when pasture is in short supply. Due to the low rainfall and low temperatures in winter, pasture at this time is poor both in terms of the quantity and quality available. Under such fluctuating seasonal conditions the production of meat and wool should vary during the year, as occurs when sheep are grazed in other seasonally arid environments (Purser, 1980) Manipulation of management to allow optimal productivity in these environments can only be attempted when there is a clear description of current management and production. The objectives of this study were to describe the seasonal changes in production on three farms representing major sheep growing areas and to relate these changes to the system of management (time

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of shearing, supplementary feeding and grazing location), reproduction (time of pregnancy and lactation) and seasonal conditions.

Materials and Methods

Locations, environment and management

Huang Cheng farm is located in the Qilian mountains in Gansu Province (lat. 37°55'N, long. 101°52'E, see figure 1). The elevation ranges from 2,400 to 3,500 metres and the temperature from 29°C in winter to +32°C in summer. Average annual rainfall is 375mm.

Nanshan farm is located in the Tianshan mountains in the Xinjiang Uygur Autonomous Region (lat. 43°31'N, long. 87°E, see figure 1). The elevation ranges from 900 to 2,600 metres and the temperature from −31°C in winter to +31°C in summer. Average annual rainfall ranges from 300 to 600 mm, depending on elevation.

Aohan farm is located in the east of the Inner Mongolia Autonomous Region (lat. 42°18'N, long. 119°49'E, see figure 1). The farm is not in a mountainous area and temperatures range from −19.5°C in winter to +36.6°C in summer. Average annual rainfall is 200 to 350mm.

On all farms, the rain falls almost exclusively in

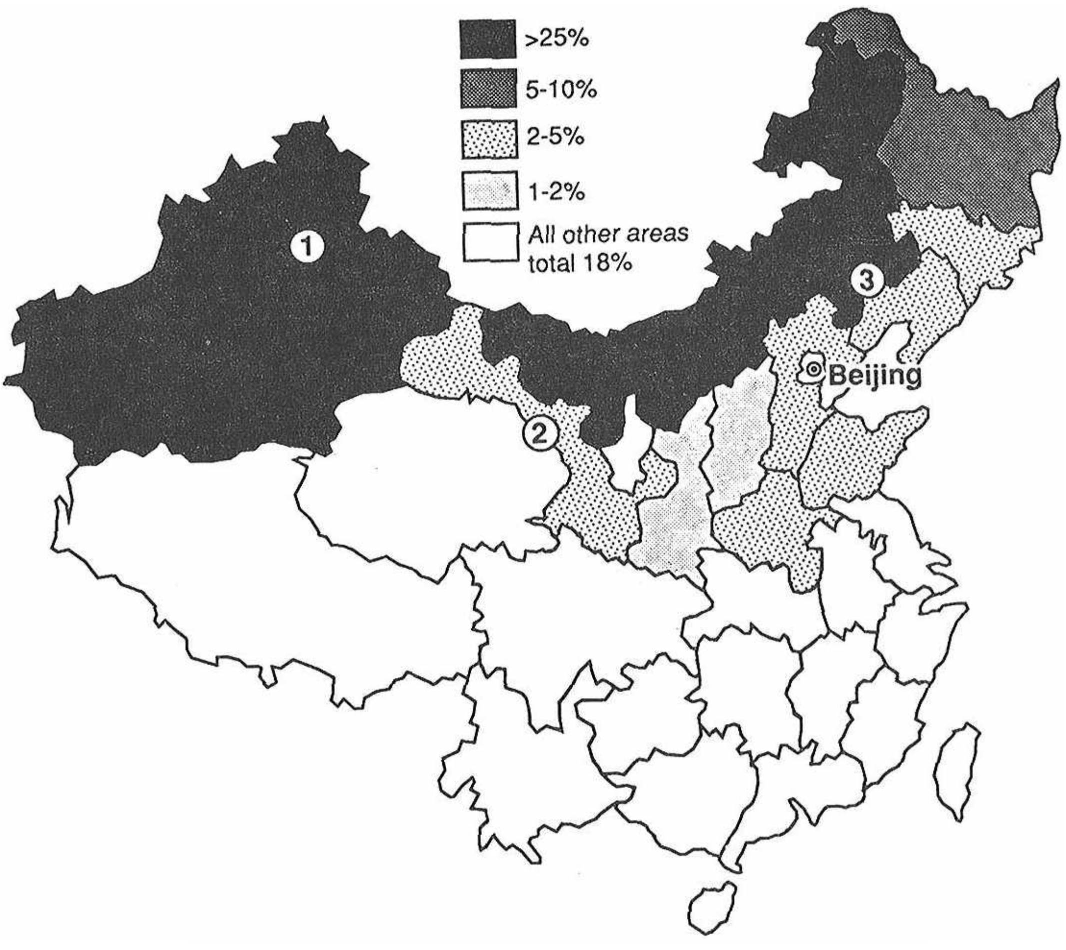

Figure 1. Distribution of fine and semi-fine wool sheep in provinces and regions of China (from Copland, 1987). Sheep are not uniformly distributed in each region and there are few sheep in the deserts of southern Xinjiang or western Inner Mongolia. Experimental sites: 1. Nanshan farm, 2. Huang Cheng farm, 3. Aohan farm.

summer (June to August). Due to the cold dry conditions in winter and spring, only dead residues of pasture plants are available for grazing for up to seven months each year. The pasture species available are predominantly native and are grown without any inorganic fertilizer. During winter, sheep are housed for much of the time, although there is some grazing time each day.

At both Huang Cheng and Nanshan farms, sheep are managed in a traditional, semi-nomadic system. Flocks are accompanied at all times by a herdsman or group of herdsmen. The sheep are moved to the highest pastures in the warmer summer months and on to the lower slopes or desert pastures (at Nanshan only) during the other seasons. In autumn, the sheep may graze some improved pastures or crop residues (figure 2). At Aohan farm, sheep are also accompanied by herdsmen, but remain in the same grazing area for nine months of each year. In summer the sheep may be moved to alternative pastures for three months. Ewes are maintained in flocks of approximately 120 (Aohan), 200-300 (Nanshan) or 800 (Huang Cheng); they remain in one flock throughout their life at Huang Cheng and Nanshan but at Aohan groups are recomposed several times, according to expected lambing dates. At Huang Cheng, flocks are split into smaller groups of about 200 each day during grazing.

Within each system of grazing management, there are superimposed other management practices used for reproduction and supplementary feeding (figure 2). On all farms, the critical periods of pregnancy and lactation occur in either winter or spring when only small amounts of low quality forage are available for grazing. This allows lambs to grow rapidly in summer and to be of sufficient size to survive the climatic and nutritional stress

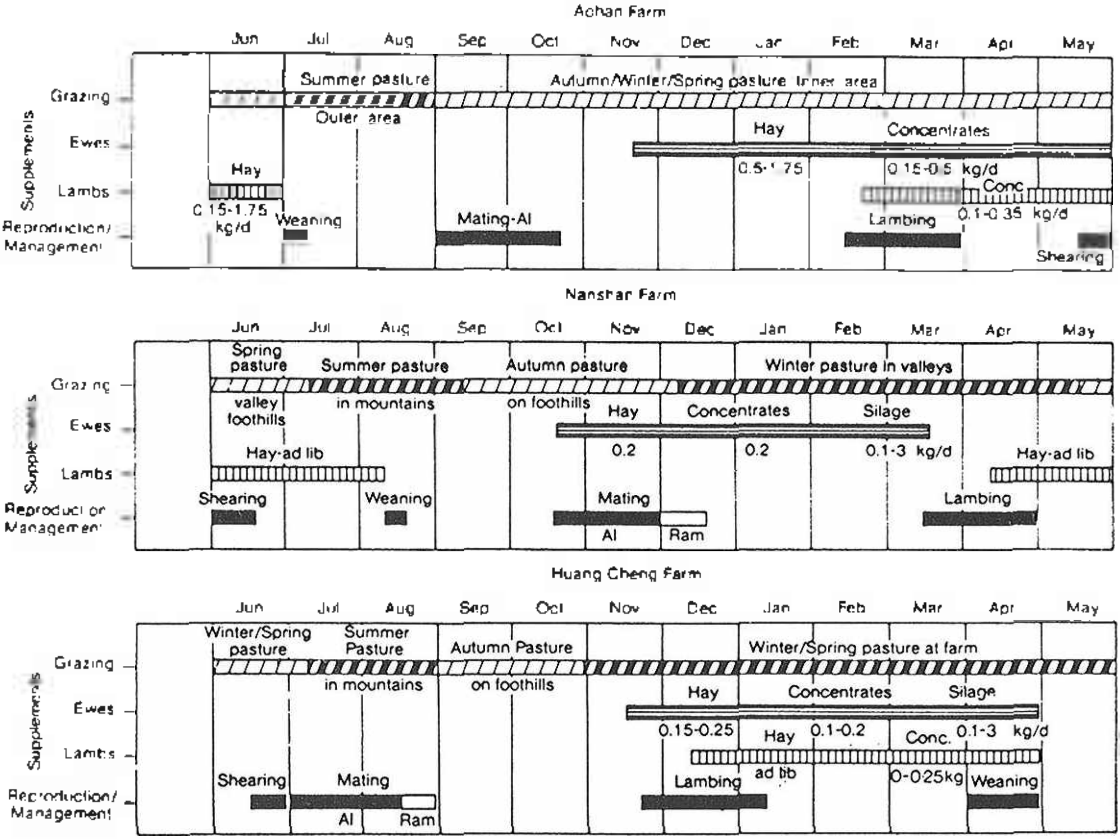

Figure 2. Management of grazing, supplementary feeding and reproduction for ewes and lambs at Aohan, Nanshan and Huang Cheng farms.

of the following winter. Mating is predominantly by artificial insemination followed by natural mating of ewes not pregnant following insemination. Mating begins in July at Huang Cheng, October at Nanshan and September at Aohan. Ewes and lambs are provided with supplements, including conserved fodder (*silage or hay*) and grain-based concentrates, in winter and spring (figure 2). The amounts and type of supplements fed depend on the supplies available, the cost, and the *seasonal conditions*.

Sheep

On each site, a representative group of approximately 100 ewes were studied for 12 months. These ewes were 2.5 to 3.5 years old and most had their second lamb during the experimental period. At Aohan farm, half the ewes were aged 2.5 years and half 1.5 years. The younger ewes had their first lamb during the experimental period. The mating, feeding and grazing management of these sheep was in accordance with the normal procedure on the farms.

Collections, analyses and recordings

The ewes were weighed 6-8 times during the year at times selected to coincide with major seasonal changes or different physiological states. At each weighing, wool, on a subsample of 30 ewes, was marked with a dyeband for the measurement of wool growth. The dyebands were applied and processed as described by Williams and Chapman (1966) for estimates of seasonal wool growth and fibre diameter. Fibre diameter was measured on individual dyeband samples using a projection microscope.

At shearing, fleeces were weighed and mid-side samples of wool taken from a subsample of the ewes for determination of yield and average fibre diameter. At lambing, lambs were weighed and the number of lambs produced was recorded. Lambs were weighed again at weaning.

Results and Discussion

Liveweight changes reflected both the seasonal conditions and physiological state of the ewes (figure 3). On all properties, sheep grew rapidly in summer and early autumn. At Nanshan farm, after the initial increase in liveweight of approximately 10 kg in summer, the sheep remained at an almost constant liveweight until January with a subsequent gradual decline through lactation until the following summer. At both Aohan and Huang Cheng farms, the seasonal cycle was more apparent. Ewes at both sites gained weight rapidly until the beginning of lambing. This weight gain would be due to an increase in body size of the ewe in early pregnancy and then to increase in conceptus size in winter during the latter stages of pregnancy. The increase in liveweight prior to lambing at Huang Cheng was approximately 12 kg and at Aohan was 16-23 kg. During the lambing period, ewes at Aohan lost 8.2 kg (adults) or 6.2 kg (maidens) and at Huang Cheng weight loss averaged 10.1 kg. Loss of weight from parturition of the foetus and other products of conception represents approximately 5 kg (Schinckel, 1963). Weight loss at Nanshan was less pronounced with

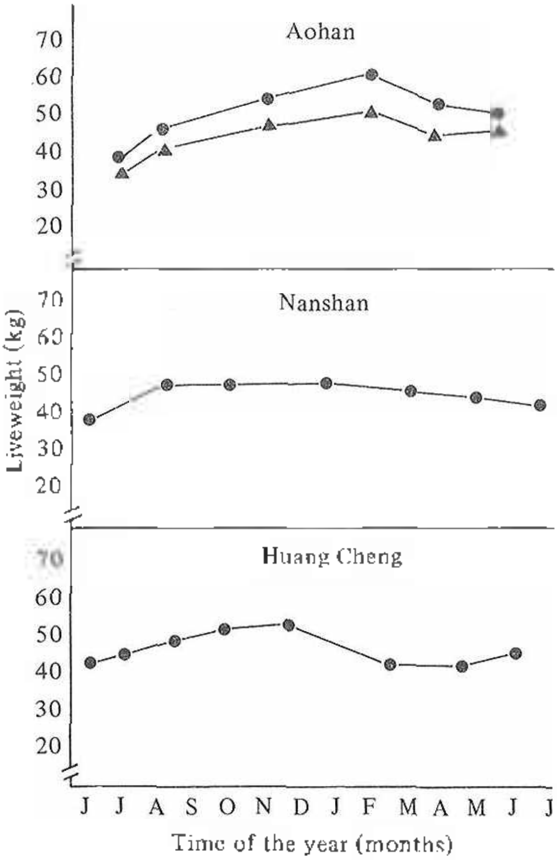

Figure 3. Seasonal changes in liveweight of breeding ewes at Aohan, Nanshan and Huang Cheng farms. ●—●, 2.5 year old ewes; ▲—▲, 1.5 year old ewes.

ewes losing 2 kg in the two months prior to lambing and another 4 kg from the start of lambing to mid-lactation. The later lambing at both Nanshan and Aohan resulted in a liveweight advantage to the ewes. Ewes on these farms were 6-12 kg heavier at the end of the experimental period than at the start. At Huang Cheng, starting weight and weight at the end of lactation were similar and by the end of the experiment ewes were 3.2 kg heavier than starting weight.

Wool production also reflected seasonal and metabolic conditions with low growth rates and diameters in winter and spring, during lactation (figure 4). At Huang Cheng, wool growth in December and January (winter) was 25% of growth in June and July (summer) and at Nanshan, growth in March and April (spring) was 27% of that in September and October (autumn). At Aohan, wool growth in April and May (spring) was 30% of that in July and August (summer). At Huang Cheng and Nanshan the reduction in wool growth was accompanied by a 7-8 micron decrease in diameter. This resulted in a clearly visible change in thickness and crimp in the wool staple (see plate 1). At Aohan diameter decreased by 4.4 microns (figure 5). These changes are similar to those reported in grazing sheep in other seasonally arid environments where there are prolonged periods of low quality forage available (Stewart, Moir and Schinckel, 1961). In this previous study, wool growth in autumn was only 32-41% of that in spring. The seasonal cycle in liveweight and wool production and quality is attributed to the decline in feed availability together with the increased demand for nutrients during pregnancy and lactation. The production of a lamb may result in a 10-20% decrease in fleece weight

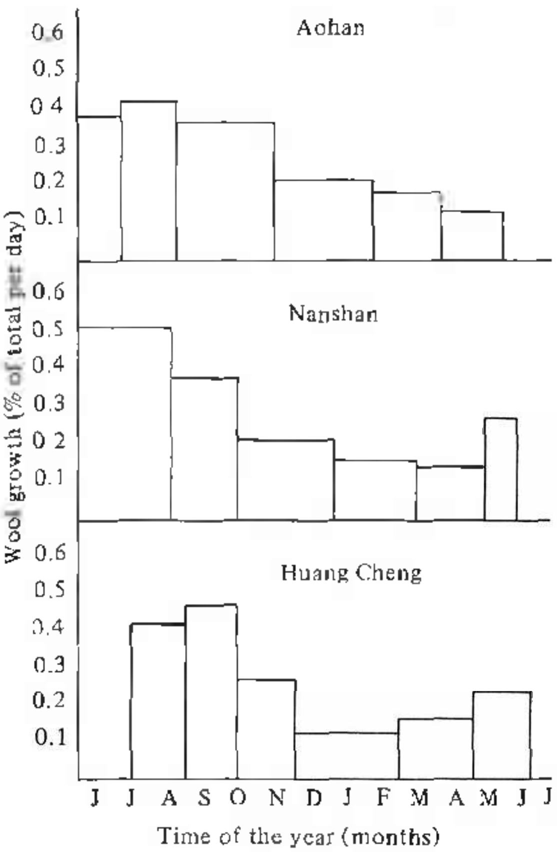

Figure 4. Seasonal changes in the rate of wool growth by breeding ewes at Aohan, Nanshan and Huang Cheng farms.

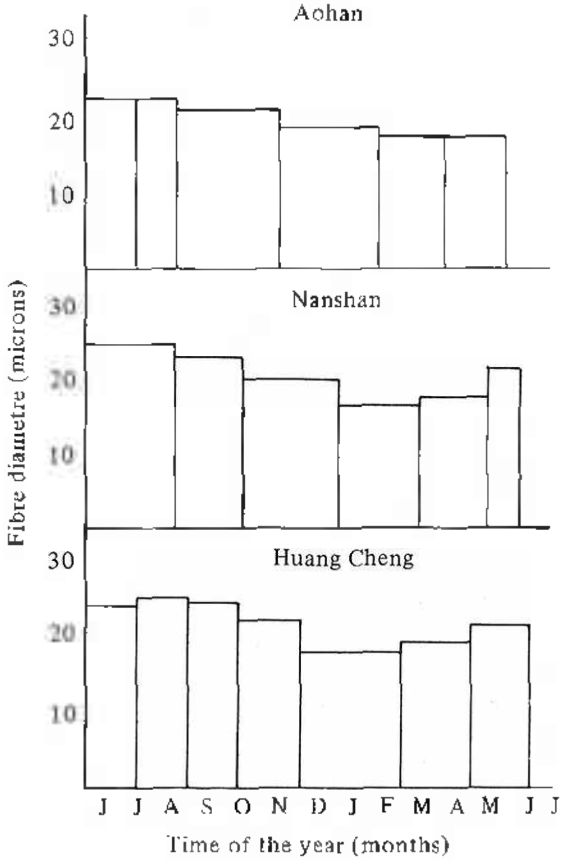

Figure 5. Seasonal changes in the average diameter of wool fibres from breeding ewes at Aohan, Nanshan and Huang Cheng farms.

(Corbett, 1979) while consumption of a poor quality diet at the same time may reduce wool growth by 30-60% (Oddy, 1985).

This variability in wool growth and diameter will cause a reduction in the tensile strength of the fibres (Hansford and Kennedy, 1988) and increased breakage of fibres will occur during processing of the wool. Preliminary results at Huang Cheng have indicated that tensile strength of wool from breeding ewes is 8-10 N/ktex (Yu and Masters, unpublished), this is well below the accepted strength for processing of 30-35 N/ktex. Such a low tensile strength will result in reduced processing quality, with decreased fibre length in the wool top and increased carding and combing losses (Whiteley, 1984).

The yield of clean wool and the weight of clean wool grown per sheep was low at all sites (table 1). In other parts of the world, yield of clean wool (from fine wool producing sheep) ranges from 45 to 78% while clean fleece weights range from 3.3 to 5.2 kg (Copland, 1987). The results of the current study indicate that production from fine wool sheep in China is at the lower end of these ranges. Average clean fleece weight (greasy fleece weight x yield/100) at Nanshan was 2.5 kg and at Aohan 3.3 and 3.2 kg. These were higher than the fleece weights from Huang Cheng of 1.8 kg. The low yields of 51, 39 and 39% for Nanshan, Aohan and Huang Cheng, are caused by dust contamination and are probably the result of a combination of factors, including, high winds, dry winter conditions, heavy grazing pressure and overnight housing in dirt floored pens.

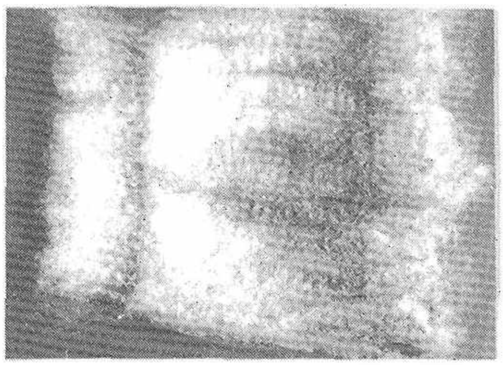

Plate 1. A typical wool sample, from a ewe grazing at Nanshan farm, showing weakness and narrowing of fibres near the base.

TABLE 1. WOOL PRODUCTION AND CHARACTERISTICS

Location	Greasy fleece wt(kg)	Yield (%)	Average diameter (microns)	Length (cms)
Huang Cheng	4.50+0.07(83)[a]	39.0+0.7(83)	22.9±0.2(83)	Not available
Nanshan	4.99±0.08(69)	51.0±1.8(19)	20.5±0.4(19)	8.0±0.3(19)
Aohan				
– Maidens	7.70±0.02(50)	42.5±2.2(53)	22.0±0.2(54)	9.1±0.2(54)
– Adults	8.04±0.03(48)	39.4±2.1(51)	21.6±0.3(51)	8.3±0.2(51)

[a]Figures shown are means ± s.e.m. with the number of values included in the mean in parentheses.

The reproductive performance of the sheep was low in comparison to sheep production in many other parts of the world and also below many of the other breeds of sheep in China (Wong, 1988) but similar to that of Merino sheep in mediterranean areas such as Western Australia (Knight et al, 1975). Results of this study at Huang Cheng support those previously published (Wong, 1988). Lamb birth weights were within an acceptable range but at Huang Cheng the weights at weaning were low (table 2). The low weaning weight clearly demonstrates the difficulties that exist in trying to grow the lambs sufficiently quickly to enable survival during the following winter.

Overall the characteristics of sheep production in the remote grazing areas of China are very similar to those in a mediterranean climate, such

TABLE 2. REPRODUCTIVE PERFORMANCE AND LAMB WEIGHTS

Location	Ewes mated	Lambs born	Lambing (%)[b]	Lamb weight (kg)	Weaning weight (kg)
Huang Cheng	858[c]	682[c]	79.5	3.85±0.08(51)[a]	17.2±0.7(31)
Nanshan	124	98	79.0	3.83±0.07(45)	25.2±0.5(44)
Aohan					
– Maidens	59	53	89.8	4.10±0.02(40)	20.8±0.3(61)
– Adults	57	54	94.7	4.50±0.02(33)	25.3±0.5(56)

[a]Figures shown are means ± s.e.m., with the number of values included in the mean in parentheses, or discrete numbers.

[b]Number of lambs born/number ewes mated x 100.

[c]Figures from entire flock in year following the experiments described.

as Western Australia. Lambing percentages in both regions are usually below 90% and there are the same seasonal trends in liveweight and wool growth, with wool production decreasing by 70-75% at some times of the year. Changes in the diameter of wool are also similar. However, fleece weights and yield of clean wool in China are far below those in most other regions where fine-wool sheep are grown.

The low levels of production indicate a potential for increased production based on improvements in animal breeding, nutritional management and animal health. These results provide a basis for the evaluation of alternative management strategies for improving sheep production and for devising experiments to test alternative feeds or supplements in three major sheep growing areas in northern China.

Acknowledgements

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