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Intra-annual sheep price patterns and factors underlying price variations in the central highlands of Ethiopia

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ABSTRACT

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A sheep market survey was undertaken to determine the effects of certain animal and market characteristics on price and the pattern of sheep prices in relation to seasons. Nine key Ethiopian central highlands markets were surveyed for a period of one year in 1989. Each market was surveyed once a week on the main market day. Price, weight, sex, age, colour, condition score, breed type and buyer's purpose were recorded for all completed transactions as well as the numbers offered and sold on each market day. A total of 50062 cases were recorded.

Three markets, each representing redistributive, intermediate and terminal markets, as identified by the distribution in buyer's purpose were chosen for further analysis. Considerable weekly price variation was evident in these markets. Prices were also seasonal with higher premiums paid during some religious festivals. Animal characteristics (weight, age, condition, sex, colour) as well as buyer's purpose and seasons were variably important in explaining variation in price among animals within weeks. Variations in the composition of these characteristics from week-to-week were among factors underlying changes in weekly mean prices. R^2 varied from 0.2659 to 0.3583 in the quadratic price per kg model and from

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0.7822 to 0.8413 in the quadratic price per head model in the three markets. However, it was found that price per head was predicted equally well overall by estimated price per kg multiplied by actual weights and that because of wide variation in weights, both within and between weeks, price per kg is more useful market information.

INTRODUCTION

The Ethiopian highlands represent an important sheep producing area accounting for 75% of the nation's flock (Constable, 1984). Farmers consider livestock more reliable form of wealth than other alternatives and sheep are a readily convertible source of cash at time of need as well as an important source of meat. On the average three head of sheep are slaughtered per family per year and about 40% of farmer's cash income from animal trade in the central highlands is accounted for by sale of sheep (Gryseels, 1988).

In spite of the importance of sheep in the household economies of this region, little emphasis has been given to market research. Interventions addressing increased production may need to consider the market aspect simultaneously. Farmers need to be aware of the desired characteristics of animals as well as price patterns so that they can plan breeding and fattening programs and breed selection consistent with the best seasonal prices and consumers preferences.

There is neither regular market information on prices and supplies nor grades and standards. Agreement on price is reached by a long one-on-one bargaining between a seller and a buyer. Animals are sold on a per head basis. Under such circumstances, prices paid will reflect buyers' preference for various animal characteristics (e.g. sex, weight, age, condition, breed, and colour), the season of the year, the purpose as to whether the animals are purchased for consumption, breeding, fattening or resale, and buyer's and seller's bargaining skills. A report on the central highlands livestock survey the most recent known to the authors (Ayele and Hillmann, 1975), tried to determine, among other things, factors affecting differences in price levels in a given market and between markets at the different rounds of the survey. The most vivid shortcoming of this study was that the data was collected during an abnormal (drought) year and as a result its conclusions were not necessarily representative.

The present article focuses on data and analysis of price and price determinants throughout the year at the terminal, intermediate and redistributive markets in the central Ethiopian highlands. Weekly prices over a period of one year are analysed to determine intra-annual price patterns and the effects of animal and market characteristics on prices.

DATA AND METHODS

Nine key central highland markets – Shola, Addisu Shola, Debre Berhan, Deneba, Enewari, Degollo, Ginchi, Debre Zeit and Degollo – were purposively selected, to capture the main pattern of movement of sheep and benefit from existing ILCA's¹ outreach research stations, and included in a sheep market survey. These markets are within about 185kms (linear distance) radius of Addis Abeba, the most important terminal market, and most of them lie north-east of Addis Abeba, along the Addis Abeba–Degollo route. The survey was undertaken on the main weekly market day for a period of one year beginning in January and ending in December 1989. In a few markets the survey was started and completed a few weeks later.

All completed transactions on ordinary market days and as many completed transactions as could be tracked on festival market days were recorded. A festival period signifies religious festivals and New Year's day. A festival period was represented by two market days: the market falling on the festival day (or the preceding market day closest to the festival day) and the one preceding it. Price, weight, sex, age, condition, colour, number offered and sold, buyers' purpose, buyer and seller type, and time of sale were recorded.

Recording was done at the exit gate(s) if fenced or at one or two of the most frequented departure routes if open market places. Recording started at about 8:00 in the morning and continued until about 5:00 in the afternoon. In all 50 062 animals were recorded (Shola 6453, Addisu Shola 1922, Debre Berhan 8609, Deneba 7326, Enewari 3638, Degollo 7808, Ginchi 9263, Debre Zeit 3619, Dejen 1424).

Age was approximated by the type and number of teeth. Condition was assessed by certain physical characteristics apparent in sheep of different degrees of fatness, i.e., on and around the back bone in the loin area and the last rib, and above the kidney (Carles, 1983). While Carles discussed six condition scores, only four condition scores ranging from one for poor to four for very fat sheep were used in the present study.

Due to the difficulty in identifying specific breeds in the market place, only four major groups were classified: hairy thin tailed, woolled thin tailed, fat tailed and fat rumped (Minutes of the Technical Committee on National Sheep Research and Development Policy, 1975). Information on price and purpose of purchasing was obtained from buyers as they left the market. Sheep were weighed with dial scales.

¹ International Livestock Center for Africa.

To facilitate selection of representative markets for analysis the markets were classified on the basis of the distribution of buyer's purpose (for approaches used in market classification see for example: Herman, 1979; Solomon and Tilahun, 1983). Accordingly, all the markets included in the survey fall into either terminal: Shola, Addisu Shola, Dejen, Debre Zeit and Debre Berhan (with 98.5, 98.8, 97.0, 90.1 and 46.7%, respectively, bought for slaughtering) or redistributive: Degollo, Ginchi, Enewari and Deneba (with 81.1, 57.7, 53.0 and 49.1%, respectively, bought for resale). Though classified as a terminal market the Debre Berhan market was almost equally as important as a redistributive market (45.6% bought for resale). Thus, this market is designated as an intermediate market. Shola and Degollo (the most typical terminal and redistributive markets, respectively) and Debre Berhan (an intermediate market) were selected for analysis. The following equation was estimated for each of the markets selected for analysis:

$$\begin{aligned}
 P = & b_0 + b_1W + b_2W^2 + b_3T + \sum_{i=4}^9 b_iF_i + \sum_{i=10}^{11} b_iS_i + \sum_{i=12}^{16} b_iA_i + \sum_{i=17}^{19} b_iC_i \\
 & + \sum_{i=20}^{22} b_iK_i + \sum_{i=23}^{25} b_iR_i + b_{26}(W * T) + \sum_{i=27}^{28} b_i(W * S_i) + \sum_{i=29}^{33} b_i(W * A_i) \\
 & + \sum_{i=34}^{36} b_i(W * C_i) + \sum_{i=37}^{39} b_i(W * R_i) + \sum_{i=40}^{45} b_i(W * F_i) + \sum_{i=46}^{47} b_i(T * S_i) \\
 & + \sum_{i=48}^{52} b_i(T * A_i) + \sum_{i=53}^{55} b_i(T * C_i) + e_i
 \end{aligned}$$

where P is price per kilogram (in EB)²; W is weight in kg; T is time in week; F , S , A , C , K and R are dummy sets signifying season, sex, age, condition, colour, and purpose of buying, respectively. The b_i s are structural parameters of the equation.

RESULTS AND DISCUSSION

Market composition

Table 1 presents overall annual market composition of the terminal, intermediate and redistributive markets. Sex distribution of sheep sold varied from market to market. The low proportion of female sheep in the terminal market reflects a parallel low preference for female sheep for

² 2.07 EB (Ethiopian Birr) = US\$1.00.

TABLE 1

Percentage market composition of central highlands markets by animal characteristics and type of market

Animal characteristics	Type of market		
	Terminal market	Intermediate market	Redistributive market
(A) Sex			
male	50.5	43.0	56.4
castrate	38.5	9.9	4.2
female	11.0	47.1	39.4
(B) Age (year)			
≤ 1	62.4	72.8	86.0
2	26.6	6.9	4.8
3	2.4	6.1	2.1
≥ 4	8.6	14.2	7.1
(C) Condition			
poor	13.6	29.8	5.6
average	55.3	64.9	90.0
fat	21.1	4.9	4.1
very fat	10.0	0.4	0.3
(D) Colour			
white	28.0	19.0	20.6
brown	29.0	35.3	34.4
black and white	11.6	24.0	11.6
black and other	31.4	21.7	33.4

slaughtering purpose as they are very often suspected of pregnancy and pregnant animals under normal circumstances are not slaughtered by tradition. A higher proportion of castrated sheep in the terminal market was not unexpected as they represent the most preferred category for slaughter, heavy and fat, by the relatively high income section of the urban population.

Most sheep (64.3%) sold in the central highlands markets were lambs of less than a year age. Castrates, on the average, are older than male and female sheep, only 22% of the castrates were less than two years of age, while 94.3% and 62.5% of males and females, respectively, fall in this age group. Agyemang et al. (1985) reported that farmers take rams out of service for castration or sale at about 2 years of age. On the average 55% of castrates in the central highlands markets were either fat or very fat whereas only 4% of males and females each fall in this category. Castrates alone account for 73% of the combined fat and very fat category.

All sheep recorded at the intermediate and redistributive markets were fat-tailed type. This type also predominated in the terminal market. Fat

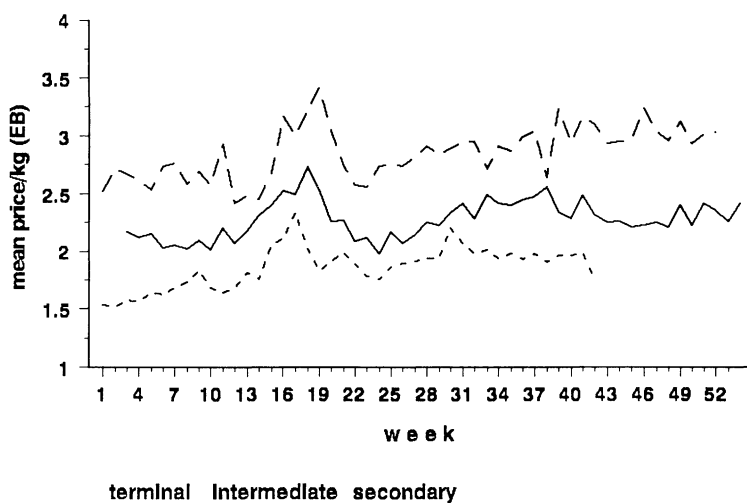


Fig. 1. Weekly mean prices per kg.

rumped sheep represented only a very small proportion and mainly in the terminal market.

Intra-annual sheep price pattern

Figure 1 depicts weekly mean prices per kg for the three markets considered. Considerable weekly mean price variation was apparent in these markets. Weekly mean prices were highest in the terminal and lowest in the redistributive market throughout the year. Overall annual mean prices per kg for the terminal, intermediate and redistributive markets were 2.84, 2.26 and 1.85 EB, respectively. Weekly mean prices per kg varied between 2.41 and 3.41 EB in the terminal, between 1.98 and 2.73 EB in the intermediate and between 1.52 and 2.33 EB in the redistributive markets. In addition to variation over time in numbers offered and demanded there is variation in desirable attributes or characteristics among sheep, both within market days and between market days. It will be seen later that these differences also give rise to weekly mean price variations.

Both the quantity purchased and offered for sale considerably increase during religious festivals. The lowest demand as well as the number offered for sale is expected to occur during fasting periods.³ The Id-alfater, which marks the end of the Moslem *Ramadan* fasting period and which in 1989

³ There are 139 obligatory and 82 optional fasting days in a year. The *Hudade* (Lent) fasting period is the longest of all, 55 days, and ends in early April.

TABLE 2

Probability levels ($Pr > F$) of tests of significance of factors included in price per kg equation for the terminal, intermediate and redistributive markets

	Terminal market	Intermediate market	Redistributive market
Weight	0.0001	0.0041	0.0105
Weight ²	0.0001	0.0032	0.0001
Week	0.0054	0.0147	0.0001
Season	0.0001	0.0001	0.0617
Sex	0.0012	0.0017	0.5284
Age	0.5601	0.0001	0.0022
Condition	0.5961	0.0001	0.0001
Colour	0.0001	0.0001	0.0001
Buyer purpose	na	0.0064	0.0001
Weight \times time	0.9905	0.1483	0.0322
Weight \times sex	0.0281	0.0972	0.1488
Weight \times age	0.6965	0.0001	0.0577
Weight \times condition	0.7998	0.0001	0.0060
Weight \times buyer purp.	na	0.0154	0.0016
Weight \times season	0.0001	0.0001	0.0001
Week \times sex	0.0011	0.0007	0.0001
Week \times age	0.2381	0.4499	0.0164
Week \times condition	0.0006	0.0383	0.0003

na, not applicable, virtually all for slaughtering.

occurred a week after the Ethiopian Easter, was the peak price period in terms of price per kg in the terminal market. The peak price in the intermediate market occurred during the Ethiopian Easter.

Apart from producers' response to increased demand for sheep during festivals, seasonality of supply is affected by producers need for cash, lambing pattern, and variation in quantity and quality of grazing in relation to rainy and dry seasons. Gryseels (1988) noted that small ruminants were the first to be considered for sale when food and seed grain stocks are depleted. The highest demand for grain seed and the lowest stock of food grain occurs during June to end of September. In addition cash needs are high before the harvests begin. Gryseels also reported that the peak lambing season was from September to November and relatively equally distributed during the rest of the year.

Econometric results

Table 2 presents probability levels of (F) tests of significance of the variables included in the price per kg equation for each of the markets under consideration. Most of the variables included in the equation are

TABLE 3(a)

Estimated parameters of main effects of price-per-kg equation for the terminal, intermediate and redistributive markets

	Terminal market	Intermediate market	Redistributive market
Intercept	2.9967 **	3.0769 **	1.6915 *
Weight	-0.0595 **	-0.0496	-0.0425
Weight ²	0.0015 **	0.0008 **	0.0008 **
Time	0.0115	0.0024	0.0504
Sex			
male	0.3134 **	0.1856 **	-0.0010
castrate	0.5037 **	0.2607	0.1374
female	0.0000	0.0000	0.0000
Age (year)			
< 1	0.2078	0.9619 **	0.4526 **
1	0.1293	0.6331 **	0.4273 **
2	-0.0070	0.4099 *	0.7036 **
3	-0.2094	0.6306 **	0.3545
4	-0.0259	0.0781	0.4760 **
> 4	0.0000	0.0000	0.0000
Condition			
poor	-0.4272	-1.1680	-0.4633
average	-0.3303	-1.6154	-0.4452
fat	-0.2619	-0.7811	0.3283
very fat	0.0000	0.0000	0.0000
Colour			
white	0.0805 **	0.1197 **	0.0563 **
brown	0.0544 **	0.1029 **	0.0217 *
black and white	-0.0018	0.0276	-0.0455 **
black	0.0000	0.0000	0.0000
Buyer purpose			
resale	na	-0.1361	-0.1201 *
slaughter	na	-0.1417	-0.2942 **
fattening	na	0.2724	-0.0349
reproduction	na	0.0000	0.0000
Season			
Christmas	-0.2202 *	-0.3758 **	0.0022
Easter	0.1804	0.3179 **	-0.0079
Id-al-fater	0.5626 **	0.3139 **	0.2809
Id-al-adha	0.2886	-0.2129 *	0.0321
New Year	-0.4876 **	-0.3139 **	-0.0456
Maulid	-0.2702	-0.0391 **	-0.2401 **
Lent	-0.1456	-0.2799 **	0.0055
Non-festival	0.0000	0.0000	0.0000
N	6221	8546	7779
R ² (price/kg)	0.3238	0.2659	0.3583

* $P < 0.05$, ** $P < 0.01$.

na, not applicable, virtually all for slaughter

significant in at least two markets and all are significant in at least one market. The R^2 s from this model (0.3238, 0.2659, and 0.3583 for the terminal, intermediate and redistributive markets, respectively) were superior to those calculated using antilogs from a log-linear model (0.3047, 0.2596, and 0.3512 for the respective markets).

A price per head equation fitted with these variables generated R^2 s of 0.7822, 0.7973 and 0.8413 for the terminal, intermediate and redistributive

TABLE 3(b)

Estimated parameters of interaction effects of price-per-kg equation for the terminal, intermediate and redistributive markets

	Terminal market	Intermediate market	Redistributive market
<i>Interaction with weight</i>			
Weight \times time	0.0000	-0.0001	-0.0001
Weight \times sex:			
male	-0.0107 *	-0.0055 *	0.0033
castrate	-0.0122 *	-0.0045	0.0041
female	0.0000	0.0000	0.0000
Weight \times age (year)			
< 1	-0.0070	-0.0172 *	-0.0047
1	-0.0030	-0.0061	-0.0060
2	0.0004	0.0012	-0.0148 *
3	0.0050	-0.0049	-0.0030
4	0.0003	0.0109	-0.0089
> 4	0.0000	0.0000	0.0000
Weight \times condition			
poor	0.0106	-0.0042	0.0115
average	0.0059	0.0253	0.0204
fat	0.0041	0.0058	0.0074
very fat	0.0000	0.0000	0.0000
Weight \times buyer purpose			
resale	na	0.0101	0.0076 **
slaughter	na	0.0127 *	0.0131 **
fattening	na	-0.0053	0.0031
reproduction	na	0.0000	0.0000
Weight \times season			
Christmas	0.0096 *	0.0138 **	-0.0070
Easter	0.0051	-0.0037	0.0144 **
Id-al-fater	0.0023	-0.0061	-0.0102
Id-al-adha	-0.0096	0.0074	-0.0011
New Year	0.0199 **	0.0249 **	0.0016
Maulid	0.0123	0.0060	0.0070
Lent	0.0045	0.0165 **	0.0054 **
Non-festival	0.0000	0.0000	0.0000

TABLE 3(b)
continued

	Terminal market	Intermediate market	Redistributive market
<i>Interaction with week</i>			
Week \times sex			
male	-0.0055 **	-0.0013	-0.0040 **
castrate	-0.0015	0.0055 **	-0.0013
female	0.0000	0.0000	0.0000
Week \times age			
< 1	0.0041	-0.0044	0.0030
1	0.0044	-0.0026	0.0078 **
2	0.0059 *	-0.0027	0.0038
3	0.0042	-0.0033	0.0088 *
4	0.0030	-0.0030	0.0052 *
> 4	0.0000	0.0000	0.0000
Week \times condition			
poor	-0.0039	0.0088	-0.0321 *
average	-0.0017	0.0111	-0.0342 **
fat	0.0040	0.0126	-0.0409 **
very fat	0.0000	0.0000	0.0000

markets, respectively. However, because of the large week-to-week variation in weight, to be seen later, price per kg was used in the analysis. Moreover, price per head was predicted equally well ($R^2 = 0.7852, 0.7971$ and 0.8415 for the terminal, intermediate and redistributive markets, respectively) by estimated price per kg multiplied by actual weights.

Tables 3(a) and 3(b) record estimated parameters of the price per kg equation for the terminal, intermediate and redistributive markets. Positive and negative coefficients within a set of dummy variables signify premiums and discounts in EB, respectively, relative to the dummy in the base. Where the overall effect of a dummy group was significant, the T -test was used to check whether the individual premiums or discounts were different from zero. In some cases the F -tests indicate overall significance of the dummy set, but none of the classes within this set show a significant difference from the chosen base. For example see condition under the intermediate and the redistributive markets. In such instances there must be at least two other variables which are significantly different from each other. The arbitrariness of the dummy variables assigned to the basis and the limitation of the comparisons to within class differences are undesirable features of the statistical package.

The different patterns of variation in price per head and price per kg caused by week-to-week variation in average weights is shown by plotting mean price per head and mean price per kg on the same graph (Fig. 2) for

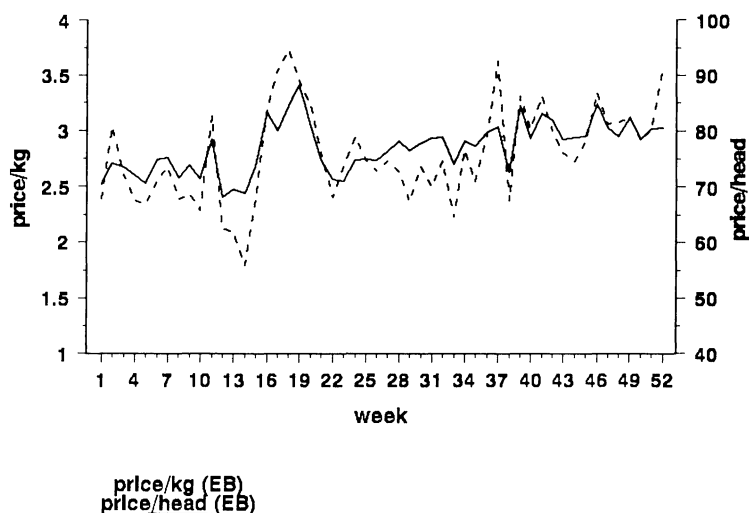


Fig. 2. Weekly mean price per kg and per head contrast, terminal market.

the terminal market. If the weights did not vary at all from week-to-week, the two price lines would maintain a constant difference. Sheep sold in the terminal market were on the average heavier than in either of the other two markets (Fig. 3). The overall annual mean weight for the terminal, intermediate and redistributive markets were 26.6, 20.2 and 19.7 kg, respectively.

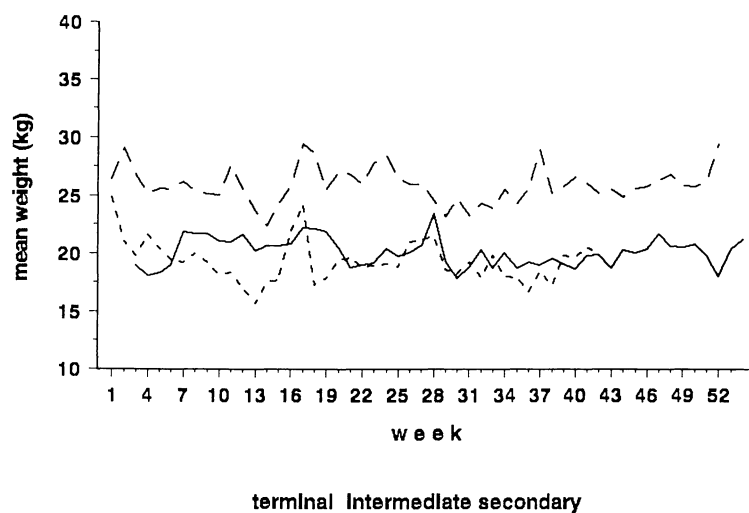


Fig. 3. Weekly mean weights.

The quadratic structure of the effect of weight on price per kg indicates that prices first decline to a minimum and increase as weight increases. The equations for males, castrates and females were calculated and plotted for each of the three markets in order to determine the pattern of price variation in relation to animal weight (figures not included). Most of the males and females in the terminal market were less than one year of age. Their weights ranged both above and below w^* .⁴ The mean weight of the male group was slightly smaller than w^* while, for females, mean weight was slightly higher than w^* . Thus for males and females premiums in price per kg were offered both as weights decreased below w^* and increased above w^* . The mean weight of castrates was well above w^* indicating that price per kg was strongly rising with increasing weights. This reflects a higher demand for castrates that are both fat and heavy and results in higher per animal price for castrates.

The picture is similar in the intermediate market but somewhat different in the redistributive market. In the redistributive market, prices per kg of all three sex categories are strongly rising as weights increase. One can only speculate as to why the relationship between price per kg and weight are so different from the other two markets. The redistributive market is quite remote and animals are purchased mainly for resale where as they are nearly all purchased for slaughtering in the terminal market and for slaughtering and resale in the intermediate market. Animals purchased for resale must be trekked a long distance from the country to terminal markets. Perhaps these conditions explain the emphasis favouring higher weights in the redistributive market.

A significantly higher premium offered for castrates in all the three markets was not unexpected. Castrated and fattened sheep locally known as *mukit* (also applicable to goats) are on the average the heaviest group. Castrates are relatively old, 70% of them between 2 and 4 years, and fat to very fat (55%) in condition. Gryseels (1988) noted that farmers castrate sheep for fattening in order to fetch higher prices. Castrates are preferred by the relatively higher-income buyers.

Condition had a significant overall effect on price at the intermediate and redistributive markets but not at the terminal market. The explanation for the non-significance of condition and age at the terminal market appears to be the large number of very diverse consumers. While many of these consumers are sophisticated and quality discerning many others are apparently not skilled and knowledgeable about quality factors.

⁴ Signifies the weights at which minimum price per kg occurs.

Generally, consumers prefer lambs because of their tenderness and low weight. The low weight translates to low price per head. Certain colours are preferred to others and especially so for some localized occasions. Sheep sold during the Easter–Id-al-fater weeks received the highest premiums in all the markets. The purpose for which sheep were bought made significant overall price differentials in the intermediate and redistributive markets. Virtually all sheep were bought for slaughter at the terminal market. A significant time trend was indicated in the three markets. However, this was not considered as a regular within year cyclical phenomenon.

SUMMARY AND IMPLICATIONS

Characteristics of sheep sold varied among the central highland markets, partly reflecting consumers' preference. For example, in contrast to the terminal market where sheep were purchased mainly for slaughter, relatively higher proportion of female sheep were observed in the intermediate and redistributive markets. The proportion of castrates, fat and very fat sheep was highest in the terminal market. However, most sheep sold in the central highlands markets were of average condition and lambs of a year or less than a year in age.

There is a considerable week-to-week variation throughout the year in sheep prices per kg in the central highlands markets. These variations are related to variations in overall supply and demand, characteristics of animals offered for sale, purpose of buying and the season. Factors affecting the number offered for sale include taking advantage of high demand during religious festivals, lambing season, quality and quantity of grazing, as well as cash needs for crop inputs and later for food purchase just before harvest when grain stores are low.

Animal characteristics that affect price per kg are weight, sex, age, condition and colour. In addition, the purpose for which the animal was purchased, whether for resale, slaughter, fattening or reproduction, affected price. Market composition with respect to these characteristics varied from week-to-week which suggests that weekly mean prices per kg vary partly due to varying market composition effect. A significant time trend over the year was also observed in two of the three markets analysed. Though this trend may continue into the next year, it is not regarded as a within year cyclical phenomenon.

Calculation of predicted price per kg multiplied by the observed weight demonstrated that the price per kg model is of equal predictive value for price per head when weight is known. Given the high variation in weights

both within and between weeks, the price per kg would seem to be more useful market information than price per head.

The results suggest that there may be some benefit from co-ordinating fattening, breeding and marketing programmes to take the best advantage from some preferred animal characteristics and selected festival markets. However, further analysis will be needed for optimizing fattening and controlled breeding programmes. For example, production analysis is needed on costs as well as animal response to alternative fattening programmes and seasonal grazing to use in combination with information generated in the present study on effects of weight, age, condition, sex and seasons on prices.

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