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THE FUTURE OF CHINESE WOOL PRODUCTION

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The size, geographic distribution and breed structure of the Chinese flock are examined and the likely constraints on expansion of wool production are identified. Causality analysis is used to establish the importance of prices paid to producers as determinants of production levels and as government policy instruments. It is argued that output increases in the medium term are most likely to arise from improved cut per head and that opening of new pasture lands may result in increases in sheep numbers in the long run.

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The abundance of labour in China has meant that the textile industry has been a leading growth sector in the industrialisation of the Chinese economy. After changes in emphasis in economic planning in the mid 1970s, the growth of the industry accelerated with more emphasis on exports and adoption of modern equipment. In the subsequent growth the Chinese textile industry surpassed the United States industry in terms of output and became the largest in the world. By 1981 textile output accounted for 16 per cent of China's total industrial output.

Production figures indicated that annual output of fabric in 1983 was approximately 15 billion metres of which 58 per cent was cotton, 35 per cent synthetic and only about 1 per cent wool (Australian Wool Corporation, personal communication, 1984). While 1 per cent seems small, it amounted to approximately 350 kt of greasy wool which is equivalent to 40 per cent of the 1986-87 Australian clip. Traditionally, most of mill requirements have been met from Chinese domestic production. However, in the last decade, with rapid expansion of textile production and the prominent position of wool products in China's textile export expansion, mill demand has outstripped Chinese domestic wool supply.

In 1982 China met 75 per cent of its raw wool demand from domestic sources; by 1987 this figure had declined to less than 50 per cent with imports from all major suppliers (except South Africa) being expanded rapidly. This expansion has important implications for the Australian wool market. Chinese imports have increased, with some hiccups, since the mid-1970s so that in 1986-87 they purchased 12 per cent of Australian supply and were Australia's second biggest wool customer. Thus it is of importance to the Australian wool industry whether the expansion that has occurred in Chinese mill demand will result in expansion of Chinese domestic production of wool or whether Chinese textile manufacturers will continue to meet a high proportion of their needs from overseas.

In this study background is provided on the composition of the Chinese sheep flock as well as other factors influencing wool production, the responsiveness of Chinese supply to economic incentives is examined, the likelihood of increased production and constraints on expansion of Chinese wool are discussed and, finally, some conclusions are drawn.

Background

China has the third largest sheep flock in the world after Australia and the USSR. The sheep population reached a peak in 1981-82 of 110 million and since then has declined to 94 million (Commonwealth Secretariat 1986). Sheep are raised for both wool and mutton and the breeds reflect this dual purpose. There are three principal Chinese breeds, Mongolian, Tibetan and the Kazak, a fat rump type. These breeds are carpet wool type sheep. Since the early 1950s efforts have been made to develop a fine apparel wool industry by introducing merino genetic material from both the USSR and Australia. This has resulted in fine wool increasing as a proportion of total wool output.

Despite the emphasis on fine wool production, much of the clip remains coarse and the approximate micron composition in 1982 was: 24.5 micron and finer - 25 per cent; 24.6 to 27.5 micron - 20 per cent; 27.6 to 32.5 micron 15 per cent; and 32.6 micron and coarser - 40 per cent (Australia Wool Corporation, personal communication, 1984).

TABLE 1

Sheep Numbers and Wool Production for 1982

Province	Sheep numbers	Wool production	Fine wool production
	million	t	t
North-east			
Heilongjiang	3.4	12919	6998.5
Liaoning	1.7	5263	2268
Jilin	1.5	5215	1836
North			
Shandong	3.2	7166	3765
Hebei	4.1	6570	3470
Beijing	-	-	-
Tianjin	-	-	-
Henan	2.9	5611	3544
Shanxi	3.7	3359	856
North-west			
Shaanxi	1.8	3100	1618
Gansu	7.7	8971.5	2535.5
Inner Mongolia	20.4	48815	22[illegible]13
Ningxia	1.9	2713	146
Xinjiang	19.2	38831.5	31842
Qinghai	13.6	15337.5	545.5
East			
Zhejiang	1.8	3711	2487
Jiangsu	0.9	-	-
Shanghai	-	-	-
Anhui	5.0	1555	269
Central			
Hubei	-	-	-
Hunan	-	-	-
Jiangxi	-	-	-
South			
Guangdong	-	-	-
Guangxi	-	-	-
Fujian	-	-	-
South-west			
Sichuan	3.6	2339.5	328
Guizhou	0.3	-	-
Yunnan	1.7	1445	370
Xizang	12.0	7490.5	25.5

- Negligible amount.
Source: Editorial Board of the Chinese Agricultural Yearbook (1986).

Sheep are largely confined to the northern and western pastoral areas and few sheep are raised in the agricultural or cropping areas. Table 1 gives some idea of the location of the Chinese sheep raising industry and fine wool production areas.

Wool production per sheep is low in China. Average cut per head is less than 2 kg when calculated by dividing total wool production by total sheep numbers (Commonwealth Secretariat 1986). Such a measure usually overstates the actual cut per head. The effect of the low greasy wool production per sheep is exacerbated by the low yield in China of between 40 and 45 per cent clean (Copland 1986). As a consequence, the average clean wool production per sheep is less than 1 kg. This is around a quarter of the Australian and New Zealand cuts of 3.6 and 4.0 kg clean, respectively (when calculated on a similar basis). Average cuts have been increasing rapidly. Cross and Spinks (1986) report that clean cut increased from 0.75 kg in 1978 to 0.95 kg in 1985, reflecting improved genetic strains. This 20 per cent increase in cut per head over a seven year period is extraordinarily high compared with the 2 per cent increase achieved in Australia during the same period.

Mutton and wool are expected to be joint products since both are produced from the same animal. However, whether production is occurring under a set of joint economic constraints, those on wool and those on mutton, or whether mutton production occurs largely independently of, or simply as a by-product of wool is an empirical question. Mutton production is only a small proportion of Chinese red meat production although it is high in absolute terms (see Table 2). Approximately 94 per cent of red meat production is from pigs. Mutton (60 per cent) competes with beef (40 per cent) for the remainder of the market.

TABLE 2

Production of Meat

Meat	1980	1981	1982	1983	1984
	kt	kt	kt	kt	kt
Pork	11 341	11 884	12 718	12 161	14 315
Mutton	445	476	524	545	565
Beef	269	249	266	315	370

Source: US Department of Agriculture (1985).

A factor affecting wool production is the importance of mutton in the sheep raising enterprise. Between 1978 and 1984 mutton consumption rose by 27 per cent reflecting increases in consumer incomes (US Department of Agriculture 1985). During the same period sheep numbers fell probably because of the small rate of increase in the procurement price of wool relative to mutton. This is illustrated in Figure 1 which shows the levels of the official procurement prices of wool, mutton and beef. While mutton production is important it is apparent from published Chinese planning objectives that the emphasis in the Chinese sheep industry in the future will be on wool production. The idea of specialised mutton production has been mooted.

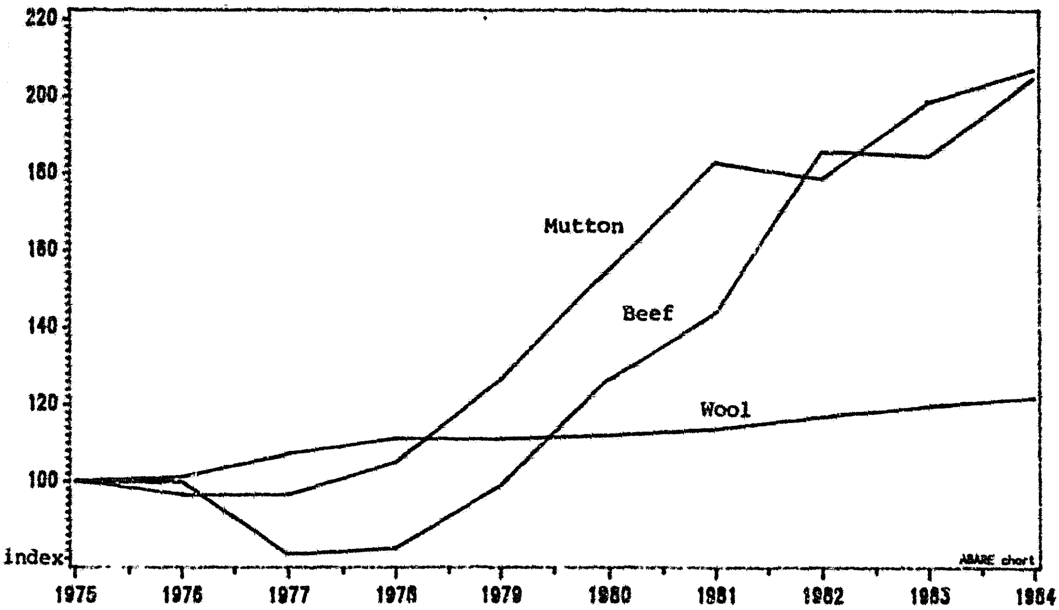

FIGURE 1 - Price Index Movements.

Husbandry practices in China reflect the harsh climatic conditions. Annual temperature ranges in some sheep producing areas are of the order of -40°C to 30°C. Sheep in Inner Mongolia and the grasslands are shedded for up to six months of the year while sheep in the mountainous regions of the north-west are moved over long distances to winter pastures. Shedding of sheep frequently leads to a reduction in wool quality due to staining and cotting. Nutritional stress and reduced wool growth often occur when sheep have to walk long distances (Copland 1986).

Most of the pastoral areas in China are not fenced and hence shepherding is the most common grazing practice. Shearing practices are primitive and labour intensive and parasites, specifically lice, require frequent spraying that often damages the wool. These management techniques contribute to the low yields and a deterioration in wool quantity. This situation appears to be reinforced by inadequate price differentials for quality differences. The main price differentials are related to wool length. For example, the highest quality category, wool finer than 25 micron, and wool broader than 37 micron have a common procurement price (Department of Primary Industry 1985). This contrasts with the Australian situation where the price for 19 micron wool has recently been around three times that of 30 micron wool.

The responsibility for planning and administering China's agricultural production rests with the Ministry of Agriculture. This ministry is operated by the State Council which operates through the State Planning and Economic Commission, the Ministry of Finance, the People's Bank of China and the State Price Bureau. With such a complicated framework, a single department can seldom take a significant action without consulting other related or potentially affected departments. As a result the process of adjustment of state prices has tended to be dominated by attempts to solve the most urgent difficulties without due consideration to the subsequent long run impacts.

In recent years the level of sheep numbers and wool production have fallen reflecting complaints by wool producers that the official procurement price is too low (Copland 1986). By 1985, the situation had deteriorated to the extent that wool producers began selling wool outside the state purchasing system. High demand for wool pushed prices up dramatically and the state price for wool rose from 4.26 yuan to 6 yuan. Individual traders offered much higher prices. Herdsmen who had sold wool to the state early in the season demanded compensation while others stopped selling.

In 1986 the state responded by adopting a uniform pricing policy in all wool growing areas. Trading of wool by individuals was banned. As a result, herdsmen refused to shear their sheep and the clip fell below target, and wool stores, usually full by mid-June, lay empty.

Since 1978 there have been a number of political reforms. Of these, two in particular have had a large impact on the agricultural sector. First, the area allowed for private cultivation, or in the case of sheep raising, the grazing of private flocks, has been allowed to increase. Second, the Chinese authorities have introduced the production responsibility system which encourages collective units to implement the principle of distributing income in proportion to work accomplished. This was taken a step further in 1981 when the system of assigning responsibility for production to households was officially deemed as being suitable for certain areas of China.

An important consideration in the future of wool production in China is overgrazing. Both Copland (1986) and the World Bank (1985) emphasise that China's pastoral zones are currently overstocked and consequently problems of soil erosion and depletion are being encountered in many areas. While overgrazing has been a problem since the 1960s in Inner Mongolia and Northern Hebei, the problem has worsened in recent years due to emphasis in policy on expanded sheep numbers. The policy of encouraging private flocks which make use of common grazing resources has also been a significant contributing factor. It appears that these recent policy changes have resulted in a breakdown in the collective control of pasture management practices .

Price Responsiveness of Production

A central issue in Chinese agricultural production is the effectiveness of prices paid to producers as an incentive for increased output. The Chinese government has made extensive use of economic incentives to influence such diverse outcomes as birth rates, production of goods and services and the demographic structure of the population. While it seems likely that incentives are provided to control wool output it is not clear what type of incentives have been used historically or how effective they have been. Thus the proposition is examined that wool output has been directly influenced by wool procurement prices and indirectly influenced by mutton prices. While it would also have been desirable to compare the influence of beef prices this was not possible due to the limited period for which beef price data were available. In recent years beef and mutton prices have moved in a similar manner.

The initial approach taken was to specify and estimate a production equation for wool. However, two types of problem were encountered. First, it was not clear what type of production function was appropriate. While some general aspects of the commune and family systems of production are known, detailed information on production possibilities and technical aspects of production is still not readily available. The second problem that arose was that when statistical testing of the relationships between wool output and wool and mutton prices under simple CES assumptions was undertaken using simple regression techniques, it quickly emerged that the parameters were unstable. Using annual observations from 1960 to 1984 the signs of coefficients on prices were positive and the coefficients were significant. However, subdivision of the sample period revealed that the coefficients varied significantly over time. The result was consistent with the expectation that major agricultural policy decisions made by the Chinese government had influenced the structure of incentives faced by wool producers.

Thus an alternative procedure was adopted based on a method of testing for feedback described by Geweke (1982). The technique requires that the series are wide-sense stationary and non-deterministic. To test for feedback between variables x_t and y_t the following equations are specified and estimated using ordinary least squares.

$$(1.1) \quad x_t = \sum_{s=1}^{p} E_{1s} x_{t-s} + u_{1t}.$$

$$(1.2) \quad x_t = \sum_{s=1}^{p} E_{2s} x_{t-s} + \sum_{s=1}^{p} F_{2s} y_{t-s} + u_{2t}.$$

$$(1.3) \quad x_t = \sum_{s=1}^{p} E_{3s} x_{t-s} + \sum_{s=0}^{p} F_{3s} y_{t-s} + u_{3t}.$$

$$(2.1) \quad y_t = \sum_{s=1}^{p} G_{1s} y_{t-s} + v_{1t}.$$

$$(2.2) \quad y_t = \sum_{s=1}^{p} G_{2s} y_{t-s} + \sum_{s=1}^{p} H_{2s} x_{t-s} + v_{2t}.$$

$$(2.3) \quad y_t = \sum_{s=1}^{p} G_{3s} y_{t-s} + \sum_{s=0}^{p} H_{3s} x_{t-s} + v_{3t}.$$

The tests used by Geweke were multivariate and approximate. Since all the above equations involve only a single x_t and a single y_t it was possible to form the corresponding exact tests. The series were differenced once to allow for strong linear trends in the three relevant variables (wool production, wool price and mutton price). Three lags were used in each equation, so that $p = 3$ throughout.

Following Geweke's notation we write:

$$\hat{\Sigma}_i = n^{-1} \sum_{t=1}^{n} \hat{u}_{it}^2, \qquad i = 1, 2, 3,$$

$$\hat{T}_i = n^{-1} \sum_{t=1}^{n} \hat{v}_{it}^2, \qquad i = 1, 2, 3.$$

The first null hypothesis was that y_{t-s}, $s = 1, 2, 3$, did not feed back linearly into x_t. Given that this was true then

$$\frac{(\hat{\Sigma}_1 - \hat{\Sigma}_2)/p}{\hat{\Sigma}_2/(n - 2p)} \sim F_{p,n-2p}.$$

The second null hypothesis was that the x_{t-s}, $s = 1, 2, 3$, did not feed back linearly into y_t. Given that this was true then

$$\frac{(\hat{T}_1 - \hat{T}_2)/p}{\hat{T}_2/(n - 2p)} \sim F_{p,n-2p}.$$

The third null hypothesis was that there was no instantaneous linear feedback between y_t and x_t. This could have been tested equally well in either direction, but the test statistic actually used was

$$\frac{\hat{\Sigma}_2 - \hat{\Sigma}_3}{\hat{\Sigma}_2/(n - 2p - 1)} \sim F_{1,n-2p-1}.$$

Since the (first differenced) data used were annual from 1960 to 1984 and three lags were needed, there were 22 effective observations ($n = 22$) for each equation.

<u>Case 1</u>: x_t is wool production and y_t is wool price.

$\hat{\Sigma}_1 = 95.61$ $\hat{T}_1 = 89.40$

$\hat{\Sigma}_2 = 42.80$ $\hat{T}_2 = 81.66$

$\hat{\Sigma}_3 = 42.73.$

For the first null hypothesis $F_{p,n-2p} = F_{3,15} = 6.58$ which is significant at the 1 per cent level. For the second null hypothesis $F_{p,n-2p} = F_{3,15} = 0.51$ which is not significant. For the third null hypothesis $F_{1,n-2p-1} = F_{1,15} = 0.02$ which is not significant.

We conclude that there is strong evidence for a lagged influence of wool price on wool production, but not the other way round, and that there is no evidence of any instantaneous feedback between them.

<u>Case 2</u>: x_t is wool production and y_t is mutton price.

$\hat{\Sigma}_1 = 95.61$ $\hat{T}_1 = 2.063$

$\hat{\Sigma}_2 = 77.46$ $\hat{T}_2 = 1.887$

$\hat{\Sigma}_3 = 66.72.$

For the first null hypothesis $F_{p,n-2p} = F_{3,15} = 1.25$ which is not significant. For the second null hypothesis $F_{p,n-2p} = F_{3,16} = 0.51$ which is not significant. For the third null hypothesis $F_{1,n-2p-1} = F_{1,15} = 2.41$ which is not significant.

We conclude that there is no evidence for any lagged influence of mutton price on wool production, nor the other way round, and that there is no evidence of any instantaneous feedback between them.

Some general conclusions can be drawn about the Chinese incentive system for wool production. First, prices paid by the Chinese government strongly influence the output of wool. This implies that any central decision making with respect to output can be readily put into effect. Second, any effect of mutton prices on wool production is small and hence increased use of sheep as a red meat source is not likely to influence wool production substantially. Finally, it is apparent that despite the changes in political organisation that occurred over the sample period the price mechanism remained robust and was important in determining economic outcomes.

Constraints on Wool Production

Wool production in China is constrained by two factors. The first of these is sheep numbers which are, in turn, constrained by the availability of pasture. The second is clean cut per head which is low and reflects management, nutritional and genetic factors.

Chinese authorities have stated that approximately 27 million hectares of land in China's southern regions that is not currently utilised is earmarked by the government as being suitable for development as grazing land (World Bank 1985). The World Bank report expresses doubts about the viability of the proposal and suggests the number of hectares available may be overstated. While it appears some pasture land is likely to be opened to sheep for wool production it is possible that the Chinese prefer beef to mutton and that this preference would result in some of this additional pasture being used for beef production. In addition, beef production may be more suitable on ecological grounds. While there is no published evidence on this issue hearsay evidence supports the conclusion that the 'filing' herding pattern of sheep causes ruts in pasture and, unlike in Australia, the Chinese native species are not readily destroyed by crushing due to cattle.

In China's southern grazing regions sheep numbers initially increased after the move to the production responsibility system. However much of this area was already seriously overgrazed and the rise in sheep numbers of the early 1980s has resulted in serious land degradation. Thus, it appears the scope for increasing sheep numbers in the south will be restricted until some widespread pasture improvement has been undertaken. Returns from pasture improvement are expected to be low in this area because of the poor quality of the land.

Thus policies aimed at increasing sheep numbers through increasing pasture area and pasture productivity are not likely to be successful for some years. Hence raising wool production by raising animal productivity must be viewed as more important. The Chinese Government has made increasing cut per head a priority in its wool policies. Numerous projects designed to upgrade the genetic potential of the flock through artificial insemination, specialised stud farms and the like are currently in progress. These projects often have the dual objectives of improving the cut per head and improving fibre quality while retaining a large enough animal to meet mutton requirements. An idea of the success of such policies can be obtained from comparisons of the cut per head of China's fine wool sheep and the average cut per head of all sheep. Fine wool sheep in China cut 4 kg greasy yielding 1.5 kg clean, compared with the average production for all Chinese sheep which in 1986 was 1.88 kg of greasy wool and less than 1 kg clean (Merino Export Review Committee 1987). The success of the program to upgrade the genetic potential of the flock will be largely determined by nutritional factors. If nutrient intakes are not improved it will mean ultimately that the potential of genetic improvement will not be fully realised. Thus improved pasture productivity through matching livestock numbers to carrying capacity, destocking of some areas and changed management practices are likely to be priorities in Chinese wool policy. This may mean that sheep numbers have to remain stable or even be reduced.

Conclusion

The major point of interest in Chinese wool production from the perspective of Australia is its capacity to expand. In the analysis it has been shown that in the short term expansion would be more likely to result from improved cut per head than from an increase in sheep numbers. There are two principal reasons for arriving at such a view. First, cut per head of Chinese sheep is very low by world standards and there is potential for increased cut through improved husbandry and breeding. Second, because the carrying capacity of existing Chinese pasture lands is unlikely to be increased in the short run, any increase in sheep numbers for some years ahead is likely to be at the expense of other agricultural enterprises.

The statistical analysis shows that Chinese wool producers are price responsive. Hence, if wool production obtains a higher priority from the Chinese government, with increased producer payments and incentives for quality, including cleanliness, it is likely that it could be expanded. Given the development of the Chinese textile export industry and periodic shortages of foreign exchange this possibility should not be discounted. The relationship between mutton prices and wool production indicates that even if a portion of wool production has been as a by-product of the meat industry the mutton industry is unlikely to be a strong influence on wool production in China. Whether this will continue to be so or whether the trend towards specialization of meat and wool production will become stronger or weaker is not clear at present. Major programs are being undertaken to upgrade the genetic potential of fine wool sheep in China and it seems likely this would favour specialisation.

Expansion of wool production in China is a stated objective of the Chinese government and it is apparent that the economic need and capacity for expansion exists. The success of polices in expanding wool production is likely to depend on a broad range of issues and it is not certain that economic stimuli, in the form of increased wool prices, will be provided by the Chinese Government.

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