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A Framework for Livestock Policy Development in South Korea

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A FRAMEWORK FOR LIVESTOCK POLICY DEVELOPMENT IN SOUTH KOREA

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Preface

This research project was originally funded by the International Development Research Centre in Canada to formulate a framework for livestock policy development in South Korea.

The study reported on herein was the product of a collaborative effort involving eight researchers, who are college professors and researchers at the relevant institutions in Seoul and other provincial levels, producing research products and developing the capacity of individual researchers in a particular subject of research work.

We have attempted to assemble the best available statistical information and economic understanding of the livestock sector of Korean agriculture, and a comprehensive analysis was made about how it has been changing, why it has been changing and what its implications are. Since the project itself began with an ambitious sectoral study of the livestock industry, it has featured close cooperation at all times with a number of policy makers, tapping their interest in this research.

This final report is composed of 11 chapters including 15 papers. By no means all of the papers emphasize what one might say is a sectoral view, because the papers range from the study of production--- particularly beef and dairy products--- to changes in consumption and projection of trends, embracing the source of feedstuffs and the wholesale and retail market systems.

The team of researchers wish to thank the many individuals and organizations that have helped us by providing all available existing valuable information relative to this research. Among individuals to whom we express gratitude, Jeffrey Fine arranged for financial support and encouraged us very much in our carrying through this research. At the same time, he and Dr. Ralph Lattimore were very helpful in the development of the manuscripts through preliminary discussion with us a number of times.

Even though I received very valuable and cordial assistance from many persons, this study does not cover all of the problem areas to be considered in the due course of policy making by the government, a shortcoming which I as research leader of this project should be first to acknowledge. In this view, I hope to be able to contribute to subsequent issues during coming years. Thanks to all.

Young Kun Shim
Project Leader

I. Summary

1. From 1971 to 1987, the total annual consumption of beef, pork, and chicken rose rather rapidly, from 170,000 mt in 1971 to 669,000 mt in 1987 at an annual rate of increase of 18.3 percent. As for per capita consumption, it increased at an annual rate of 12.6 percent from 5.2 kg to 15.7 kg. Over the same period, foodgrain consumption per person fell from 224.3 kg to 175.7 kg, an annual rate of decline of 1.4%.

2. Our studies have projected the future demand for various meats, the result indicates that the total meat consumption in 1991 will be 908,000 mt at an annual rate of increase of 9.0%. As a long-term projection, the total meat consumption in the year 2001 was estimated to be 1,259,000 mt.

This dramatic change may alter types of farming and necessitate reorganization of land utilization to produce more meat and livestock products to satisfy these demand. In addition, increases in demand for meat and livestock products will necessitate increases in feed imports, and it may also be necessary to find a way to produce more feed in Korea.

3. Average household consumption of all kinds of meat in our study was 5.55 kg per household per month. The greatest percentage of this consumption was for chicken (40 percent), followed by beef (38 percent), and pork (22 percent). As household income increased, consumption of meat increased substantially. However, the increase in consumption differed significantly among types of meat.

4. More than 50 percent of the total households studied purchased meat one or two times a month. Approximately 70 percent of the total households bought an average of 600 grams of beef or pork per purchase. However, as household income increased, meat was purchased more frequently and in larger amounts.

5. About 50 percent of the households prefered to buy prepackaged beef. However, the remaining 50 percent did not want to buy it, primarily because they felt that meat quality deteriorated in the process of packaging and freezing.

6. The estimated income elasticities of demand were 1.34 for beef, 0.44 for pork, and 0.22 for chicken. Therefore, beef showed the greatest response to income, while chicken showed the least response. Income elasticities for domestic beef and imported beef were 1.45 and 1.18, respectively.

7. The majority of consumers had a strong preference for domestic beef rather than pork and chicken mainly because of the good taste of fresh meat and established eating habits. On the other hand, the taste and quality of imported frozen beef did not satisfy consumers' needs and wants. There was a tendency for consumers to show a stronger preference for domestic beef as household income increased.

8. In 1987, cattle and hog raising farms are small in size, averaging 2.3 head of cattle and 14.1 hogs, respectively. Each small scale livestock production remains a complementary or supplementary side-business to crop production. Historically, most cattle were

raised for draft use and cattle and hogs were sold for emergency cash needs such as the financing of crop cultivation, living expenditures, and repayment of debts.

9. The optimum herd size figure was determined to be eight. Farmers should not try to increase herd size beyond availability of low cost resources such as family labour and agricultural by-products. An increase in herd size does not entail economies of scale. Calf and concentrate purchased from the market form a fixed cost which accounts for 85% of total cost so little room is left for cost reductions on individual farms which lack an on-farm breeding system.

10. This study concluded that producers invested rationally. Traces of over investment were only observed for concentrate and labour. Roughage alone experienced underinvestment. The regression coefficients of technical efficiency revealed significant negative values in both labour cost and total production cost. Thus, production costs could possibly be reduced through more efficient use of labour.

1. This study observed that in response to higher future prices, farmers may increase their inventories. The number of cattle which otherwise would have been slaughtered would be reduced. The respective positive and negative signs of inventory and supply functions implies that short-term price policy to increase the supply of native cattle may not be advisable.

12. This study focussed on farms which raised native cattle to earn additional income. The results obtained above indicate that it may be better for commercial farms to raise beef breed cattle rather than native cattle since the former more efficiently convert feed into beef. Of course, investments in roughage production, on-farm breeding systems, and in other areas would be required.

13. It was found that there are considerable discrepancies in the performances of milk cows belonging to different size herds. Annual per head milk production converted into 3.2 percent butter fat equivalent is 5,289 kg in the 1 to 5 head group, 5,583 kg in the 6 to 10 head group and 6,000 kg in the 11 or more head group. Despite these differences, operating costs are identical except for hired labour costs which increase as herd size exceeds 5. However, the higher costs on farms with larger herds were more than counterbalanced by the higher performance levels of the dairy cows.

14. Ratios of marginal value product to opportunity cost revealed that milk producers make rational use of concentrate but they under-invest in labour because of the competing labour requirements of dairy and crop enterprises on part-time dairy farms.

15. Sample farms were found to operate within the range of increasing returns to scale. Thus, scale expansion in these part-time farms may occur without financially injurious results. Lack of labour and capital, however, restricts expansion of the scale of operations.

16. The study estimated that optimum herd size of dairy cattle was 13 head. Current herd size is only 6.7 head. This result and evidence of economies of scale point toward a potential for further scale expansion on part-time dairy farms. Such expansion would increase milk production in Korea and help meet domestic demand for dairy products.

17. Yearly total consumption of feedstuff has increased by nearly 3.2 times during the last 17 years, from 5.0 million mt in 1970 to 15.9 million mt in 1987. The proportion of concentrated feeds accounted for 26.4 percent of total consumption in terms of quantity in 1970, but this proportion increased greatly reaching 61.8 percent in 1987.

18. The rate of self-sufficiency for concentrated feed consumed has decreased from 54 percent in 1975 to 28 percent in 1987. This decreasing domestic feed supply is one of the most difficult problems facing development of the livestock industry in Korea. Concentrated feeds using imported feedgrains have a major role to play in the expansion of livestock production on a majority of the farms now raising livestock.

19. Regarding trends in the dependence on assorted feed, for hogs and beef cattle the total increases in consumption have been more than 21.9 times and 50.9 times, respectively. A stable consumption pattern has been realized in the case of feed for dairy cattle and its share of total consumption was 15.6 percent in 1987.

20. Increased consumption of assorted feed has accelerated the reliance on the procurement of feedgrains from abroad. The quantity of these imports totaled about 442 thousand mt in 1975 and increased to 5,649 thousand, of which 60 percent was composed of corn in 1987.

21. The local livestock market was most often conducted periodically on a small-scale once every five days at the rural market place. The average daily volume of livestock handled per commission merchant was approximately 2-5 head of cattle and hog on average. The majority of commission merchants were engaged only part-time in livestock transactions through the rural markets.

22. Since most transactions of livestock are made in the absence of objective trading standards throughout the market channels, experience in the business is considered crucial to a successful marketing operation. The number of years engaged in the business varied with the type of livestock dealer, but the average dealer had been engaged in the business from 7-15 years. The survey results showed that the dealer's experience in the business had a statistically significant and positive correlation with the number of livestock he handled.

23. The local livestock markets which are equipped with one or more scales accounted for 38 percent of the total markets in Korea. The relatively low number of scales in use may be explained by the trading practices; the price for draft cattle was determined by physical appearance, power capacity, age, and other non-weight characteristics. On the other hand, the price for beef cattle was determined by the

estimated beef percentage and grade in relation to the cattle species, shape, age, and degree of fattiness. Most dealers based their judgement on these points, rather than using the scales.

24. The average cattle or hog shipper had working capital of more than 3 million won, of which about 46 percent of the cattle shipper's and 13 percent of the hog shipper's working capital were financed by loans from private sources charging a monthly interest rate of 2-3 percent. The average local cattle and hog assembler employed working capital of 454 thousand won and 137 thousand won, respectively, with borrowed money (private loans) at an interest rate of 2-3 percent per month accounting for about 60 percent of their working capital.

25. So-called "merchant credit" was closely interrelated with the buying and selling of livestock. Generally, merchants or processors made extensive use of loans to producers or other merchants as a means of obtaining livestock. The amount of credit advanced by wholesalers was about 3-5 million won per assembler. No interest was charged, but the assemblers pledged to bring his livestock to the slaughterhouse of the lender within one or two months.

26. In the case of marketing, some commissionmen advanced no-interest loans averaging 1-2 million won to assemblers with the latter's pledge that he would deliver a certain number of hogs within a 10-30 day period. In turn, these assemblers advanced hog raisers a part of the payment for livestock, 100-200 thousand won per farmer 3-7 days before delivery. The advance accounted for approximately 10-12 percent of the average merchant-lender's working capital.

27. As of the end of 1987, the number of slaughterhouses totalled 184 across the country. Approximately 25 percent of these slaughterhouses had modern facilities, while 71 percent either had outdated facilities or were without any cold storage or refrigeration facilities. About 4 percent of the total had only simple slaughtering facilities.

28. In 1987, the total numbers of cattle and hogs slaughtered were about 1,005,000 head and 6,476,000 head, respectively. These numbers have been increased greatly as compared with the figures in 1970. The increase rates of slaughtering cattle and hogs were 3.6 times and 10.5 times, respectively. The average number of slaughters by each plant was only 15 head of cattle and 96 head of hogs per slaughterhouse per day. In the case of the three slaughterhouses in Seoul, the numbers of cattle and hogs slaughtered were 230 head of cattle and 1930 head of hogs per plant per day. Generally, the number of cattle slaughtered was still small compared with the plant capacity.

29. The functions of the wholesale markets and slaughterhouses are to slaughter livestock and to sell beef and pork carcasses at auction. In 1987, the volume of transaction of beef and pork in Seoul wholesale meat markets was 212 thousand heads and 1,761 thousand heads, respectively. The wholesale market sold beef carcasses equivalent to 697 head a day and handled an average of 5,786 pork carcasses a day.

30. A grading system for beef and pork carcasses was introduced by the Central Wholesale Meat Market in March 1969. The wholesale

grading program based the comparative values of meat on such grade factors as conformity (appearance), quality, and beef weight. The grades for beef and pork carcasses were: special, superior, medium, inferior, and off-grade. However, it is impracticable to evaluate each carcass even at auction.

A retail grading system was introduced in July, 1968. Beef was graded as superior, special, medium, and other on the basis of the retail cut. Nevertheless, due to the consumers' lack of awareness of the grades coupled with the dealers' non-compliance, the grading system was not actually practiced.

31. Marketing margins per head of cattle marketed from farm gate to Seoul were on the average about 52,700 won. The proportion of total marketing margins to Seoul consumer prices was about 30 percent, indicating that producers received 70 percent of the consumer price per head equivalent for beef carcasses. Of the marketing margins received by middlemen, the ratio of the marketing costs to the middlemen's receipts was 43:57. Transportation costs, payments to commission men at the livestock market, and taxes were the largest cost items, making up 62 percent of the total marketing costs.

Within the entire marketing process, retailers received the highest share of the marketing margins -- about 60 percent. The proportions of the shippers' and local assemblers' marketing margins to the total margin were 30 percent and 10 percent, respectively.

32. The transportation of beef and pork carcasses was much more economical than that for live cattle and hogs. The average transportation cost per head of live cattle and hogs from the farm gate to Seoul was 13,706 won and 2,170 won, respectively, while that for the shipment of beef and pork carcasses by refrigerated truck was 6,749 won and 1,273 won, respectively. As for the composition of costs, carcass transportation by refrigerated truck was lower than the costs including physical body weight loss and the shipment of live cattle and hogs by truck.

33. About 80 percent of total households bought beef and pork from traditional meat retail stores. Only 15 percent purchased meat from supermarkets. However, the number of households which bought meat from supermarkets increased considerably as household income increased. Consumer patronization rate of supermarkets for buying meat was much higher for households located in apartment estates than for those in residential districts.

34. Because the retail prices of beef and pork are regulated by authorities in Korea, butchers cannot charge more than the regulated prices. In contrast, there is no ceiling or control for unit wholesale prices. However, the degree of price fluctuation at wholesale markets is only affected to a certain extent by the regulated retail prices. For this reason, the wholesale prices are changing much more than the retail prices at all times, but they have a tendency of moving together in a parallel fashion both up and down.

35. The gross receipts of butcher shops in Seoul were about 27-36 million won per month per store, of which the proceeds from beef accounted for 77-80 percent. The remainder was primarily from the sale of pork. The won value of meat purchased by the retailer constituted about 96 percent of total expenditures. The remainder was business operation expenses. Annual average net incomes per store ranged from 1,400 thousand won to 2,400 thousand won. An important finding in connection with the net income figures was the importance of good knowledge and the experience of the retailer in dealing in live animals given the absence of objective weighing and trading facilities. This helps explain why entering the retail market for livestock is difficult for inexperienced entrepreneurs.

36. Farmers' access to needed market information through information agencies was very limited. Even the price information available was not adequate for the farmers' livestock marketing decisions due to the ambiguity of the available data and to limiting application of the grading system. Consequently, the majority of farmers obtained price information from local assemblers or brokers either at the local market or on the farm. The local assemblers, in turn, depended heavily on merchants in other cities and shippers for their price information. The major market information medium used between farmers and dealers was direct personal communication.

2. Recommendations

1) It is desirable to plant forage crops for livestock feed on paddy fields using a double cropping system. This intensive paddy-forage double cropping system would not only expand the size of farm management of each household, but it also would utilize idle land resources and family labor during the off-farming season in winter. In other words, the expansion of the livestock sector requires better utilization of existing agricultural and natural resources.

For instance, grazing cattle in forested land utilizing wild grasses could reduce feeding costs and labor charges, and cattle manure would help nourish trees. Grazing might damage some young trees, but the economic advantages of grazing would probably outweigh any damage. Therefore, it would be worthwhile to utilize the forest lands as a method of increasing the number of cattle and also encouraging the kind of cattle production that does not depend on foreign grain and does not require foreign exchange.

It would further reduce production costs as compared with those farm households which now depend largely on imported feeds. Another advantage of this method would be that even in the event of a decline in the price of cattle or a drastic increase in the price of imported feeds, production would continue since variable costs would be covered at least in the short run. Therefore, this method is desirable to cushion the impact of fluctuating market conditions on livestock farms. Moreover, it might bring about increases in farm income and the number of cattle raised. Thus government support of such forage production programs through subsidies might be warranted.

2) The highest item in the production cost of beef is not feed or labor but the cost of purchasing livestock. In order to reduce the unit production cost of beef, it is desirable to fatten cattle, once purchased, to the point where they reach maximum economic weight. Provided that there is no change in the prices of products and feeds, the best way to obtain this maximum economic weight is to use feed in such a way that cattle gain the most weight per unit of feed consumed. In practical terms, according to the Livestock Experimental Station, the optimum fattening weight for native cattle is around 480 to 520 kilograms. In reality, however, the cattle traded in Seoul reached market at much lower weights of 380 to 410 kilograms. The difference is attributed to the fact that even though the same amount of feed was used for cattle at individual farms as at the Experimental Station, differences in cattle raising techniques were apparent.

3) The urgent need for cash on the part of small-sized livestock farms makes it difficult for them to fatten cattle over a long period of time. If farmers knew more about improved practices of livestock raising and the superior breeds being raised at the Livestock Experimental Station were disseminated to livestock farms, then the marketing weight of cattle sold would be heavier. This would result in greater beef production per an equivalent number of cattle marketed. In addition, policy support should be provided in the areas of credit and extension of production information to increase the marketing weight of cattle sold.

4) According to our study, the production cost per kilogram of beef declined by if the herd size was increased and the production cost was lowest on the farms raising 8 head of cattle. At present, however, the average cattle herd per

farm is much smaller. Those farm households which raise one or two head accounted for 81.5 percent of the total farms that raised cattle in 1987. In other words, because of the small size of cattle production, unit production cost is high and international competitiveness is very weak. The number of cattle raised per farm should be increased in order to promote increased production efficiency. However, most farms are too small in size and thus they are unable to expand herd levels to optimum levels without outside assistance.

It may be necessary to introduce government support policies which assist farmers in expanding herd size. In order to maximize the effectiveness of government assistance, those relatively young farmers with previous experience in cattle production should be selected and provided with institutional loans so that they could expand their operational scale to an optimum level. In the past, large amounts of livestock funds were released to encourage the livestock industry. However, this program was not helpful in expanding the scale of livestock production per farm because the funds were distributed not only to current livestock producers, but also to a large number of farmers who wanted to start livestock production for the first time. Hence the funds increased the number of small-scale, suboptimal units, in effect, aggravating the production efficiency problem. Rather, what is needed is a policy support program that enables those farms already specializing in livestock production to reduce their average production cost instead of increasing the number of new farms that raise livestock.

5) In the past, cattle were raised chiefly for draft purposes. They were raised using the by-products of crop farming such as straw, bran, and hulls of grain and beans. Since cattle raising today is intended mostly to produce beef rather than to raise and maintain animals, it is desirable to select areas that are ideal for cattle raising and set up specific production areas there. If such production areas were established, the advantages of cost reduction could be realized through large-scale market transactions, as many farms in the given production area could purchase feeds and other production materials, obtain market information, and adjust the number of head sold per day on a cooperative basis.

6) An improved livestock industry would then take root in Korea through the realization of rationalized management, the use of professional knowledge , and more accurate market timing on a long-term basis. At the same time, the selected production areas would be helpful for developing the livestock sector as an industry and for increasing operational efficacy through farmers' cooperatives.

7) In 1980, a law was passed to stabilize the price of livestock products. Basically the law requires that the retail prices for meat and livestock products be controlled. For this the government put forth a method under which a price stabilization zone was set for beef and pork based on policy considerations. Livestock product

prices are maintained within the stabilization zone which has upper and lower price limits.

This price system method works through direct intervention by the government. Under the system, if the market prices for livestock products decline below the lower limit within the stabilization zone, the government purchases the excess supply of livestock products from markets for stockpiling. If prices exceed the upper ceiling price of the stabilization zone, the government releases meat from the stockpile on hand or imports products to bring market price down. This policy has, in effect, stabilized the prices of livestock products within the price stabilization zone. Therefore, it would be worthwhile to continue even in the future along with a grading system.

8) Total consumption of livestock products has increased greatly in the past 20 years. Here, there needs to be an accurate estimate of how far such consumption will increase each year in the future. Based on such estimates, a level of required production increase can be estimated, and the government should prepare projections of overall demand and supply for the coming year and determine in advance the quantity to be imported. However, there is a problem of estimating demand and supply most accurately due to the lack of or inaccuracy of prevailing data and is why the demand of meat is a complicated task and requires a continued support by the government to make it a reliable estimate from time to time.

In particular, data on the amount of beef consumed, the number of chickens and hogs slaughtered and the quantity of chicken and pork consumed in the rural areas by farm households is not fully reflected in statistics because the slaughter of chickens or hogs does not require any permission from administrative authorities.

There are many low-income people in Korea who, instead of using meat as a staple food as Westerners do, regard meat as a luxury good which can only be used on special days such as traditional holidays or family ritual occasions such as funerals or weddings. On such special occasions, large amounts of meat are consumed regardless of one's income level, despite the fact that there are many people who have not eaten much meat for several months. In other words, in the Korean diet meat represents an optional item which can be used or omitted depending on income level. Thus, the general trend is that during an economic recession market demand for meat or other livestock products declines substantially due to the shortage of disposable cash in low-income families. But, when their income level rises, average meat consumption per person increases substantially. That is why the income elasticity of meat for the lower income classes is more than one.

9) If large-scale meat packing or processing plants were established around slaughterhouses in the production areas so that meat or processed meat could be supplied directly to retailers or to city supermarkets, it would have the effect of not only reducing marketing costs through the reduction of shipping costs and the

elimination of middlemen, but it would also lead to the sale of fresher meat. In addition, the establishment of meat processing plants and slaughterhouses in rural areas would provide additional employment opportunities through which farmers could have wage incomes during the off-farming season. In this connection, it is desirable that the government provide financial loans or tax privileges to such facilities in rural areas.

10) There are many persons who contend that raising milk instead of draft cattle or beef cattle is desirable because of the anticipated increased consumption of milk as income grows. However, the problem is that the pace of milk consumption increase has already slowed down and little expansion of consumer demand can be expected. In fact milk is not a customary food for Koreans, though it is a good food with high nutritive value. In general, the young generation likes to drink milk very much while the older generation does not like it so much In addition, people tend to shun the meat of dairy cows because they think it does not taste as good as that of native cattle.

However, when we consider the shortage of available livestock resources, it may be desirable to raise exotic dairy cows rather than native cattle in order to supply beef through the slaughter of unproductive old dairy cows and young male cattle. To this end, prices lower than for the beef cattle or Korean cattle should be established for the meat of dairy cows. For, under the present system in which the price is the same for every kind of beef, it is natural that consumers prefer and will choose the beef of native cattle rather than dairy cows. In addition, the expansion of the market for milk processed products such as butter and cheese should be developed to consume as much milk is produced.

11. Raising livestock using heavily imported grains is a problem when the price of feedgrains rises sharply in the world market. As a result, the livestock industry could be seriously damaged and countless farms may liquidate their stock over a period of time. Taking into account such circumstances, there should be some restrictive control for new entry of large-scale commercial farms that rely only on imported feed. On the other hand, it would be worthwhile to promote the operation of traditional farms raising livestock as a sideline business using locally available food resources.

As imported feeds have become readily available lately, increasing amounts of funds from non-agricultural sectors have been channelled to chicken and hog raising businesses. During periods of market oversupply, Livestock Cooperatives were able to exersise some control over livestock marketing by member farm households. But, such controlled sales do not apply to the production of the new commercial farms sector. So, when market prices plummet, a reduction in unit production costs is possible only for large-sized farms through expanded production based on adequate capital reserves. This dual market structure then becomes a factor aggravating protracted low price levels due to imbalances between demand and supply.

12. Government policy makers believe that raising livestock with imported feedgrains is more desirable than the direct import of meat. The government bases this belief on the fact that under the circumstances where an average farm households farms approximately one hectare, the only way to boost farm household income is to encourage livestock production as a sideline business there by making more productive use of family labor. Furthermore, even if remuneration to family labor for livestock production activities is not adequate, this additional source of income is better than none. Since rural employment problems are increasingly serious and rural-urban migration continues due to chronically low rural incomes, government policy is to encourage livestock production, to increase use of local resources and by-products as feedstuff and, as a final measure, to import feed to meet feed shortages when necessary.

It is hoped that this policy will alleviate some of the most acute rural income and productivity problem. Livestock price policies in Korea have been primarily targeted at demand. Little attention to the question of who should be engaged in livestock production.

I. Introduction

1.1 The Problem Agenda

As per capita incomes and population have grown, especially in urban areas, the dietary pattern and food attitudes have changed gradually in the direction of western style consumption with the substitution of more animal protein for cereals and vegetables. Such an increase in the market demand for meat and dairy products has caused a sequence of adjustment problems in the agricultural sector.

A shortage has emerged in livestock products and meats. That is, domestic production has risen slower than domestic consumption at market prices. This is due to the fact that most small size farms emphasize production of food grains for home consumption as a first priority rather than market-oriented production of other commodities. Moreover, most farmers have limited arable land and lack capital. Hence, they cannot allocate even a part of their land resources to pasture.

In addition, national emphasis given to rice and barley production, which included price supports and the provision of new seeds, made food grains relatively more attractive than livestock production in terms of economic return and risk. However, the importation of feedgrains and meat has increased rapidly since 1972. Accordingly there has been a growing interest in the development potential of a livestock industry using domestic resources.

From an economic standpoint, although conscious of the need to look at the entire system from production to consumption of livestock products and feed, Korea is primarily concerned with problems which hold back or create bottlenecks in the industry.

The problems relating to the livestock industry are not only new, but are also very complicated and intermingled with other issues. The discussion to follow in this study covered a wider range which should be considered when studying the livestock industry. These problem areas are interrelated aspects of feed and livestock sector development increases in consumer demand, inefficient marketing systems, shortage of domestic production, inadequate processing facilities and foreign exchange requirements for feedgrain imports.

1) Consumption Trends

Consumption of all meats increased about 3.9 times from 170,000 mt to 669,000 mt during the last sixteen years, 1971-87. Accordingly, the per capita consumption of meat grew 3.0 times from 5.2kg to 15.7 kg. In addition, the consumption of chicken eggs and fresh milk per capita has increased by 2.0 and 16.9 times, respectively, during the same period. These data indicate a relatively high rate of increase as compared to many other Asian countries where incomes were not growing as fast, but the per capita consumption of these products remains well below the levels prevailing in Japan and other developed countries.

This increase in demand for all meat and dairy products caused a sequence of new adjustment problems not only in the livestock sector but also for Korean agriculture which has historically been based on food crop cultivation. The adjustment problems are how to meet the growing demands for livestock products, feed grains, food grains and other agricultural products in the most efficient manner possible, while at the same time protecting national food security without creating hardships for the small-scale Korean farmers during the adjustment period.

In accord with the foregoing discussion, one dimension of an economic analysis of the livestock industry in Korea must concentrate on estimations of changes in consumer demand for livestock products and meat consistent with population growth increasing national income.

2) Production Trends

The total number of livestock on all farms has increased gradually since 1971. Particularly the number of dairy cattle and swine has increased 15.4 and 3.2 times, respectively, but the absolute number of dairy cows, 463 thousand, is still quite small in comparison with native Korean cattle which accounted for about 1,923 thousand head in 1987.

Although the production of livestock products and meat has increased as a whole, it has particularly not kept up with demand for meat mainly due to the limited feedstuffs weather variability and to the relatively low fluctuated market prices. The shortages of meat from time to time were being met through imports.

Virtually all arable land is now devoted to growing foodgrains rather than for use as pasture or for growing fodder crops. Since Korea faces a relative scarcity of resources for their production, most farmers feed livestock with byproducts of foodgrains, wild grasses harvested from river banks and hillsides, and purchased feedstuff . However, the shortage of feedstuff has grown rapidly in recent years, and these shortages have been supplemented by feedgrain.

Most Korean farmers have not relied heavily on commercial feed because the price of commercial feed is rather expensive compared to prices of products. If there is any way to increase feed production using domestic resources, a great potential exists for increased production of livestock. Of course, this would depend largely on the ratio between the production cost of feed and the price of livestock products.

As the prices of beef, pork, and chicken have increased recently, a considerable number of large-scale hog and poultry farms have been established by non-agricultural sector entrepreneurs. The number of large farms is still small compared with traditional livestock farms, but their production has started to affect the market greatly. Such farms generally do not produce any feedstuffs, but rely on commercial feeds processed largely from imported feedgrains.

By contrast, most small traditional farms are raising only one or two head of cattle and are unable to increase the number of livestock greatly due to limited capital and limited farming resources to produce feedstuffs and byproducts (Appendix Table 5). Newly established commercial farms have a great potential to expand the industry because of their relative large scale of and their reliance on commercial feed and will thus strongly affect the market in future.

3) Marketing System Problems

The livestock and meat markets are not only new in contrast to other product markets in Korea, but also the organization and structure of the livestock and meat markets are very different from those existing in other product markets. Recently, the number of livestock and meat that must be transported internally has increased greatly. However the marketing facilities and infrastructure have not expanded as fast as the growth in domestic production and imports.

Since people must eat regularly, the marketing system must provide a regular, stable, reliable food supply throughout the year. Consumers also prefer that food and meat prices be reasonably stable. During the period of 1976 through 1987, yearly average wholesale prices of beef and pork increased 2.3 times and 2.0 times, respectively and price fluctuated widely between months within a year.

All retailers of meat and dairy products are very small in size, have small amounts of capital, and lack access to credit at reasonable bank rates. One observer of the marketing system has stated that the present distribution system is a product of expediency pressured by the need to direct an increased amount of livestock products and meat to different market levels.

As a result, there are numerous allegations of inefficiency and structural weakness. Accordingly, marketing costs are alleged to be expensive in comparison to the functional services provided.

4) Processing Facility Problems

Until 1972 there were 69 feed plants which had a total yearly capacity of 1,373 thousand mt. Most of the plants were very small in size and technologically outmoded. Total actual production was about 776,000 mt, and thus they were utilized at only 57 percent of plant capacity due to a complex mix of factors including technical and economic inefficiencies.

The need for more feed production encouraged the government to undertake a progam of reducing the import of finished products while increasing feedgrain imports. Recently, six plants with relatively larger plant capacity have been constructed, and this expansion is an important step toward reaching self-sufficiency in feed milling.

In 1978, the recorded rate of plant operations was 125 percent of the plant capacity, due to day and night operation. Nevertheless, the volume of production was still below farmers' demand at certain times and at certain locations. The result was a supply-demand imbalance which was expected to become worse in the years ahead unless more plants were built. To make up for capacity shortage in feed processing, five more large size plants were built thereafter. At present, there are 80 factories on stream with a total production capacity of 20,455 mt per day.

Many of the logistical and operation problems of feed processing were thus solved, and Korean farmers could obtain more of the proper types of commercial feeds at the right time. This has contributed greatly to increases in the total number of livestock raised.

The construction of feed plants and slaughter houses requires permission from the government. In addition, the government controls the total production of commercial feed through the allocation of feedgrains as raw materials. Nevertheless, there has been difficulty in monitoring the demand and supply situation, resulting in over production by the processors. Recently, feed producers produced more and more commercial feeds without careful regard for the market situation. This happened because historically demand exceeded supply and the government assured a price level for market transactions.

Such support by the government helped to encourage the expansion of production capacity, and it has provided an incentive for processors to use cost saving technology in order to increase market share and profits. However, at some point in time, government policy will need to promote further reduction in production costs in order to achieve levels of efficiency comparable to feed processing factories in the advanced countries.

5) Foreign Exchange Requirements

The projected future demand for all meat based on historical data is estimated at about 0.79 million mt in 1991 by the government.

This represents an increase of 1.9 times over the 0.43 million mt consumed in 1980. This implies an increase in feedgrain imports from about 2.5 million mt in 1980 to 5.5 million mt in 1990. However, this rapid growth in imports will be a heavy burden on the national economy in terms of foreign exchange.

The price of livestock products has fluctuated in the domestic market due to unstable domestic production conditions, unstable world market prices, inappropriate government policy, and changes in feed prices. Unusual price fluctuations in livestock products have often created difficulties in the development of the industry.

There is no possible way to reach feedstuff self-sufficiency given the domestic supply of feedstuff in the coming decade. Thus, the growth rate of the industry depends largely on the availability of imported feedstuff. In this connection, the economic problem is to allocate domestic feedstuff resources in the most efficient way possible and supplement them through imports.

Therefore, a study of the livestock and feedgrain industries must investigate the respective problem areas and development capacities comprehensibly in response to the growing demand for livestock products. This kind of integrated economic study will help future planning by the processors, farm producers, marketing agents as well as the government.

Unfortunately, limitations of available data and limited empirical research impede analysis of the economics of the livestock industry especially in regard to efficiency problems in the production of feed and livestock products, their distribution, processing, consumption, and the effects of the industry on foreign trade. This study proposes to answer economic questions fundamental to any rational policy formation.

1.2 Objectives of the Project

The principle objective of this project is to formulate the most efficient strategies for the development of the Korean livestock sector on the basis of a comprehensive and integrated economic analysis. More specifically, the project is designed:

a) to project Korean consumption of the principal livestock products to 2001 on the basis of changes in personal income, relative prices and consumer tastes;

b) to carry out an economic analysis of the meat wholesaling system including processing, transport and storage, and in this context to examine the regulatory and marketing activities of government and marketing institutions;

c) to conduct a functional analysis of the meat retailing system and to identify the various measures required to meet increased demand in an economically efficient manner;

d) to prepare projections of domestic production of the major livestock products as a function of consumer demand, available resources, productivity, and government support policies for both inputs and outputs;

e) to determine total feedgrain requirements as a function of changes in domestic livestock production and the relative prices of feed;

f) to determine the optimal location, size, and type of processing facilities and points of distribution that will reduce the cost of commercial feeds at the farm gate;

g) to estimate, on the basis of projections, feedgrain requirements and the economic implications for Korean agriculture of different degrees of self-sufficiency in the production of feedgrain; and

h) to identify, on the basis of the foregoing analysis, the long term implications of various development strategies for Korean trade in feedgrains and livestock, by type of product and quantity.

1.3 Sources of Data

1) Secondary data

Most secondary data on the livestock industry are published by the government, including basic information on total numbers of livestock, kinds and ages of various livestock groups, feedstuffs trade, number and size of livestock farms, and total production of meat and livestock products.

Price data and estimates of the quantities of various meats sold are published by the National Livestock Cooperative Association, an institution financially supported by the government for handling imports of meat and feedstuffs. The Korean Feed Association collects from manufacturers and publishes information on the milling of commercial feeds including data on the sources of materials, quantity of production, and kinds of products. However, much of the existing data is inconsistent, since the original purpose of data collection by the corporation or the association was concerned with their own business. Therefore, the data often require adjustments for realistic insights into the nature of the livestock sector.

Previous case studies have been used for cross-section comparisons with the data obtained from field surveys. Many in-depth studies have been made on the improvement of feeding practices, the establishment of feeding standards and livestock breeding by the Livestock Experimental Station, a research institute within the Rural Development Administration. Their experimental research data on feed requirements for livestock production has been utilized to determine the yearly requirement of feedstuffs.

2) Field survey data

In order to achieve an integrated view of the subject, five in-depth field surveys were conducted since there was no reliable data on many aspects of the livestock situation. The field surveys emphasized the detailed collection of consistent data needed for national decision making relating to the building of strategies for the development of the livestock sector in Korea.

The field surveys focused on patterns and attitudes toward change in the consumption of meat, knowledge about western foods, distribution systems, marketing costs, market structure, marketing agents, structure of feed milling, possible domestic production, actual level of feeding, and theoretical requirements of feedstuffs.

The proposed project was implemented in seven phases. The relationship between phases are explained diagramatically in Appendix Figure 1. In addition, it is proposed to tap supplemental information from local extension workers, agricultural cooperative staff members and village leaders.

1.4 Methodology

The feed and livestock sectors in Korea constitute new areas of research. Seven interrelated aspects of the feed and livestock sector development were covered: Consumption, retail trade, wholesale trade, feed requirements, production, feed processing and international trade, emphasizing the analysis of survey data. These seven aspects and the methodologies followed in their analyses are discussed below.

Phase 1. Consumption study

The principal objective of this phase was to project Korean consumption of the principal livestock products to the year 2001 on the basis of changes in personal income, relative prices, and consumer tastes.

With respect to the demand for livestock products, it was planned to carry out three related studies. The first was an analysis of price and income elasticities of meat for urban and rural consumers. It is of great interest to analyze the growth of meat consumption under differing assumptions concerning prices of meats relative to prices of other foods and concerning expansion of income and population.

The second study analyzed the livestock product consumption patterns and purchasing behavior of urban households, and the third study was an investigation of prospects for meat consumption in the future.

For the projection of the demand for meat and livestock products in the years 1991 and 2001, two different approaches were used. One approach utilized aggregate time series data on price levels and the quantity of actual consumption of meat to predict the possible demand in the short-run. Another approach was based on household survey data on consumers' behaviors and attitudes about consumptions and purchase of various meats in the future as a long-run projection.

In general, the demand for one kind of meat depends largely upon the price of that item, prices of all other meat substitutes and complementary meat products, and disposable income.

A) Time series data analysis

Price data at major selected markets and disposable income per capita are available on a yearly basis from the central bank. Indices of both food and non-food prices was used in the demand function in order to reduce intercorrelation among price variables and also to save degrees of freedom. In addition, various functional forms and variable specifications were tested and modified to meet both economic justifications and statistical requirements.

B) Consumer survey data analysis

No data were available on the purchased quantity of livestock products at different price levels, so this required a direct household survey of consumers. From this investigation, the extent of meat consumption by kind and quantity was observed in relation to such variables as availability of cash on hand, behavioral and demographic factors, location of meat markets, and seasonal changes in consumption patterns and preferences. The function so derived was more accurate than similar measures derived from secondary data analysis. For one thing, the official data do not include information on private slaughtering.

Since available published data indicate only the level of consumption for meat and livestock products in aggregate terms by year, the real quantitative picture of prevailing consumption for them by income and by occupation groups was not available. Therefore it was almost impossible to project the future consumption by income groups as their respective incomes increased without detailed micro data from households. This survey was designed to reveal the factors which influence the possible changes in demand for livestock products including meat.

Survey 1

To get an insight into consumer behavior and trends in the purchase of meat and other livestock products, a household survey was conducted. The sample size was rather large, about 600 households in the five major cities. Since adequate data were not available to make a sound assessment of consumer demand for meat and livestock products, the respondent households were selected on a probability basis, and personal interviews were carried out by the students in the Department of Agricultural Economics and Home Economics.

Phase 2. Wholesale trade study

This research focussed on the economic analysis of the meat wholesaling system including processing, transportation, and storage, and was designed to examine the regulatory and marketing activities of government and marketing institutions.

Since the major role of wholesalers in the market involves buying, selling, and pricing activities, their collective decisions guide the flow of dairy products, meat, feedstuffs and other supplies through marketing channels and determine what is available (where, when, and at what price) and the amount of income from the sale of the products, meat, and feedstuffs.

In Korea, agricultural production is geographically dispersed, and the products are supplied by many small producers, creating structural problems for marketing. To provide the right kind of livestock products in sufficient quantities to consumers at the right time requires overcoming present inefficiencies in the marketing system. Because many functions and stages are involved in the flow of commodities, it was necessary to analyze the prevailing marketing functions over time and space provided by dealers and governmental agencies in order to learn how to improve the marketing system.

In order to appraise marketing costs more accurately using data obtained from the field, a least-cost solution of a modified linear programming model was tested. Such cost analysis was not well justified in the Korean situation because it limited with the available data that type of distribution possible to analyze the system for meat, livestock products, commercial feeds at least cost from the areas of production, processing, and import to the consuming market. But tested were alternative marketing systems which would have major effects on the structure and on the performance of the livestock marketing system.

The primary source of information for this phase of the study was obtained largely from farmers, agricultural cooperative staff members, extension workers, and various dealers at different markets in the system because studies relevant to marketing of livestock products in Korea were limited or not available. For this research, it was necessary to gather information about all aspects of the livestock wholesale business.

Survey 2

Wholesalers were selected from different market levels, including local and central markets. Approximately 60 wholesalers from local markets and the central markets were surveyed. The sample markets surveyed were those connected directly with the 20 townships used for the retailer survey. Interviews were conducted by university students and were based on questionnaires (prepared and pretested before the main survey). The students received appropriate training prior to the survey. They operated in seven two person teams each team surveyed three markets. In addition two graduate students and the project leader took part in both the pre-test and the field survey.

Phase 3. Retail trade study

This phase of the project focused on a functional analysis of the meat retailing system and the identification of those factors which would enable projected demands to be met in an economically efficient manner.

From a research methodology standpoint, retail market analysis was difficult. It required time-consuming baseline surveys designed to provide first hand information about how markets operate and what marketing methods were used. Much imagination was required to gain depth of insight and understanding about the factors helping or hindering desired performance. For example, one of the most serious obstacles to improving the efficiency of the meat marketing system appeared to be the absence of a system of grades and standards which was simple enough to be used by participants in the industry, yet able to differentiate the quality of meat sold at retail stores.

As markets expand, new retail trade methods must be applied for efficient performance. Unfortunately, new methods were not easily adopted because there were numerous retail stores that operate on a small scale as family enterprises. As the volume of livestock marketing has increased recently, there has been an increase in the number of stores which has also led to an increase in the number of small independent units. The increased number of these small-scale stores has caused other problems in terms of the possible extension of economies of scale.

Since there has been little detailed empirical study on the retail marketing system, it was necessary to conduct a comprehensive field survey to obtain the relevant data. Much time was spent in the markets collecting data, but this effort helped to identify what are the main problems and will hopefully advance the formulation of clear policy of guidelines for the improvement of meat marketing.

Survey 3

A survey of retailers was conducted in Seoul in terms of size and location of the butchers. A sample size of 80 retailers was surveyed, and the sample was drawn randomly from all retailers.

In the process of the field survey, source material in the following categories was collected through personal interviews with retailers and other dealers in local markets;

(a) Market outlets for consumers, assemblers, and middlemen of meat and livestock products, (b) assessment of retailers' preferences at each stage in the marketing chain, (c) seasonal differences in consumer preferences for meat and dairy product purchase, (d) price levels as compared with the wholessale market, (e) relative importance of the marketing channels through which live animals were channeled from farmers to consumers, (f) marketing functions performed by marketing channels, and the numbers and types of dealers at different marketing levels

Phase 4. Feed requirements study

The aim of this phase of the project was to determine total feedgrain requirements as a function of changes in domestic meat and livestock production and the relative price of feed. In estimating the various kinds of feedstuffs required to feed the projected increase in the number of livestock, heavy reliance was placed on the physiological and nutritional data provided by the Livestock Experimental Station.

Using the data available at the Livestock Experimental Station demand for nutrients in feedstuff was estimated for a certain quantity of livestock production based on the prices of feedstuff, the prices of the livestock produced, and technological change. In addition, different assumptions were made concerning the quality of livestock, farmer's efficiency, qualitative improvements in feeds, and the relative prices of feedgrains or nutrients to determine the total feed requirement for a given animal at a given time.

Utilization of the existing data of the Livestock Experimental Station for this study was relatively easy because good relations exist with their researchers. However, visits made to officials at the livestock experiment station and to consumers to explain what information was needed, where the information was going to be used, and the purposes of the research.

Phase 5. Production analysis study

The principal objective of this phase of the study was to prepare projections of domestic production for the major livestock products as a function of consumer demand, available resources, productivity, and government support policies for both inputs and outputs, and to estimate, on the basis of projections of feedgrain requirements, the economic implications for Korean agriculture of different degreesof self-sufficiency in the production of feedgrains. In accord with usual assumptions about the income elasticities of total consumption patterns, meat and dairy products consumption was expected to increase with economic growth, and these trends were projected to continue into the foreseable future.

Domestic beef production has remained far below demand. In 1978, domestic production of beef was only 70 percent of total consumption The possibilities for expansion of animal production are limited due mainly to the shortage of available land resources and price instabilities for both commercial feeds and livestock.

One critical problem associated with animal husbandry is that individual farm families are concerned primarily with home consumption and food security, so emphasis has been placed on the production of staple foods rather than livestock products which are market-oriented and risky. In order to access prospects for achieving a higher degree of self-sufficiency in livestock production and to determine the effects of increased livestock production, rural income, private profitability in production was analyzed by means of farm budget surveys. Also analyzed were a number of trade-offs between livestock products and alternative commodities. In this context, attempts were made to determine the main constraints to the expansion of livestock production.

In order to devise programs which would encourage individual farmers to raise animals as well as produce food crops, price levels, technology, subsidies and supporting infrastructures for the livestock sector were examined.

The main sources of data used in the study were livestock farms and the Livestock Experimental Station within the Rural Development Administration. In addition, extension workers, cooperative staff members, and village leaders were also interviewed.

Survey 4

Due to lack of reliable data on livestock farming, a farm survey was necessary. This survey focused on generating data necessary to understand farmers' knowledge about, experience with, and attitudes towards raising livestock and crops for increasing the production of meat and milk. A detailed, nation-wide farm survey covered the following categories of information.

Livestock farms:

Type, size of resources, land value, availibility of feedstuffs, farming practices, explanation of changes in livestock raising practices, quantities sold, feedstuff purchased, farmers' organization, village infrastructure, cropping systems, availability of cash and credit, production costs by kind, impacts on expanding farm business, possible pasture, price levels, etc.

Farmers and farming families:

Sources of income, attitude toward livestock farming, knowledge and practices of raising livestock, experience with and assessment of government programs for animal husbandry and extension services, farm family goals and how these were affected by raising livestock, future plans for farming, constrains to expansion of farm size, etc. Approximately 126 beef farms undertook record-keeping for two years and 121 dairy farms were surveyed for these analysis.

In the selection of about 126 sample farms, sampling emphasis was placed on the size of farm, location of markets, region, etc. Individual farmers kept farm records for two years. With the data obtained from the record-keeping by farmers, it was possible to identify alternative systems that could help increase production efficiency.

Phase 6. Feed processing study

The basic objective of this phase was to determine the optimal location, size, and type of milling facilities and points of distrubution that reduced the cost of commercial feeds at the farm gate level.

This phase of the project attempted to identify what should be done to increase the efficiency of plant operations and supply feed cheaply and under what circumstances these changes can be expected to occur. Of course, lower prices alone will not lead to substantial increases in livestock production as long as other constraint factors remain unchanged, but it is certainly a necessary condition for increasing the production of livestock by farmers.

The costs of feed processing were reviewed based on plant capacity and were compared with prices of imported feedstuffs and the policy restrictions currently imposed. The employment of alternative feed processing technologies was also studied. In order to identify investment opportunities, the entire question of the Korean feed processing business was considered.

Based on the production costs of each plant, the researchers recommended to the government that some inefficient mills be shut down and that more efficient mills make further investments in their plant and make productivity-enhancing changes in their operations. Since the remaining plants will have greater technical efficiency and operate at levels closer to their effective capacity, they should be able to supply feed at lower prices.

In addition, government laws and regulations, established business customs, tariff rates for imports,ethical codes, and contractual agreements were reviewed to find possible ways to lower food prices and to reduce serious problems of price fluctuations in the market.

Survey 5

Available data on the feed processing business were very limited and thus it was essential to conduct a careful survey on such plants to understand fully the current situation and prevailing problem areas, and to examine the cost of feed milling by plant size and location.

This investigation was jointly undertaken with the National Livestock Cooperative Association which has marketing responsibilies of feedgrains and meat. The Association covered all expenses for the field survey.

Their survey on feed processing plants generated primary data on such variables as location, size, capacity, type of products, source of raw materials, manufacturing costs by kind of feed, outlets for the products, operation rate of plant capacity, profitability of the business, current policies for supporting and controlling plants, plant expansion plans, etc.

Phase 7. International trade study

The principal objective of this phase was to identify, on the basis of the foregoing analyses, the long term implications of various livestock development strategies for Korean trade in feedgrains and livestock, by type of product and quantity.

The prices of feeds and livestock products were compared with the prices of imported commodities. Alternative trading strategies were explored to minimize the prices of feeds at the point of import, and to reduce serious problems of price fluctuations in the market.

This study was based on secondary data relating to the through agricultural trade included both structural estimations and predictions. At present, it appears that a significant change in the production of exporting countries such as the US, Canada, and Australia will directly influence markets in the importing countries.

In order to closely observe the situation of the livestock industry and to collect available relevant data, project leaders have been visited survey areas from time to time.

In fact, this comprehensive study on the livestock industry was made possible by generating appropriate data through a number of field studies due to the limited published data and empirical research available. It was unrealistic to expect any one organization or person to undertake a comprehensive analysis of all of of these problem areas. Collaborative research on these problems was badly needed to discover what can be done to facilitate the development of the livestock industry in order to provide maximum net social benefits through increasing the supply of livestock products to meet increasing demand.

II. Overview of Korean Agriculture

2.1 The National Economy

Korea is a peninsula that lies in continental East Asia. It has an area of about 220,000 square kilometers. About 70 percent of this peninsula is covered by mountains and hills, and only about 20 percent of the total land area is cultivated. At the end of the second world war in 1945, Korea was freed from Japanese colonization which had lasted for 36 years. However, it was divided into two portions, south and north, with about the same land size.

Owing to the division, the unity of the national economy was completely broken. The northern half had the advantages of mineral resources that could be used for developing an industrial sector, while the southern half had a traditional farming base. However, most of the existing infrastructure in both north and south was destroyed during the Korean war (1950-1953).

The total population in South Korea increased at a rapid rate from 21,502 thousand in 1955 to 42,082 thousand in 1987. This means that the population increased by twofold during the last 32 years. Consequently, the population density per square kilometer increased from 218 to 419 persons. Moreover, the population density per hectare of arable land reached 19.6 persons in 1987. This may be the highest rate in the world.

The government was determined to exercise a strong influence over the development of the national economy. As a first step, a five-year economic plan was implemented in 1962. Its aim was to move away from the low income agricultural base towards a moderate stage of industrialization by promoting small manufacturing enterprises. Although South Korea is not well endowed with mineral resources, favorable economic growth has occurred since 1962. This growth has been steered by the continuing five-year plans and it has been based on a relatively large educated labor force, considerable foreign aid, and a huge amount of foreign loans.

Table 2-1. Average Growth Rate by Industry, 1962-86

At 1980 constant market prices

Year	GNP	Agriculture Forestry and Fishery	Non-Agriculture Sectors	Per Capita GNP
	....	%	....	US $
1962-66	7.8	5.6	9.6	613
1967-71	9.6	1.5	14.5	941
1972-76	9.7	6.1	10.9	1,367
1977-81	5.8	-0.6	7.5	1,669
1982-86	8.6	3.7	9.5	2,344
1962-86	8.3	3.3	10.4	

Source: Economic Planning Board, Major Statistics of Korean Economy

The average annual growth rate of GNP through the period of the five five-year economic plans was 8.3 percent in 1980 constant market prices (Table 2-1). The GNP growth averaged 7.8 percent per annum during the first five-year period (1962-66); 9.6 percent during the second plan period (1967-71); 9.7 percent during the third plan period (1972-76); 5.8 percent during the fourth plan period (1977-81); and 8.6 percent during the fifth plan period (1982-86).

In the course of the industrialization programs since 1962, the rate of growth in the agricultural sector averaged only 3.3 percent per annum from 1962 to 1986, whereas the rate in other sectors including manufacturing and social overhead costs increased by 10.4 percent per annum. The growth rate of the agricultural sector is not only slow, but also it has been uneven with some negative growth due to unusual changes in weather conditions.

As a result, the relative share of the agricultural sector in gross national product has decreased from a yearly average of 34.8 percent in the period of 1962 through 1966 to 12.8 percent in the 1982-1986 period at current market prices (Table 2-2).

Table 2-2. Industrial Origin of GNP, in Korea, 1962-86

At current market prices

Period	Agriculture, Forestry Fishery	Mining and Manufacturing	Social Overhead Costs and Other Services
	.... %	....	
1962 - 66	34.8	20.5	44.7
1967 - 71	26.8	22.2	51.0
1972 - 76	23.5	28.4	48.1
1977 - 81	15.8	30.7	53.5
1982 - 86	12.8	30.1	57.1

Source: EBP, Major Statistics of Korean Economy, 1987

Food production as a whole has grown continuously since 1962, but the rate of growth in agricultural productivity has been slower than that of consumption growth. All of the grains which are produced are used for human consumption, yet total production is not sufficient to meet demand for even subsistance needs. Most farmers have been motivated to produce more food grains for family consumption and for sale. However, the deficit in domestic production is growing year after year due largely to increases in population, income and the demand for feed grains. The self-sufficiency ratio for domestic food grain production was as high as 93.9 percent for all grains in 1965. It has since continuously decreased to 41.3 percent in 1987. In particular, the self-sufficiency rates for rice and barley, the most important food crops, were 99.8 percent and 97.2 percent, respectively.

Table 2-3. Self-Sufficiency Rate of Foodgrains, 1965-87

Year	All	Rice	Barley	Wheat	Corn	Soybeans
1965	93.9	100.7	106.0	27.0	36.1	100.0
70	80.5	93.1	106.3	15.4	18.9	86.1
75	73.0	94.6	92.0	5.7	8.3	85.8
77	65.1	103.4	53.4	2.3	6.2	67.5
79	59.8	85.7	117.3	2.4	3.4	43.4
80	56.0	95.1	57.6	4.8	5.9	35.1
81	43.2	66.2	72.7	2.7	6.1	29.7
83	50.2	97.7	120.0	6.0	2.8	25.7
84	48.7	97.5	103.9	0.6	3.1	23.5
85	48.4	103.3	82.6	0.4	4.1	22.5
86	44.5	96.9	82.3	0.2	3.5	18.8
87	41.3	99.8	97.2	0.1	2.4	16.2

Source : MAFF

However, the rates ~~were significantly~~ of self-sufficiency were very low for wheat and corn with only 0.1 percent and 2.4 percent of their consumption supplied domestically (Table 2-3). At present, only the domestic production of rice, potatoes and vegetables is sufficient and these need not be imported to meet internal demand.

In order to supplement this shortfall in demand for various grains, grain imports have been necessary for many years. In 1987, total imports were 10.2 million tons of grain consisting of 4.8 million tons of corn, 4.2 million tons of wheat, 1.1 million tons of soybeans (Table 2-4).

Table 2-4. The Imports of Grains, 1962 - 87

Unit: in thousand mt

Year	Total	Rice	Barley	Wheat	Corn	Soybean	Other
1962	499	-	47	398	2	16	36
65	570	-	-	496	67	7	-
68	1,497	216	106	1,027	105	17	26
71	2,667	907	-	1,384	315	61	-
74	2,571	206	299	1,427	573	66	-
77	3,822	-	322	1,979	1,370	151	-
80	5,051	580	-	1,810	2,234	417	10
81	7,233	2,245	-	2,095	2,355	529	9
82	5,946	269	-	1,940	2,814	536	387
83	7,216	216	-	1,861	4,167	724	248
84	7,141	-	-	2,648	3,223	694	576
85	7,336	-	-	2,996	3,035	885	420
86	8,434	-	-	3,443	3,697	944	350
87	10,213	-	-	4,223	4,792	1,131	67

Source: MAFF

In addition, a shortage has emerged in livestock products and meat. This is mainly due to the fact that most farmers have limited available land and thus they place primary emphasis on producing more grains for family consumption rather than raising animals. Thus a considerable volume of meat and livestock products was also imported.

The payment for grain import was 1,115 million US dollars and livestock products imports including raw materials for manufacturing amounted to 1,376 million US dollars in 1987. These trends are likely to increase in the coming years.

Total imports including agricultural and the other manufacturing materials were valued at $41.0 billion in 1987. (Table 2-5). All agricultural products accounted for only 6.0 percent of the total amount of imports. Although the industrial output has risen steadily

Table 2-5. Trade Balance between Imports and Exports

In million US dollars

Year	Exports (A)	Imports (B)	Balance (A-B)
1962	55	390	-355
65	175	416	-241
70	835	1,984	-1,149
75	5,801	7,274	-2,193
77	10,047	10,811	-764
79	15,056	20,339	-5,283
80	17,505	22,292	-4,787
81	21,254	26,132	-4,878
82	21,853	24,251	-2,398
83	24,445	26,192	-1,747
84	29,245	30,632	-1,387
85	30,283	31,136	-853
86	34,715	31,584	3,131
87	47,280	41,020	6,260

Source: EPB, Major Statistics of Korean Economy, 1987 and rapidly since 1962, the lack of sufficient material resources and the resulting dependence on imports of various materials such as certain capital goods, raw materials and crude oil makes the industrial sector vulnerable to changes in prices in the world economy.

Total exports, on the other hand, increased from the $17.5 billion registered in 1980 to 47.3 billion in 1987. The annual growth rate of the export market during the last seven years was 28.4 percent. Regarding the growth rate of total exports on a product basis, manufactured goods accounted for 29.4 percent per year and agricultural, forestry and marine products only 6.5 percent during the last seven years. Again, the relative importance of agricultural and marine products as export items was decreasing year after year from 31.7 percent in 1970 to 5.3 percent in 1987. By contrast, the relative importance of manufactured goods increased from 68.3 percent of total exports to 94.7 percent during the same period. Major export commodities are footwear, transport equipment, textiles, rubber tires, electronic products, etc.

Financial deficits due to trade imbalances and foreign borrowing snowballed until 1985, when the outstanding foreign debt reached an estimated 46.8 billion dollars. Debt repayment requires promoting further exports, decreasing imports of final products for domestic use, borrowing less money from foreign external markets, and boosting domestic savings.

The sixth five-year plan (1987-91) targets the increase in exports at 10.0 percent per annum compared with a projected 11.0 percent rise in imports. Accordingly, in 1991 exports should reach 55.8 billion and a trade account surplus of 5.0 billion is expected with the outstanding foreign debt expected to decrease to 32.9 billion dollars in 1991. In addition, the government predicts that the ratio of domestic savings to GNP will rise from 28.6 percent in 1985 to 33.5 percent in 1991. Assuming that such predictions are accurate, the repayment of foreign loans is not expected to present major problems in the national economy. As a matter of fact, the balance of trade showed a surplus of 6,260 million US dollars in 1987, the second consecutive year of surplus which has helped the government pay back a certain amount of the old debts ahead of schedule. Moreover, the Korean economy is expected to continue its robust growth rate and to enjoy a favorable balance of trade from now on. From this optimistic perspective, the economy is expected to continue to grow at a rapid rate in the near future.

2.2. The Agricultural Sector

In 1987, 65.7 percent of a total land area of 9,917 thousand hectares was classified as forest land and only 21.6 percent was classified as arable. In spite of the low percentage of total land area currently under utilization, there is not much room for expanding the cultivable land base due to a mountainous topography and poor soil. Moreover, the cultivated land area has limited year-round utilization potential due to climatic and cropping pattern constraints as well as economic limitations.

Korea has four seasons. A frost-free period of almost 7 months, from April to October, is considered to be adequate for rice cultivation and a variety of dryland crops. All of the crop lands freeze after barley and wheat are sown in late October. This freeze lasts for five months from November to March of the following year.

The annual precipitation normally averages about 1,300 millimeters but may be as high as 2,500 mm in some years. The monsoon usually brings heavy rain and about 60-70 percent of the annual precipitation falls during four months from May through August.

1) Cultivated Land Area

For the nation as a whole, about 2,143 thousand hectares were cultivated in 1987. Based on the availability of irrigation facilities, 63.1 percent of the arable land was classified as paddy field and 36.9 percent as upland (Table 2-6). Different cropping systems exist for each of the two types of land. All of the paddy fields produce mainly rice during summer. About 18 percent of the total paddy land is double cropped with winter barley, wheat, spring vegetables, and forage crops. Uplands are used for a variety of coarse

Table 2-6. Areas of Cultivated Land in Korea, 1967-87

Year	Total Area of Cultivated Land	Percent		Rate of Land Utilization
		Paddy Field	Upland	
1967	2,312	55.8	44.2	142.0
71	2,271	55.7	44.3	136.5
74	2,238	56.7	43.3	138.2
77	2,231	58.4	41.6	135.5
80	2,196	59.5	40.5	125.3
83	2,167	60.7	39.3	123.8
84	2,152	61.3	38.7	124.9
85	2,144	61.8	38.2	120.4
86	2,141	62.1	37.9	119.9
87	2,143	63.1	36.9	120.0

Source: MAFF

grains, vegetables, fruits, and industrial crops during the summer, and about 23 percent of this land is double cropped with winter barley, wheat, and vegetables. As a result, the national cropping ratio for all arable land totaled 120.0 percent in 1987. This means that only 20 percent of the total arable land had two crops planted in the same field during the year.

The government has placed a high priority on the task of expanding the arable land area by reclamation of forest and tidal lands. Such land reclamation efforts have been carried out by the government for the last two decades. However, the reclaimed area so far totals only about 50,000 hectares. Worse still much of the reclaimed land has exhibited inferior cropping potential because of inadequate top soil and the newly added land has not matched that taken out of production for non-agricultural uses such as housing, urban development, roads, factory sites, etc. This latter trend is important for future agricultural production potential as there is mounting pressure on the more fertile plains for urban and industrial needs.

The government sought at the same time to increase productivity of the existing land. More intensive use of currently available arable land, particularly paddy fields, was promoted. However, paddy field cultivation requires regular and adequate rainfall in the growing season. So, availability of water is very important. The annual precipitation normally averages about 1,200-1,300 millimeters, and this amount of rainfall and a period of no frost for seven months are possible for rice cultivation once a year.

The distribution of rainfall by month is uneven and sometimes less than or more than the needed amount occurs in the growing season particularly at the time of rice transplanting. This often results in either severe flooding or drought and causes an increase in the shortage of food and feed grains. Thus, irrigation of paddy fields in Korea is largely a matter of supplementing the relatively abundant but somewhat erratic rainfall.

There is a long history of government support for construction of the additional irrigation facilities and for the maintenance of existing systems to supply water for paddy fields. Even administrators in old times have traditionally believed that water is the most crucial constraint to increasing crop production in Korea. Consequently, most of the policy-makers have realized the necessity for the continued improvement of and investment in irrigation facilities.

Table 2-7. Percentage of Irrigated Paddy Fields by Water Source, 1965-86

Year	Total Area of Paddy Fields	Irrigated Paddy			Rainfed
		Irrigated	Partially Irrigated	%	
1965	1,286	22.1	19.7	41.8	58.2
70	1,284	24.7	33.3	58.0	42.0
75	1,277	28.5	33.4	61.9	38.1
80	1,307	32.4	35.9	68.3	31.7
82	1,312	33.8	36.1	69.9	30.1
83	1,316	34.2	36.4	70.6	29.4
84	1,320	35.7	36.1	71.8	28.2
86	1,329	36.1	36.5	72.6	27.4

Source: MAFF

Through the construction of water reservoirs as well as pumping stations, 72.6 percent of total paddy land possessed irrigation facilities by the end of 1986 (Table 2-7). This means that the acreage of irrigated paddy field has increased by 30.8 percentage points during the last 21 years, from 41.8 percent in 1965 to 72.6 percent in 1986.

However, 36.5 percent of the paddy fields now classified as irrigated are only partially irrigated with uncertain water supplies. In addition, most of the previous irrigation projects have emphasized supplying water for rice cultivation and have not been concerned with upland water and drainage problems that exist on most paddy fields.

2) Farm Size

As a result of the land reform law of 1950, all cultivators were given land ownership rights over lands cultivated at the time, but it was stipulated that all land holdings be limited to a maximum of 3 hectares. In 1987, the average farm household cultivated only about 1.1 hectares of land, but 63.8 percent of the total farm households held less than one hectare and their land is usually fragmented and dispersed in several places.

In 1967, the total farm population was about 16.1 million. That was the largest farm population in Korean history, and it accounted for 53.4% of the total population. In 1987, there were about 7.8 million people on farms and the proportion of the farm population to the total population declined to 18.5 percent (Table 2-8). This means that the farm population decreased by 8.3 million people or by 51.6 percent during the last 20 years. Total farm households, however, have decreased by only 26.3 percent from 2,587 thousand to 1,871 thousand during the same period.

Table 2-8. Percent of Farm Population and Number of Family Members 1965-1987

Year	Total Population	Total Farm Population	Percent of Farm Population	Family Member Per Farm
1965	28,705[000]	15,812[000]	55.1	6.31
67	30,131	16,078	53.4	6.22
70	32,241	14,422	44.7	5.81
75	35,281	13,244	37.5	5.57
80	38,124	10,827	28.4	5.02
83	39,929	9,999	23.7	4.74
84	40,513	9,015	22.3	4.57
85	41,055	8,521	20.8	4.42
86	41,569	8,180	19.7	4.29
87	42,082	7,771	18.5	4.15

Source: Ministry of Agriculture, Forestry and Fisheries

As a consequence of the decrease in farm population, farmers have purchased small farm machines to cope with labor shortages during peak farming seasons. The government has promoted the purchase of these farm machines by partially subsidizing machine costs. As a result, the number of machines used by farmers has increased several-fold during the last decade (Table 2-9).

Of course, there are a number of other new technologies and practices which are available that can substitute for labor and embody potential productivity increases. However, change resulting from the adoption of new technology by small-scale farmers is limited not only by the limited arable land, but also by the lack of incentive to invest in farming due to the belief that it is a less profitable business than activities in the industrial sector. This belief has made it more difficult for Korean farmers to adjust to today's changing socio-economic environment and market conditions.

Table 2-9. Total Number of Farm Machinery Holdings by Year

Year	Power Tiller	Farm Tractor	Rice Trans-planter	Binder	Sprayer	Threshing Machine
1965	1,111	-	-	-	7,579	18,909
70	11,884	61	-	-	45,008	41,038
75	85,722	564	16	-	137,698	127,105
78	194,780	1,601	531	3,487	235,225	185,947
80	289,779	2,664	11,061	13,652	330,663	219,896
82	422,006	5,575	19,660	17,294	403,653	253,552
84	538,273	9,684	30,893	22,635	427,185	286,647
86	683,611	16,167	59,580	32,860	581,646	294,264
87	711,374	19,863	76,070	38,418	622,496	302,572

Source: MAFF

3) Grain Production

Since the available crop land is limited, Korean agriculture is characterized by its heavy emphasis on grain production rather than on forage crops and pasture in order to meet food requirements. As shown in Table 2-10 grain crops including rice, barley, wheat, pulses, and also potatoes and other miscellaneous crops accounted for 68.3 percent of the total area of land utilized in 1987. In terms of area planted to particular crops, rice is the most important, accounting for 48.6 percent of total cultivated land.

There is significant potential to increase barley production because of its technical feasibility as the second crop on paddy fields after rice harvesting, but the actual area devoted to its production has been gradually decreasing, from 33.7 percent of the total acreage in 1965 to 8.0 percent in 1987. Also some other crops such as potatoes, pulses, and miscellaneous grains are decreasing in relative importance and total area planted. However, the area which is cropped in vegetables and fruits has recently increased at a rapid rate since these crops are sold at relatively better prices than other food crops. This is because the demand for those crops has increased because of higher incomes and greater marketing opportunities given an expanding urban population.

Table 2-10. Changes in Land Utilization for Crops Planted, 1965-87

Item	1965	1975	1985	1987
Total Arable Land	2,256	2,240	2,144	2,143
Total Area Planted, Thousand ha.	3,560	3,144	2,592	2,598
Food Crops, %	90.5	80.2	68.7	68.3
Rice	33.5	38.7	47.7	48.6
Barley + Wheat	33.7	24.2	9.3	8.0
Pulses	10.3	10.3	7.6	8.2
Potatoes	6.0	4.6	2.5	1.8
Miscellaneous	6.0	2.3	1.6	1.7
Special %	1.7	3.8	5.1	6.8
Vegetables, %	4.2	7.8	13.0	11.9
Fruits, %	1.2	2.4	4.2	4.4
Mulberry Fields, %	1.4	1.4	0.5	8.3
Others, %	1.0	4.5	8.5	0.3

Source: MAFF

The total acreage devoted to the main food crops has decreased by 44.9 percent during the last twenty-two years. However, the total production of food grains has increased by 2.5 percent during the same period due mainly to increased yields per hectare. This trend is particularly noticeable in rice production.

Rice production accounted for 5.5 million out of the 6.7 million tons of food grains produced in 1986 (Table 2-11). Although the area planted to rice was 71.1 percent of the total area planted for food crops, rice production accounted for 82.1 percent of total food grain production. This means that rice yields were higher than those of other food crops.

Table 2-11 Total Production (Polished) of Food Grains and Other Crops and the Proportions of Each Crop, 1965-87

Year	Total Production	Kinds of Crops				
		Rice	Barley	Pulses	Potatoes	Other
	000 mt	....		%	....	
1965	6,524	53.7	25.4	3.1	16.0	1.8
70	6,937	56.8	26.2	3.9	11.3	1.8
75	7,645	61.1	23.6	4.5	9.6	1.2
80	5,324	66.7	17.0	5.0	8.1	3.2
81	6,915	73.2	13.3	4.6	6.6	2.3
82	6,804	76.0	12.1	4.3	5.4	2.2
83	7,133	75.7	11.3	4.0	5.0	2.0
84	7,315	77.7	11.3	4.0	5.0	2.0
85	6,990	80.5	8.4	3.9	5.1	2.1
86	6,773	82.8	6.8	3.7	4.8	1.9
87	6,687	82.1	7.8	4.0	3.9	2.2

Source: MAFF

Average Korean rice yields of 4.4 tons of polished rice per hectare were very high in comparison with other Asian rice producing areas. Heavy fertilization, easy access to markets for rice, application of sufficient pesticides, adoption of high-yielding varieties, high performance of new farming technologies, and the society's cultural heritage all seem to explain this high level of yields. In addition, rice, due to its relatively high price supported by the government, has become a favorite crop to cultivate.

In particular, the consumption of fertilizer in Korea has risen rapidly as the country has attempted to close the food deficit gap. The government gave high priority to the development of a fertilizer industry in order to produce fertilizer domestically and reduce dependence on imports. The first, a small urea plant with an annual production capacity of 85,000 tons, was opened in 1960 and thereafter it has been sufficiently expanded. At present, there are seven plants with a total annual production capacity of 1.6 million tons at nutrient basis were in operation. This production was only about 0.9 million tons in that same year. As a result, production exceeded domestic consumption by 70.2% in 1987.

The government has taken a leading part in investing and establishing the fertilizer production industry from the beginning to the present. It was necessary not only to reduce the drain on the limited foreign exchange due to continuous importation of finished fertilizer but also it was intended to supply enough fertilizer for farm uses as needed while encouraging private enterprise into the industry.

In addition, the chronic food grain shortage of the Korean economy led to a high priority placed on the development of a high-yielding rice variety by the government. The traditional variety of rice widely cultivated is the Japonica type which is characterized by easy lodging, little responsiveness to fertilizer, and much susceptibility to rice blast. In order to improve such defects, a new rice variety had to be developed.

As the first high-yielding variety Tongil was developed and was released to farmers in 1971. The Tongil variety possesses such high-yielding traits as high response to fertilization, a short and strong stalk, and less lodging. The original Tongil variety however had some drawbacks. This included the easy shattering of grains at the time of harvest, poor taste and lower price compared to traditional rice.

Nevertheless, the area planted in the new high-yielding varieties of rice had steadily increased for several years since its dissemination. In 1978, the area planted under Tongil rice reached 76.2 percent of total paddy fields (Table 2-12). Thereafter the percentage of paddy fields in high-yielding varieties has continuously decreased. In 1987, this figure was only 19.6 percent of total paddy fields due mainly to a price drop at market and a reduced quantity of government purchases. It seems that many farmers are more concerned with private economic benefits in terms of price level rather than with national rice production needs in terms of quantity.

Table 2-12. Production of Paddy Rice by Variety, 1975-87

Area : 1,000 Ha

Year	Area Planted	Traditional Rice		Tongil Variety	
		Area	Yield/Kg	Area	Yield/Kg
1975	1,198	924	351	274	503
76	1,196	663	396	533	479
77	1,208	548	423	660	553
78	1,219	290	435	929	486
79	1,224	480	437	744	463
80	1,220	616	292	604	287
82	1,176	790	413	386	489
83	1,220	801	420	419	483
85	1,233	890	437	343	504
86	1,233	961	449	272	472
87	1,259	1,012	431	247	457

Even if there are still many farmers who are reluctant to commit all of their paddy fields to HYV of rice, all farmers adopted the new farming technologies recommended for HYV rice including vinyl covered seedbeds, water management, early transplanting, application of pesticides and other chemicals in more adequate quantities, etc. These new farming practices have served as effective technologies for traditional as well as HYVs and thus have contributed greatly to high rice yields. In 1985, the total value of rice production amounted to 84.6 percent of the total value of all food grains produced, 36.0 percent of the total value of agricultural products, and approximately 6.1 percent of GNP.

Production indices of individual food crops have grown slowly since 1968, and hence their rates of growth have been lower than the growth rate of total agricultural production that includes food crops, fruits and livestock as shown in Table 2-12. Since the rate of increase in the total production of foodgrains has remained far below the level which would adequately satisfy demand, shortages are expected in the years to come.

Table 2-13. Agricultural Production Indexes, 1963-86

Base Year = 1979-81

Year	All Production	Food Crops	Vege-tables	Fruits	Livestock
1968	59.1	86.6	34.0	29.2	30.7
71	68.0	95.2	40.0	30.3	39.8
74	77.8	100.2	40.8	52.1	62.1
77	101.6	122.1	83.9	80.8	73.9
80	86.5	77.8	98.3	91.9	89.2
81	102.3	104.3	97.8	100.6	98.6
82	108.0	104.0	101.9	133.8	119.0
83	119.8	108.1	111.9	158.8	156.6
84	119.7	112.2	91.5	139.6	165.2
85	123.0	109.4	107.3	168.8	172.4
86	128.0	107.2	125.0	169.7	177.4

Source : MAFF

4) Farm Income

Since the rate of growth in agricultural productivity has been slower than that in other economic sectors, farm household income is usually lower than incomes of salaried workers (Table 2-14). The proportion of farm to non-farm income was about 78.8% in 1971 and thereafter tha rate steadily increased for some years. In 1975, farm household income exceeded that of people in the non-agricultural sectors due mainly to high government price supports for rice. However, this trend was short-lived and the percentage of farm to nonfarm income has continuously decreased thereafter down to 83.8 percent in 1987

Table 2-14. Sources Farm Income by Year, 1971-87

Unit : 1,000 Won

Year	Farm Income Per Household (A)	Source of Income		Percent (B/A)
		Farm	Non-Farm(B)	
71	356	292	64	18.1
75	873	715	158	18.1
80	2,693	1,755	938	34.8
82	4,465	3,031	1,434	32.1
84	5,549	3,699	1,850	33.3
85	5,736	3,699	2,037	35.5
86	5,995	3,677	2,318	38.7
87	6,535	4,016	2,519	38.5

Source : MAFF

The main reason for the relatively lower incomes of farmers compared to people in other economic sectors is the low price level for most agricultural products. In fact, there are 1.9 million farms that produce somewhat identical crops and most are small-sized farms which sell their produce immediately after harvest due to cash needs. The farmers inevitably must compete with each other and thus market prices for farm products are maintained at relatively low levels. Hence, farm household income, including both income from farming and off-farm income, has fallen behind that of people engaged wholly in non-farm activities.

In addition, the increase in the price indices of farm products tends to be lower than that of the products purchased by farmers. As a result, farm income has usually fallen behind that of the workers in non-agricultural sectors. Currently, living conditions and diets of farmers are less adequate than those of people in the non-agricultural sectors. For this reason, many farm people have left for urban or industrial areas without much concern for securing appropriate job opportunities. This situation may lead to an oversupply of workers compared to the demand, resulting in serious social problems that must be solved in the future. In view of this situation, it now appears inevitable that in the coming years strong support policies by the government are required to increase both the agricultural production potential and off-farm income simultaneously.

In short, through the implementation of the five-year economic development plans since 1962, a considerable amount of capital has been invested in agriculture by the government in order to increase agricultural production and farmers' incomes. In the course of industrialization, the agricultural sector has also developed to some extent under the influence of high industrial growth.

Among various efforts to increase productivity in agriculture, the government has initiated a series of programmes that include provision of institutional loans as working capital, payment of subsidies for purchasing farm machines, dissemination of new farming practices, expansion of irrigation facilities, supplying of agricultural chemicals on credit basis, etc. These programmes have increased the production potential of Korean farms.

Without the direct intervention of the government in agricultural production and markets for the products, the level of the total agricultural production, particularly in rice may well have been much lower. In practical terms, intervention by the government was designed to enhance the farmers' economic position and it has been as effective as anticipated. As a result, farmers have been able to increase their income to some extent. However, a renewed challenge to further improve farming methods is required in the Korean agriculture.

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III. Development of the Livestock Industry

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3.1 Relative Importance of Livestock Sector

The livestock sector is still less important when compared with other farming sectors in terms of the total value of agricultural production. As shown in Table 3-1, the value of domestically produced rice and other food grains accounted for 57.4 percent of the total value of agricultural production, while the value of both livestock and livestock products represented 11.4 percent in 1975. This means that Korean agriculture has been characterized primarily by production of various staple food crops and vegetables for the subsistence needs of the people.

Due to recent increases in average per capita income, the demand for meat and livestock products has increased substantially. This increasing demand has been met both through more production and imports that cover domestic shortfalls. The expanding market demand for livestock products has made livestock production relatively more profitable than food crop cultivation.

The rapid increase in livestock production is shown by the fact that the total value of livestock products increased substantially to 25.2 percent of total agricultural production in 1985. This growth is due not only to the expansion of sideline livestock production by

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traditional farms, but also to the entry of new livestock farms established by entrepreneurs from the non-agricultural sectors.

Table 3-1. Proportion by Commodity of Total Value of Farm Production, 1975-85

(at Current Market Prices)

Year	Total Value of Farm Prod.	Food Crop	Vegetables	Livestock	Livestock Products	Others
	B. Won	....		%	....	
1975	2,651	57.4	15.2	7.7	3.7	16.0
77	4,301	54.1	17.9	11.1	3.4	13.5
79	6,771	49.7	22.2	13.8	3.2	11.1
81	9,150	48.8	17.9	16.7	4.9	11.7
82	9,861	44.3	15.6	21.0	4.5	14.6
83	10,719	43.2	12.9	25.7	5.0	13.2
84	11,463	43.3	14.8	22.7	5.0	14.2
85	12,344	42.5	18.2	20.2	5.0	14.1

Source: Ministry of Agriculture, Forestry and Fisheries

As household incomes have increased with economic development, the total consumption of livestock and livestock products has tended to increase more than other agricultural products. Accordingly, as consumption increases, increases in meat and livestock production can be expected to continue in the future.

For the present, Korean livestock farms can be classified into two basic groups --- traditional farms which raise Korean native livestock, and entrepreneurial livestock farms run by people who entered the business from the non-farming sector.

Most traditional farms raise only one or two head of livestock in order to provide extra cash income for the household. Usually, these small-sized farm operators will buy young livestock requiring relatively little capital and fatten the animal for several months to a year, in preparation for sale. In this case, farmers are feeding the animals mostly with by products from crop farming. Other farms either buy a young calf or a middle-sized animal and raise them for draft purposes and for breeding. However, the main reason for the rearing of imported calves by large-sized enterprise farms is to sell them after fattening, not for draft.

At any earlier stage of development when livestock products were produced largely as a sideline business on traditional crop farms, there were neither problems of short supply nor oversupply because the market demand for meat and livestock was negligible due to very low levels of income and the automatic balance of production with consumption. As the national economy developed, the size of the farm population as compared to the total population decreased, and the number of farms also decreased. Accordingly, the production of livestock sector was not able to respond quickly to the increased demand for livestock products. As a result, severe fluctuations in the prices of livestock products occurred and have become a matter of concern for national economic planners because of their impact on the stability of the general price level.

3.2 Increases in Number of Livestock

The total number of livestock currently on farms has increased greatly in recent years due to favourable prices and some government support policies providing relatively low prices for assorted feed rations and for the distribution of cheap foreign calves for fattening and breeding, the same is true in the case of native cattle which are used for draft purposes on some crop farms or are fattened for sale to provide supplemental farm income. The total number of native cattle increased from 1,314 thousand head in 1965 to 2,553 thousand head in 1985 (Table 3-2). This meant that the rate of increase during the last two decades was 94.3 percent and the annual rate of increase was 4.7 percent. However, the number of native Korean cattle has decreased significantly during the past two years due to the expection of beef import liberalization in the near future.

Table 3-2. Increase in Livestock and Poultry Population, 1965-87

Unit: Thousand Head

Year	Native Cattle	Dairy Cattle	Hog	Chicken
1965	1,314	7	1,382	11,893
70	1,286	24	1,126	23,633
75	1,556	86	1,247	20,939
80	1,427	180	1,784	40,130
82	1,526	228	2,183	46,592
83	1,940	275	3,649	49,239
84	2,318	334	2,958	46,483
85	2,553	390	2,853	51,081
86	2,370	437	3,347	56,095
87	1,923	463	4,281	59,324

Source : MAFF

There were several reasons for the increase in the number of native cattle until 1985. First, the trend was attributable largely to high price levels for domestic beef due to the halt of beef imports in 1984. As a consequence, many farmers wanted to raise cattle. So, calf prices increased by 91.8 percent in 1982 and by 52.6 percent in 1983. Such high prices for calves and cattle encouraged the retention of cattle and a subsequent increase in the number of native cattle.

Second, the government provided institutional credit and the distribution of imported calves at a low price to farmers who were willing to raise livestock. This policy accounts, in part, for the increased number of native Korean cattle.

Another consideration was that by regulation, female cattle could be slaughtered only after they were over six years old, but no minimum slaughter weight or age existed for male cattle until 1985. Using this rule, the government intended to bring about an increase in the total population of cattle by extending the reproductive period of female cattle.

It is interesting that many small-sized farmers are reluctant to raise female calves because old female cattle are cheaper than male cattle due to these restrictions on the slaughtering age. This means that small-sized farms are not very interested in raising cattle for breeding rather than for fattening or growing purposes.

In 1984, the price of a female calf dropped by 35 percent and that of a male calf by 28.3 percent as compared with the previous year's prices. In response, the government abolished the regulation on slaughtering in order to stop any further drops in price of female calves and to stabilize the number of cattle raised. On the other hand, the government permitted the import of a greater number of live calves than were needed to stabilize the price levels at previous market levels.

Dairy cattle have been introduced to Korean agriculture very recently. Koreans started to drink milk only since 1960s. Thereafter, the total number of dairy cattle has increased greatly from 7 thousand head in 1965 to 463 thousand head in 1987 (Table 3-2). In fact, the government has been providing special support for developing dairy farms through distribution of the imported dairy cattle at the lower price without imposing a tariff and rationing assorted feed at a special price. In addition, a profitable price for raw milk sold at the farm gate was set. Accordingly, dairy farming became one of the most profitable, stable, and prosperous agricultural businesses, but it was difficult to enter because the acquisition of dairy cattle was not available at the market. Since 1985, overproduction problems have appeared and there has been some difficulty in marketing all of the milk produced. Nevertheless, the number of dairy cattle did not decrease because it is still a relatively good business and expectations are that milk consumption will increase in the coming years.

As for hog production, the numbers raised have increased sharply since 1970. The total number of hogs raised in Korea increased from 1,382,000 head in 1965 to 4,281,000 head in 1987. This represents about a three-fold increase over a 17 year period. However, this increase has involved cyclical fluctuations between seasons and years. These fluctuations occur because most farmers are quite sensitive to change in market conditions and find it relatively easy to adjust the number of hogs they raise.

Of course, sometimes hog producers have lost money when the production costs suddenly surge due to increases in the price of imported feed grains. When the market price fails to cover production costs, hog farmers lose money. Small-scale hog producers who raise animals as a sideline business are especially hard hit and often must liquidate their stock in order to survive. However, even under adverse financial conditions, large-scale hog production financed with large funds can continue production for a longer time and can often recover the losses from price declines when price increases occur later.

Whenever feed prices decrease due to declines in the price of feedgrains on the world market, it is relatively easy to increase the number of hogs raised and thus expand meat production. However, excess supplies eventually result and market prices again drop. This production cycle results in periodic fluctuations in hog prices and production.

Since livestock raising is intended to yield profits, it is expected that farming practices and managerical ability will consistently improve so as to increase returns per unit of production not only through the expansion of herd size but also through cost reduction.

Poultry production is also an important component of total livestock production. Approximately, 11,893 thousand chickens were raised in 1965 and the number of chickens has increased greatly to 59,324 thousand in 1987. Thus chicken production has expanded about fivefold during the last 22 years.

3.3 Number of Livestock Farms

A large number of Korean native cattle is raised on small-sized farms, often only one or two head. Among a total of 1,871 thousand farm households, 45.6 percent or 854,269 farm households raised native cattle in 1987. Approximately 81.6 percent of all cattle farms had a herd size of only 1 or 2 head, while the percentage of cattle farms raising 3-4 and 5-6 head was 11.1 percent and 3.2 percent, respectively (Table 3-3). Only 2.2 percent of the farms raised more than 10 head of cattle.

Table 3-3. Percentage of Farms Raising Cattle by Herd Size, 1975-87.

Year	Total Farms Raising Cattle	Heads				
		1-2	3-4	5-6	7-9	Over 10
	000	....	....	%	....	....
1975	1,277	97.7	2.0	0.2	..... 0.1	
78	1,176	94.9	4.3	0.5	0.2	0.1
80	948	93.9	4.6	0.8	0.3	0.4
82	896	88.2	8.3	2.0	1.0	0.5
83	971	81.2	13.3	3.3	1.5	0.7
84	1,037	76.1	16.2	4.5	2.2	1.0
85	1,048	74.1	16.4	4.9	2.4	2.2
86	991	77.8	13.8	3.9	2.1	2.4
87	854	81.6	11.1	3.2	1.9	2.2

Source : National Livestock Cooperatives Federation

In the case of traditional farms, it appears difficult for them to raise large numbers of cattle because of the limitations of capital and on-farm feed production. However, the number of households raising several head of cattle has increased slightly each year. It seems, however, that substantial increase can be expected in the future.

By contrast with Korean native cattle, dairy cattle operations was introduced as a new agribusiness in 1970's. Prior to this cows were raised for milk and thus were not counted in food production statistics. The total number of dairy cattle reached only 9,415 head in 1975. Thereafter, the number increased continuously to about 44 thousand in 1985 and then decreased to 38 thousand in 1987 (Table 3-4). The average herd size of dairy farms was much larger than for those farms raising native cattle. Only 8.2 percent of farms raising milk cows had less than two head, while 85.4 percent of the farms raising native cattle in 1987 fit into that category.

Table 3-4 Percentage of Farms Raising Dairy Cattle by Herd Size, 1975, 1980-87

Year	Total Number of Dairy Cattle Farms	Herd Size					
		1-2	3-4	5-6	7-9	10-14	Over 15
1975	9,415	30.8	17.6	13.2	11.9	11.4	15.1
80	22,122	22.1	20.1	16.6	13.5	12.2	15.5
81	18,229	13.7	17.6	16.8	17.3	15.2	19.4
82	22,536	15.8	18.5	16.4	16.5	14.7	18.1
83	29,537	18.8	20.1	15.4	15.5	13.9	16.3
84	37,646	19.2	21.2	16.4	14.7	13.2	15.3
85	43,760	18.7	20.8	16.3	15.0	13.4	15.8
86	42,728	13.4	17.3	17.3	18.2	13.7	20.1
87	38,131	8.2	12.7	15.5	20.4	16.5	26.7

The percentage of farms raising over 10 head of dairy cattle was 43.2 percent, whereas only 2.2 percent of those farms raising Korean cattle had herds that large. It is obvious that most of the dairy cattle farms are new entry farms established by well-capitalized operators from the non-agricultural sector.

As a matter of fact, dairy cattle are much more expensive to maintain when compared with the native cattle of the same body weight. Thus, the actual assets of dairy farms are usually many times greater than the traditional crop farms raising a small number of livestock.

As for hog raising, in 1977, 29.5 percent of all farm households raised hogs, and this percentage decreased continuously to 16.2 percent in 1987. Although the number of hog farms decreased sharply, the total number of hogs raised in Korea more than doubled the last 10 years.

The proportion of farms raising less than four head each decreased from 97.0 percent in 1975 to 72.4 percent in 1987. Moreover, the proportion of hog farms raising more than 100 head increased from 0.3 percent in 1980 to 2.0 percent in 1987 (Table 3-5). As a result, the number of hogs raised per farm increased from an average 1.3 head in 1965 to 3.5 head in 1980 to 14.1 head in 1987.

In the case of chickens, the number of farm households raising chickens accounted for 32.1 percent and 14.4 percent of the total farm households in 1980 and 1987 respectively. Ninety-eight percent of the total farms raising chickens had less than 19 chickens per farm in 1976. The percentage of those chicken-raising farms with flocks of less than 19 chickens has remained relatively unchanged through 1987. By contrast, the percentage of farms more than 1,000 chickens, which accounted for only 0.4 percent of the total chicken-raising households in 1975, increased several-fold to 2.2 percent in 1987. (Table 3-6).

Table 3-5 Percentage of Farms Raising Hogs by Herd Size, 1975, 1980-85

Year	Total Number of Farms Raising Hogs	Head					
		1-4	5-9	10-19	20-29	30-99	100+
1975	654,257	97.0	1.6	0.8	0.2	0.3	0.1
80	502,899	91.5	3.7	2.6	0.8	1.1	0.3
81	424,992	89.5	4.5	3.8	0.6	1.2	0.4
82	443,852	87.2	5.5	4.6	0.6	1.6	0.5
83	539,403	79.0	8.8	8.2	0.8	2.3	0.9
84	362,474	82.0	6.3	6.7	0.9	2.8	1.3
85	251,196	81.7	5.5	5.5	1.7	3.7	1.9
86	262,403	77.2	7.1	7.3	2.3	4.2	1.9
87	302,891	72.4	8.7	8.5	3.0	5.4	2.0

Source: National Livestock Cooperatives Federation

It is said that the optimum number of chickens that can be raised with family labor is around 10,000. But, since small-sized farm households cannot financially sustain flocks of this size, the vast majority of those farm households raising chickens continue to hold very small flocks. The number of farm households raising 1,000 chickens has recently increased from 1.3 percent of the total chicken farms in 1980 to 2.2 percent in 1987 due mainly to the entry of new commercialized farms into the livestock industry.

Table 3-6. Percentage of Farms Raising Chickens by Flock Size, 1980-87

Year	Total Number of Farms Raising Chickens	Number of Birds				
		1-19	20-49	50-999	1,000-4999	5,000+
1976	1,236,771	98.0	1.3	0.3	0.4	0.3
80	692,219	96.5	1.7	0.5	1.0	0.3
81	628,380	97.9	0.5	0.3	1.0	0.3
82	618,463	97.9	0.4	0.3	1.0	0.4
83	538,369	98.0	0.4	0.2	0.9	0.5
84	367,004	97.4	0.6	0.2	1.1	0.7
85	302,775	96.6	0.8	0.4	1.3	0.9
86	281,736	96.4	0.9	0.5	1.1	1.1
87	268,704	96.1	1.2	0.5	1.0	1.2

Source : National Livestock Cooperatives Federation

In 1980, some 692 thousand farm households raised 40,130 thousand birds, but the number of farms raising chickens declined to 269 thousand in 1987 whereas the number of chickens raised increased significantly to 59,324 thousand birds. This means that the average number of chickens raised per farm rose from 58 birds in 1980 to 221 birds in 1987. This statistic indicates that the scale of chicken production has been greatly expanded recently.

In fact, the decline in the total number of chicken farms during the past seven years was 61.2%, a yearly average decline of 8.7%. Nevertheless, the total number of birds raised increased by 47.8% over the same period, a yearly average increase of 6.8 percent. Taking into account the fact that the percentage of total chicken-raising farms with flocks of less than 19 birds has remained at the 96-98 percent level, the increase in the number of chickens is due solely to the entry of new large-scale farms specializing in poultry production. Thus, these large farming enterprises have been replacing traditional poultry producers.

As regards broiler production, some 500,000 farm households raised five million broilers in 1980. Although the number of farm households raising broilers declined to 400,000 in 1987, the number of broilers increased substantially to seven million. This means that the average number of broilers raised per household rose from 92 in 1980 to 178 in 1987. It seems that from 1983 on, broiler production has overexpanded beyond demand. In fact, the decline in the total number of chicken farms means that large-scale broiler production as a commercial enterprise has become the major trend in the industry and that these producers have come to monopolize the market. Many small-sized farms, on the other hand, gave up raising broilers as a sideline activity.

This trend is understandable in past in view of the fact that transportation costs are high for shipping broilers from remote farm areas to urban areas where consumer demand is high. Unit transportation costs are high because of the need to ship produce in the form of live broilers in as much as consumers prefer to buy live birds rather than dressed ones. It is customary for consumers to choose live birds at the market and have the butcher dress the bird in front of the buyer.

Given this consumer preference, commercial poultry producers who have recently entered the business from the non-agricultural sector are mostly located in areas adjacent to cities. Such broiler production relies heavily on assorted feed that is produced near urban areas, unlike traditional producers who relyon byproducts from crop production. These new enterprise farms thus have the advantage of secure supplies of feeds and obtain market information cheaply enabling them to reduce marketing costs. However, location in the suburban areas of cities often requires the payment of higher labor costs than in rural areas. The advantages of the suburban location in terms of lower production and marketing costs appear to offset any higher labor costs. For this reason, almost all the farms now raising more than 10,000 broilers are located in the vicinity of cities.

3.4 Entry of Commercial Farms

Recently, the entry of large-sized commercial full-time livestock firms has increased rapidly. The number of such large-sized enterprise firms with capital generated from investments in the non-agricultural sector is still small, but the production of these firms has already had a substantial influence on market supply and prices. Such farms generally do not produce any feedstuffs, but rely on commercial feeds which are processed with imported feedgrains. These new types of farms are causing significant structural changes in the livestock sector and their influence may become even more pronounced in the coming years.

On the other hand, because of their dependence wholly on imported feeds, these farms are quite vulnerable to cost-price squeezes when the price of imported feedgrains rises. Thus, a change in price levels of feedgrains in the world market would directly affect the profitability of these farms. As a whole, the livestock industry in Korea seems to be more vulnerable to these external shocks, thus leaving it more unstable and relatively less prosperous than other business.

Whereas the base for large-scale livestock production has been expanding due to large capital investments in poultry farms and hog raising, the level of livestock production as a traditional farm household sideline business has steadily declined. In 1980, the number of farms raising hogs was approximately 503 thousand. This number decreased dramatically by 71.6 percent to 303 thousand in 1987.

In the case of livestock production by enterprise farms, economies of scale are realized because a large amount of capital can be used to ensure effective farming. By contrast, when livestock production is undertaken as a sideline business by crop farms, the manure obtained therefrom is used for crop farming to improve soil fertility. However, the farms that specialize in the livestock business feed poultry and hogs commercial feed rations only and are not concerned using animal manure for soil improvement purposes in the process of cultivating land.

This situation may cause environmental pollution due to the generation of offensive effluent, and consequent water contamination.

The increasing number of large-scale livestock farms has inevitably brought about these pollution problems. In addition, if manure is not used as a soil amendment, this may lead to reduced soil fertility and productivity in traditional crop farming due to the lack of the organic manures produced by livestock. From this persepective, the continued production of livestock as a sideline business to crop farming requires policy attention.

As shown above, the extent of entry by entrepreneurs into the livestock industry varies depending on the kind of livestock. Surveys conducted so far show that the share of non-farm capital in the livestock industry is about 90 percent in the case of broilers and about 20 percent in the case of layers. However, the share of such large-scale operations is extremely small in number when it comes to livestock commodities like beef and dairy cattle.

The reasons for variation by livestock product are explained below. First, feed efficacy is relatively higher for feeding small and medium size livestock than for large size livestock, and thus they yield a larger production gain from a given quantity of feed used. Second, even if there is a supply shortage in the production of eggs and broilers, there is no possibility of them being imported thus reducing incentives to expand production. It is relatively easy to increase the production of chickens and hogs whenever the market demand or prices increase. Third, the capital turnover rate is high in broiler and chicken raising. When we take into account these economic factors, continuous flows of investment can be expected in the commercial poultry and hog business. In this connection, there are policy arguments for some kind of democratic control of non-farm funds to cope with the social impacts of this situation. Unless some control over expansion of commercial farms is effected, livestock production by crop farmers as a sideline business will decrease as these producers cannot compete with the large-sized firms.

Development of Commercial Livestock Products

The amount of milk production was 48,000 tons in 1970, and it reached 452,000 tons in 1980, an increase of 9.4 times over a 10 year period. Milk production further increased to 1,337,000 tons in 1987, an increase of 27.9 times over the last 17 years. However, even though most milk cows are not fed much pasture hay but are mostly fed with concentrated feeds, yield levels per head still remain low. The per head average of 4,500-5,000 kg of milk is much lower than in other dairy farms in developed countries. As a result, the unit cost of milk production is high, but the total production of milk tends toward periodic oversupply.

One of the reasons for this overproduction is that the government encourages the promotion of milk production as milk is necessary for a wholesome diet, and thus it guarantees a favorable price which reflects actual production costs in order to provide an incentive to farmers to increase production. In other words, the government sets the retail price. To maintain this price level, the government pays subsidies to guarantee a specific amount of income per unit for producers. The government also purchases any excess supply in order to stabilize the market price.

Therefore, producers have incentives to expand production regardless of the market demand and supply situation because they can obtain a fixed unit price for all the production sold. As a result, raising milk cows has brought relatively more stable incomes to dairy producers than to other kinds of livestock production and thus recently the number of milk cows has increased sharply. In particular, the enterprise farms that entered from the non-agricultural sectors have increased the number of cows faster than traditional farms where dairy cattle are a side-line business. This means that the commercial farms are becoming more important in the changing structure of the dairy industry.

Egg production increased from 2,456 million in 1970 to 6,573,000 million in 1987. This is about a 2.7-fold increase over a seventeen year period. All the eggs produced were consumed domestícally. Even when there was a transitory period of short supplies, no eggs were imported. So, Korea has always been self-sufficient in egg production.

As for beef production, the total number of cattle steadily increased until 1985, but total meat production and average annual rates of increase were insufficient to meet the needs of the people. (Table 3-7). Moreover, the total number of cattle has steadily decreased since 1986 because many farmers believed that the government would open the beef market allowing the import of cheap beef without imposing high tariffs or other trade constraints.

Table 3-7. Rate of Self-sufficiency for Meat, 1975-87

Year	Total Demand for Beef	Supply Prod.	Supply Import	Per Capita Consumption	Self-Sufficiency Ratio
	....	Thousand mt	....	Kg	%
1975	225	225	-	6.4	100.0
78	375	328	47	10.1	87.5
80	433	423	10	11.3	97.8
82	443	398	45	11.3	89.8
83	530	481	49	13.3	90.7
84	564	550	16	13.9	97.2
85	593	588	5	14.4	99.7
86	601	597	4	14.4	99.4
87	669	669	-	15.8	100.0

Source : MAFF

In fact, traditional farms have a difficulty of increasing a large part of their available limited resources toward raising cattle. The commercial farms have a different structure from the traditional family farm that has existed in the livestock sector. Livestock production by the new commercial farms will continue to expand at a rapid rate because they can feed animals with commercial feeds at the relatively attractive prices now existing for imported feedstuffs. Easy expansion in hog and poultry production means that supply should cover domestic demand without difficulty.

However, a shortage of beef production may easily occur in the future due to uncertainties about the increasing number of cattle in the future. One stabilization measure is to maintain the stable production of native cattle through providing stable price levels or encouraging greater consumption of milk through policy programs. If chronic overproduction of milk can be avoided, old milk cows could be utilized as beef sources after their milk production years.

3.6 Trends in Meat Consumption

Data on consumption of all kinds of meat in Korea show that annual consumption per capita was no more than 5.3 kilograms in 1970. Of that amount, 50.5 percent was pork while the shares of beef and chicken were 22.6 and 27.4 percent, respectively. In 1987, per capita annual consumption had increased to 15.8 kilograms, a 3-fold growth over the last 17 years (Table 3-8). The proportion of pork in total meat consumption in 1987 was 56.3 percent, whereas the consumption of beef and chicken accounted for 22.8 and 20.9 percent, respectively. This data shows that the relative importance of pork in the meat diet increased by 5.8 percent, the share of chicken decreased by 6.5 percent, and the relative importance of beef remained unchanged when compared with the 1970 figures.

In terms of consumer meat preferences, it seems that most Koreans prefer beef to other meats though beef is more expensive. This taste for beef may be related to the perception that it is somewhat of a luxury consumption good, since many consumers buy it only occasionally. Also, consumers know more ways to cook beef than pork.

Table 3-8. Proportions of Various Kinds of Meat Consumed Per Capita, 1970-87

Year	Meat Consumption per Capita	Percent of Meat Consumed		
		Beef	Pork	Chicken Meat
	Kg	....	%	....
1970	5.3	22.6	50.3	27.4
71	5.2	23.2	47.5	29.3
72	5.5	21.8	48.8	29.4
73	5.5	24.0	48.2	27.8
74	5.8	25.7	47.7	26.6
75	6.4	31.3	44.0	24.7
76	6.8	30.8	44.4	24.8
77	8.1	27.6	47.7	24.7
78	10.1	30.6	47.5	21.9
79	11.4	26.5	52.5	21.0
80	11.3	23.1	55.9	21.0
81	10.2	23.7	53.3	23.0
82	11.3	24.0	53.6	22.4
83	13.3	21.8	55.6	22.6
84	13.9	18.9	60.2	20.9
85	14.4	20.1	58.4	21.5
86	14.4	25.0	53.5	21.5
87	15.8	22.0	56.3	20.9

Source: National Livestock Cooperative Federation, Materials on Price, Demand and Supply of Livestock Products, 1988, pp.76-77.

As for patterns of meat consumption by income level, people in high-income groups tend to use beef exclusively, while low-income earners generally often choose the less expensive pork and chicken. Because the land size of Korea is relatively small and the Koreans are of a homogenous nature, no regional discrepancy is seen in the pattern of meat consumption. However, there is a clear difference between the rural and urban people due to income disparities.

Since there are many high-income families among urban consumers, a stable consumption pattern for beef continues throughout the year in cities. In the rural areas, not only is the amount of meat consumption less than in urban areas, but also the general trend is to substitute less expensive pork and chicken for beef.

The trend of monthly consumption of meat indicates that 30 to 50 percent more beef is consumed in months containing special days, than in other months, with the months in which Chusok and Lunar New Year's Days fall experiencing particularly high demand. Accordingly, the prices of livestock in rural markets suffer seasonal variations from month to month due to these changes in market demand and supply.

The consumption of pork has increased substantially from 2.6 kg in 1970 to 8.8 kg in 1987. But, a possibility exists that the past pace of increase in pork consumption per capita will slow down in the near future. It is said that in Korea people eat pork only because it is cheaper than beef. This means that if their incomes grow, they would prefer beef to pork. In fact, people tend to shun fatty foods like pork partly because cooking methods are unknown.

In addition, there is a seasonal decline in consumption in summer based on the idea that it is hard to digest pork during hot summer days.

There are no separate and accurate statistics available on the consumption of broilers. Annual consumption of chicken per capita steadily increased from 1.4 kg in 1970 to 3.3 kg in 1987 because chicken was relatively cheap and its price was quite stable compared with beef and pork prices. However, since the method of cooking chicken is plain compared with pork and beef, it seems that there will be a limit to further substantial expansion of chicken consumption. In particular, the fact that recently an increasing number of people have come to believe that fish is better than meat for one's health is likely to promote fish as a substitute for chicken and pork in the coming years. Under these circumstances, adjustments of the production and supply of chicken will become a major policy concern in the future.

As is the case with broilers, the production of layers is undertaken on a large scale financed by non-farm funds in suburban areas near large cities. Since feed prices remain stable and grain prices had been on a downward trend, the cost of purchased feed has generally tended to decline. However, because wages are on the increase in these large-scale operation, attempts are made to pursue profits through expanded production. This may cause an oversupply and the plummeting of the price of eggs in the future. In reality, it seems that the only increase in production of eggs needed will be commensurate with population growth. Since the price elasticity of demand for eggs is relatively low, even a slight oversupply could lead to a sharp price decline. Thus, the impact of demand and supply conditions on price changes in this industry could be large. So, in the near future, the most important marketing task is to stabilize the demand and supply of eggs thus ensuring price stability, in that industry.

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IV. Meat Consumption Patterns and Purchasing Behavior of Urban Households

In-Joon Seol*

I. Introduction

Increasing incomes, industrial improvements and other changes in socio-economic conditions have resulted in sharp increases in consumer demand for meat and in steady improvement of dietary patterns in urban households in a way that has given a growing importance to such foods as meat, vegetables and fruits formerly considered luxury items. This has led to a departure from the conventional rice-oriented dietary patterns.

However, Korea has failed to cope effectively with the dramatic surge in the demand for meat primarily due to an inefficient production system for livestock and a lack of adequate price mechanisms for controlling meat supply in the long run. As a result, a chronic shortage of domestic beef and a large imbalance between the supply and demand for pork and chicken have resulted. Moreover, despite government efforts to improve the food marketing system, meat marketing has remained out of date. Excessive marketing margins and unreasonable conduct in business transactions of livestock and meat have emerged as major factors detrimental to the development of the Korean livestock-meat industry.

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The Korean people's strong preferences for beef have undermined government attempts to substitute pork and chicken for beef. Despite the steady promotional activities stating that pork and chicken are cheaper than beef and carry a high nutritional value, the reluctance to use pork and chicken persists, and consumers' strong preferences for domestic beef show no signs of decline. Lately, the government has imported large number of beef cattle from abroad to increase the supply of beef and to increase the number of raising cattle. However, because of differences in taste and quality between domestic beef and imported beef, it is questionable how well imported cheap beef could serve as a substitute for domestic beef. It was feared by farmers that large quantity of cheap imported beef might have not only undermined the development of the livestock-meat industry but also caused a setback in a plan to increase Korean native cattle numbers.

As income continues to rise and consumption patterns grow more diverse in the quest for luxury foods, domestic consumption of beef, pork and chicken will continue to expand. However, the marginal production cost of domestic beef is extremely high and it will be very difficult to attain a state of beef self-sufficiency. Thus seen, the future basic policy of livestock development should be directed towards the stable production and supply of cheaper meat, through cost reduction made possible by improvement in production technology and increases in marketing efficiency. More important, an effective means should be devised to improve the existing meat consumption patterns focused on domestic beef. One possible method would be to establish price differences among various types of meat enough to make pork and chicken stronger substitutes for beef. Another method would be to carry out positive promotional activities to increase consumers' demand for pork and chicken, and to reduce their strong preferences for beef. Promotional activities would include the development and dissemination of new methods of cooking pork and chicken.

In order to develop and promote the programs to improve meat consumption patterns, first there is a need to identify consumers' attitude toward the various kinds of meat. Information regarding the types and amounts of meat purchased, the source and time of such purchases, the method of purchase, and what factors affect preferences and purchases should be obtained.

In addition, it must be understood that there exist marked differences in meat consumption patterns and purchasing behavior between Seoul and provincial cities. Heterogeneity in various sectors such as society, economy and culture between the urban capital and less developed cities causes these differences. However, there has been no in-depth study of this situation.

1. Objectives of the Study

Based on the various issues discussed above, this study attempts to provide materials needed for the improvement of meat consumption patterns and purchasing behavior by studying and analyzing consumers' demand for, and then method of purchasing of beef, pork and chicken. This study attempts to obtain information necessary for the formulation of desirable policies for the stability of meat prices.

The specific objectives of this study are to obtain answers to the following questions:

(1) Which kind of meat do urban households purchase, and in what amounts and how ?

(2) How do changes in meat consumption of urban households differ according to changes in various factors such as income, family size and occupation ?

(3) What is the degree of consumers' preferences for domestic beef, and to what extent are consumers satisfied with pork and chicken ?

(4) What are the causes of the consumers' positive and negative aspects towards imported beef ?

(5) What is consumers' opinion of grading and pre-packaging meat ?

(6) What are the differences in meat consumption and the method of purchase between Seoul and provincial cities, and what major factors contribute to such differences ?

2. Selection of Sample Households

To collect information necessary for the analysis of meat consumption patterns and purchasing behavior of urban households, a household survey was conducted in Seoul and in some provincial cities Taegu, Kwangju, Suwon, Jinju and Chongju.

Originally, 2,000 households -1,200 in Seoul and 800 in the provincial cities - were surveyed. However, some of them were excluded from the final tabulation and analysis stage because they did not provide consistent information regarding income or some other major items. Therefore, the number of households included in the final analysis was 1,667, of which 1,128 were from Seoul and 539 from the provincial cities.

3. Method of Data Collection

This survey was conducted for two months in August and September, 1982. The survey was carried out under the so-called field survey method, in which trained surveyors directly made door-to-door visits and filled survey sheets through interviews with family heads or housewives. The data collected by surveyors were carefully reviewed by senior surveyors in charge of the survey of their respective areas. Those surveys considered incomplete or unclear were clarified by a supplementary survey. Households whose monthly incomes were less than one hundred thousand won or which consisted of only one person in the family were excluded from the survey, since their consumption patterns were assumed to be abnormal.

II. Meat Consumption Patterns of Urban Households

1. Food Expenditure Patterns

Socio-economic characteristics such as household incomes, family size and the occupation of the household head were taken as major factors having a major effect on the food expenditure patterns of urban households. Consumers' responses in food expenditure to changes in these factors will be explained in this section.

Table 1 shows that monthly total consumption expenditure per household was 364 thousand won on the average, of which food accounted for 135 thousand won. Engel's coefficient was 37. Per capita monthly total consumption and food expenditure were about 74 thousand won and 27 thousand won, respectively, figures which were substantially higher than those surveyed by Economic Planning Board.[1/] Regionally, Seoul showed much higher household consumption and food expenditure than the provincial cities and its Engel's coefficient was a little lower. As household income increased, both total consumption and food expenditure experienced rapid increases. However, the rate of increase in total consumption expenditure was less than the rate of increase in income. This shows a declining average propensity to consume. At the same time, the rate of increase in food expenditure was less than that of total consumption expenditures, causing the Engel's coefficient to decrease. Engel's coefficients by income groups were as follows; the lowest income group with monthly income of 100-299 thousand won per

Table 1. Monthly Total Consumption and Food Expenditures per Household and Engel's Coefficients by Region, Income, Family size, and Occupation of Household Head, 1,667 Households Surveyed

Unit : 1,000 won

	No. of Households Surveyed	No. of Family Members	Total Consumption Expenditures	Food Expenditures	Engel's Coefficients
All Households	1,667	4.94	364 (74)	135 (27)	37.1
By Region					
Seoul	1,128	4.95	403 (81)	148 (30)	36.7
Provincial cities	539	4.94	282 (57)	108 (22)	38.3
By Income(1,000 won)					
100 - 299	346	4.42	186 (42)	81 (18)	43.5
300 - 499	590	4.47	283 (63)	112 (25)	39.6
500 - 699	418	5.10	411 (81)	150 (29)	36.5
700 - 999	169	5.33	570(107)	201 (38)	35.3
1,000 or over	144	5.97	751(126)	241 (40)	32.1
By Size of Family					
2 - 3	293	2.62	257 (98)	97 (37)	37.7
4 - 5	819	4.51	354 (78)	132 (29)	37.3
6 - 7	447	6.37	434 (68)	156 (24)	35.9
8 or over	108	8.63	448 (52)	180 (21)	40.2
By Occupation of Head					
Clerical workers	882	4.84	353 (73)	131 (27)	37.1
Laborers	185	4.95	283 (57)	112 (23)	39.6
Merchants	475	5.17	387 (75)	145 (28)	37.5
Others	125	4.72	482(102)	164 (35)	34.0

Note : Figures in parentheses represent per capita consumption and food expenditures.

household, 43.5; the middle income group with 500-699 thousand won, 36.5; the highest income group with 1,000 thousand won or over, 32.1. This declining trend of the Engel's coefficients is explained by the fact that the income elasticity of the demand for all food becomes inelastic as income increases.

The increase in household income led to a substantial increase in the absolute amount of per capita food expenditure. Per capita monthly food expenditure in households of the lowest income group was only 18 thousand won, while in households of the highest income group it was 40 thousand won. Due to limited information, it was difficult to accurately determine all the detailed factors leading to the absolute rise in per capita food expenditures. However, factors leading to such a rise includes the fact that high income households consumed good quality and expensive foods, and also sought better services from the food marketing system and spent a larger portion of their income eating out.

Table 1 indicates that an increase in family size led to a lesser rate of increase in average food expenditure per household and to a declining trend of Engel's coefficients. However, per capita food expenditures declined as the number of family members increased.

1/ According to the Family Income and Expenditure Survey conducted in 1982, per capita monthly total consumption expenditure was fifty-seven thousand won, of which food expense accounted at twenty-three thousand won. The Engel's coefficient was about 41. For more detailed information, see "Annual Report on the Family Income and Expenditure Survey", Economic Planning Board, 1982, pp. 58-59.

That is, per capita monthly food expenditure of a household with two to three persons was 37 thousand won, but that of a household with eight persons or over was no more than 21 thousand won. The reduced per capita food expenditure among large families was presumably due to the fact that large families tended to have many children (therefore, per capita income was small) and economies of family size occurred as family size increased.

The relationship between average monthly food expenditure per household and the occupation of household heads was studied. Households whose family head was engaged in commerce spent 145 thousand won which figure was slightly higher than for those households whose household heads were engaged as clerical workers and skilled or manual laborers. The household heads engaged as skilled or manual laborers spent on the average 112 thousand won a month which represented the lowest figure, and the Engel's coefficient of this group was 39.6, the highest. The differences in food expenditures and Engel's coefficients among the occupations of household heads were due to differences in the type and quantity of foods they purchased as well as to income differences.

2. Meat Consumption Patterns

Monthly meat consumption for all households surveyed was 5.55kg per household or 1.12kg per capita, on the average, as shown in Table 2. Chicken accounted for 40 percent of the total meat consumed, followed by beef, 38 percent, and pork, 22 percent. Monthly average consumption of imported beef per household was 0.64kg, which represented 11 percent of all meat consumed and 30 percent of all beef consumed. This share of imported beef was larger than previously assumed.

Only fresh meat consumed in households was taken into account by the survey. Processed meat and meat consumed in eating out by members of households were not included because of survey difficulties. The findings of this survey compared favourably with other estimates regarding the overall quantity of meat consumed, but substantial differences appeared in the relative quantities of the types of meat consumed.[1/]

This survey showed that the amount of chicken consumed was quite large relative to that of pork. It is believed that this is attributable to the fact that the survey was conducted in the summer season when demand for chicken is high while that for pork is low.

1/ The estimates of the National Livestock Cooperatives Federation indicated that per capita monthly meat consumption was about 0.94kg on the national average in 1982. These quantities were 16 percent less than the quantities consumed by the sample households in this study. Pork accounted for the largest quantity 54 percent of the total meat consumed. Beef was second with 24 percent, followed by chicken with 22 percent. See "Materials on Price, Demand & Supply for Livestock Products", National Livestock Cooperatives Federation, Research Report 84-1, pp. 88-89.

Other meat consumption surveys conducted in the summer season by the National Livestock Cooperatives Federation revealed that per capita monthly meat consumption in Seoul was about 1.5kg, compared with 1.17kg obtained in this analysis. Of the total, beef and chicken represented 33 percent and 39 percent, respectively. The remaining 28 percent was pork. See "Report on the Consumer Preference Survey for Meat", National Livestock Cooperatives Federation. Research Report 81-5, 1981. 9, p. 5.

Table 2. Monthly Meat Consumption per Household by Region, Income, Family Size and Occupation of Household Head

Unit : kg

	Beef			Pork	Chicken	Total
	Domestic	Imported	Sub-total			
All Households	1.47	0.62	2.09	1.22	2.24	5.55(1.12)
By Region						
Seoul	1.65	0.80	2.45	1.22	2.11	5.78(1.17)
Provincial cities	1.08	0.25	1.33	1.21	2.52	5.06(1.02)
By Income(1,000won)						
100 - 299	0.60	0.28	0.88	0.95	1.84	3.67(0.83)
300 - 499	0.93	0.46	1.39	1.05	2.04	4.48(1.00)
500 - 699	1.63	0.70	2.33	1.31	2.49	6.13(1.20)
700 - 999	2.65	1.09	3.74	1.49	2.57	7.80(1.46)
1,000 or over	3.94	1.32	5.26	1.95	2.90	10.11(1.69)
By Size of Family						
2 - 3	1.05	0.35	1.40	0.83	1.84	4.07(1.55)
4 - 5	1.39	0.61	2.00	1.14	2.26	5.40(1.20)
6 - 7	1.81	0.79	2.60	1.46	2.40	6.46(1.01)
8 or over	1.84	0.76	2.60	1.77	2.54	6.91(0.80)
By Occupation of Head						
Clerical workers	1.42	0.62	2.04	1.17	2.25	5.46(1.13)
Laborers	1.10	0.36	1.46	1.34	2.47	5.27(1.06)
Merchants	1.63	0.67	2.30	1.36	2.38	6.04(1.17)
Others	1.78	0.84	2.62	0.77	1.22	4.61(0.98)

Note : Figures in parentheses represent per capita meat consumption per month.

The amount and compostion of the meat consumed showed sizable regional differences. Monthly meat consumption per household in Seoul was 5.78kg, but 5.06kg in provincial cities, 0.72kg less than Seoul. Seoul households consumed much more beef and less chicken than households in provincial cities. The consumption of pork was roughly equivalent. For imported beef, monthly consumption per household was 0.8kg in Seoul, more than three times as much as in the provincial cities. This is due to the fact that imported beef was being released chiefly in the Seoul area when this survey was conducted.

There was a close positive relationship between household income and the amount of meat consumed. Average monthly meat consumption per household was no more than 3.67 kg for the lowest income group with monthly income of 100-299 thousand won, but no less than 10.11 kg for the highest income group with monthly income of 1,000 thousand won or more. Per capita meat consumption of the high income group was also much higher than that of low income group. In addition to consuming more beef, high income households also consumed more pork and chicken than low income households. Beef consumption showed a wider difference between the high and low income groups, than either pork or chicken consumption. Accordingly, beef's share of total meat consumption was 24 percent for the lowest income group, but increased to 52 percent for the highest income group. By comparison, chicken's share declined from 50 percent of the lowest income group to 29 percent of the highest income group, as did pork's share, from 26 percent to 19 percent. Thus an increase in household income would --- should meat price and other conditions remain unchanged -- lead to an increase in beef consumption at a rate greater than that of either pork or chicken. The consumption of imported beef, too, was greater among the high income households than among low income households. This difference was far greater than that of pork and chicken.

As family size increased, families consumed more meat. However, the rate of increase in meat consumption was less than the rate of the increase in family size, which resulted in the declining per capita meat consumption. Average monthly meat consumption per household was 4.07 kg for the households with two to three members, and 6.91 kg of households with eight or more members. Thus per capita consumption declined sharply from 1.55 kg to 0.8 kg as household members increased from two to three members, to eight or more members. The reduced per capita meat consumption of the households with large family members can be explained by the fact that declining per capita income of households with large family members resulted in reduced per capita food expenditure as discussed earlier.

Average meat consumption per household according to occupation of the household head was determined. Consumption was 6.0 kg, among households whose heads were engaged in commerce. This was the greatest figure, consumption among the households whose heads were clerical workers was 5.4 kg, a little more than the 5.27 kg consumed by the households whose heads were skilled or physical laborers. It was shown that meat consumption per capita was almost directly proportional to income level per household. The households having skilled or physical laborers had conspicuously low beef consumption, 1.46 kg. Their chicken and pork consumption however, was higher than the households whose heads were clerical workers.

All of the households surveyed purchased one or more of the three types of meat -- beef, pork and chicken - at least once during the period of this survey. But a considerable number of the households did not purchase or consume one or two types of meat at all. Of the total households surveyed, 5 percent did not consume beef, while 23 percent and 29 percent did not consume pork and chicken respectively. Most of the households which did not purchase beef were the low income groups and simply could not afford to purchase expensive beef. The only major reasons for not using pork and chicken were traditional taboos, such as oriental medicinal claims that pork and chicken lead to high blood pressure.[7)]

3. Estimates of Consumer Demand for Meat

A. Estimation Model and Data Used

The socio-economic conditions affecting the urban demand for meat include; disposable income of households, family size, composition of family by sex and age, occupation of family members, and family members' tastes and preferences for meat. However, it is difficult to define and quantify factors other than household income and family size. Therefore, in this analysis only disposable income and family size were used as explanatory variables of consumer demand for meat.

In general, change in income is considered to be the most important demand-shifter. In this analysis, however, total consumption expenditure was used as a proxy for income. This was because it was extremely difficult to collect reliable income information through the household survey. It is known that income information from surveys generally under-estimate income. This trend is more prevalent in the high income households than the low income households. The consumption expenditure is generally used as an explanatory variable of demand, in the event that income data are not available. In some instances the consumption expenditure is used even when income information is available, because the consumption expenditure is a better measure of "true" income due to the fact that in the short run consumers have more control over expenditure than over income.[3)]

Family size is an important factor determining the demand for meat. To consider in full detail the effect of family size on demand for meat, it is desirable to include sex and age compositions of households, in addition to the number of family members, in the consumption unit based on nutritional requirements. However, such adjustments were impossible with the information collected. Therefore, only the number of persons in the family was used in estimating effects of family size.

A functional demand formula in which the meat consumption of urban households was considered as a function of household consumption expenditure and family size, is a double logarithmic regression equation described in equation 1.

$$\log Q = \alpha + \log Y + \gamma \log N \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

Where Q ... Average monthly meat consumption per household(gram)

Y ... Average monthly consumption expenditure per household (won)

N ... Number of family members per household (persons)

Equation 1 was estimated using the OLS method of regression. For this model, individual observations were classified into 14 household consumption expenditure groups and then average household consumption expenditure, average meat consumption and family size were calculated for each group.

In addition, the income elasticity of demand for meat was estimated, using only per capita consumption expenditure as an explanatory variable and per capita meat consumption as a dependent variable. Per capita information was determined by dividing average household consumption expenditure and average meat consumption by the number of family members. The functional relationship between two variables is described in equation 2.

$$\log (Q/N) = a + b \log (Y/N) \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

Equation 2 was estimated using the OLS method of regression in a double logarithmic equation, which yields an estimate of income elasticity directly. In this analysis, individual observations were converted into a per capita basis and then classified into 14 groups of per capita consumption expenditure. For each group, per capita consumption expenditure and per capita meat consumption were calculated.

B. Results of Estimation

The estimation results of consumer demand for meat by types of meat are given in Table 3. Since double logarithmic functions are used, the estimated regression coefficients indicate elasticities. The figures in parentheses represent the standard errors of each regression coefficient. The values of the coefficient of determination (R^2) are all high. This is mainly because grouped data were used rather than individual observations.[3)] These estimated elasticities for meat represent constant elasticities over the range of income between 100 thousand won and about 1,100 thousand won per month per household.

The income elasticity for chicken estimated with equation 1 is not statistically significant, but all other income elasticities are highly significant. Consumption of all types of meat increased as household income rose, but to a varying degree depending on the type of meat. The income elasticity for beef was 1.34 which showed an elastic response to income. The estimate of the income elasticity for domestic beef is 1.45, much higher than that of imported beef, 1.18. The estimates of the income elasticities for pork and chicken are 0.44 and 0.22, respectively, indicating very inelastic responses to income.

Family-size elasticities estimated using equation 1 all have negative signs and are statistically insignificant. The negative sign of the family-size elasticities result from the fact that, as an increase in family-size makes the family relatively poorer, the family, after an increase in expenditure on relatively inexpensive food grains and other necessary goods, cannot but spend less on other expensive goods such as meat.

Table 3. Estimated Income and Family Size Elasticities for Meat

		Constant Term	Estimated Elasticities		R^2
			Income(Y)	Family-Size(N)	
Equation 1	Beef	0.725	1.342*	-1.214	0.9959
			(0.106)	(0.442)	
	Domestic	0.541	1.447*	-1.559	0.9858
			(0.205)	(0.850)	
	Imported	0.288	1.182*	-0.772	0.9633
			(0.309)	(1.282)	
	Pork	2,282	0.434*	-0.439	0.9665
			(0.099)	(0.411)	
	Chicken	2,872	0.216*	-0.104	0.8205
			(0.148)	(0.614)	
Equation 2	Beef	0.617	1.076*	-	0.9950
			(0.031)		
	Domestic	0.422	1.097*	-	0.9918
			(0.041)		
	Imported	0.189	1.024*	-	0.9888
			(0.045)		
	Pork	1.902	0.276*	-	0.8448
			(0.050)		
	Chicken	2.052	0.350*	-	0.8311
			(0.068)		

Equation 1 : $\log Q = \alpha + \beta \log Y + \gamma \log N$
Equation 2 : $\log(Q/N) = a + b \log(Y/N)$

Figures in parentheses are the standard errors of the respective regression coefficients.
* Significant at the one percent level.

The income elasticities for meat estimated using equation 2 are statistically significant. With the exception of chicken, all estimates are lower than those determined using equation 1. In particular, the income elasticity for pork is 0.28, much lower than the estimate under equation 1. However, the income elasticity for chicken is 0.35, much higher than the estimate under equation 1.

The income elasticities for meat estimated using this cross section analysis were compared with the estimated values from the time series analysis determined in previous studies. The income elasticity of beef was similar to previous estimates, while those of pork and chicken were lower than previous estimates.[1/] Of course, because of the conceptional difference between cross section and time series analyses, it may be meaningless to directly compare the income elasticities estimated using the two methods. The time series data reflect the dynamic change involving various economic, social and institutional changes occurring in the past, whereas cross section data indicate the static condition of a specific time. It is important, however, to understand that the income elasticity estimated

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1/ The National Livestock Cooperatives Federation estimated the elasticity of demand for meat using annual time-series data for the period 1961-79. This estimation showed that the elasticities of demand with respect to income were 1.21 for beef, 1.11 for pork, and 0.40 for chicken. The measure of income elasticity of demand for pork is much higher than the results obtained from cross section data in this analysis. For estimation methods and procedures, see "A Study on the Demand-Supply Estimation and Stabilization for Meat", National Livestock Cooperatives Federation, Research Report 81-6. December 1981, pp. 8-13.

from cross section data reflect a long-term response rather than a short-term one.

The income elasticities for pork and chicken estimated in this analysis using the data for quantity demanded (in terms of weight) were also lower than those estimated in previous cross-section analyses using family budget data.[2/] The difference between coefficients of income elasticity of quantity and expenditure results from the consumption of better quality and more expensive processed meats as consumer income rises.

2/ The elasticities of meat expenditures with respect to total consumption expenditures were estimated by National Agricultural Cooperatives Federation using family budget data prepared by the Economic Planning Board. This analysis showed that the expenditure elasticities of pork ranged from 0.72 in 1977 to 0.46 in 1978 and those of chicken from 0.69 in 1977 to 0.43 in 1978. See the Purchases of Agricultural Products, National Agricultural Cooperatives Federation, "Monthly Review", January 1980, p. 29.

III. Meat Purchasing Behavior of Urban Households

1. Consumer Preferences for Meat

As discussed earlier, consumers' preferences for domestic beef were found to be extremely high. The reasons for their preferences for domestic beef are indicated in Table 4. Fifty-nine percent of the households cited better taste; twenty-seven percent cited established eating habits. It should be noted that the habit of taking tasty domestic beef over a long period of time could lead to established eating habits, thus the two main reasons cited would be related each other.

Regionally, the absolute majority -- more than 85 percent -- of households in both Seoul and provincial cities preferred domestic beef because of its better taste and their established eating habits. In Seoul, taste was cited more frequently than established habits. But in provincial cities the opposite occurred, established habits were cited more frequently than taste. The households with high income cited taste most frequently, but low income households cited established eating habits most frequently. The reasons for consumers' preferences for pork are as follows. One reason cited by 33 percent of the household was the inexpensive price of pork. This reason was more common in provincial cities than in Seoul, and among low income households than among high income households. Thus, pork could serve as a substitute for domestic beef to a certain extent by keeping the

Table 4. Reasons for Consumers' Preferences for Meat by Region and Household

Unit : % of households

	All households	Region		Level of Household Income(1,000won)				
		Seoul	Provincial cities	100-299	300-499	500-699	700-999	1,000 or over
Domestic Beef								
Good taste	59.2	64.1	51.1	57.6	56.2	60.9	62.1	64.7
Established eating habits	26.6	22.1	34.0	28.2	29.2	24.4	23.7	22.9
Easy to buy the desired parts	7.5	7.5	7.4	5.0	7.7	8.4	8.7	7.9
Near by shops do not sell imported beef	3.3	2.7	4.3	5.6	3.1	3.0	1.8	1.8
Others	3.4	3.6	3.2	3.6	3.8	3.3	3.7	2.7
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Pork								
Cheap	33.0	30.2	39.5	41.6	36.2	27.7	26.8	23.6
Particular flavour	25.6	24.4	28.5	24.8	26.6	26.3	24.3	23.3
Cooking methods	11.1	9.9	13.9	10.9	11.0	10.7	11.0	13.8
Enjoy an occasional change in diet	21.0	25.6	10.2	12.3	18.5	23.8	27.5	33.6
Other	9.3	9.9	7.9	10.4	7.7	11.5	10.4	5.7
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Chicken								
Particular flavour	35.1	34.7	36.0	30.9	33.2	35.9	39.8	43.5
Enjoy an occasional change in diet	26.7	29.5	20.0	20.4	26.0	29.1	30.8	32.0
Reasonably priced	19.0	17.9	21.6	26.9	21.4	15.4	16.0	5.5
Convenient to cook	9.0	8.9	9.3	9.7	9.3	9.7	7.7	6.7
Others	10.2	9.0	13.1	12.1	10.1	9.9	5.7	12.3
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

pork price low relative to the domestic beef price. The substitution effect was strongest among low income households. Another reason cited by twenty-six percent of the households was particular flavour of pork. Twenty-one percent of the households said they used pork to enjoy an occasional change in diet, and 11 percent of the households said diverse dishes could be cooked with pork.

The most frequently cited reason for consumers' preference for chicken was its particular flavour. Thirty-five percent of the households gave his response. Twenty-seven percent of the households said they took chicken as an occasional change in diet and 19 percent of the households said its reasonable price encouraged them to buy chicken. The major reason for consuming chicken for high income households was its particular flavour; for low income households its reasonable price was most attractive.

Consumers' responses to imported beef, both positive and negative, are shown in Table 5. Positive responses included; inexpensive price, grading by parts, accurate weights, and convenience in purchasing. These responses could be grouped into two reasons for consuming imported beef. Essentially, it was inexpensive and convenient to purchase because it was graded by parts and pre-packaged. However, it is very important to note that despite the government's low-price policy for imported beef, only 25 percent of the households cited inexpensive price as a reason for preference. This was less than was presumed. A more commonly cited reason for the use of imported beef lay in its grading and packaging rather than in price.

Regionally, households in provincial cities used imported beef mainly because it was cheaper than domestic beef. In Seoul, households used imported beef mainly because of its grading and pre-packaging. Low-income households placed their greatest emphasis on price, but high income households on grading and pre-packaging.

Negative responses to imported beef included; distrust of contents because pre-packaging did not permit close examination; difficulty in purchasing because the supply of imported beef was limited in provincial cities; and fact that imported beef had been frozen. Those households which did not trust the contents of pre-packaged meat represented 37 percent of the total households. Regionally, 42 percent in Seoul and 28 percent in provincial cities did not trust the contents of the pre-packaged meat. This consumers' distrust of imported beef is derived from the fact that fat or low quality meat were added in excessive amounts to packaged contents. But it is presumed that a more fundamental reason for the distrust was due to consumers' long accustomed habits of purchasing beef by examining contents in person at their butcher stores. Difficulties in purchasing were cited by 24 percent of the households. Regionally, 33 percent in provincial cities, but only 19 percent in Seoul cited difficulties in purchasing. Even among provincial cities difficulties were most common in small cities. Dislike of imported beef because it has been frozen and because its price was expensive compared with its taste, were cited by 18 percent and 13 percent of the households respectively. These latter two responses were more prevalent among high income households.

Table 5. Consumers' Responses to Imported Beef by Region and Household Income

Unit : % of households

	All households	Region		Level of Household Income(1,000won)				
		Seoul	Provincial cities	100-299	300-499	500-699	700-999	1,000 or over
Positive Responses								
cheaper than domestic beef	25.2	21.3	38.3	36.7	27.7	20.5	18.5	16.5
graded by parts	24.8	26.6	19.0	21.1	22.3	27.4	26.5	25.4
convenient to purchase	21.0	22.9	14.9	14.8	21.4	23.3	27.5	29.2
accurate weights	17.1	18.1	13.5	12.9	16.3	17.0	21.1	21.0
other	11.9	11.1	14.3	14.5	12.3	11.8	6.4	7.9
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Negative Responses								
distrust contents	36.6	42.4	28.2	33.3	35.9	44.0	38.1	29.0
difficult to purchase	23.6	18.6	32.6	30.4	26.8	16.3	11.9	13.9
dislike frozen meat	17.6	20.2	14.1	10.8	15.1	22.0	26.4	32.6
dislike taste	12.6	10.5	13.1	13.5	13.6	8.7	15.4	16.9
other	9.6	8.3	12.0	12.0	8.6	9.0	8.2	7.6
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

2. Household Location and Place of Meat Purchase

The places of consumers' purchases of beef and pork included ordinary butcher shops, supermarkets, department stores and shops of the Livestock Cooperatives. Of these, ordinary butcher shops operating as independent retail outlets, specializing in beef and pork, were patronized most often by consumers consumer patronage of supermarkets has been increasing recently, but was and is was still low.

Table 6 shows that as many as 79 percent of the households used to purchase meat at ordinary butcher shops, while a mere 15 percent purchased meat from supermarkets or department stores. In general, households more often patronized butcher shops in their own neighborhood rather than those in marketplaces. This is probably because of greater convenience, trust in quality and quantity and credit opportunities at neighborhood butcher shops.

Regionally, 72 percent of the households patronized ordinary butcher shops in Seoul. The patronization rate for butcher shops was much higher in provincial cities, particularly for those in market-places. The patronization rate for supermarkets and department stores was much higher in Seoul than in provincial cities. The patronization rate of retail shops operated by the Livestock Cooperatives was 5 percent on the average, but 7 percent in Seoul and 0.2 percent in provincial cities. The sluggish patronizing of Livestock Cooperatives shops and the large regional gap were attributable to the fact that few of these retail shops existed and nearly all of them were located in Seoul.

Table 6. Place of Consumers' Meat Purchases by Region and Household Income

Unit : % of households

	All households	Region		Level of Household Income (1,000won)				
		Seoul	Provincial cities	100-299	300-499	500-699	700-999	1,000 or over
Butcher Shops	79.3	72.3	93.9	89.0	83.9	74.9	69.2	61.8
in village	(63.8)	(65.2)	(60.7)	(63.0)	(64.9)	(64.6)	(63.3)	(59.0)
in market	(15.5)	(7.1)	(33.2)	(26.0)	(19.0)	(10.3)	(5.9)	(2.8)
Supermarkets & Department stores	15.3	19.9	5.8	6.7	11.0	19.1	26.6	29.2
Shops of Livestock Coop.	4.9	7.2	0.2	4.0	4.9	5.7	3.6	6.2
Other Shops	0.5	0.6	0.1	0.3	0.2	0.3	0.6	2.8
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
No. of Respondents	1,667	1,128	539	346	590	418	169	144

As household income rose, high income households, patronization rate of ordinary butcher shops fell and the rate of patronization for supermarkets and department stores rose significantly. The patronization rate for ordinary butcher shops was 89 percent for the lowest income group with a monthly income of 100-299 thousand won. However, the rate was 62 percent for the highest income group with a monthly income of 1,000 thousand won or over. By contrast, the patronization rate for supermarkets and department stores was 7 percent for the lowest income group and 29 percent for the highest income group. This phenomenon is attributable to the fact that as consumers' income increased and dietary patterns improved, consumer demand for marketing services increased and consumers preferred the supermarkets where they could make all their purchases at one stop.

The places of meat purchases varied widely between residential districts and apartment estates as shown in Table 7. In Seoul, the patronization rate for ordinary butcher shops was 83 percent for the households in residential districts while the rate was only 47 percent for the households in apartment estates. On the other hand, the patronization rate for supermarkets and department stores was only 9 percent in residential districts but it was 46 percent in apartment estimates. In the case of provincial cities, the patronization rate for ordinary butcher shops was 96 percent in residential districts and 87 percent in apartment estates while the patronization rate for supermarkets and department stores was 3 percent in the residential districts and 14 percent in appartment estates.

Table 7. Place of Consumers' Meat Purchases by Household Location

Unit : % of households

Purchasing Place \ Location of House	Seoul				Provincial Cities			
	Residential districts	Apartment estates	Others	Average	Residential districts	Apartment estates	Others	Average
Butcher Shops	82.6	47.1	83.9	72.3	96.3	86.5	92.0	93.9
in village	(73.9)	(43.8)	(75.3)	(65.2)	(64.8)	(50.5)	(52.0)	(60.7)
in market	(8.7)	(3.3)	(8.6)	(7.1)	(31.5)	(36.0)	(40.0)	(33.2)
Supermarkets & Department Stores	8.5	46.2	12.4	19.9	3.2	13.5	8.0	5.8
Shops of Livestock Coop.	8.4	5.5	3.7	7.2	0.3	-	-	0.2
Other Shops	0.5	1.2	-	0.6	0.2	-	-	0.1
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
No. of Respondents	716	331	81	1,128	378	111	50	539

3. Purchase Size and Frequency

The amount of meat consumers purchase over a specific period of time depends on purchase size and purchasing frequency. Therefore, it is important to know not only the amount of meat purchased but also purchase size at one time and purchasing frequency.

Although consumers can purchase any amount of beef at any time, the average individual purchase size for beef in more than 70 percent of the households both in Seoul and in provincial cities was just 600 grams as shown in Table 8. Presumably, this is because the long-held custom of the Korean using the "Keun" (equivalent of about 600 grams) which has been the traditional basic unit of weight in Korea.

High incomes with a monthly income of 1,000 won or more tended to make large beef purchases. As much as fifty percent of these households purchased more than 600 grams of beef at one time. Among the lowest income households with monthly income of 100-299 thousand won, only 5 percent purchased more than 600 grams of beef at one time. Purchases over 600 grams were generally made in 600 gram multiples such as 1,200, 1,800 and 2,400 grams in most cases.

The purchasing frequency of beef varied among households. Beef was purchased 1-2 times per month in 50 percent of the households and 5 times or more per month in 18 percent of the households. Regionally, many households in provincial cities purchased beef 1-2 times per month, while in Seoul a relatively greater number of

Table 8. Average Purchase Size and Frequency for Beef by Region and Household Income

Unit : % of households

	All households	Region		Level of Household Income(1,000won)				
		Seoul	Provincial cities	100-299	300-499	500-699	700-999	1,000 or over
Purchase Size (at a time)								
Less than 600 grs.	11.6	7.8	20.4	18.7	13.8	8.9	6.5	2.1
Just 600 grs.	71.2	70.7	73.7	76.6	76.6	72.0	60.9	47.9
601 grs. or over	17.2	21.5	5.9	4.7	9.6	19.1	32.6	50.0
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Purchasing Frequency (per month)								
1	26.7	22.5	36.7	55.5	33.3	13.5	6.5	2.8
2	24.7	24.4	25.7	26.1	29.4	26.1	14.8	7.7
3	15.8	17.1	13.1	9.7	18.7	18.6	16.6	10.6
4	15.1	15.9	13.7	4.4	10.9	21.3	24.3	25.4
5	17.7	20.1	10.8	4.3	7.7	20.5	37.8	53.5
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
No. of Respondents	1,585	1,095	490	299	561	414	169	142

Table 9. Average Purchase Size and Frequency for Pork by Region and Household Income

Unit : % of households

	All households	Region		Level of Household Income(1,000 won)				
		Seoul	Provincial cities	100-299	300-499	500-699	700-999	1,000 or over
Purchase Size (at a time)								
Less than 600 grs.	13.9	9,9	21.4	16.0	15.4	13.3	10.7	7.4
Just 600 grs.	72.2	74.2	68.4	73.4	75.8	70.7	66.9	64.8
601 grs. or over	13.9	15.9	10.2	10.6	8.8	16.0	22.4	27.8
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Purchasing Frequency (per month)								
1	32.8	32.3	33.7	41.6	33.9	27.5	21.5	25.9
2	34.4	35.0	33.3	36.5	34.5	34.5	35.5	26.9
3	12.5	12.9	11.5	8.4	14.4	13.6	14.9	8.3
4	11.3	10.5	12.7	9.5	10.6	12.7	17.4	16.7
5	9.0	9.3	8.8	4.0	6.6	11.7	10.7	22.2
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
No. of Respondents	1,277	844	433	274	443	331	121	108

Table 10. Average Purchase Size and Frequency for Chicken by Region and Household Income

Unit : % of households

	All households	Region: Seoul	Region: Provincial cities	Level of household Income (1,000 won): 100-299	300-499	500-699	700-999	1,000 or over
Purchase Size (at a time)								
Less than 1,000 grs.	10.7	13.0	6.0	12.9	9.2	11.0	13.2	7.6
1,000-2,000 grs.	42.7	49.1	29.6	39.5	43.0	40.8	44.2	52.4
2,000 grs. or over	46.6	37.9	64.4	47.6	47.8	48.2	42.6	40.0
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Purchasing Frequency (per month)								
1	49.6	46.4	56.1	55.3	52.6	47.8	37.2	44.8
2	28.5	29.5	26.5	27.5	29.6	27.1	33.3	24.8
3	10.0	11.6	6.8	10.3	9.5	9.0	14.7	8.5
4	7.1	6.9	7.3	5.6	5.1	9.0	7.8	11.4
5	4.8	5.6	3.3	1.3	3.2	7.1	7.0	10.5
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
No. of Respondents	1,178	793	385	233	412	299	129	105

households purchased beef 3 times or more per month. As household income increased, the number of the households who purchased beef 1-2 time per month declined conspicuously, whereas the number who purchased beef or more times per month increased. Among the lowest income households with a monthly income of 100-299 thousand won 56 percent purchased beef once a month and only 4 percent purchased beef more than 5 times per month. By comparison, among the highest income households with a monthly income of 1,000 thousand won or more, 3 percent purchased beef only once a month while 54 purchased beef 5 or more times per month increased.

As with beef, 72 percent of the households purchased pork in the traditional basic unit of 600 grams as shown in Table 9. This was virtually the same in all regions. Those with high incomes tended to purchase larger amounts at one time. However, the income responses were not so sensitive as with beef. Specifically, purchasing frequency for pork tended to rise as income rose, but was less responsive than for beef. Sixty-seven percent of households purchased pork 1-2 times per month. This frequency was a little less than in the case of beef.

Unlike beef and pork, chicken was purchased in per bird unit. All households that purchased chicken made their purchases one bird at a time. However, the weight of a chicken purchased differed. Purchases in provincial cities were heavier than those in Seoul.

Chicken was purchased 1-2 times per month in 78 percent of the households. High income households tended to purchase chicken relatively more often.

4. Grading and Packaging of Meat

Grading of meat is an important function which must be introduced to improve the efficiency of any meat marketing system. In Korea, the grading of beef based on the price tag system was first introduced in July 1968. Efforts continued to be made thereafter to introduce an overall meat grading system. Such efforts were unsuccessful due to a lack of understanding of the grading system on the part of consumers, and also to unfair selling activities by some meat retailers. A grading system is presently in force at some supermarkets and department stores, but the majority of butcher shops depend entirely on traditional methods of sale and have no grading system at all. It has been well known that under such traditional methods of sale, meat retailers were more concerned with increasing their profits than in improving customer services. As a result, using unfair scales,mixing low quality meat with high quality meat, and other unfair practises were common activities in the meat retail sector.[6,9)]

According to this survey, more than 70 percent of the households said that they purchased short ribs or sirloin, the beef cuts in greatest demand. A considerable number of households also said that when they bought pork they desired lean meat. Data from the Livestock

Cooperatives, however, indicate that short ribs and beef sirloin account for only 21 percent of a carcass. Moreover, the findings of another survey indicate that high quality meat such as beef sirloin and pork lean meat was supplied directly to HRI establishments (hotel, restaurant and institution), and that it was extremely difficult for households to purchase meat of this quality from butcher shops. Therefore, it appeared that, due to consumers' inability to evaluate meat quality, they must have purchased different cuts than what they actually thought they bought.

As far as consumers are concerned, basic conditions for the adoption of the meat grading system have been met in most cases because consumers indicated that they were willing to tolerate considerable price differences if beef and pork were retailed by part and grade. However, there should be more in-depth study before any system is implemented, because difficult technical problems must be solved as early as possible.

In conjunction with the adoption of the meat grading system a program of pre-packaging meat for sale should be adopted. The objectives of the meat grading system can be effectively attained only when pre-packaged meat is sold. Table 11 shows consumers' view of meat pre-packaging. About half of the households supported the adoption of pre-packaged meat while 30 percent opposed it. The sale of pre-packaged beef was supported by 57 percent of the households and the sale of pre-packaged pork by 53 percent. The sale of pre-packaged meat was advocated more by Seoul households and high income households than by provincial households and low income households. The number of the households opposed to pre-packaged meat was unexpectedly large, however. The major reasons for opposing pre-packaged meat were; the mistaken belief that if domestic beef were packaged, its taste would deteriorate to the level of imported packaged beef; reluctance to change from traditional habits of purchasing meat directly from butcher shops.

IV. Summary and Conclusion

The major purpose of this study is to estimate the consumer demand for meat and to examine the nature of consumers' meat preferences and their purchasing behaviors. For the study a household survey was conducted in August and September of 1982, in six cities Seoul, Taegu, Kwangju, Suwon, Jinju and Chungju. A total of 2,000 households was included in the sample. From the survey data collected, useable schedules were tabulated for 1667 households.

Major findings obtained from the study are summarized as follows:

(1) About 37 percent of total consumption expenditure was spent on food. The expenditure share for food was lower in Seoul than in provincial cities and declined substantially as household income increased.

(2) Average household consumption of all meat was 5.55 kg per month per household. The greatest percentage of this consumption was for chicken (40 percent), followed by beef (38 percent), and pork

Table 11. Consumers' Preferences for Packaged Meat

Unit : % of households

	All households	Region		Level of household Income(1,000 won)				
		Seoul	Provincial cities	100-299	300-499	500-699	700-999	1,000 or over
Domestic Beef								
Want it	56.7	57.4	55.2	50.0	54.4	59.2	64.8	67.7
Do not want it	29.5	27.8	33.2	33.6	30.2	29.9	23.5	22.1
Indifferent	3.8	14.8	11.6	16.4	15.4	10.9	11.7	12.2
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Pork								
Want it	52.6	54.3	48.8	47.7	50.7	54.2	60.5	58.6
Do not want it	32.7	30.0	38.6	35.7	34.0	31.3	29.0	28.6
Indifferent	14.7	15.7	12.6	16.6	15.3	14.5	10.5	12.8
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
No. of Respondents	1,642	1,124	518	342	586	412	162	140

(22 percent). As household income increased, consumption of meat increased substantially. However, the increase in consumption differed significantly among types of meat.

(3) The estimated income elasticities of demand were 1.34 for beef, 0.44 for pork and 0.22 for chicken. Therefore, beef showed the greatest response to income, while chicken showed the least response. Income elasticities for domestic beef and imported beef were 1.45 and 1.18, respectively.

(4) The majority of consumers had a strong preference for domestic beef rather than pork and chicken mainly because of good taste and established eating habits. On the other hand, the taste and quality of imported beef did not satisfy consumers' needs and wants. There was a tendency for consumers to show a stronger preference for domestic beef as household income increased.

(5) About 80 percent of total households bought beef and pork from traditional meat retail stores. Only 15 percent purchased meat from supermarkets. However, the number of households which bought meat from supermarkets increased considerably as household income increased. Consumer patronization rate of supermarkets for buying meat was much higher for households located in apartment estates than for those in residential districts.

(6) More than 50 percent of households purchased meat one or two times a month. Approximately 70 percent of households bought an average of 600 grams of beef or pork per purchase. However, as

household income increased, meat was purchased more frequently and in larger amounts.

(7) Grading and packaging services were not provided at retail stores. As a result there was no basis for fair trade. Therefore, retailers had an advantage over their customer. Consequently, most consumers were cheated when they bought meat at retail stores.

(8) About 50 percent of the households wanted to buy pre-packaged beef. However, the remaining 50 percent did not want to buy it, primary because they felt that meat quality deteriorated due to packaging and freezing.

The major findings pointed out and discussed in this study were; (a) consumers' strong preference for domestic beef, (b) consumers' negative responses to imported beef because of its poor taste and quality, (c) inefficient use of traditional weights and measures in meat retailing, and (d) lack of grading and packaging services for meat. These problems have existed in the meat retailing system for a long time. They have resulted in increased meat retailing margins and irrational meat consumption behavior. For improvements in the meat retailing system as well as in consumption patterns and purchasing behavior of urban households it is desirable to import better quality beef, to develop cooking methods for pork and chicken, and to establish a meat grading and packaging system at the retail level.

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V. Projections of Demand for Selected Food Products

Long-term Demand Projections for Farm-Food Products, Model Development and Application toward 2001

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For decades demand predictions for farm-food products have been made extensively by planning officials as well as by agricultural economists because detailed information of future demand for farm-food products is essential in planning agricultural development programs. Most of the previous attempts can be characterized by two features: use of a single demand equation specified intuitively and estimated by commodity using national per capita consumption of farm-food products to obtain price and income elasticities; an assumption that the obtained elasticities are constant over the predicting period.

In those attempts demand for each commodity was determined one by one independently and changed proportionally according to income increase without limitation. In addition, demand for farm-food products, for example, wheat was determined as a function of wheat's own price and income despite the fact that demand for wheat is not determined by its own utility and price but derived from the consumer's demand for foods made from it - breads, noodles, and cakes.

As a result, internal consistency was not maintained and a violation of the constraint as well as the biological budget limitation particularly in the long-term prediction occured. This deficiency

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results from a gap between theory and prediction model. This gap forces economists to start their prediction by deciding that theory can be sacrificed for the sake of practical operation.

In the present study, two complementary courses of action are taken to cope with the gap between theory and the prediction model. First, the demand function is strictly specified in the framework of classical demand theory and the prediction model. First, the demand function is strictly specified in the framework of classical demand theory and estimated using household budget data. As the functional form of the demand function, AIDS proposed by Deaton and Muellbauer (2)is adopted, AIDS assumes Engel curves are non-linear and income and price elasticities vary according to income and price levels.

In addition, the household is dichotomized into the farm household and the non-farm household and a separate demand system is applied to each because there are crucial differences between them in socio-economic conditions. Second, the prediction of demand for farm-food products is obtained in three steps: in the first step, given disposable income, total consumption expenditure is determined with the total consumption function; in the second step, food demand is predicted by commodity with the demand system under the constraint of total expenditure determined in the first step; in the third step, food demand is converted into demand for farm-good products with input-output coefficients of processed foods.

The plan of the paper is as follows. In section I the total consumption function is estimated and, given disposable income, total consumption expenditure is predicted with the estimated function.

Section II presents the modified AIDS demand system. Section III describes the estimation of the demand system. In section IV food demand is predicted assuming constant prices and the predicted food demand is converted into demand for farmfood products in section V. We end with the concluding remarks of section VI.

Total Consumption Expenditure

As the basic functional form of the consumption function a Keynesian type is adopted:

$$(1)\ TC\ (t) = a + by\ (t)$$

where TC stands for total expenditure per person. Y is disposable income per person. and t is the t-th period. Annual Reports of the Urban Household Survey (conducted by the Economic Planning Board) for the years 1964 to 1981 provide the expenditure data for the non-farm household. For the farm household the Report on the Results of the Farm Household Economic Survey (conducted and published by the Ministry of Agriculture and Fisheries) for the years 1964 to 1981 is used. For the non-farm household, equation (1) was modified as follows to adjust auto-correlation of the error term[1] :

$$(2)\ TCu\ (t) = A_0 + A_1 Yu\ (t) + A_2 Yu\ (t-1) + A_3 TCu\ (t-1)$$

where A_0 to A_3 are parameters and u stands for the urban household. The estimated results are shown in Table 1. Meanwhile, for the farm household, the partial adjustment type of equation (1) specified as follows showed best fit.

$$(3)\ TC\ (t) = B_0 + B_1 Yf\ (t) + B_2 TCf\ (t-1)$$

where B_0 to B_2 are parameters and the subscript f denotes the farm household. The estimated results are presented in Table 2.

Demand System for Food

The demand function can be derived from a specific preference system which is consistent with classical demand theory. The consumer preference system can be defined by three alternatives in the context of demand theory (Sawada, 1981). The traditional procedure to derive the demand system is to set up the direct utility function and then to apply the first order condition of utility maximization. The Linear Expenditure System belongs to this procedural category. The second procedure is to specify the indirect utility function and then to apply Roy's Identity. The logarithmic linear expenditure system belongs to this procedural category. The third procedure, to be adopted in this study, is to define the expenditure (cost) function and then to apply Shepard's Lemma to derive the compensated demand system. The compensated demand system is transformed into the ordinary demand system by substituting into the indirect utility function.

The expenditure function can be specified by the flexible functional form (6) that has enough parameters to be regarded as a reasonable approximation to whatever the true function may be (Deaton and Muellbauer, 1980).

$$(6)\ \ln TC = \alpha_0 + \Sigma\alpha_i \ln P_i + \frac{1}{2}\Sigma\Sigma\gamma_{ij}{*}\ \ln P_i \ln p_j + \beta_0 U \ \Pi P_i^{\beta_i}$$

where TC stands for total expenditure, P_i is the price of the i-th commodity, and α_i, β_i and γ_{ij} are parameters. Since the cost function should be homogeneous in P, we have

$$(7)\ \sum_i \alpha_i = 1, \sum_i \gamma^*_{ij} = \sum_j \gamma^*_{ij} = \sum_i \beta_i = 0$$

Taking the logarithmic derivative of the expenditure function with respect to price, and applying Shepard's Lemma, we have budget share equations in prices and utility, i.e. the Hicksian demand function. For a utility - maximizing consumer, (6) can be inverted to give U as a function of P and TC which gives the indirect utility function. Substituting the result into the Hicksian demand function, we obtain the budget share function of P and TC, i.e. the AIDS demand functions.

$$(8)\ W_i = \alpha_i + \sum_j \gamma_{ij} \ln p_j + \beta_i \ln \frac{TC}{P}$$

where W_i is the budget share of the i-th commodity, $r_{ij} = \frac{1}{2}\gamma_{ij*} +$ γ_{ji*}), and P is the price index defined as

$$(9)\ \ln P = \alpha_0 + \sum_i \alpha_i \ln p_i + \frac{1}{2}\sum_{i}\sum_{j} \gamma_{ij} \ln P_i \ln p_j$$

The theoretical restrictions apply directly to the parameters: Adding-up requires $\sum_i \alpha_i = 1, \sum_i \beta_i = 0, \sum_i \gamma_{ij} = 0$ for all j. Homogeneity is satisfied if and only if, for all i, $\sum_j \gamma_{ij} = 0$. Symmetry is satisfied provided $\gamma_{ij} = \gamma_{ji}$ for all i and j. In the AIDS, income and price elasticities are measured in the following manner (Ray, 1980).

$$(10)\quad \eta_i = \frac{\beta_i}{\hat{\omega}_i} + 1 \qquad i = 1, ---, n$$

$$(11)\quad \varepsilon_{ij} \; \frac{g_{ij}}{\hat{\omega}_i} - \eta_i \hat{\omega}_j \qquad i, j = 1, ---, n$$

where η_i is income elasticity, ε_{ij} is price elasticity, and $g_{ij} = \gamma_{ij} + \beta_i\beta_j \ln(\frac{TC}{P}) - \hat{\omega}_i\delta_{ij} + \hat{\omega}_i\hat{\omega}_j$ and δ_{ij} denotes the Kronecker delta. Note that $\hat{\omega}_i$ denotes predicted budget share.

Equation (10) shows that the i-th commodity is necessity if $\beta_i < 0$. However, with $\beta_i < 0$, ω_i decreases with income so that the commodity turns out to be inferior in the end. On the contrary, if $\beta_i > 0$, the i-th commodity is a luxury good and ω_i increases with income. However, note that, with $\beta_i > 0$, income elasticity can not be less than unity in any case so that the commodity remains a luxury . In other words, the Engel curves implied by the AIDS are non-linear but monotic, which contradicts reality. For example, Figure 1 illustrates that the Engel curves of the Korean non-farm household for selected food items, based on cross-section data, are not monotonic. Therefore the AIDS can be modified to a quadratic form to make it more flexible.

$$(12)\quad w_i = \alpha_i + \Sigma\gamma_{ij}\ln P_j + \beta_i \ln TC/P + \lambda_i \left\{\frac{\ln TC}{P}\right\}^2 \qquad i = 1, ---, n$$

where $\Sigma\lambda_i = 0$ and all other restrictions imposed on (8) are also in effect[2]. In the quadratic AIDS, income and price elasticities are computed by substituting β_i and β_j in (10) or (11) with ($\beta_i + 2\lambda_i \ln TC/P$) and ($\beta_j + 2\lambda_j \ln TC/P$) respectively.

The demand functions (8) and (12) are not amenable to econometric analysis because of the large number of independent parameters entering into the equations. The length of the time series available is short relative to the number of items that enter into the consumption budget. The problem is further complicated by multicollinearity among price series.

In order to cope with these problems, restrictions implied by the neoclassical theory of consumer choice are imposed as already mentioned. And further, the utility function is assumed to be weakly separable so that utility maximization takes place in two stages: in the first stage, income is allocated to groups of commodities, and then, in the second stage, the optimal levels of commodity demand within each group are determined within the group budget constraint determined in the first stage (Bieri and Janvry; 1970).

Final income and price elasticities in the two-stage demand system are computed as

$$(13)\quad \eta_r = \eta_R \times \eta_r^R \qquad (r \in R)$$

$$(14)\quad \varepsilon_{rr'} = \varepsilon_{rr'}^R + (1 + \varepsilon_{RR})\eta_r^R \hat{\omega}_{r'}^R \qquad (r',\ r \in R)$$

$$(15)\quad \varepsilon_{rk} = \varepsilon_{RK}\eta_r^R \hat{\omega}_k^K \qquad (r \in R,\ k \in K)$$

where R and K denote groups of commodity, r and k stand for commodities, and the superscripts denote the conditional elasticities and budget shares.

Parameter Estimation of the Demand System

The two sets of estimates obtained from both time series and cross-section data were combined with appropriate weights so that information from both data sources could be utilized in the prediction. Commodities were first classfied into eight food groups and one non-food group. The eight food groups are cereals and potatoes, livestock products and fish, vegetables, condiments confectionary and drink, alcoholic drink, other food and restaurant meals. The system of cereals and potatoes includes six commodities: rice, barley, beans, miscellaneous creals, wheat products, potatoes. The group of livestock products and fish includes beef, pork, chicken, other meat, egg, and fish. Egg and fish are grouped in the same group with meat since they are regarded as good substitutes for meats in the Korean diet. The subsystem of confectionary and drink includes four commodities: soft drink, candy and cakes, fruits, fluid milk. In sum, the demand system includes twenty-two food commodities and one aggregated non-food commodity.

Annual household time series and/or cross-section data by income class for the period 1964 to 1981 were used for parameter estimation. Household budget data were obtained from the same source mentioned in section I. The Consumer Price Index reported by the EPB was used as price index for the non-farm household when items of the CPI coincided with our classification. Otherwise, unpublished data kept in the EPB were used to compute price indexes. For the farm household, the farmer's selling price and purchasing prices were averaged by weighing with self-supplied and purchased shares of each commodity to obtain the actual farmer's consuming prices.

Time series household budget data was first applied to (8) with an error term, which is assumed to have an expectation of zero, to be temporally uncorrelated and to have a contemporaneous variance-covariance. The Price index can be approximated with the Divisia index to make equation (8) a linear regression since it has been shown that if the cost function is a translog form, the Divisia index can provide estimates of changes in real income (Jorgenson and Zvi Griliches, 1971).

$$(16) \quad d \ln P^* = \Sigma \frac{1}{2} (w_{it} + w_{it-1}) \; d \ln P_i$$

where P* means approximated price index.

If restriction across equations are imposed, OLS estimates are no longer efficient despite the fact that all equations contain the same explanatory variables. Therefore, the seemingly unrelated regression problem applies, and the Restricted Generalized Least Squares (RGLS) has to be applied to all equations simultaneously (Johnston, 1972, pp 155-159, 238-241). However, in actual estimation one equation has to be dropped from the model because only n-1 equations are linearly independent due to $\Sigma W_i = 1$. Parameters of the dropped equation are computed using the homogeneity restrictions. Estimated results are not presented here but are available upon request. Income and own price elasticities implied by the demand system estimated using time series data are presented in Table 3. Since a discussion about details of these results is beyond the score of this paper, we point out only that the magnitudes and signs of the estimated elasticities are generally relevant.

To obtain another set of estimates for β_i and λ_i, time series pooled cross-section data for the period 1966 to 1981 was applied to equation (12). Price terms are subtracted and year dummies are set in constant terms to absorb all price effects between years. Income elasticities computed are shown in Table 4.

For the actual prediction, two sets of estimates obtained above were combined: coefficients β_i and λ_i of the first stage system were determined as the arithmetic averages of the two estimates mentioned above. Equal weights were given for the years 1981 to 1991 while a weight of 5/6 was given to cross-section estimates and a weight of 1/6 was given to time series estimates for 1991 to 2001. The weights were chosen arbitrarily so as to obtain a reasonable prediction for all commodities at the same time. However, cross-section data was available only for nine commodity groups of the non-farm household. Therefore we assumed that λ_i of the farm household is the same as that of the non-farm household. For the second stage demand systems, time series estimates were applied without adjustment. It can be safely said, however, that the quadratic characteristic of the Engel curves was reflected already in the first stage demand system. Final coefficients used for the actual prediction are presented in Tables 5 and 6.

Forecasting Food Demand

In this chapter food demand for the years up to 2001 is predicted using the consumption function and the demand system obtained in the previous chapters.

Disposable income per capita was assumed to increase 5.6% per annum from 1981 to 1991 and 5.1% from 1991 to 2001 following the Long-Term Plan of the Korean Economy (KDI, 1983).

Total consumption expenditure per capita was first predicted. The actual computation procedure is as follows:

For the non-farm household,

(16-1) $TCu\ (t) = TCu\ (t-1) + dTCu\ (t)$

where $dTCu\ (t) = A_1 dYu\ (t)$

For the farm household,

(16-2) $TCf\ (t) = TCf\ (t-1) + dTCf\ (t)$

where $dTCf\ (t) = B_1 dYf\ (t) + B_2 dTCf\ (t-1)$

Forecasted results for selected years are shown in table 7. The per-capita consumption expenditure of farm households is predicted to increase 5.2% per annum between 1981 and 1991 and 5.3% per annum between 1991 and 2001. That of urban households is predicted to increase 5.0% per annum from 1981 to 1991 and 4.8% per annum from 1991 to 2001. **We turn to predicting food demand under** the constraint of total expenditure discussed above.

The cost share of the R-th commodity group at time t, $W_R\ (t)$, is defined as

(17) $W_R\ (t) = W_R\ (t-1) + dW_R\ (t)$

Taking the time derivative of (12), setting prices constant, and substituting the result into (17), we obtain

(18) $W_R\ (t) = W_R\ (t-1) + \{\beta_R + 2\lambda R\ \ln TC\ (t)\}\ GTC\ (t)$,

where GTC means the growth rate of total expenditure.

Therefore, we obtain the consumption expenditure for the R-th commodity of TC_R, multiplying the predicted W_R with TC

$$(19) \quad TC_R\ (t) = TC\ (t) \times W_R\ (t)$$

Meanwhile, by definition

$$(20) \quad W_R\ (t) = \frac{CQ_R\ (t) \times P_R\ (t)}{TC\ (t)}$$

where CQ_R is demand for the R-th commodity group. Taking the logarithmic time derivative of equation (20, and linking it with the time derivative of equation (12), we have

$$(21) \quad GCQ_R\ (t) = GTC\ (t) + \left\{ \beta_R + 2\lambda_R \ln TC\ (t) \right\} GTC/W_R$$

where GCQ_R is the growth rate of demand for the R-th commodity group. Thus we obtain the predicted demand for the R-th commodity group using the following definition.

$$(22) \quad CQ_R\ (t) = CQ_R\ (t-1) \left\{ 1 + GCQ_R\ (t) \right\}$$

Following a similar procedure, we can obtain the predicted demand for the r-th commodity in the R-th commodity group CQ_r^R.

$$(23) \quad GCQ_r^R\ (t) = GTC_R\ (t) + \beta_r GTC_R/W_r^R$$

$$(24) \quad CQ_r^R\ (t) = CQ_r^R\ (t-1) \left\{ 1 + GCQ_r^R\ (t) \right\}$$

Forcecasted results are presented in Tables 8 and 9.

Investigating the predicted demand for the nine commodity group we find that, in the non-farm household, demand for all food items except cereals increase. Cereal consumption decreases. Particularly, demand for alcoholic drink and restaurant meals increase the fastest, more fast than non-food demand.

In the farm household, cereals demand seems to increase a little bit up to 1987 but then decrease thereafter. Livestock products and restaurant meals show the highest increasing rate for farm households.

The predicted results of the second stage demand system show that beans demand in the non-farm household will drop down to almost zero. However, it should be noticed that total demand including soybean products such as soybean cake and sauce may not decrease so fast or may even increase. This point will be investigated in section V. It is worthwhile to note that livestock products demand will increase faster in the farm household than in the non-farm household.

Conversion of Food Demand into Demand for Farm-Food Products

Farm-food products are consumed in various types of food. For example, eggs are used in bread, cakes and restaurant meals as well as in home consumption. To find out total demand for eggs, we have to first compute the quantity to be used in these foods and then sum up all of them and multiply by population.

In the actual computation, the following formula is used.

$$(25) \quad TQ_i(t) = \Sigma_j VQ_{ij}^F \times CQ_j^F(t) \times POP^F(t) + \Sigma_j VQ_{ij}^u \times CQ_j^u(t) \times POP^u(t)$$

where TQ_i stands for total consumption of the i-th farm-food product, VQ_{ij} denotes quantity of the i-th farm-food product used in the j-th food in the base year, POP means population index and CQ_j demand index for the j-th food. The superscript F means the farm household and u the non-farm household. VQ_{ij} were computed from "1978 Input-Output

Table " published by the Bank of Korea (presented in the Appendix). Population was obtained from the Population-Migration Model of the Korea Rural Economics Institute. The computed total and per capita per year consumption are shown in tables 9 and 10.

Table 10 shows that rice per capita consumption steadily decreases down to 86kg in 2001 while demand for vegetables increases up to 1991 but decreases thereafter. In Japan, rice per capita consumption in 1981 was about 75kg and vegetables consumption reached the maximum level in mid-1970s before it started to. It is striking that total wheat, beans and miscellaneous cereals consumption increases while their home consumption decrease as shown in Tables 7 and 8. This contradiction is mainly due to the fast increase of indirect consumption. Specifically, wheat consumption increases mainly due to a fast increase in candy and cakes consumption; miscellaneous cereals due to condiment and starch: and beans mainly due to soybean cakes and sauce.

Per capita meat demand will increase to 24.7kg in 2001 from 10.2 kg in 1981, and milk demand to 54.4kg from 14.4kg at present. These figures can be compared with current consumption in Japan where meat consumption is about 21kg per capita and milk 65kg per capita in Japan. Looking at the forecasted results by commodity, beef consumption per capita will increase to 6.4kg from 2.4kg at present and total demand will reach about 326 thousand M/T, or 3.5 times the level of present consumption. It is worthwhile to note that 36 percent of total beef demand is derived from restaurant meals. Per capita demand for pork, chicken, and eggs will increase up to 11.6kg, 6.7kg, 16.1kg respectively, which means their total consumption will be 2.8, 3.8, and 3.9 times the present levels.

Finally, to check the relevance of the prediction, implicit income elasticities implied by the prediction were computed with

$$(26)\quad \eta_i(t) = GCQ_i(t) / GY^{\gamma}(t).$$

where GY means growth rate of income. As shown in Table 11, almost all estimates are plausible and coincide well with Japan's experience.

Conclusions

In this study, demand for farm-food products was predicted with an approach different from previous studies. That is, farm-food products demand was not forecasted directly but rather through household food demand. Household food demand was predicted with a demand system estimated with household budget data and then converted into demand for farm-food products. As the functional form of the demand system, the AIDS system was applied.

Applying this approach to future demand until the year 2001 in Korea, we obtained plausible and consistent results for almost all commodities. The most striking result is that rice per capita consumption will decrease down to 86kg from the present level of 130kg, while meat and milk consumption respectively will increase to 24kg, and 54kg from their present levels of 10kg and 14kg. This dramatic change in food demand will force us to alter the concept of "staple food" in Korea and to reorganize the land utilization structure. In addition, rapid increases in demand for livestock products will result in tremendous increases in feed imports insofar as we want to keep our present self-sufficiency rate in livestock products. Thus, we have to find a way to produce feed in Korea and to switch a food grain policy from an emphasis on "saving in rice consumption" to "promoting a preference for rice".

Table 1. Parameter Estimates of the Non-Farm Household Consumption Function

Parameters	Estimates
A_0	8,332.6800
A_1	0.7244 (16.717)
A_2	-0.5255 (3.3283)
A_3	0.7170 (3.7371)
R^2	0.9969

Notes: The figures in parentheses are t-values.

Table 2. Parameter Estimates of the Farm Household Consumption Function

Parameters	Estimates
B_0	4,239.3945
B_1	0.3641 (5.4674)
B_2	0.5480 (4.7589)
R^2	0.9819

Notes: The figures in parentheses are t-values.

Figure 1. Budget Shares by Income Class

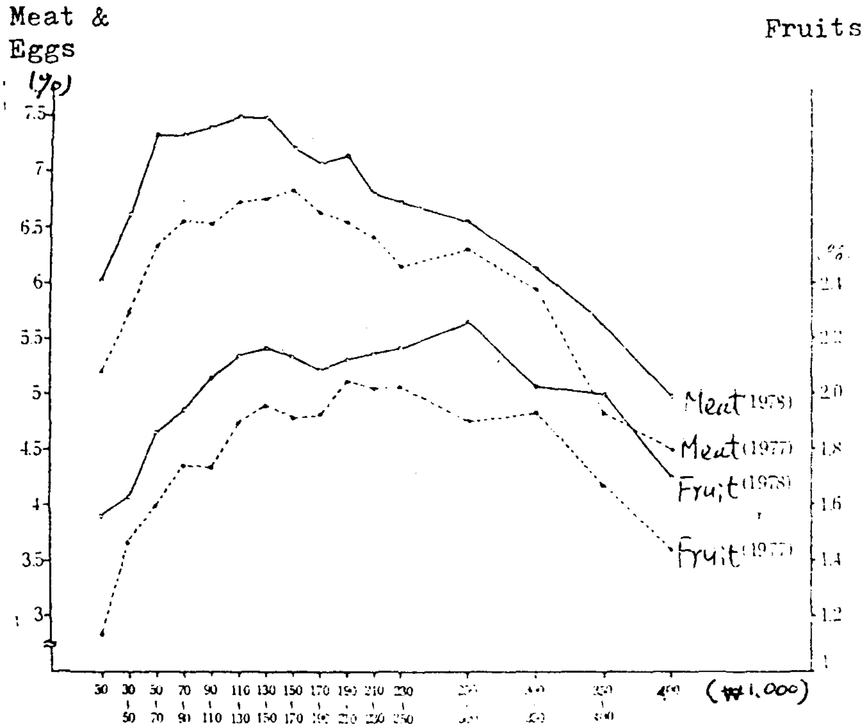

Table 3. Income and Own Price Elasticity Estimates of Food, 1975.

	Exp. Elast.		Price Elast.		Income Elast.	
	Urban	Rural	Urban	Rural	Urban	Rural
Cereals	0.1344	0.2213	-0.3679	-0.2062	0.1094	0.2142
Rice	0.1676	0.2400	-0.5968	-0.3249	0.1364	0.3290
Barley	-0.3209	-0.2359	-0.8813	-0.3797	-0.2612	-0.2283
Beans	0.9291	0.1784	-0.9382	-0.6605	0.7564	0.1726
Misc. Cereals	0.0592	0.1423	-1.9450	-0.6240	0.0482	0.1377
Wheat Products	0.0817	0.0981	-2.6838	-0.1654	0.0665	0.0949
Potatoes	0.2339	0.0524	-1.1397	-1.5104	0.1904	0.0507
Livestock Products	0.9479	2.1555	-0.7498	-1.5698	0.7717	2.0859
Beef	0.9326		-1.5200		0.7592	
Pork	0.8287		-1.4174		0.6746	
Chicken	1.6523	2.8108	-1.0411	-1.4100	1.3451	2.7200
Other Meat	0.8982		-0.9322		0.7312	
Fishes	0.7924	1.4907	-1.2920	-1.1565	0.6451	1.4426
Eggs	1.4353	4.0250	-0.5864	-1.4885	1.1685	3.8950
Vegetables	0.7614	1.2159	0.9297	-0.9999	0.6199	1.1766
Other Food	1.1189	1.8916	-1.7560	-1.0315	0.9109	1.8305
Condiment	1.0096	1.4405	-0.8754	-1.3360	0.8219	1.3940
Confectionary	1.4227	1.5143	-1.1710	-1.6435	1.1582	1.4654
Fruits	1.1638	1.3017	-0.8331	-1.6364	0.9474	1.2597
Cakes	1.2756	1.5414	-0.7784	-1.5867	1.0385	1.4916
Soft Drinks	1.8368	1.6694	-1.3338	-1.2152	1.4953	1.6155
Milk	2.1716	4.3173	-1.4304	-1.7881	1.7679	4.1779
Alcoholic Drinks	2.2088	0.7267	-1.5934	-1.8892	1.7982	0.7032
Restaurant Meals	2.4240	2.5500	-3.1138	-1.0031	1.9734	2.4676
Non-Food	1.3161	1.4093	-0.8746	-1.0155	1.0714	1.3638

Table 4. Income Elasticities of the First Stage Demand System Obtained from the Cross-Section Data, Non-farm Household

Groups of Commodity	Income Elasticities
Cereals	0.5819
Livestock Products & Fishes	1.0944
Vegetables	0.7462
Other Food	0.7269
Condiment	0.9591
Confectionary & Soft Drinks	1.0335
Alcoholic Drinks	0.8220
Restaurant Meals	1.3480
Non-food	1.1977

Table 5. Parameters of the First Stage Demand System for Forecasting

Commodity Groups	Farm Household		Non-Farm Household			
			1981 - 1990		1991 - 2001	
	β_R	λ_R	β_R	λ_R	β_R	λ_R
Cereals & Potatoes	-0.1875	0.0089	-0.1505	0.0089	-0.1155	0.0149
Livestock Products & Fishes	0.0197	-0.0077	0.0015	-0.0077	0.0050	-0.0128
Vegetables	-0.0018	-0.0046	-0.0097	-0.0046	-0.0099	-0.0077
Other Food	0.0006	-0.0006	-0.0018	-0.0006	-0.0047	-0.0009
Condiment	0.0042	-0.0031	-0.0007	-0.0031	-0.0014	-0.0052
Confectionary	0.0034	-0.0033	0.0089	-0.0033	0.0038	-0.0054
Soft Drinks						
Alcoholic Drinks	-0.0030	-0.0003	0.0046	-0.0003	0.0003	-0.0004
Restaurant Meals	0.0040	-0.0004	0.0113	-0.0004	0.0070	-0.0007
Non-Food	0.1604	0.0111	0.1364	0.0111	0.1154	0.0182

Table 6 Parameters of the Second Stage Demand System for Forecasting, β_r

Commodidy Groups		Farm Household	Non-Farm Household
Cereals & Potatoes	Rice	0.0766	-0.0114
	Barley	0.0000	0.0000
	Beans	-0.0089	0.0378
	Misc. Cereals	0.0000	0.0000
	Wheat Products	-0.0250	-0.0366
	Potatoes	-0.0427	0.0102
Livestock Products & Fishes	Beef	0.1245	-0.0043
	Pork		-0.0135
	Chicken		0.0379
	Other Meat		-0.0012
	Fishes	-0.1670	-0.0731
	Eggs	0.0425	0.0542
Confectionary & Soft Drinks	Fruits	-0.0683	-0.0843
	Cakes & Candy	0.0061	-0.0027
	Soft Drinks	0.0150	0.0388
	Milk	0.0472	0.0729

Table 7. Predicted Per-Capita Consumption Expenditure for Selected Years

Unit: Won in 1975 Constant Price

Year	Farm Household	Non-Farm Household
1981	170,856	250,619
1986	218,987	318,990
1991	283,497	408,772
1996	367,496	515,077
2001	476,769	651,400

Table 8. Forecasted Demand by Commodity Group, Index Based on 1981

	Farm Household					Non-Farm Household				
	1981	1986	1991	1996	2001	1981	1986	1991	1996	2001
Cereals & Potatoes	100.0	103.6	101.4	89.3	61.3	100.0	95.3	93.8	76.6	62.5
Livestock Products & Fishes	100.0	137.2	185.2	244.2	314.4	100.0	123.6	150.7	173.7	193.5
Vegetables	100.0	121.2	144.1	166.0	182.4	100.0	112.2	119.0	107.5	72.0
Other Food	100.0	127.9	164.0	209.0	264.5	100.0	123.3	150.7	173.6	197.1
Condiment	100.0	128.7	165.4	210.3	264.2	100.0	122.7	148.0	166.4	179.5
Confectionary & Soft Drinks	100.0	127.0	157.1	186.3	208.7	100.0	130.1	167.6	203.1	243.3
Alcoholic Drinks	100.0	120.2	144.4	171.9	202.1	100.0	138.4	188.3	234.8	292.7
Restaurant Meals	100.0	157.8	241.6	358.4	519.6	100.0	148.4	214.9	287.2	383.1
Non Food	100.0	136.7	188.7	260.4	358.6	100.0	134.3	181.6	240.1	318.8

Table 9 . Forecasted Demand by Commodity, Index Based on 1981

		Farm Household					Non-Farm Household				
		1981	1986	1991	1996	2001	1981	1986	1991	1996	2001
Cereals & Potatoes	Rice	100.0	103.7	101.5	89.4	62.4	100.0	95.6	84.9	78.1	64.9
	Barley	100.0	103.4	101.4	90.2	64.8	100.0	95.6	84.8	78.0	64.8
	Beans	100.0	101.6	100.6	95.2	80.0	100.0	83.7	45.0	23.7	N.A.
	Misc. Cereals	100.0	103.4	101.4	90.2	64.8	100.0	95.6	84.8	78.0	64.8
	Wheat Products	100.0	100.7	100.3	97.5	86.8	100.0	97.9	92.3	88.4	79.9
	Potatoes	100.0	98.1	99.2	103.9	106.0	100.0	93.8	79.0	70.0	53.0
Livestock Products & Fishes	Beef	100.0	148.3	214.3	299.0	403.9	100.0	123.0	149.1	171.0	189.6
	Pork						100.0	121.0	144.3	163.6	179.7
	Chicken						100.0	134.4	175.8	212.3	244.4
	Other Meat						100.0	122.9	148.8	170.5	188.9
	Fishes	100.0	119.6	138.3	153.8	164.0	100.0	118.6	138.8	155.0	168.4
	Eggs	100.0	155.6	233.3	335.3	463.5	100.0	136.5	180.6	219.8	254.2
Confectionary & Soft Drinks	Fruits	100.0	121.9	144.9	166.1	181.6	100.0	123.5	150.8	174.8	200.3
	Cakes	100.0	127.4	157.8	187.2	209.3	100.0	125.8	156.6	184.3	214.6
	Drinks	100.0	129.4	162.6	194.8	219.4	100.0	138.5	188.6	237.5	294.3
	Milk	100.0	150.6	211.7	274.8	324.9	100.0	141.5	196.2	250.0	313.0

Table 10. Forecasted Total Demand by Commodity

	Total Quantity Demand				Growth Rate		
	1971	1981	1991	2001	1971-81	1981-91	1991-2001
	. . . . Thousand M/T				. . . . . . % per annum		
Cereals & Potatoes	8,865	8,307	9,275	9,184	△0.65	1.11	△0.10
Rice	4,597	5,109	5,221	4,380	1.06	0.22	△1.74
Barley	1,276	499	437	303	△8.96	△1.32	△3.60
Wheat	1,054	1,333	1,889	2,458	2.38	3.55	3.01
Misc. Cereals	76	413	644	881	18.44	4.54	3.18
Beans	221	380	492	609	5.57	2.62	2.16
Potatoes	1,641	573	592	553	△9.99	0.33	△0.68
Vegetables	2,224	4,801	7,376	6,720	8.00	4.39	△0.93
Fruits	327	760	1,476	2,342	8.80	6.86	4.72
Meat	211	394	792	1,259	6.44	7.23	4.74
Beef	48	93	195	326	6.84	7.68	5.27
Pork	113	210	392	590	6.39	6.44	4.17
Chicken	50	91	205	343	6.17	8.46	5.28
Eggs	106	211	486	820	7.13	8.70	5.37
Milk	73	558	1,442	2,778	22.56	9.96	6.78
Fishes	489	1,005	1,769	2,566	7.47	5.82	3.79
Oil & Fats	74	231	432	648	12.11	6.39	4.16
Oil	48	169	316	478	13.41	6.46	4.23
Fats	26	63	115	170	9.25	6.20	3.99

Table 11. Forecasted Per Capita Per Year Demand

Unit: kg

	1971	1981	1991	2001
Cereals & Potatoes	269.0	214.5	205.6	179.9
Rice	139.5	131.9	115.7	85.8
Barley	38.7	12.9	9.7	5.9
Wheat	32.0	34.4	41.9	48.2
Miscellaneous Cereals	2.3	10.7	14.3	17.3
Beans	6.7	9.8	10.9	11.9
Potatoes	49.8	14.8	13.1	10.8
Vegetables	67.5	124.0	163.5	131.7
Fruits	9.9	19.6	32.7	45.9
Meat	6.4	10.2	17.6	24.7
Beef	1.5	2.4	4.3	6.4
Pork	3.4	5.4	8.7	11.6
Chicken	1.5	2.4	4.5	6.7
Eggs	3.2	5.4	10.8	16.1
Milk	2.2	14.4	32.0	54.4
Fishes	14.8	26.0	39.2	50.3
Oil & Fats	2.2	6.0	9.6	12.7
Oil	1.5	4.4	7.0	9.4
Fats	0.8	1.6	2.6	3.3

Table 11. Implicit Income Elasticities Implied by the Predictions for the years 1981, 1991 and 2001

	Farm Household			Non-Farm Household		
	1981	1991	2000	1981	1991	2000
Cereals	0.1237	0.1425	-1.2025	0.0695	-0.0050	-0.3343
Rice	0.1905	-0.2638	-1.7872	-0.0509	-0.1899	-0.8681
Barley	0.1632	-0.2632	-1.5668	0.0825	-0.0485	-0.4782
Wheat	0.2605	0.2453	-0.1712	0.2494	0.2614	0.1412
Misc. Cereals	0.5266	0.5967	0.3015	0.4924	0.3783	0.2185
Beans	0.2614	0.1664	0.0452	0.4021	0.3064	0.4722
potatoes	0.0460	0.1583	-0.0402	0.0125	0.1263	0.8186
Vegetables	0.7281	0.6344	0.3326	0.5199	-0.0127	-1.4357
Fruits	0.6498	0.5866	0.2218	0.7727	0.6035	0.5212
Meat	1.4832	1.3814	1.1532	0.7751	0.6590	0.4382
Beef	1.9971	1.6461	0.5974	0.7816	0.6577	0.5776
Pork	0.9537	1.1199	1.3931	0.6754	0.5538	0.3492
Chicken	1.9971	1.5562	1.2757	1.0614	0.8219	0.4895
Eggs	1.7485	1.4377	1.1874	1.1278	0.8704	0.4666
Milk	2.1904	1.1111	0.6072	1.2762	0.9952	0.8753
Fishes	0.7022	0.4643	0.1384	0.6616	0.4985	0.3118
Oil & Fat	0.9300	0.9247	0.8569	0.7645	0.6097	0.3579
Oil	0.9145	0.9294	0.8540	0.8202	0.6127	0.4015
Fats	0.9674	0.9135	0.8638	0.6122	0.6010	0.3026

Apprendix

Input-Output Relation Between Food & Agricultural Products in Non-Farm Households

Unit: M/T

	Home Consumption	Indirect Consumption							
		Wheat Products	Other Food	Condiment	Cakes	Soft Drink	Milk	Alcoholic Drink	Restaurant Meals
Rice	3492.51	0.51		18.90				13.54	18.90
Barley	108.98			7.78				42.18	4.29
Beans	113.66	10.64	86.83	44.50	8.70		13.34		3.31
Miscellaneous Cereals	131.29	2.07	187.87	19.58		2.56		19.56	2.07
Wheat		796.33		15.73	284.60			145.14	44.92
Potatoes	355.37		42.92		1.15			214.41	0.17
Beef	67.07		0.44						15.17
Pork	178.50		5.19						1.16
Chicken	79.47		0.49						
Fishes	837.06		21.61		0.50				17.29
Eggs	183.15	1.69			0.87		0.11		0.08
Vegetables	3343.42	16.32	154.11	144.99					136.35
Fruits	695.86	0.23	14.67			0.08		0.23	0.08
Milk	547.84								
Oil			22.40	98.70		8.00			5.20
Fats			0.10	46.10					2.30

Apprendix

Input-Output Relation Between Food & Agricultural Products in Farm Household

Unit: M/T

	Home Consumption	Indirect Consumption							
		Wheat Products	Other Food	Condiment	Cakes	Soft Drink	Milk	Alcoholic Drink	Restaurant Meals
Rice	1571.02			6.13				4.46	1.02
Barley	375.30			2.40				13.82	0.30
Beans	68.36	1.98	13.41	13.72	1.10		0.23		0.23
Miscellaneous Cereals	32.09	0.37	29.03	5.91		0.17		6.44	
Wheat		148.23		4.80	35.32			47.86	2.93
Potatoes	166.69		6.65		0.11			70.59	
Meat	44.86		0.48						1.19
Fishes	124.02		3.32		0.10				1.11
Eggs	24.71	0.32			0.11				
Vegetables	925.15	2.88	24.01	44.65					9.12
Fruits	46.51		2.28					0.08	
Milk	10.16								
Oil			3.40	30.40		0.60			0.40
Fats				14.20					0.20

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Projections of Demand and Supply of Meat and Livestock Products

Yong Jin Kim

Demand reflects a consumer's desire to acquire a good or service. In economic terminology, demand represents a consumer's behaviour according to changes in price for the good or service, while all other things are equal. Thus demand reveals the amount of a good or service that the consumer intends to buy at a given price level. But it is not the actual amount of a commodity purchased or consumed. Demand can be classified into two categories: that is, individual demand and aggregate demand, which is equivalent to the sum of the individual demands in an economy.

Both long-term and short-term demand for meat and livestock products will be projected in this paper so that they can be utilized as basic guidelines for governmental policies in stabilizing prices through a balanced supply and demand.

1. Long-term Demand Projections

Factors determining demand for meat and livestock products include their own-prices, prices of related commodities (complementary and substituting), population, income level, tastes, weather condition, and so forth. When forecasting short-term demand, the above factors must be considered. However, price variations in long-term projection of demand are not believed to be significant. Thus price factors

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* This is the short-term Projection by CVLCF

are excluded in the long-term projections, especially when projecting total meat demand.

When projecting the specific demand for beef, pork and chicken, the estimated composition rates for beef, pork, and chicken are applied to the projected total amount of demand for meat.

A semi-log function is employed for meat demand projection. Time-series data on per capita consumption of beef, pork, and chicken and per capita GNP during the period of 1974-1983 are used by estimation.

Long-term demand equations for eggs and milk are specified by log-log functional forms including as independent variables; real owner price and real income level. The observational data for variables cover the period of 1971 through 1983.

The criteria for selecting well-fitted equations are as follows; (1) R^2, (2) sign of coefficient, (3) magnitude of coefficient, (4) t-value, and 5) Durbin-Watson (D,W) statistic. The following equations are selected demand projection models according to the above criteria.

A. Meat Demand Projection Model

$$TM_t = -94,991.9 + 15,451.2 \ln GNP_t$$

(t-value)

$R^2 = 0.8945$ N = 10 (1974-1983)

where TM_t = per capita consumption of meat per year t (g)

GNP_t = GNP per capita at year t (1980 constant 1,000 won)

B. Eggs Demand Projection Model

$$\ln Q_t^E = 4.7828 - \underset{(-3.25)}{0.4573} \ln P_t^E + \underset{(3.43)}{0.3834} \ln GNP_t$$

$R^2 = 0.9137$ N = 13 (1971-1983)

Where Q_t^E = per capita egg consumption at year t (*number of eggs)

P_t^E = real retail price of eggs at year t (won/10 eggs)

GNP_t = GNP per capita at year t (1980 constant 1,000 won)

C. Milk Demand Projection Model

$$\underset{\text{(t-value)}}{\ln Q_t^M} = -3.5927 - \underset{(-2.66)}{1.0554} \ln P_t^M + \underset{(17.24)}{2.7486} \ln GNP_t$$

$R^2 = 0.9773$ N = 13 (1971-1983)

Where Q_t^M = per capita milk consumption at year t (g)

P_t^M = producer's real price of milk at year t (won/kg)

GNP_t = GNP per capita at year t (1980 constant 1,000 won)

D. Equations for Composition Rate Estimation for Beef, Pork, and Chicken

(1) Composition of Beef Consumption

$$\ln \Delta B_t = 3.3845 - 0.1466 \ln T$$

$R^2 = 0.8105$ N = 6 (1978-1983)

Where ΔB_t = proportion of beef to total meat (Beef, Pork, and Chicken) consumption at year t

T = time variable (T=1 at 1978)

(2) Composition of Pork Consumption

$$\ln \Delta P_t = 3.8931 + 0.0658 \ln T$$

$$R^2 = 0.6219 \qquad N = 6 \ (1978\text{-}1983)$$

Where ΔP_t = proportion of pork to total meat consumption at year t

T = time variable (T=1 at 1978)

(3) Composition of Chicken Consumption

$$\ln \Delta C_t = 3.0573 + 0.0274 \ln T$$

$$R^2 = 0.2245 \qquad N = 6 \ (1978\text{-}1983)$$

Where ΔC_t = proportion of chicken to total meat consumption at year t

T = time variable (T=1 at 1978)

The projected amount of demand for meat and livestock products based on the above long-term demand projection model are presented in Table 1 and Table 2.

Table 1. Aggregate Demand for Meat and Livestock Products

Unit : 1,000 M/T

Classification		1983	1986	1991	Increase Rate (%) 1983-1986	Increase Rate (%) 1986-1991
Meat	Total	530	653	908	7.2	6.8
	Beef	115	145	195	8.0	6.1
	Pork	295	360	507	6.9	7.1
	Chicken	120	148	206	7.2	6.8
Eggs		271	301	379	3.6	4.7
Milk		729	990	1,872	10.7	13.6

Table 2. Per Capita Demand for Meat and Livestock Products

Unit : kg

Classification	1983	1986	1991	Increase Rate (%)	
				1983-1984	1986-1994
Meat Total	13.19	15.51	19.91	5.5	5.1
Beef	2.81	3.44	4.28	7.0	4.5
Pork	7.38	8.56	11.11	5.1	5.4
Chicken	3.00	3.51	4.52	5.4	5.2
Eggs	6.80	7.15	8.31	1.7	3.1
Milk	18.24	23.51	41.00	8.8	11.8

2) Short-term Demand Projections

In the short-term model for projecting demand for meat and livestock products for the year 1984, price factors, which are not significantly considered for long-term projections, are included such as major independent variables.

A demand function can be theoretically derived from a consumer's utility maximization process which depends on income, commodity's own price, prices of complementary and substituting commodities, tastes, etc. However, all of these factors cannot be adopted for statistical projection models. Among the measurable factors, the statistically significant and theoretically meaningful factors are finally selected for model building.

The estimated short-term demand projection models are as follows:

A. Demand for Beef

$$\ln Q_t^B = -3.0720 - \underset{(-2.71)}{0.9196} \ln P_t^B + \underset{(1.88)}{0.4370} \ln P_t^P$$
(t-value)

$$+ \underset{(1.75)}{0.3823} \ln P_t^F + \underset{(7.75)}{1.8951} \ln GNP_t$$

$R^2 = 0.9588$ N = 13 (1971-1983)

Where Q_t^B = per capita consumption of beef at year t (g)

P_t^B = real retail price of beef at year t (won/600g)

P_t^P = real retail price of pork at year t (won/600g)

P_t^F = real retail price of fish at year t (won/kg)

GNP_t = per capita GNP (1980 constant 1,000 won)

B. Demand for Pork

$$\ln Q_t^P = -2.1018 + \underset{(1.70)}{0.7721} \ln P_t^B - \underset{(-2.26)}{0.7026} \ln P_t^P$$
(t-value)

$$+ \underset{(0.51)}{0.501} \ln P_t^F + \underset{(3.91)}{1.2793} \ln GNP_t$$

$R^2 = 0.9438$ N = 13 (1971-1983)

where Q_t^P = per capita consumption of pork at year t (g)

C. Demand for Chicken

$$\ln Q_t^C = 2,4525 + \underset{(4.12)}{0.4199} \ln P_t^B - \underset{(-3.84)}{0.2723} \ln P_t^C$$
(t-value)

$$+ \underset{(7.15)}{0.5489} \ln GNP_t$$

$R^2 = 0.9763$ N = 13 (1971-1983)

where Q_t^C = per capita consumption of chicken at year t (g)

P_t^C = real farm price of chicken at year t (won/kg)

D. Demand for Eggs

$$\ln Q_t^E = 4.7828 - \underset{(-3.25)}{0.4573} \ln P_t^E + \underset{(3.43)}{0.3837} \ln GNP_t$$
(t-value)

$R^2 = 0.9137$ N = 13 (1971-1983)

where Q_t^E = per capita consumption of eggs at year t (number of eggs)

P_t^E = real retail price of eggs at year t (won/10 eggs)

E. Demand for milk

$$\ln Q_t^M = -3.5694 - 1.0644 \ln P_t^M + 2,7529 \ln GNP_t$$
(t-value)

$R_2 = 0.9773$ N = 13 (1971-1983)

where Q_t^M = per capita consumption of milk at year t (g)

P_t^M = real farm price of milk at year t (won/kg)

The above estimated models generally show that prices and income effects are significant. The cross-substitution effects for chicken, eggs, and milk were not statistically significant, and were thus excluded in the demand projection models.

Table 3 presents the price (owner and other related) elasticities and income elasticities of demand for meat and livestock products. The cross-effect of beef price on the demand for pork and chicken appears to be relatively large. The income elasticity of the demand for beef is the largest, the largest among the five commodities as is the owner price elasticity.

Table 3. Price and Income Elasticities of Demand for Meat and Livestock Products

Demand for	Price Elasticity						Income Elasticity
	Beef Price	Pork Price	Chicken Price	Fish Price	Egg Price	Milk Price	
Beef	-0.9169	0.4370	-	0.3823	-	-	1,8951
Pork	0.7721	-0.7026	-	0.1501	-	-	1,2793
Chicken	0.4199	-	-0.2723	-	-	-	0.5487
Eggs	-	-	-	-	-0.4573	-	0.3837
Milk	-	-	-	-	-	-1.0644	2,7572

Finally, the above elasticities are utilized to estimate the amounts of demand for meat and livestock products for the year 1984. The related factors in forecasting the 1984 demand for meat and livestock products include price level, population, and GNP growth rate. Two alternative assumptions are made for the price levels, especially for the projections of beef and pork demand.

(1) Assumption I

All prices increase as much as the total wholesale price level; except for pork prices which are assumed to decrease by 2 percent, due to over supply.

(2) Assumption II

Pork price will decrease by 8 percent. Other price levels are the same as in assumption I.

The population for 1984 is assumed to be 40,578 thousands which is 1.57 percent larger than that for 1983. A 7.5 percent increase in GNP (5.9 percent in GNP per capita) and a 2 percent increase in wholesale price level is also assumed.

The estimated aggregate demand and per capita demand for meat and livestock products are shown in Table 4 and Table 5.

Table 4. Aggregate Demand for Meat and Livestock Products

Unit : thousand M/T

<table>
<tr><th rowspan="3">Classification</th><th rowspan="3">1983</th><th colspan="3">1984</th><th colspan="2">Increased Amount Assumption</th><th colspan="2">Increased Rate (%) Assumption</th></tr>
<tr><th rowspan="2">MAF[a/] Estimate</th><th colspan="2">Assumption</th><th rowspan="2">I</th><th rowspan="2">II</th><th rowspan="2">I</th><th rowspan="2">II</th></tr>
<tr><th>I</th><th>II</th></tr>
<tr><td>Meat Total</td><td>530</td><td>580</td><td>584</td><td>594</td><td>54</td><td>64</td><td>9.2</td><td>10.8</td></tr>
<tr><td>Beef</td><td>115</td><td>126</td><td>128</td><td>125</td><td>13</td><td>10</td><td>11.3</td><td>8.7</td></tr>
<tr><td>Pork</td><td>290</td><td>327</td><td>330</td><td>343</td><td>35</td><td>48</td><td>11.9</td><td>16.3</td></tr>
<tr><td>Chicken</td><td>120</td><td>127</td><td colspan="2">126</td><td colspan="2">6</td><td colspan="2">5.0</td></tr>
<tr><td>Eggs</td><td>271</td><td>280</td><td colspan="2">282</td><td colspan="2">11</td><td colspan="2">4.1</td></tr>
<tr><td>Milk</td><td>729</td><td>896</td><td colspan="2">860</td><td colspan="2">131</td><td colspan="2">18.0</td></tr>
</table>

a/ Ministry of Agriculture and Fisheries

Table 5. Per Capita Demand for Meat and Livestock Products

Unit : kg

Classification	1983	MAF[a/] Estimate	1984 Assumption I	1984 Assumption II	Increased Amount Assumption I	Increased Amount Assumption II	Increased Rate(%) Assumption I	Increased Rate(%) Assumption II
Meat Total	13.27	14.30	14.40	14.65	1.13	1.38	8.5	10.4
Beef	2.89	3.10	3.16	3.10	0.27	0.21	9.3	7.3
Pork	7.38	8.00	8.14	8.45	0.76	1.07	10.2	14.5
Chicken	3.00	3.10	3.10		0.10		3.3	
Eggs	6,80	6,90	6,96		0.16		2.4	
Milk	18.24	22.10	21.20		2.96		16.4	

a/ Ministry of Agriculture and Fisheries

2. Supply Projections

Supply projections of meat are generally more complicated and more difficult than their demand projections. There are many factors which influence meat production or meat supply that are rapidly changing and are related to various non-economic factors.

The meat supply consists of domestic production and import. Domestic production is a function of input prices, output prices received by producers, technological levels, government support, and so forth, while import is determined by the supply-demand gaps and the desired level of stabilized market prices as well as sociopolitical factors.

Since the imported amount of meat tends to be politically decided, the supply based on domestic production would be economically meaningful while considering the supply projections of meat. Thus this paper emphasizes the projection of domestic production rather than the supply projection as a whole. The underlying assumptions for the supply projections in this scope are as follows:

(1) beef prices under the low-price policy increases as much as general wholesale prices;

(2) there is no import of beef cattle, but small amounts of beef are imported in case of supply shortages;

(3) steers are slaughtered at 400kg-weights (22 month-old) and cows are slaughtered at the age of six;

(4) the dressed beef per cattle weights 148.4kg;

(5) pork and chicken are domestically produced to the level at which consumer demand can be met. It is also assumed that they are institutionally controlled at an appropriate price level, in order to reduce the risk of over or under-supply.

1. The Model of Supply Projections

Theoretically, under profit maximization conditions, a commodity's domestic supply is determined by its own price, prices of other related commodities, input prices, and technological levels. The supply function can be written as

$$Q^s_{it} = S_i\,(P_{1t-1m}\ P_{2t-1},\ ---,\ P_{it-1},\ P_{F1t-1},\ ---\ ,\ P_{Fjt-1},\ T_t,\ V_t)$$

Where Q^s_i = domestic supply of it the product (i=1,-----,n)

P_i = price of i th product

P_{Fj} = price of j the input (j=1,------,m)

T = technological level

V = error term

It is believed that supply of a commodity is a function of expected price. When a simple or static price expectation is assumed, the previous year's price can be used as the expected price as it appears in the above model. This assumption is applicable to crops, but not appropriate for perennial crops. Thus a dynamic price expectation model is more desirable for meat supply projections. The expected price in a dynamic price expectation model can be expressed as

$$P^*_t = f\ (P_{t-1},\ P_{t-2},\ P_{t-3},\ ------------)$$

This expected price would be the weighted average of the lagged prices.[1/]

The projection of the future meat supply based on the above theoretical model is not an easy job especially in Korea's market

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1/ B.Y.Sung, Analysis of Food Economy Problems, Korea Rural Economics Institute, PP. 64-65.

structure. It is almost impossible to acquire accurate data on prices, technological level, political variables and other related factors. Also, many more factors than those theoretically specified must be considered because meat supply in Korea's market has been considerably influenced by political measures including capital and technical supports.

For this reason, this paper first projects the number of livestock being raised. The number of livestock can be estimated by using the number of livestock born, and dead livestock . Then, this estimated number is utilized for the projection of livestock products supply. It is expected that this methodology would provide more realistic supply projections than the model defined in pure theoretical specifications.

The number of cattle and hog being raised during a period can be derived by the following equation.

$$L_{t-1} = L_t + B_{dt} + I_{dt} - D_{dt} - S_{dt}$$

Where L_{t+1} = Number of livestock at the end of a period (Cattle: at the end of the year, Hog: at the end of June and at the end of December)

L_t = Number of livestock at the beginning of a period (Cattle: at the beginning of the year, Hog: at the beginning of January and at the beginning of July)

B_{dt} = Number of livestock born during period t (Cattle: a year, Hog: January to June and July to December)

I_{dt} = The net number of livestock imported during period t (Cattle: a year, Hog: January to June and July to December)

D_{dt} = Number of livestock dead during period t (Cattle: a year, Hog: January to June and July to December)

S_{dt} = Number of livestock slaughtered during period t (Cattle: a year, Hog: January to June and July to December)

The number of produced livestock(B_{dt}) is obtained by nultiplying L_t by the ratio of livestock born (with fertility) among total livestock, r_t, and by the reproduction ratio among the adult livestock (with fertility), b_t: that is,

$$B_{dt} = L_t \cdot r_t \cdot b_t$$

The net number of imported livestock(I_{dt}), which is decided by government, is the number of imported livestock less the number of exported livestock during the period.

The number of dead (D_{dt}) is calculated by multiplying the number of young livestock by the death rate.

In computing the number slaughtered, it is assumed that 20% of cows older than 2 years and 64% of all steers are butchered.[2/] The production of dressed meat is given by multiplying the number of slaughtered livestock by the weight of dressed meat per head of livestock.

2. Short and Long-term Supply Projections of Livestock Products

When the supply of livestock products is projected according to the above methodology, livestock products except for beef are assumed to be equal to the amounts of demand[3/] both in short-term and in long-term. Table 1 presents the projected supply of livestock products.

2/ Cows can be slaughtered when 6 years-old, and steers can be slaughtered when 18 to 20 months-old.

3/ The amounts of demand are obtained from the Ministry of Agriculture and Fisheries.

Table 1. Supply Projections of Meat

(Unit : thousand M/T)

Livestock Products	Year				Growth rate (%)	
	1983	1984	1986	1991	83-86	86-91
Meat Total	482	535	611	896	8.2	8.0
Beef	67	81	103	183	15.4	12.2
Pork	295	327	360	507	6.9	5.9
Chicken	120	127	148	206	7.2	5.7
Eggs	271	280	301	379	3.6	3.9
Milk	729	896	990	1,872	10.7	11.2

3. Demand for and Supply of Livestock Products

Table 2 compares the projected demand and supply of livestock products. These figures show that the shortage of beef supply is 48 thousand M/T in 1983, but it will be reduced to 12 thousand M/T in 1991. Accordingly, the self-sufficiency rate of beef production is expected to increase to 93.8% in 1991 from 58.3% in 1983.

Under the assumption that livestock products except for beef will keep their supply and demand equal, the self-sufficiency rate of total meat production would become 98.6% in 1991. The self-sufficiency rate of total meat production in 1983 was 90.9%.

IV. Quarterly Forecasts of the Number of Livestock

1. Theoretical Model

The estimation function for the number of livestock can be derived from the process of producers utility maximization while raising livestock . The theoretical factors determining this utility maximization include

(1) income (above production cost),

(2) price of livestock in question,

(3) prices of complementary and substituting livestock ,

(4) changes in demand for livestock products, and

(5) preferences for livestock

Table 2. Projected Demand for and Supply of Livestock Products

(Unit: thousand M/T)

Classification		1983	1984[a]	1986	1991
Meat Total	Demand[b]	530	580	653	908
	Production	482	535	611	896
	Shortage	48	45	42	13
	Self-Sufficiency ratio (%)	90.9	92.2	93.6	98.6
Beef	Demand[b]	115	126	145	195
	Production	67	81	103	183
	Shortage	48	45	42	12
	Self-Sufficiency ratio (%)	58.3	64.3	71.0	93.7
Pork	Demand = Supply	295	327	360	507
Chicken	Demand = Supply	120	127	148	206
Eggs	Demand = Supply	271	280	301	379
Milk	Demand = Supply	729	896	990	1,872

a/ The amount of livestock products demanded for 1984 was estimated by the Ministry of Agriculture and Fisheries.

b/ Demand means actually the amount demanded.

If the price of livestock is determined at the level above the production cost, the desire to raise the livestock would increase. Substitution effect is expected if the relative price between livestock changes . The changes in demand for livestock products and governmental policy will also influence the decision as to on the number of livestock to be raised.

The theoretical model for the estimate of the number of livestock can be written by

$$Q_i = f\ (P_i,\ P_j,\ P_k,\ Q_F,\ T,\ U)$$

Where Q_i = the number of i th livestock,

P_i = the price of i th livestock,

P_j = the price of j the livestock which is a substitute to i th livestock

P_k = the price of k th livestock which is complementary to i th livestock,

Q_F = the number of adult livestock (especially female) which directly determine the increase or decrease in the number of i th livestock through reproduction,

T = producer's preference, and

U = error term

2. Statistical Model

Based on the above theoretical model, the statistical estimation model can be specified using the factors that are measurable with statistical significance.

Data used for forecasting the number of livestock were the quarterly number of livestock from 1974 to 1983, monthly price levels, monthly and quarterly amounts of feeds, and so forth.

Livestock for casting models for 1983 are as follows.

A. Korean Cattle (including beef cattle)

(1) Model I

$$\ln Q_t^{CW} = \underset{(\text{t-value})}{2.8272} + \underset{(1.35)}{0.0369} \ln P_t^{CW} - \underset{(-0.24)}{0.0134} \ln I_t^{PF}$$

$$+ 0.6963 \ln Q_t^{CM} - 0.0357 \ln P_t^{HG}$$

$R^2 = 0.9532$ DW = 1.7028 N = 19 (June 1974-June 1983)

(2) Model II

$$\text{Ln } Q_t^{CW} = 3.2620 + \underset{(1.40)}{0.1050} \ln P_{t-6m}^{B} - \underset{(-0.87)}{0.1467} \ln I_{t-6m}^{PF}$$

$$+ \underset{(3.30)}{0.6187} \ln Q_{t-6m}^{CM} - \underset{(-0.20)}{0.0120} \ln P_{t-6m}^{HG}$$

$R^2 = 0.6399$ DW = 2.2279 N = 18 (Dec. 1974- June 1983)

<u>Connotations</u> : Q_t^{CW} = Number of cattle in quarter t (thousands)

P_{t-6m}^{B} = Farm Price of Steer at 6 months before t (Won/Kg)

I_{t-6m}^{PF} = Price index of feeds purchased at 6 months before t (1975 = 100)

Q_{t-6m}^{CM} = Number of cows older than 2 years at 6 months before t (thousands)

P_{t-6m}^{HG} = Farm Price of Hog at 6 months before t (won/kg)

B. Hogs

(1) Model I

$$\ln Q_t^{HG} = 2.8314 - \underset{(-3.13)}{0.03071} \ln P^B_{t-6m} + \underset{(2.17)}{0.2436} \ln P^{H/F}_{t-6m}$$
(t-value)

$$+ \underset{(4.79)}{0.5257} \ln Q^F_{t-4m}$$

$R^2 = 0.7626$ DW = 1.7453 N = 16 (June 1979-March 1983)

(2) Model II

$$\ln Q_t^{HG} = 1.5427 - \underset{(-0.99)}{0.1476} \ln P^B_{t-6m} + \underset{(2.7)}{0.4439} \ln P^{H/F}_{t-6m}$$
(t-value)

$$+ \underset{(0.72)}{0.1382} \ln Q^F_{t-3m} + \underset{(2.1)}{0.5579} \ln Q^M_{t-6m}$$

$R^2 = 0.7767$ DW = 1.8393 N = 16 (June 1979-March 1983)

Connotations: Q_t^{HG} = Number of Hogs in quarter t (thousand)

P^B_{t-6m} = Farm price of steer at 6 months before t (won/kg)

$$P^{H/F}_{t-6m} = \frac{\text{Price of Hog per 90 kg at 6 months before t}}{\text{Price of feeds per 300kg at 6 months before t}} \times 100$$

Q^F_{t-4m} = amount of assorted feeds supplied at 4 months before t (M/T)

Q^F_{t-3m} = amount of assorted feeds supplied at 3 months before t (M/T)

Q^M_{t-6m} = Number of adult female hogs at 6 months before t (thousands)

C. Chicken for eggs

$$\ln Q_t^{EG} = 1.4017 + \underset{(2.14)}{0.2095} \ln P_{t-3m}^{EG} + \underset{(1.40)}{0.1266} \ln P_{t-3m}^{EF} + \underset{(12.13)}{0.5223} \ln Q_{t-1q}^{EF}$$

$R^2 = 0.9246$ DW = 1.3782 N = 32 (March 1975-March 1983)

<u>Connotations</u> : Q_t^{EG} = Number of chicken for eggs in quarter t (thousands)

P_{t-3m}^{EG} = Farm price of eggs at 3 months before t (won/10 large eggs)

P_{t-3m}^{EF} = Price of assorted feeds at 3 months before t (won/25kg)

Q_{t-1q} = amount of asorted feeds supplied during previous quarter (M/T)

D. Broiler

$$\ln Q_t^{ck} = 5.1294 + \underset{(1.24)}{0.1688} \ln P_{t-1m}^{CK} + \underset{(2.58)}{0.2737} \ln Q_{t-2m}^{CK} + \underset{(1.20)}{0.0970} \ln Q_{t-1q}^{CF} + \underset{(0.60)}{0.0258} \operatorname{Sin} 90_t{}^o - \underset{(-4.41)}{0.2491} \operatorname{Cos} 90_t{}^o$$

$R^2 = 0.7976$ DW = 1.3385 N = 32 (March 1975-March 1983)

<u>Connotations</u> : Q_t^{CK} = Number of broilers in quarter t (thousands)

P_{t-1m}^{CK} = Price of broiler at 1 me month before t (won/kg)

Q_{t-2m}^{CK} = Number of hatched chicks at 2 months before t (thousand

Q^{CF}_{t-1q} = amount of feeds supplied during previous quarter (M/T)

Sin, Cos = cyclical variations

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VI Production of Meat and Livestock

I. Economic Analysis of Beef Production

Suk-Jin Cho*

1) Introduction

Korean native cattle have been principally used for draft purpose, beef and manure being useful byproducts. In recent years, however, the value of native cattle as a draft animal has gradually decreased following the spread of power tiller and other agricultural machineries. This phenomenon is likely to be further accelerated in the future. In addition to this, consumer demand for beef has increased remarkably with rising incomes and changes in consumer preferences. During the last decade, per capita consumption of beef in Korea more than doubled, from 1.2 kilograms in 1970 to 2.6 kilograms in 1980.

In accordance with such increases in beef consumption, the role of native cattle has shifted from that of draft to beef animal. However, due to the low profitability of beef production, domestic supply of beef has failed to meet the increasing demand. Consequently, a good deal of foreign beef imported in 1978 were almost 40 percent of total domestic consumption in that year. Admittedly, such stopgap measure of importing foreign beef explicitly contributed to the stabilization of domestic consumer prices, albeit temporarily. However, such imports also rendered significant negative impacts on the domestic beef production maintaining price to low level. Both the inventory and production of native cattle

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were decreasing over 1979-1981 mainly due to the low price of beef caused by the sustantial imports of beef in 1978. As a result, the government limited imports of foreign beef to 27 thousand tons in 1979 and stopped imports in 1980 to promote domestic production.

However, the ascending trend of prices in 1981 again triggered imports of foreign beef. The amount reached 32.6 thousand tons in 1981, 72.9 thousand tons in 1982 and 64.6 thousand tons in 1983. Such a short-term import policy to keep balance between demand and supply with no considerations on the structural and income problems of domestic beef producing farms seems to have greatly distorted inherent production foundations. The domestic beef price repeated had its ups and downs since 1975. Such a cyclical variation has caused the income of beef producing farms to be quite unstable. This trend may be continued, so far as we do not establish proper means to meet the excess demand in the long-term perspectives.

A country with only 22% arable land, the future food problems of Korea hinge greatly upon the effective utilization of mountain and hillside land which covers about 65 percent. Moreover, there are no proper second crops for rice paddy which can substantially contribute to the improvement of farm income. In this respect, it is not implausible to encourage import substitution of beef to a certain limited extent while making the most use of idle domestic resources.

With such problems in mind, this study aims at investigating effective ways of improving domestic beef production. To achieve this goal, we perform an economic analysis at the microlevel using individual farm records. In addition, we also examine producer's response to price change at the national level. The plan of this study is as follows. In Section II, descriptions of sample data are given. In Section III, principal component and factor analyses are applied as a means of examining the general features of beef production. In Section IV, cost function analysis is performed followed by a production function analysis in Section V in order to derive some implications on the optimum herd size and producer's behavioral patterns in allocating scarce resources. In Section VI, both inventory and supply functions are estimated using macor data to get further insights into producer's response to current price changes. Finally, conclusions, limitations and suggestions for future study are offered in Section VII.

2) Description of the Sample Data

The individual farm records used in this study were collected through a nation-wide sample survey performed in 1980 and 1981. The data include monthly observations of quantities and values of inputs employed as well as quantity and value of beef produced. Unlike the traditional farms raising one or two heads of native cattle mainly for draft power, the sample farms surveyed in this study keep beef production enterprise as an important source of additional farm income. The total number of farms surveyed amounts to 126 and 125, respectively in 1980 and 1981. Among these, the number of farms continually surveyed both in 1980 and 1981 was 89.

A summary comparis on of key indicators taken from the 89x2 data matrix is listed in Table 1. As one can easily verify, differences in the values of key indicators are quite negligible between two years. First of all, the annual per farm herd size is almost fixed at eight heads. The beginning weight of steer turned out to be four kilograms heavier in 1980 than in 1981. The same is true in the case of slaughter weight revealing 411.4 and 407.2 kilograms, respectively in 1980 and 1981. Per head weight gain is 107 Kilograms in 1980 and 407.2 kilograms in 1981. Also notice that there exists no pronounced difference in the fattening period between the two years.[1/] Most farms in our sample seem to be engaged in short-term fattening with no on-farm breeding system. They purchase steers weighing about 270 kilogrmas and achieve a weight gain of about 140 kilograms during six months.

3) Principal Component and Factor Analysis

Many factors influence beef production, i.e., herd size, supply of feed, labor, land, etc. It is difficult to include all of these factors in evaluating and diagnosing beef production. In dealing with such problems, the method of Principal Component Analysis(PCA) and Factor Analysis(FA) can be used as powerful tools. In order to investigate the general features of beef production by means of PCA

1/ The values of weight gain and fattening period in Table 1 are means of whole cattle including both slaughtered and under fattening. The same values derived for slaughtered turned out to be 140 kilograms and 180 days, respectively.

and FA, a total of 16 variables were chosen using 126 individual farm records from a 1980 survey. The means of the 16 variables are represented in Table.

(1) Description of Principal Component and Factor Analysis

Before we move to the results of both PCA and FA, it is helpful to briefly describe the theoretical frameworks of both methods. Detailed explanations are suppressed here since they are available in many other works (Cooley and Lohnes 1971, Anderson 1958 and Johnston 1972).

When we perform PCA using the correlation matrix, the relationship between the principal component(%) and the original variable(X) can be expressed as follows.

$$
\begin{aligned}
Z_1 &= a_{11}x_1 + a_{12}x_2 + \dots + a_{1p}x_p \\
Z_2 &= a_{21}x_1 + a_{22}x_2 + \dots + a_{2p}x_p \\
&\dots\dots\dots\dots\dots\dots\dots\dots \qquad (3.1) \\
A_m &= a_{mi}x_1 + a_{m2}x_2 + \dots + a_{mp}x_p
\end{aligned}
$$

$$\sum_{i=1}^{P} a_{ki}^2 = 1 \quad (k = 1,2,\dots\dots,m) \qquad (3.2)$$

In (3.1) we can verify that the principal component(z) is expressed as a linear function of x(the mean deviation of the original variable X divided by standard deviation). The coefficient a_{ki}(k=1,2,....,m; i=1,2,....,p) stands for the element of the Eigen vector, the squared sum of which equals unity as illustrated in (3.2). The variance of Z_k equal $_k$ the Eigen value derived from the correlation matrix of the original variable X. The contribution rate of Z_k to the total variance of standardized variable x's which equals p is given by the ratio λ_k/p, thus, the accumulated contribution rate of m principal components can be expressed as follows.

$$\sum_{k-1}^{m} \lambda_k/p \tag{3.3}$$

In addition, the principal components $Z_k(k = 1,2,\ldots,m)$ are uncorrelated with each other. In a sense, the method of PCA can be considered as a method of transforming the inter-correlated original variable X's into a new set of variables which are pairwise uncorrelated.

On the other hand, the FA is a method of explaining the original variable X's by a small number of independent common factor(F) and specific factor(U)(Kendall 1968). In FA the relationship between X and F can be expressed as follows.

$$\begin{aligned} X_1 &= b_{11}F_1 + b_{12}F_2 + \ldots + b_{1m}F_m + U_1 \\ X_2 &= {}_{21}F_i + b_{22}F_2 + \ldots + b_{2m}F_m + U_2 \\ &\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \\ X_p &= b_{p1}F_1 + b_{p2}F_2 + \ldots + b_{pm}F_m + U_p \end{aligned} \tag{3.4}$$

In the above, the coefficients $b_{ik}(i-1,2,\ldots,p;\ K=1,2,\ldots,m)$ represents factor loadings between X_i and F_k. If we ignore the specific factor U's in (3.4) and assume that m equals p, then the expression in (3.4) can be transformed into the same form in (3.1). Thus we can find that PCA is a possible estimation method in FA. In (34.) we have to estimate b_{ik} in advance to the rotation of the factor pattern. For the estimation of factor loading b_{ik}, we use PCA and for the rotation of factor pattern, we adopt the Varimax Rotation Method (Cooley and Lohnes 1971).

(2) Results of Principal Component Analysis

Using the 16 variables listed in Table 2, we first performed PCA, Table 3 lists the Eigen values the magnitudes of which exceeds unity. The accumulated contribution rate of these five Eigen values turned out to be 80%, in which was verified using the relationship in (3.3). This means that the five principal components $Z_1 - Z_5$ which correspond to the given eigen values in Table 3 explain 80% of the total information included in the original 16 variables X's. On the other hand, the values of factor loading(FL) which correspond to the correlation coefficients between principal components and X's are listed in Table 4. The values in the last column of Table 4 express the portion of variance of the original variables X's explained by the five principal components $Z_1 - Z_5$. For instance, the value 0.8477 in the first line means that 94.2% of variance of gross revenue(X_1) can be explained by the orthogonal five principal components. From the value of FL in Table 4, we can see that the first principal component Z_1 is highly correlated with variables representing 'farm size', the second one Z_2 with variables representing 'technical efficiency' and the third one Z_3 with fattening period X_{14}. However, the relationships between Z_4 and Z_5 and the 16 variables X's are not necessarily clear. One of the primary objectives of PCA lies in calculating principal component scores and classifying samples by order of their magnitudes in order to investigate the general features of each classified sample group. In Table 4, however, the meanings of the fourth and fifth principal components are not clear.

(3) Results of Factor Analysis

To obtain the relationships between Z's and X's in a more explicit form, we perform FA using the results of PCA in the above. By means of FA, we can polarize the values of FL in Table 4, making large values larger and vice versa. Using Varimax Rotation Method, we estimated new values of FL listed in Table 5 where we can verify that the results are more clearcut compared with the values in Table 4.[2/] In Table 5 we can find that F_1 is highly correlated with variables such as gross revenue (X_1), concentrate cost(X_2), roughage cost (X_3), depreciation(X_5) and interest on own capital (X_7) all of which can be regarded as representing farm size. The second factor F_2 is negatively corrlated with daily weight gain(X_9) while revealing positive correlation with total cost per kilogram of weight gain(X_{11}) and labor per kilogram of weight gain(X_{15}). The third factor F_3 shows high positive correlation with fattening period(X_{14}) and per head weight gain(X_{16}). Finally, the fourth factor F_4 shows positive correlation with profit (X_{12}). Therefore, it is not implausible to interprete the four factors F_1-F_4 as proxy variables respectively representing, farm size, technical efficiency, fattening period and profitability.

2/ In Table 5 we listed only four factors F_1 - F_4 to avoid complexity and make the interpretation easy.

Next using the values of FL exceeding 0.7, we calculated factor scores for each sample farm as follows.

1st factor (farm size):

$$F_1 = 0.856X_1 + 0.901X_2 + 0.763X_3 + 0.901X_5 + 0.925X_7 \quad (3.5)$$

2nd factor (technical efficiency):

$$F_2 = -0.882X_9 + 0.786X_{11} + 0.869X_{15} \quad (3.6)$$

3rd factor (fattening period):

$$F_3 = 0.962X_{14} + 0.714X_{16} \quad (3.7)$$

4th factor (profitability):

$$F_4 = 0.953X_{12} \quad (3.8)$$

In Table 5 one can recognize that F_2 is negatively related to variables representing the level of technical efficiency. For instance, the value of factor loading between daily weight gain(X_9) and F_2 is -0.882 while the value between total cost per kilogram of weight gain(X_{11}) and F_2 is 0.786. This means that the factor score of F_2 calculated in (3.6) is in reverse relation with the level of technical efficiency. Thus we reversed the sign of F_2 obtained in (3.6) and numbered the four factor scores obtained in the above in order of magnitude from the highest farm to the lowest. Using these order numbers conferred on each farm, we calculated Spearman's rank correlation coefficients. The results are represented in Table 6 where the values of r_{12}, r_{14}, r_{23} and r_{24} turned out to be positive while only the value r_{13} was negative.

Recalling the meanings of the above four factors, the results of the positive rank correlation coefficients seem to be consistent with what one would expect a priori. If we ignore r_{23} which lacks statistical significance, the results of positive coefficients in the above mean that the pairwise two factors go parallel within the realm of our data point. For example, larger farms tend to be technically more efficient and more profitable than small farms. Likewise, farms with higher level of technical efficiency are more profitable than otherwise. In a sense, this can be construed as implying that expansion of herd size is feasible when the level of technical efficiency is high enough to bring about increase in profit. Unlike other positive values in Table 6, the value r_{13} turned out to be negative implying that the fattening period becomes shorter as the farm size increases. In beef production many factors influence the determination of optimum slaughter age, ie., prices of beef and feed, growth rate, interest rate and age of the animal. Cattle producers can be thought of as portfolio managers regarding cattle as capital as well as consumption goods, depending on the change in the above-mentioned parameters (Jarvis 1969).

Most farms in our sample purchase steers weighing about 270 kilograms. These steers gained 140 kilograms during six months through intensive use of concentrate and negligible roughage. Thus the average slaughter weight of Korean native cattle is about 410 kilograms. For any heavier cattle the efficiency of converting feed into beef begins to decline drastically. The cost share of roughage is very low. It is about three percent on the average and shows decreasing trend as herd size increases. Unlike roughage, the share of concentrate cost is about

10 percent on average and increases with herd size. This phenomenon may be ascribable to the fact that most farms in our sample depend on straw, wild grasses and agricultural byproducts for roughage. However, these are not sufficient in quantities as herd size increases. Furthermore, it is difficult for producers to invest in grassland development since it is so expensive and involves many restrictions. Since more concentrate is used on larger farms the growth rate become higher. Therefore, less time is required in achieving the target weight for slaughter of about 410 kilograms.

In addition, many farms in our sample are in debt for which they have to pay interest and the amount of borrowed principal increases with farm size. Under high interest rate, the sum of interest charges incurred increases as the fattening period prolongs. Thus it may become profitable for producers to sell their cattle as a consumption good rather than retaining it as a capital good. As the weight of Korean native cattle nears 400 kilograms producers become aware that the increased marginal cost caused by lowered feed conversion rate will not be fully compensated by the going market price.

Heavy dependence on concentrate and interest charges make it more profitable for producers with large herd size to sell their cattle earlier. This may also be the reason why the value of rank correlation coefficient between farm size and fattening period(r_{13}) turned out to be negative in Table 6.

Herd Sizes and Cost Changes

In the preceding section we have discussed the general features of beef production using the results of both PCA and FA. The results obtained were somewhat abstract but such analyses were designed only to grasp the general situation surrounding beef production. In this section we perform cost function analysis to delve further into detailed problems involved in beef production.

In the preceding section we found that profitability is closely related to the farm size and technical efficiency. Consequently, the need for adoption of both farm size and technical efficiency as independent variables in our estimation of cost functions seems obvious. However, it is difficult to use the factors F_1 and F_2 obtained in the previous section directly since they defy direct measurement from the individual farm records. Thus in this study we decided to use proxy variables; herd size for farm size factor F_1, and ratio of observed to estimated values $Y/\hat{Y}$ for technical efficiency factor F_2 where Y stands for the dependent variable of a production function defined and estimated as follows.

$$\hat{Y} + 111.720 + \underset{(5.13)}{1.205X_1} + \underset{(10.4)}{0.833X_2} + \underset{(4.5)}{1.348X_3} + \underset{(0.3)}{0.051X_4} \qquad (4.1)$$

$R^2 = 0.985$, d.f = 121

Y = annual gross revenue,

Y = expected value of Y,

X_1 = calf cost,

X_2 = concentrate cost,

X_3 = roughage cost,

X_4 = miscellaneous cost.

All variables in the above are measured in thousand wons and within the parentheses are t-ratios. A total of 126 individual farm records surveyed in 1980 were used in estimating the above production function. The rationale for adopting the ratio Y/Y as a proxy variable representing technical efficiency lies in the consideration that a farm with higher levels of technical efficiency can produce more than a farm with lower levels of technical efficiency.

For the estimation of cost functions, the dependent variable are defined in per head cost terms(y_i) and independent variables are herd size(x_1) and the ratio Y/Y(x_2) adopted as proxy variables representing farm size and technical efficiency, respectively. Using the same data and linear function employed in (4.1) we estimated cost functions with all costs measured in thousand wons. Thus the degrees of freedom are 123 in all functions in the below and within the parentheses are t-ratios.[3/]

Concentrate cost:

$$\hat{Y}_1 = 75,701 + \underset{(2.5)}{1.405}x_1 + \underset{(0.2)}{0.038}x_2, \qquad R^2 = 0.049^* \qquad (4.2)$$

Roughage cost:

$$Y_2 = 19.901 - \underset{(2.4)}{0.250}x_1 - \underset{(1.2)}{0.044}x_2 \qquad R^2 = 0.063^* \qquad (4.3)$$

3/ We also estimated the same functions (4.2)-(4.10) with x_2 substituted by the negative values of the technical efficiency factor($-F_2$) obtained in (3.6). The results were quite similar in terms of both signs and statistical significance of regression coefficients. The only exception was observed in the case of the roughage cost function (4.3) where the sign of regression coefficient for x_2 turned out to be positive. The values of R-square in (4.2)-(4.10) with an asterisk(*) mean that they are statistically significant at the 5% level.

veterinary and fuel cost:

$$\hat{Y}_3 = 31.659 - \underset{(4.6)}{0.764x_1} - \underset{(0.9)}{0.065x_2}, \qquad R^2 = 0.162^* \qquad (4.4)$$

depreciation cost:

$$\hat{Y}_4 = 7.609 - \underset{(2.9)}{0.108x_1} - \underset{(1.2)}{0.020x_2}, \qquad R^2 = 0.080 \qquad (4.5)$$

labor cost:

$$\hat{Y}_5 = 206.360 - \underset{(9.1)}{4.841x_1} - \underset{(2.6)}{0.600x_2}, \qquad R^2 = 0.443^* \qquad (4.6)$$

total cost:

$$\hat{Y}_6 = 988.630 - \underset{(1.9)}{3.738x_1} - \underset{(2.2)}{1.881x_2}, \qquad R^2 = 0.073^* \qquad (4.7)$$

In addition to the above cost functions, we also estimated regression equations for daily weight gain(y_7), average slaughter weight(y_8) and average fattening period(y_9) with x_1 and x_2 as independent variables. The results obtained appeared as follows.

daily weight gain:

$$\hat{Y}_7 = 0.493 + \underset{(4.6)}{0.012x_1} + \underset{(1.3)}{0.001x_2}, \qquad R^2 = 0.171 \qquad (4.8)$$

average slaughter weight

$$\hat{Y}_8 = 385.350 + \underset{(1.1)}{1.104x_1} + \underset{(0.2)}{0.073x_2}, \qquad R^2 = 0.011 \qquad (4.9)$$

average fattening period:

$$\hat{Y}_9 = 145.110 - \underset{(3.0)}{1.817x_1} + \underset{(0.9)}{0.241x_2}, \qquad R^2 = 0.068^* \qquad (4.10)$$

The low values of R^2 in the above are due to the fact that we defined dependent variables in per head cost instead of total cost. In terms of statistical significance of regression coefficients, the magnitude of t-ratio for x_1 exceeds 2.0 in all cases but for the total cost in (4.7) and the ratio for x_2 exceeds 2.0 in the case of wage and total cost. At the same time, we can also verify that the sight of x_1 in all cost functions except for concentrate is negative. This result is quite consistent with what we described in the preceding section. Put another way, per head cost of concentrate goes up as herd size increases and the opposite is true in the case of roughage. Accordingly, daily weight gain is positively related to herd size as can be verified in (4.8). As a result, less time is needed in finishing the fattening and achieve the target weight as herd size increases. This can be ascertained from the negative regression coefficient in (4.10).

The regression coefficient of technical efficiency(x_2) turned out to be significant in the case of labor cost in (4.5) and total cost in (4.7). Recalling that technical efficiency in production is embodied in labor, farms with good technical efficiency can do the same amount of work with less labor than otherwise. Producers are required incessant decision-making so far as production continues and their levels of technical efficiency play important roles in production. In this respect, the result in (4.7) is intriguing in the sense that expansion of herd size does not significantly contribute to the reduction of total cost whereas technical efficiency does. This result can be construed as implying that reduction of production cost can be better accomplished through improvement of the producer's technical efficiency rather than by expansion of herd size. Under the present structure characterized by heavy dependence on concentrate, negligible use of roughage and no on-farm breeding system, achievement of economies of scale seems implausible.

In an attempt to add realism to the relationship between herd size and production, we plotted average cost as a function of herd size in Figure 1.[4/] The AC curve in Figure 1 can be regarded as revealing a long-run average cost curve in the respect that it is depicted by connecting the lowest point of varying production levels of cross-section samples. As one can easily verify, the AC curve in Figure 1 shows an 'L' shape which declines abruptly until the herd size reaches about eight heads. This coincides with the average annual herd size of 8.3 heads of our sample data. The annual herd size of eight heads means that the usual number of native cattle being raised within a farm is four heads since the average fattening period is six months. The evidence in Figure 1 again implies that it is difficult to realize economies of scale when herd size exceeds about eight heads in a year. To the extent that the sum of cost shares of calf and concentrate which are purchased from market at fixed prices accounts for almost 85% of total production cost, the realization of economics of scale is implausible. This is particularly so when we consider that the cost share of roughage in our sample is only two percent, most farms use family labor which is flexible in quantity and all inputs are required in relatively fixed amounts. Consequently, cost reduction become difficult when herd

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4/ Our sample data do not include sufficient number of farms with more than 25 heads. Thus it is not clear whether the AC curve will show the same unvarying herd-size-and-cost relationship when the herd size exceeds 25 heads. Thus the portion of the dotted line in Figure 1 does not necessarily reflect real world phenomenon.

size exceeds the limit that can be effectively taken care of using agricultural byproducts and other existing facilities with no extra investments for roughage production and hired labor. In this respect, the coincidence of average herd size of sample data and the herd size corresponding to the inflection point of AC curve in Figure 1 can be construed as indicating that the behaviour of beef producing farms is rational under given environmental conditions. Of course, the 'L' shape AC curve in Figure 1 implies that herd size can be further extended to a certain limit without incurring cost increase. However, such increase of herd size can make both crop and beef producing enterprises within a farm compete for limited resources which may cause increases of unit cost. This may be the main reason why most farms in our sample center around the inflection point in Figure 1. Thus it is not implausible to conclude that the optimum per farm annual herd size of native cattle production as an additional income source is about eight heads. If the annual herd size exceeds this limit, the relationship between crop and beef production may shift from a complementary or supplementary one to a competitive one in terms of resource utilization.

For other types of beef production such as full-time and commercial farms, the optimum herd size hinges greatly upon the environmental conditions. Investments in roughage production and other labor-saving facilities including on-farm breeding system will greatly mitigate the cost pressure making the realization of economies of scale easier. At the same time, in such farms raising of specialized beef breed cattle would be desirable in terms of the efficiency of converting feed into beef. In this respect, the recent government policy to encourage expansion of grasslands for eligible producers is good for the establishment of large-scale beef producing farms.

5) Production Function Analysis

The goal of this section is to investigate the input-output relationship in beef production through the estimation of a production function. For the estimation, individual records from farms which were surveyed twice over the 1980-1981 period are used. The number of sample farms surveyed in a single year amounts to 89, thus the total number of sample farms used in our estimation is 178. Combined cross-section and time-series data are used because such data can provide us with better information than can the cross-section data of a single year. However, in the estimation of the production function using this kind of data, care should be taken to eliminate biases stemming from unequal technical efficiency among different farms and shifts over time (Mundlak 1961, Hoch 1962). To avoid this kind of biases, we adopted following linear form of Covariance Analysis Model(Scheffe 1959).

$$Y_{ij} = a_0 + t_i + m_m + a_k X_{ijk} + U_{ij} \qquad (5.1)$$

$(1 = 1,2,\ldots,I;\ J - 1,2,\ldots,J:\ K = 1,2,\ldots,K)$

In the above Y_{ij} indicates the output of the j^{th} farm in year i,x_{ijk} is the k^{th} input of farm j in year i, U_{ij} stands for error term of farm j in year i with zero mean and constant variance. Terms such as a_0, t_i, m_j and a_k are all parameters to be estimated by sample data. Parameters t_i and m_j are interpreted as time and farm specific neutral efforts for which following assumptions hold.

$$\sum_{i=1}^{I} t_i = \sum_{j=1}^{J} m_j = 0 \qquad (5.2)$$

On the other hand, all variables employed for estimation are measured in thousand wons and defined as follows.

Y = annual gross revenue,

X_1 = calf cost,

X_2 = labor cost,

X_3 = concentrate cost,

X_4 = roughage cost.

All the above variables are deflated using the 'Farm Purchasing Price Index'(1980=100). Numerical results of estimation are listed in Table 7 where OLS means the results obtained by usual Ordinary Least Squares Method with no consideration of t_i and m_j. On the other hand, COVA means the results of the Covariance Analysis Method. In Table 7, the high R^2 values indicate that variances of dependent variables can be entirely explained by the independent variables employed here. Using the results in Table 7, we tested the following null hypotheses in order to secure unbiased parameters for the production function.

$$H_1 : t_i = 0, \ (i=1,2) \qquad (5.3)$$

$$H_2 : m_j = 0, \ (j=1,2,\ldots,89) \qquad (5.4)$$

The F-statistic for each null hypothesis appeared as,

$$F(1,\ 172) = 10.382 \quad F\ (1,\ 120:\ 1\%) = 6.85 \qquad (5.5)$$

for H_1 in (5.2) and,

$F(88, 85) = 0.816 \quad F(60, 60: 1\%) = 1.84 \qquad (5.6)$

for H_2 in (5.3).

The result in (5.5) rejects the null hypothesis (5.3), whereas the result in (5.6) does not reject H_2 in (5.4). This implies that neutral farm specific effect m_j is not significantly different from zero while the time specific effect t_i is. We may consider that the results obtained in the above are not consistent with what one would expect a priori. Unlike crop production which is mainly subject to weather conditions, livestock farming is more susceptible to producer's technical efficiency than crops (Schultz 1964). This is particularly true when we consider that livestock production consists of several subsectors including breeding, disease control, maintenance and roughage production for all of which producer's efficiency can play a very important role. Thus more opportunities exist in livestock production for producer's technical efficiency to render influences to the outcome of production than in crop production. In this study, however, the neutral farm specific effect m_j in (5.1) which can be regarded as reflecting the relative level of technical efficiency in the j^{th} farm turned out to be insignificant. The reasons for such phenomenon can be explained in two ways. First, the sum of the cost shares of both calf and concentrate explains 85% of total production cost. This can be regarded as fixed since the above two inputs almost invariably are purchased from market. Other inputs are also required in relatively fixed quantities. Thus only a limited scope of production processes remain for which the producer's technical efficiency can affect. Second, the term m_j in (5.1) is entered in neutral form, thus it can reflect not only the farm specific effects of technical efficiency but also differences in environmental conditions. Accordingly, the term m_j can be regarded as reflecting the mixed effects of several qualitative factors which defy direct measurement. The effects of these qualitative factors can be thought of as counterbalancing each other. These two facts may be the main reasons why the farm specific term m_j in (5.1) turned out to be insignificant.

Consequently, the results of COVA 1 in Table 7 correspond to what we want to obtain since the null hypothesis in (5.4) was accepted in (5.6). And we interpret the results of production function analysis using the parameters obtained in COVA 1. First of all, the high value of R^2 in COVA 1 guarantees that most variance of the dependent variable can be explained by the independent variables adopted. On the other hand, the sum of the production elasticities approaches unity which implies constant returns to scale at the mean levels of the variables. Recalling that the inflection point of the 'L' shape AC curve in Figure 1 coincided with the average herd size, evidence of constant returns to scale in our estimation of the production function is by no means casual.

One of the leading objectives of estimating the production function lies in investigating producer's behavioral pattern in allocating scarce resources. This can be achieved by examining how far the ratio of the marginal value product (MVP) of an input to the price or opportunity cost deviates from unity. Since the production function specified in (5.1) is linear and all variables are measured in value terms, the regression coefficients in Table 7 represent the MVP's of inputs.

Assuming an interest rate of 16% which corresponds to the government loans for short-term production fund in the sample period, the opportunity cost for thousand wons invested in beef production can be though of as 1,160 won. Consequently, the ratios of MVP's to opportunity cost becomes 0.989 for calf cost, 0.403 for labor cost 0.847 for concentrate and 1.537 for roughage.

The results above indicate that producers are quite rational in their calf cost investment. This means that the average annual herd size about eight heads in our sample is optimum that can be well taken care of under given environmental conditions. For labor cost and concentrate, traces of overinvestment are observable whereas the opposite is true in the case of roughage. These results are consistent with what was described in the cost function analysis. Most farms in our sample are engaged in native cattle production which depends heavily on concentrate utilizing straw and other agricultural byproducts with no extra investment for the production of good quality roughage. Thus the possibility that farms in our sample can improve profitability through changes in the feed ratio can hardly be ruled out. Substitution of good quality roughage for concentrate seems desirable.

Further comments are in order for labor cost. Most farms in our sample depend on family labor for which the conception of opportunity cost is inappropriate. Unless other opportunities for employment are available within commutable distance, the opportunity cost of idle labor used in beef production can be assumed as negligible though it may not equal zero. Consequently, for farms involving beef production enterprise as an additional income source, the low ratio 0.403 for labor cost is not a significant problem. However, for other types of farms engaged in commercial or full-time beef production, labor is a scarce resource and should be allocated rationally.

6) Supply Response to Price Changes for Native Cattle

The results obtained in the preceding sections provice us with useful information regarding the improvement of native cattle production. For the establishment of appropriate policy, however, we need further information on supply response to price change. In accordance with such need at the decision-making level, we estimate both inventory of and supply functions for native cattle using available aggregate data. Untill recent years, the share of native cattle kept by small farms raising one or two heads mainly for draft power explained more than 90%. The share gradually declined beginning in 1981. This share was 81% in 1983. However, the importance of these small farms both in relative and absolute senses, and the value of native cattle as a draft animal can hardly be ignored. Thus the roles assigned to native cattle as draft animals and source of cash income can be regarded as being responsive to supply response. In general, male cattle are used for draft and female cattle for producing calves. This means that the value of native cattle on small farms can change depending upon sex and given production conditions. Farmers will show response to price changes in the most profitable way so that their aggregate farm income can be maximized.

Within a period shorter than the production period of native cattle, the available quantity cannot vary much in response to current prices. From Tryfos(1974), the available quantity of native cattle in period $t(A_t)$ can be expressed as a linear function of inventory at the beginning of period $t(I_{t-1})$.

$$A_t = a_0 + a_1 I_{t-1} \tag{6.1}$$

Part of the available quantity in period t can be added to the inventory either for draft purpose or for higher price in the future. In this case, the principal determinant of the optimum inventory level(I_t^*) is the expected price(P_t^*) of the live animal. In addition, demand for draft power in small farms works as another important factor in determining the optimum inventory level. But it is not easy to consider the demand for draft power directly in model building. In this study, as an ad hoc method, we employed the number of power tillers in period $t(D_t)$ as a proxy representing farm demand for draft power. Thus the optimum inventory level of native cattle in period to can be approximated as follows.

$$I_t^* = b_0 + b_1 P_t^* + b_2 D_t \tag{6.2}$$

In the above, the expected price P_t^* is not explicitly known. But it is obvious that farmers form their expectations based on the current price (P_t). Then the current price P_t can be regarded as a proxy for the expected price P_t^* and the relationship in (6.2) can be rewritten as follows.

$$I_t^* = b_0 + b_1 P_t + b_2 D_t \tag{6.3}$$

Next, we assume partial adjustment relationship between optimum and current inventory levels.

$$I_t - I_{t-1} = c(I_t^* - I_{t-1}), \qquad o < c \leqq 1 \tag{6.4}$$

Substituting (6.3) into (6.4), the inventory in period t can be written as

$$I_t = cb_0 + cb_1 p_t + (1-c) I_{t-1} \tag{6.5}$$

On the other hand, the supply(slaughter) of native cattle can be expressed as a function of the difference between the available quantity in period $t(A_t)$ and inventory change.

$$S_t = A_t = d(I_t - I_{t-1}) \tag{6.6}$$

Substituting (6.1) into (6.6), we obtain

$$S_t = a_0 + (a_1 + d) I_{t-1} - dI_t \tag{6.7}$$

Again, substituting (6.5) into (6.7), both the inventory and supply functions can be expressed as follows where U stands for stochastic error.

$$I_t = a_{10} + a_{11} P_t + a_{12} D_t + a_{13} I_{t-1} + U_{1t} \tag{6.5)'$$

$$St = a_{20} + a_{21} P_t + a_{22} D_t + a_{23} I_{t-1} + U_{2t} \tag{6.7)'$$

We estimated the above functions by means of OLS for three categories; male, female and aggregate native cattle using the time series data over 16 years (1968-1983). The variables employed were defined as follows.

I_t = inventory of native cattle at the end of year t(1,000 head),

S_t = number of native cattle slaughtered in year t(1,000 head),

P_t = farm price of native cattle(350kg) deflated by index(1980=100) of price for commodities and services used by farmers(1,000 won),

D_t = number of power tillers in year t(1,000).

The numerical results obtained are listed in Table 8. From the results, we can see that the R^2 in inventory function is low compared with that of supply function. This may be partially due to the reliability of the data bases. The inventory data were collected through a sample survey while the slaughter data reflect. Notice that the variable D_t does not appear in all inventory functions. We omitted it since its regression coefficients turned out to be statistically not significant in all inventory functions. But the variable D_t explains a substantial portion of variations in S_t which reveals significant regression coefficients except for female cattle. With more or less than 1.0ha of arable land, the cash income that comes from cattle production enterprises plays a very important role in small farms.[5/] Therefore, even if the power tiller is a substitute for draft work of native cattle, farmers tend to maintain one or two heads of native cattle for cash income. This is quite plausible in recalling that farmers can raise cattle utilizing agricultural byproducts, wild grasses and idle labor which are all available at low cost. In addition, native cattle are well adapted to environmental conditions such as climate and disease, and are easy to take care of with no particular skill. Thus increase of power tillers does not significantly affect the inventory level of native cattle.

5/ In 1982, the average agricultural income per farm household turned out to be 3.031 million won, of which 646 thousand won (21%) came from a value increase and selling of farm animals (excluding poultry and sericulture). This implies that the agricultural income from native cattle forms a substantial portion of the total in small farms. Year Book of Agricultural and Forestry Statistics 1983, Ministry of Agriculture and Fisheries, Korea.

In addition, the results in Table 8 provide us with valuable information regarding the farmer's response to price changes. For all inventory functions, price elasticities revealed positive values. In the case of supply functions the oppsite is true except for males when the number of power tillers(D_t) is omitted. The signs of price elasticities in Table 8 can be construed as reflecting farmer's behavioral patterns in responding to price changes within a period shorter than the production cycle of native cattle. According to the results of the esimation, farmers increase inventory when the current price rises, expecting higher price in the near future. Such behaviour of farmers indirectly cause reduction in the number of cattle that would otherwise have been slaughtered, as one can easily verify from the relationship between supply and inventory in (6.6). Notice in Table 8 that such a trend is particularly strong in the case of females, presumably due to their reproductive abilities. Up to now, it has been recognized that supply of native cattle is closely related to the lagged price P_{t-4} or P_{t-2} since a rice in current price P_t can not be accompanied by an immediate increase of supply.[6/] Of course, the price elasticities of supply functions employing lagged price variables reveal positive values. But we found that farmers also show very sensitive responses to changes in the current price. The difference is that the price elasticity of supply function reveals a negative sign when we employ a current price

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6/ In an estimation of the beef supply function derived using the relationship of the distributed lag model and including the lagged price variable P_{t-4}, the price elasticities turned out to be 0.44 in the short-run and 1.39 in the long-run. For details on the estimation model and numerical results, see Huh (1979).

instead of a lagged one. Irrespective of the magnitudes, the signs of price elasticities in Table 8 provide us with very important implications regarding the farmer's response to current price changes. Also the results obtained here imply that price policy to increase supply of native cattle in the short-run is not practical.

7) Conclusions

The role of native Korean cattle has gradually changed from that of a draft animal to a beef animal. Following the spread of agricultural machinery and increase of per capita beef consumption, this trend became conspicuous during the last decade. In accordance with such changes in demand side, many farms began to raise native cattle for beef production. The cash-income-oriented motives of these farms are different from the traditional farms who kept native cattle mainly for draft purposes. The aims of this study lies in investigating problems and suggesting effective ways of beef production in farms with native cattle serving as an additional income source. To achieve such goals, an economic analysis was performed at the microlevel using individual farm records collected through the nation-side survey of 1980-1981. In addition, both inventory and supply functions were estimated using aggregate time-series data over 16 years (1968-1983) in order to derive implications on farmer's responses to price changes. The main results obtained can be summed up as follows.

1) Under the given situation with relatively low opportunity costs for family labor and agricultural byproduct use, it seems uneconomical

for farms to increase herd size of native cattle in excess of the limited resources available at low cost. The optimum herd size is about eight heads which means that the usual per farm herd size that can be well taken care of under given situations is about four heads since the average fattening period for slaughter is six months.

2) Lack of an on-farm breeding system, good quality roughages and heavy dependence on concentrate seem to work as strong restraints in reducing unit cost. Both calf and concentrate which are purchased at given prices and therefore can be regarded as fixed explains 85% of total production cost. In addition, other inputs are required in relatively fixed quantities on most farms. Consequently, there remains no room for cost reduction as herd size increases. Thus the realization of economics of scale is implausible.

3) In terms of resource allocation, producers turned out to be rational in the use of calf cost. Traces of overinvestments were observed in the cases of concentrate and labor while the opposite trend was true in the case of roughage. The ratios of marginal value products to opportunity cost revealed 0.989 for calf cost, 0.847 for concentrate, 0.403 for labor cost and 1.537 for roughage. Thus we can hardly rule out the possibility of improving profitability by substituting good quality roughages for concentrate.

4) In addition to reallocation of scarce resources, enhancement of a producer's technical efficiency seems to be another desirable way of reducing production cost. In our estimation of cost functions, the regression coefficients of technical efficiency revealed significant

negative values both in labor cost and total production cost. The results can be construed as implying that the level of technical efficiency renders noneligible influences to the reduction of production cost through labor.

5) In our estimation of inventory and supply functions performed using aggregate time-series data, it has become clear that when current price rises farmers respond by increasing inventory expecting higher price in the future. This indirectly reduces the number of cattle that would otherwise have been slaughtered. The price elasticities of inventory and supply functions respectively revealed positive and negative signs. The results imply that price policy to increase the supply of native Korean cattle in short-run is not practical.

6) Finally, some comments are in order for limitations and for suggestions for further study.

a. In this study we performed an economic analysis using input-output records of individual farms with cattle production as an additional income source. In the respect that they are engaged in short-term fattening with purchased calf and concentrate, these farms differ from the traditional farms who raise one or two heads of native cattle mainly for draft purpose. In a sense, they can be regarded as semicommercial farms pursuing cash income by converting purchased feed into beef. Though the number of these farm households and the share of beef supplied by them are still negligible, we can hardly deny the possibility that the amount of beef supplied by them will gradually increase changing the almost vertical short-run supply curve into more elastic one. Thus the results obtained in this study can be used in establishing future plans for the expansion of domestic beef production.

b. The sample used in this study does not include commercial farms specialized in beef production. But the results obtained imply that it would be better for such commercial farms to raise beef breed cattle rather than native cattle since the former more efficiently converts feed into beef. In this case, however, additional investments in roughage production, disease control, on-farm breeding systems and other labor-saving facilities seem to be inevitable in order to achieve economies of scale by mitigating cost pressure in from a long-run perspective.

c. In addition to beef production from native cattle, proper attention also has to be paid for effective utilization of dairy steers and cull cows in order to diversify sources of domestic beef supply. Recalling that the growth rate of milk consumption is most pronounced among demand growth rates for livestock products and that such a trend is likely to continue, establishment of appropriate measures to maintain proper levels of native cattle, beef breed cattle and milk cows for the balanced supply of both beef and milk is desirable from a long-run perspective.

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Table 1. Summary Description of Sample Data

Variables	Means	
	1980	1981
1. annual herd size (head)	9.3 (5.8)[a]	8.2 (6.3)
2. number of head sold per year	5.4 (4.2)	5.6 (4.0)
3. beginning weight (kg.)	274.7 (70.9)	270.3 (63.9)
4. slaughter weight[b]	411.4 (79.3)	407.2 (60.3)
5. daily weight gain	0.75 (0.23)	0.79 (0.23)
6. per head weight gain	107.2 (37.4)	115.1 (36.4)
7. concentrate per kg. of weight gain	5.5 (3.1)	5.6 (2.3)
8. fattening period (day)	148.2 (54.1)	152.1 (60.5)
9. labor per kg. of weight gain (hr.)	1.9 (1.7)	1.7 (1.0)

a Within the parentheses are standard deviations.

b In the above, the relationships between slaughter weight and other terms are not necessarily consistent since we included steers under fattening in calculating other terms but for slaughter weight which pertains to only sold cattle.

Table 2. Means of Variables Adopted for PCA

Variables(X_i)	Means	Variables(X_i)	Means
1. gross revene(won)	6,878,400	9. daily weight gain (kg.)	0.732
2. concentrate (won)	885,071	10. concentrate perkg. of weight gain(won)	918
3. roughage(won)	109,063	11. total cost per kg. of weight gain (won)	8,429
4. veterinary and fuel(won)	120,717	12. profit(won)	301,732
5. depreciation(won)	35,685	13. slaughter weight(kg.)	402
6. interest on borrowed capital (won)	44,685	14. fattening period(day)	152
7. interest on own capital(won)	248,504)	15. labor per kg. of weight gain(hr.)	2
8. selling price per kg.(won)	2,008	16. per head weight gain (kg.)	108

Table 3. Eigen Values and Contribution Rate

Eigen value(λ_i)		Accumulate contribution rate(%)
λ_1	5.5531	34.7
λ_2	2.9846	53.4
λ_3	1.9866	65.8
λ_4	1.1435	72.9
λ_5	1.0800	79.7

Table 4. Factor Loading and Contribution Rate

Principal components(Z_j) Variables(X_i)	Z_1	Z_2	Z_3	Z_4	Z_5	Accumulate contribution rate
1. gross revenue(won)	.8710	.2840	-.2891	.1403	.0033	.9427
2. concentrate(won)	.8337	.3178	.1643	-.0050	-.0112	.8232
3. roughage(won)	.8336	.2039	.2802	.1648	-.0167	.8424
4. veterinary and fuel(won)	.5399	.2551	-.0017	-.5510	-.0009	.6601
5. depreciation(won)	.8111	.3148	.1431	.1106	-.1627	.7930
6. interest on borrowed capital(won)	.6254	.1788	.3889	-.1887	.0969	.6193
7. interest on own capital(won)	.8383	.3434	-.2554	.1104	-.0995	.9080
8. selling price per kg.(won)	-.0462	.4130	.1009	.2009	.5726	.5511
9. daily weight gain(kg.)	.5514	-.4413	-.4810	-.1187	.0381	.7457
10. concentrate per kg. to weight gain(won)	-.1182	.7800	.1499	.2016	.0100	.6855
11. total cost per kg. of weight gain(won)	-.4644	.8233	-.1234	.0127	-.1838	.9426
12. profit(won)	.3282	-.1109	-.3156	.5519	.4891	.7634
13. slaughter weight(kg.)	.2412	-.0731	.0077	.5311	-.6700	.7946
14. fattening period(day)	.0035	-.2327	.9178	.2054	.0092	.9388
15. labor per kg. of weight gain(hr.)	-.6568	.6056	.2724	-.0026	.0231	.8728
16. per head weight gain(kg.)	.4775	-.5978	.5155	.0947	.0668	.8645

Table 5. Factor Loading After Varimax Rotation

Variables(X_i) \ Factors(F_j)	F_1	F_2	F_3	F_4
1. gross revenue(won)	.856	-.220	0.234	-.252
2. concentrate(won)	.901	-.073	.136	-.008
3. roughage(won)	.763	-.097	.271	.031
4. veterinary and fuel(won)	.348	-.099	0.102	-.106
5. depreciation(won)	.901	-.063	.121	.018
6. interest on borrowed capital(won)	.460	-.085	.290	.083
7. interest on own capital(won)	.925	-.140	-.230	.099
8. selling price per kg.(won)	.038	.166	.021	.067
9. daily weight gain(kg.)	0.163	-.882	-.298	.012
10. concentrate per kg. of weight gain(won)	.167	.595	-.161	-.070
11. total cost per kg. of weight gain(won)	-.067	.786	-.460	-.206
12. profit(won)	.167	-.174	-.054	.953
13. slaughter weight(kg.)	.128	-.077	.084	.013
14. fattening period(day)	-.039	.123	.962	-.061
15. labor per kg. of weight gain(hr.)	-.284	.869	-.001	-.137
16. per head weight gain(kg.)	.151	-.598	.714	-.031

Table 6. Rank Correlation Coefficient of Factors(r_{ij})

Factors(F_1)	F_1	F_2	F_3	F_4
1. farm size(F_1)		.3185	-.3695	.5630
2. technical efficiency	.3185		.2621*	.5454
3. fattening period(F_3)	-.3695	.2621*		-.9754*
4. profitability(F_4)	.5630	.5454	-.0754*	

* Statistically not significant at 5% level.

Table 7. Numerical Results of Production Function

Models	X_1	X_2	X_3	X_4	Constant	R^2	d.f[b]
	a_1	a_2	a_3	a_4	a_0		
OLS ($t_i = m_j = 0$)	1.1346 (44.4)[a]	.4707 (2.4)	1.0559 (6.5)	1.6755 (5.0)	.2508 (0.2)	.9797	173
COVA1 ($t_i \neq 0$)	1.1467 (45.5)	.4676 (2.4)	.9829 (6.2)	1.7830 (5.4)	.7305 (0.0)	.9809	172
Elasticity	.7645	.0492	.1124	.0737			
COVA2 ($m_j \neq 0$)	1.0559 (16.94)	.1454 0.2)	1.2771 (3.0)	.3843 (0.6)	.7349 (1.95)	.9890	85
COVA3 ($t_i \neq 0$, $m_j \neq 0$)	1.1058 (17.0)	.1618 (0.2)	1.1726 (2.8)	.5802 (1.0)	.5549 (1.5)	.9896	84

a Within the parentheses are t-ratios.

b Degrees of freedom.

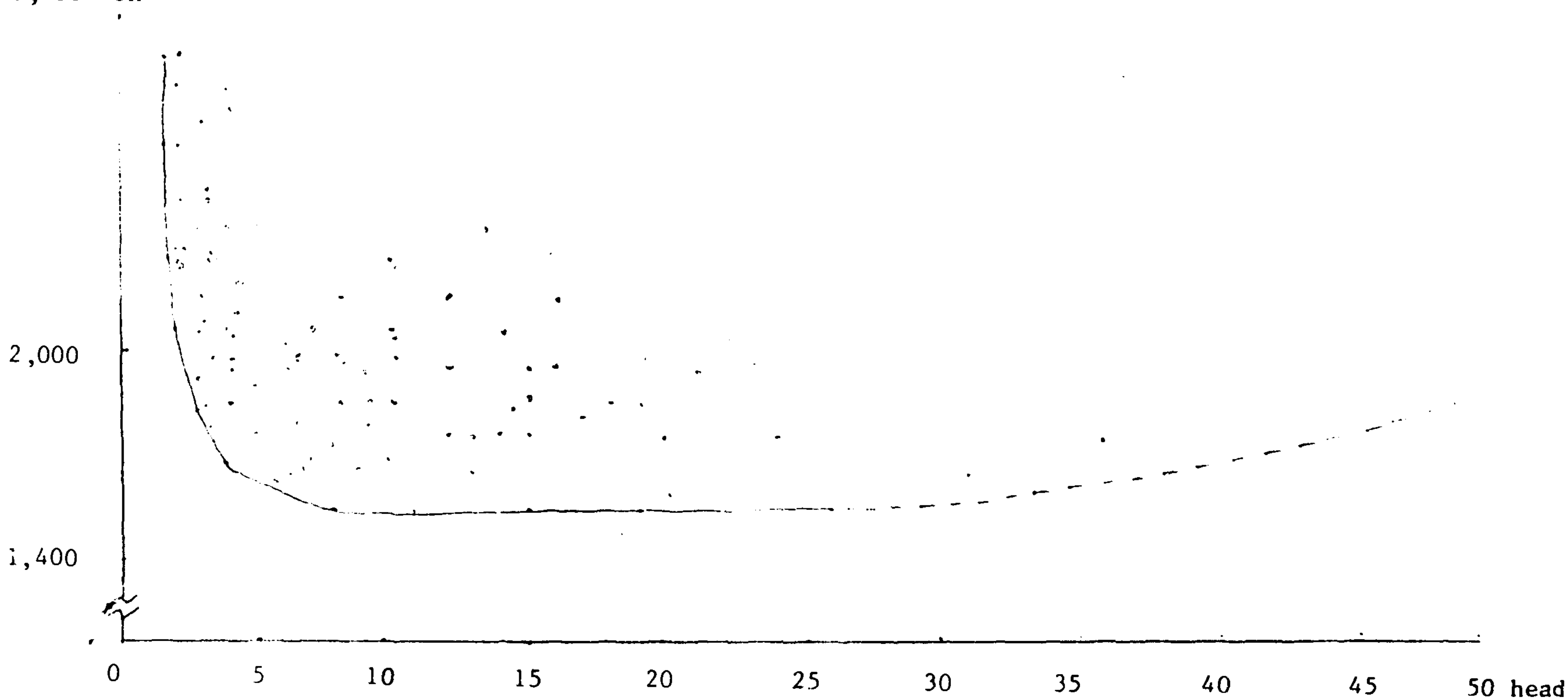
Table 8. Numerical Results of Inventory and Supply Functions for Native Cattle

Classification	Constant	P_t	I_{t-1}	D_t	R^2	Price Elasticity
(A) Male						
I_t	28.4965	52,4033	.7041		.4860	,2426
		(1.7)*	(3.2)			
S_t	-325.2641	49.9993	.9803		.5921	.4796
		(1.5)	(4.2)			
	82.3337	-56,8320	.4731	.2835	.8718	-.5451
(B) Female						
I_t	-345.9091	286,5980	.8057		.6813	.5679
		(3.8)	(4.1)			
S_t	11.1491	-94.6187	.2858		.8283	-1.8922
		(4.9)	(5.7)			
	43.2033	-105.5408	.2696	.0343	.8318	-2.1106
		(3.5)	(4.4)	(.5)		
(C) Aggregate						
I_t	-484.4422	357.1019	.8516		.6005	.5059
		(2.8)	(3.9)			
S_t	-161.0449	-57.1071	.4225		.6876	-.3702
		(1.2)	(4.9)			
	324.2402	-203.2407	.2517	.3715	.8344	-1.3175
		(3.5)	(4.9)	(3.3)		

* Within the parentheses are t-ratios.

Data Source : "Materials on Price, Demand & Supply for Livestock Products," National Livestock Cooperatives Federation 1984.
"Year Book of Agriculture and Forestry Statistics," Ministry of Agriculture & Fisheries, Korea 1975-1983.

Figure 1. Average Cost Curve (won/kg.)



Economic Analysis of Milk Production

Suk-Jin Cho*

1. Introduction

Rapid economic growth during the last decade has substantially increased per capita income in Korea. Changes in food consumption patterns both in quantity and quality have followed this increase. Particularly, per capita consumption of livestock products has increased remarkably. Of the livestock products, an increase in consumption of dairy products is the most conspicuous. Annual per capita consumption of dairy products has increased from 1.6 kilograms in 1970 to 27.8 kilograms in 1986. Following such drastic changes in demand, the total number of dairy cattle as well as per farm herd size showed a sustained increase. These upward trends both in demand and supply seem to continue for the time being.

On the other hand, the environmental conditions surrounding milk production in Korea are by no means favorable. First of all, domestic production of feed grain is so negligible in quantity and expensive that almost all feed grain is imported from international market. In addition, production of good quality roughage is quite limited mainly due to unfavorable climatic conditions and institutional restrictions. Thus milk production in Korea has been heavily dependent upon imported feed grain utilizing straw and wild grasses as substitutes for roughage. Consequently, production of milk in Korea is very susceptible to volatilities at international market.

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However, in spite of the above, the average herd size of dairy cattle in 1981 turned out to be about 11 heads as can be verified in Figure 1. This means that most farms engaged in milk production as part-time producers with crop production enterprise included. Within a farm including both crop and dairy enterprises, we can hardly exclude the possibility that both sectors will compete for limited scarce resources causing the production cost to rise.

To keep pace with the growing domestic demand, however, increase of per farm herd size seems inevitable in the future. Under such situation, information on issues including economies of scale and producer's behavioral pattern in milk production is prerequisite at the political level for establishing future plans. An economic analysis at the microlevel is necessary. Up to now, however, few studies have been concerned with such problems, presumably due to restrictions in obtaining proper data at the farm level.

The primary purpose of this study lies in performing fact-finding analysis of milk production in Korea. The plan of this study is as follows. In Section II, descriptions of sample data are given with definitions of variables used in this study. In Section III, we will investigate differences of operating cost among groups divided by herd size and arable land area. Production function analysis is performed in Section IV as a means of investigating the producer's behavioral pattern in allocating scarce resources and to know whether there exist economies of scale or not. In Section V, cost function analysis is performed to obtain implications on optimum herd size of milk cows under given situations. Finally, in Section VI conclusions are drawn, and suggestions and limitations of this study are offered.

2. Descriptions of Sample Data and Definitions of Variables

(1) Descriptions of Sample Data

The data used in this study come from the systematic input-output records of 121 individual dairy farms obtained through the nation-wide survey in 1981. The regional as well as geographical distribution of sample data are illustrated in Table 1 and Figure 2, respectively. As one can verify in Table 1, the average per farm herd size of milk cow is about seven heads which means that the total number of dairy cattle including dairy heifer is approximately ten heads since the ratio of milk cow turned out to be 0.77 in our sample. On the other hand, the number of farms with 10 to 20 heads of milk cows accounts for 21 percent of total sample farms. Thus the results obtained in this study can be regarded as mainly representing the behavioral pattern in part-time dairy farms with less than 10 heads of milk cows. (Table 1).

Our sample data include input records used for both milk cows and dairy heifers. Therefore, we segregated the portion of inputs used for milk cows in performing economic analysis. This was done by calculating the ratio of milk cows for each farm and multiplying this ratio by the annual total cost of each input. For both concentrate and roughage, we used the quantity ratios available from the records. Definitions of cost terms and other variables used in this study are as follows.

(2) Definitions of Cost Terms and Other Variables

a. Number of Milk Cows (NMC_i):

$$(2.1) \quad NMC_i = \sum_{J=1}^{12} NMC_{ij}/12,$$

where NMC_{ij} means the number of milk cows of the i^{th} farm in month j, NMC_i in (2.1) can thus be regarded as representing the average number of milk cows in farm i.

b. Ratio of Milk Cow (RMC_i):

$$(2.2) \quad RMC_i = NMC_i/Q_i,$$

where Q_i means total number of dairy cattle in the i^{th} farm which is converted into a milk cow equivalent as follows.[1/]

$$Q_i = NDHU6_i \times NDHO6_i \times 0.4 + NDHFP_i \times 0.8 + NMC_i,$$

where,

$NDHU6_i$ = average number of dairy heifer under 6 months in farm i,

$NDHO6_i$ = (") over 6 months in farm i,

$NDHFP_i$ = (") under first pregnancy in farm i.

c. Concentrate Used for Milk Cow (CM_i):

$$(2.3) \quad CM_i = TCC_i \times (QCM_i/TOC_i),$$

1/ The weights used in this study are the same with that used by the National Livestock Cooperatives Federation (NLCF) where,

TCC_i = total concentrate cost in farm i,

QCM_i = quantity of concentrate used for milk cow in farm i,

TQC_i = total quantity of concentrate used in farm i.

d. Roughage Cost (RC_i):

(2.4) $RC_i = CVR_i - (QEM_i/TQE_i)$,

where,

CVR_i = cost value of roughage in farm i,

QEM_i = quantity of ensilage used for milk cow in farm i,

TQE_i = total quantity of ensilage used in farm i.

e. Other Cost (OC_i):

(2.5) $OC_i = VC_i \times RMC_i$,

where VC_i means the sum of variable costs excluding labor and feed costs.

f. Labor Cost (LC_i)

(2.6) $= (FLC_i + HLC_i) \times RMC_i$

where FLC_i and HLC_i respectively stand for costs for family and hired labors. In the above, HLC_i is the cost actually paid for hired labor. FLC_i was derived by multiplying HLC_i per hour by the total sum of family labor.

g. Fixed Cost (FC_i):

Derivation of service flows for fixed capitals makes problems difficult. Particularly, this is true when the fixed capital consists of stock from different years. In this study, for the sake of simplicity, we defined the total service flows for both machinery and building as follow.

$$(2.7) \quad FC_i = TCS_i \ (d + r),$$

In the above, TCS_i means total capital stock in farm i, d is the depreciation rate and r stands for the interest rate. The portion of depreciation was calculated using the straight-line method and a value of 12 percent was given to the interest rate r.

h. Milk Cow Cost (MCC_i):

Milk cows in a dairy farm can also be regarded as a fixed capital like machinery and building. Thus the service flow of a milk cow in a particular year can be assumed to contribute to production. However, the derivation of service flow in this case is not easy. Due to lack of sufficient information, detailed calculation was avoided and following ad hoc method was adopted.

$$(2.3) \quad MCC_i = TCS_i \times (d + r),$$

For depreciation of milk cows in (2.8), we used the straight-line method for which we employed the average market price of a milk cow in 1981 as the acquisition price. A salvage or residual price was evaluated assuming that a milk cow weighs 550 kilograms on the average and that the price of one kilogram of live-weight is 500 won lower than that of native cattle. In addition, we assumed the economic life of a milk cow is 8.5 years. And for the age distribution, we used the nation-wide average according to which the ratios of milk cows belonging to each age class turned out to be 88% for 2 to 4 years old milk cow, 11.3% for 5 to 8 years old milk cow and 0.7% for more than 8 years old. Thus we applied 5 years of economic life for 88% of milk cows in a farm and 2 years for the rest. Finally, an interest rate of 12% was used for r in (2.8).

Changes in Operating Costs by Herd Size and Arable Land Area Group Categories

Before proceeding to more detailed analysis, it is useful to examine the general features of milk production by comparing annual per head operating cost among different farm groups divided by herd size and arable land area possessed.

1) Changes of Operating Cost Among Different Herd Size Groups

Table 2 lists per head annual operating cost and amount of milk produced for three different herd size groups. First of all, we can see that the annual milk production shows substantial differences among the three herd size groups. Annual milk production per head steadily rises as herd size increases. The difference between the 1 to 5 head group and the 11 and more group is almost 700 kilograms per year. In Korea, dairy farms raising more than 10 heads of milk cows can be regarded as full-time or specialized farms. These farms can be thought as possessing longer experience and a higher level of technical efficiency than part-time producers. Recalling that milk production consists of several subsectors which require skilled labor compared with crop production, the large gap between two groups can be regarded as reflecting differences in such qualitative factors. In terms of operating cost, both herd size and unit operating cost are in opposite relationship. The unit cost per kilogram of 3.2% butter fat equivalent (BFE) milk in the 11 and more group is 205 won which is almost 10% lower than the 224 won unit cost in the 1 to 5 head group. As one can verify in Table 2, such gaps in unit operating costs can be attributed to the unequal performance levels of milk cows belonging to the different herd size groups. To the extent we compare each cost term among the three different herd size groups, we can hardly find any pronounced differences except for labor cost paid to hired labor. The labor cost in Table 2 increases rapidly as herd size becomes larger reflecting the trend of heavy dependence on hired labor in milk production. In our sample, the ratio of family labor turned out to be more than 90% in the 1 to 5 head group and it plummeted to about 50% in the 11 and more head group. Adoption of labor as herd size increases over the limit that can be taken care of using family labor. However, such a sharp increase in labor cost in large size farms seems to be more than counterbalanced by the high performance levels of milk cows. As a result, the lowest unit operating cost is achieved in the 11 and more head group. Such costs imply increasing returns to herd size.

Another important consideration in cost is weather. Milk production is less affected by weather conditions than crops. Instead, the level of one's technical efficiency which can be regarded as closely related to education, age, experience and participation in extension programs is a key determing factor of production levels.[2/] In general, we can think that given a set of inputs a producer with higher level of technical efficiency can produce more than otherwise. At the same time, we can also think that the level of technical efficiency in full-time or specialized dairy farms is higher than in part-time dairy farms. Substantial portion of the differences in unit operating cost among the three herd size groups seems to be ascribable to these unequal technical efficiency levels.

2) Changes of Operating Cost Among Different Arable Land Area Groups

Table 2 lists the differences in per head milk production as well as unit operating costs among farms possessing different arable land areas. The land here includes both upland and rice paddy in addition to grassland. Thus the area of land can be regarded as reflecting the possibility of roughage production either in the form of agricultural byproducts or other roughages as second crops. The farms classified as less than 0.5 ha include those whose records of land area are omitted or have no particular land for roughage production. However, it is quite odd to see that the differences of roughage cost among three farm groups are almost negligible. This may be due to the fact that the roughage cost in Table 2 is the sum of cost

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2/ For detailed explanations and definition of technical efficiency see Farrell (1957).

values of inputs used in producing roughages as specified in (2.4). Thus the contents of roughage cost here mainly include the values of fertilizer, seed and labor used in producing roughages. In addition, few farms in our sample possess regular grassland for the production of good quality roughages. Instead, most farms produce barly or rye grass as second crops using part of their land. In such a situation, the per head cost value of roughage does not show significant differences among farms of unequal land area.

In contrast to such similar trends of roughage cost, the gaps of per head annual milk production and concentrate cost are obvious. Farms with more than 1.0 ha of land use less concentrate and produce more milk compared with other groups. The differences of per head annual milk production between more than 1.0 ha group and others are quite substantial showing 1,155 kilograms and 878 kilograms between less than 0.5 ha and 0.5 to 1.0 ha groups, respectively. Recalling that both concentrate and roughage play very important role in determining the level of milk production and further that the level of concentrate cost is in reverse relationship with production, it seems not implausible to assume that the roughage cost in farms belonging to more than 1.0 ha group is underestimated. Farms with more land area can utilize larger amount of roughages including straw, wild grasses and other agricultural byproducts. The average herd size of milk cow in more than 1.0 ha group turned out to be 12 heads while those of the other two groups revealed 6 heads. On the other hand, the average land area in 0.5 to 1.0 ha group showed 0.71

ha which by far falls short of the value 3.5 ha in more than 1.0 ha group. This means that the gaps of land area between more than 1.0 ha group and other groups are larger than the gaps in herd size among the three farm groups. Consequently, the conspicuous gaps of annual per head milk production in Table 3 might be ascribable to the differences in the amount of roughages actually used by milk cows belonging to three farm groups. Admittedly, the high level of concentrate cost in farms with less than 0.5 ha would have contributed to the increase of per head milk production in the short-run. On the other hand, however, we can hardly deny the negative impacts stemming from excessive use of concentrate. It is not unusual to find dairy farms producing milk heavily depending upon concentrate experience reproductive disorder which renders significant influences to the level of per head milk production. The large gap of annual per head milk production between more than 1.0 ha group and less than 0.5 ha group seems to reflect the importance of roughage in milk production. For other cost terms, both miscellaneous and labor costs show considerable differences among three groups. Annual per head labor cost in more than 1.0 ha group amounts to more than two times of the values in other two groups. Considering that the average herd size of milk cow in more than 1.0 ha group is 12 heads while it is only 6 heads in other two groups, part of the gaps of labor cost and productional level among three group can be explained by differences in technical efficiency as we have discussed in Table 2.

4. Production Function Analysis

In this section, we perform a production function analysis as a means of investigating the producer's behavioral pattern in allocating scarce resources in milk production.

1) Empirical Model and Definition of Variables

The type of function used in our estimation is Cobb-Douglas form represented in (4.1).

$$(4.1) \quad Y_u = A_0 \quad X_{ij}^{i} e^{uj}, \; (i - 1, \ldots\ldots\ldots\ldots, \; I: j = 1, \; \ldots\ldots\ldots, J)$$

In the above, Y_j and X_{ij} are variables defined below, and terms such as A_o and $_i$ are unknown parameters to be estimated by the sample data, and uj is the stochastic error term with zero mean and constant variance.

Y_j = quantity of 3.2% BFE milk on the j^{th} farm (kg)

X_{1j} = concentrate cost on the j^{th} farm (1,000 won),

X_{2j} = total labor cost on the j^{th} farm (1,000 won),

X_{3j} = miscellaneous cost on the j^{th} farm (1,000 won).

All variables in the above are measured in value terms except for the dependent variable Y which is the quantity of milk converted into its 3.2% butter fat equivalent milk. The reason we measure Y in quantity instead of value of milk is that the fit was better. The independent variable X_{2j} includes not only cost for hired labor but also that of family labor as defined in (2.5), and the concentrate cost is as defined in (2.3). The miscellaneous cost in the above includes all other costs except concentrate and labor. Before we estimate the model in (4.1), we tested several models using different combinations of variables. Thus the model and variables defined in the above are the results obtained through trial and error. Unforfunately, however, we failed in segregating roughage as an independent variable since its estimated coefficient did not satisfy sign condition and lacked statistical significance.

2) Statistical Significance of Numerical Results

Numerical results of the production function analysis are listed in Table 3. The dependent variables of M-1 and M-2 are measured in quantity of 3.2% BFE milk and those of M-3 and M-4 are in value terms measured in thousand won units. Models M-2 and M-4 include 1, 0 demies (D_i - D_4) representing different regions. This was done to take the regional differences in conditions surrounding milk production into account. The dummy variables D_1 - D_4 represent Gyeonggi, Gangwon, Chungnam and Jeonnam provinces, respectively. Thus the constant term $_0$ which corresponds to the log value A_0 in (4.1) can be regarded as representing the production conditions in Gyeongsang province. These regional dummies play the role of getting rid of biases stemming from differences in region-specific non-conventional factors including technical efficiency, climate and other qualitative factors that defy direct measurement.

Note that the results of the production function analysis in

Table 3 are satisfactory in that most parameters estimated reveal correct sign with sufficient statistical significance and the values or R^2 are high enough in all cases. Comparing the results of M-1 and M-2, one can verify that adoption of regional dummies increased the value of $_2$ while the opposite is true for $_3$ and the same trend is observable between M-3 and M-4. In a production function analysis using cross-section data, parameters estimated with no consideration of non-conventional factors are subject to a management bias (Mundlak, 1961). To get rid of such bias, estimation of an intrafirm not inter-firm production function is necessary (Bronfenbrenner, 1944). This can be done by means of the Covariance Analysis Method (Hoch, 1982). However, in order to apply the Covariance Analysis Method, cross-section data spanning at least two years are required (Scheffe, 1959). Thus in our estimation of production function with cross-section samples of a single year, application of the Covariance Analysis Method is difficult. But the regional 1, o dummies in M-2 and M-4 adopted in this study can be regarded as roughly reflecting the relative levels of region-specific non-conventional factors of farm groups belonging to different regions. In this respect, the results of both M-2 and M-4 can be interpreted as representing an intrafirm production function while both M-1 and M-3 correspond to interfirm production function.[3/]

3/ Of course, the term intrafirm or interfirm production function used in this study does not necessarily coincide with the conception used in Munlak(1961) or Hoch(1962) in the sense that we treated cross-section samples belonging to different regions as a group instead of individual farm.

The regression coefficients of D_1 - D_4 are all positive with t-ratios exceeding 2.0. This can be interpreted that the positive impact of region-specific non-conventional factors on milk production is highest in Gyeonggi followed by Chungnam, Gangwon, Jeonnam and Gyeongsang in relative sense. This trend is similar both in M-2 and M-4 except that the relative magnitude is reversed between Gangwon and Jeonnam in M-4, though the difference is almost negligible. In M-2 we can also verify that the differences among the four regions except for Gyeongsang province are negligible. This can be construed as indicating that the relative impact of region-specific non-conventional factors on milk production are almost the same in different regions but that for Gyeongsang province. As a whole, the numerical results in Table 3 are satisfactory. But in our interpretation of the results hereafter, we will use the results in M-2 that both the statistical significance of parameters and the value of R^2 are more reliable in M-2 than in M-4.

3) Producer's Behavioral Pattern in Resource Allocation

One of the primary objectives in estimating a production function lies in investigating the producer's behavioral pattern in the allocation of scarce resources. Conventionally, this has been done by examining how far the ratio of the marginal value product(MVP of an input to its opportunity cost deviates from unity. Values of MVP's derived using the results in Table 3 are represented in Table 4. Calculation of MVP's was performed by multiplying the unit price of 3.2% BFE milk in 1981(274 won) by the marginal products of inputs. For the calculation of opportunity cost, an interest rate of 16% applied to government loans for short-term production fund in 1981 was used. Since all independent variables are measured in value terms of thousand won units, the opportunity cost of an input becomes 1,160 won. The ratios of MVP's to opportunity cost derived in this way were 0.98 for concentrate, 1.26 for labor cost and 1.08 for miscellaneous cost as can be seen in Table 4. From the results above, one can easily recognize that producers in our sample farms are quite rational in the use of concentrate while traces of underinvestment are observable in the cases of both labor and miscellaneous costs.

The high ratio for labor above deserves further comment. Note that the average herd size of milk cow is 6.7 heads in Table 1. This means that most dairy farms in our sample can be regarded as part-time milk producers with crops. Accordingly, both dairy and crop enterprises compete for limited family labor. Particularly, this is true in times of sowing, transplanting and harvest of rice and other upland crops when the need for labor reaches its peak. To mitigate such demand, most dairy farms in our sample can not but use hired labor and the share of cost paid for hired labor increases considerably as herd size expands while the cost share of machinery does not vary as can be seen in Table 2. As already mentioned in the preceding section, the ratio of family labor which was more than 90% in the 1 to 5 head group abruptly dropped to less than 50% in the 11 and more head group.

This implies that milk production in our sample farms is heavily dependent on labor-using technology and the maximum herd size of milk cow that can be well taken care of using only family labor hardly exceed 6 or 7 heads at most. Thus expansion of herd size over 6 or 7 heads seems liable to trigger heavy dependence on hired labor due to the increasingly competitive relationship between dairy and crop enterprises in the use of labor. Recalling that the average herd size of our sample is 6.7 heads, it would be difficult for a farm to hire additonal labor year round to mitigate the labor shortage since it increases unit cost considerably.[4/] Thus most farms in our sample have to manage with family labor hiring additional labor temporarily at the peak labor demand periods. The high ratio of MVP to opportunity cost for wage in Table 4 seems to reflect such a situation.

The ratio of the MVP to the opportunity cost for miscellaneous costs also turned out to exceed unity. It is difficult to determine which inputs are worthy of further investment since the miscellaneous cost is the aggregated sum of several inputs including roughage, other costs, machinery, buildings and milk cows. In an attempt to isolate the relationship between the aggregated sum and the individual cost terms, we performed Principal Component Analysis (PCA).[5/]

4/ The nominal farm wage over 1967-81 has increased at the rate of 32% per annum while the rate for the raw milk selling price increased by 16%. (Monthly Review of the NACF, 1983 and Materials on Price, Demand and Supply for Livestock Products, NLCF, 1983)

5/ See Cooley and Lohnes (1971) for PAC

The results are represented in Table 5 where one can verify that only the first eigen value exceeds unity. This explains 65% of all information included in the five cost terms. This can be construed as indicating that only the first Principal Component(PC) derived has any significance in interpreting the results. In the same table, we listed factor loadings between the first PC and the five individual cost terms. The factor loadings here correspond to correlation coefficients between the first PC and five cost terms. The highest value can be found between the first PC and cow cost defined in (2.8). The values of factor loadings were 0.8577 for cow cost, 0.7649 for machinery, 0.7188 for roughage, 0.7085 for building and 0.6793 for other costs. Thus we can roughly say that the miscellaneous cost employed as an independent variable in our estimation of production function is most closely correlated with cow cost among the five terms explaining almost 74% of variations included in cow cost. Consequently, the ratio 1.08 for miscellaneous cost in Table 4 can be interpreted as implying the plausibility for additional investment in milk cow.

4. Economies of Scale in Milk Production

In the case of the Cobb-Douglas production function, economies of scale can be easily verified by examining whether the sum of production elasticities of input exceeds unity or not. Note in Table 4 that the sum $\overset{3}{\underset{i=1}{}}$ i significantly exceeds unity in all cases. This situation means that there are economies of scale in milk production. This result obtained in production function analysis is also consistent with what we discussed in Table 2 where we found that the unit operating cost of milk gradually declined as herd size increased. One of the main reasons for such a phenomenon of economies of scale in milk production might be ascribable to capital rationing. In an industry faced with a good deal of fixed capital as in dairy farming, additional investments in fixed capital sometimes become difficult and farms are liable to continue production in a region of declining average cost (or increasing returns).

Shortage of labor in dairy farms also seems to work as another reason for the phenomenon of economies of scale in milk production. Particularly, it is plausible in the case of part-time dairy farms where both crop and dairy sectors compete for limited family labor. The share of these part-time dairy farms who raise less than 10 heads of milk cows amounts for 79% of our sample. Even if the ratio of the MVP to the opportunity cost exceeds unity for labor, it would be difficult for these farms to hire additional labor, mainly due to indivisibility of labor employment. To make full use of the additional labor and achieve cost reduction in milk production, further investments in other fixed capitals such as milk cows, buildings, machinery and other facilities must occur simultaneously. However, this investment would require a lump sum of money which most part-time dairy farms can hardly produce. As a result, they are apt to maintain their herd size within a range that can be well taken care of making most use of family labor and hiring additional labor temporarily at the peak of labor demand.

The low level of producer's technical efficiency in part-time dairy farms can also work as a constraint to the expansion of the farm scale. Milk production consists of several subsectors including roughage production, culling, breeding, veterinary care, and management. Accordingly, there exists more room for producer's technical efficiency to influence production levels than in crop production.[6/] However, unlike other conventional inputs, the level of one's technical efficiency can hardly be doubled or tripled at will in the short-run. Also, in general, the level of technical efficiency in part-time dairy farms can be regarded as lower than in specialized farms. Therefore, increase in the use of conventional inputs with no improvement in the level of one's technical efficiency can cause increases in unit costs which make expansion of the farm scale implausible.

5. Herd Size and Production Cost

With respect to price as well as subsidy policies in milk production, it is quite useful to obtain information on topics such as how production cost varies as herd size changes and what the optimum scale is. Actually, however, it is not an easy work to suggest reliable answers to the problem of optimum herd size under given market conditions. First of all, we need sufficient data to examine this problem and, second, the conclusion can vary depending upon the method employed.

6/ According to the study performed by Cho (1979) in Japan, producer's technical efficiency explained almost 10% of total production cost in dairy farming.

In this section, we attempt to derive some implications on this problem by performing a cost function analysis.

1) Estimation of Average Cost Function

In estimating the average cost function, we assume that it takes the 'U' shape as economic theory dictates. Thus for the estimation we use the following quadratic function defined in (5.1).

$$(5.1) \quad Y_u = a + bX_u + cX_j^2 + e_j$$

In the above, Y_j means annual per head production cost of milk cows in farm j measured in one thousand won units and X_j stands for the number of milk cows.7/ And e_j means stochastic error term. Other terms such as a, b and c are parameters to be estimated by the sample data. Since we use cross-section data, the average cost function estimated can be regarded as representing the relationship between herd size and cost in the long-run.8/ In estimating the above function, we excluded four samples with extreme values. So a total of 117 dairy farm records were used. The result of estimation was as follows.

$$(5.2) \quad Y_j = \underset{(23.4)}{2,333.3} - \underset{(3.1)}{72.187X_j} + \underset{(2.4)}{3.100X^2}$$

$$F^2 = 0.1097, \text{ d.f} = 114$$

7/ The production cost here includes interest for own capita, returns for family labor defined in (2.6), in addition to the operating cost in Table 2.

8/ The distribution of our sample data is positively skewed. This situation means that frequency decreases abruptly as herd size of milk cow exceeds 10 heads. Thus the average cost function estimated here can be regarded as mainly representing the situation in part-time dairy farms.

In the above, the values in the brackets are t-ratios from which we can verify that all regression coefficients are statistically significant at the one percent level. The value of R^2 which is 0.1097 also turned out to be significant at the one percent level with degrees of freedom 114.[9/] Thus the quadratic function estimated in (5.2) can be regarded as representing the relationship between herd size and production cost. But we must notice the value of R^2 in (5.2) is low, irrespective of its statistical significance. Of course, we can improve the fit of the regression by excluding more samples with extreme values. But we avoided such manipulation since it did not fundamentally change the conclusions derived from the results. The low value of R^2 merely means that annual per head production cost varies over a wide range among farms belonging to a particular herd.[10/]

2) Cost Changes and Optimum Herd Size

Derivation of optimum herd size in milk production is very useful. Particularly, this is so in the respect that more effective utilization of scarce resources is possible by inducing dairy farms to operate in

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9/ The critical value of multiple correlation coefficient with degrees of freedom 100 is 0.254 at the 1% level whereas the square root of R-square in (5.2) is 0.3312 which by far exceeds the critical value.

10/ Misspecification error of the empirical model can also be regarded as another reason for the low value of R-square. But in our estimation using different models, we could not obtain significant results.

the vicinity of optimum herd size through financial support and structural policy. In order to determine the optimum herd size under given market conditions, we derived following total as well as marginal cost functions using the result in (5.2).

(5.3) $TC = 2,033.3X - 72.187X^2 + 3.100X^3$

(5.4) $MC = 2,033.3 - 144.374X + 9.300X^2$

In the above, both TC and MC respectively mean total and marginal costs and the subscript j is suppressed. We need further information on the marginal revenue(MR) of milk cows which consists of both a main product (milk) and a byproduct (calf). For evaluation of the main product, we used the average annual per head milk production of 5,508 kilograms and its unit price of 274 won in 1981. For the byproduct, we assumed a birth rate of 80% and a death rate of 10% for a dairy calf before weaning. An averaged price of both dairy steer and heifers after weaning equal to 332,500 won per head in 1981 was adopted for evaluation of the byproduct. Thus the MR of a milk cow can be expressed as follows.

(5.5) MR = (5,508 x 274) + (332,500 x 0.8 x 0.9) = 1,748.592 won

Using the above information, we draw cost curves and MR in Figure 3 where the minimum points of both average cost (AC) and marginal cost(MCO curves turned out to be (11.6, 1,613) and (7.8, 1,473), respectively (Figure 3). The vertical line drawn from the point where MR equals MC meets with abscissa at a herd size of 13 heads.

Consequently, the optimum herd size of milk cow becomes 12 heads under the given market conditions in 1981. So far as both input and output market conditions do not change in relative sense, the optimum herd size derived here is still effective. We can see that the optimum herd size for milk cows derived above is almost two times the average herd size of our sample farms as can be verified in Table 1. Thus we can say that most farms operate within a range far below that of optimum herd size. Actually, only 25 farms corresponding to 21% of the total sample turned out to be raising more than 10 heads of milk cows. If we assume that the optimum herd size of milk cows represents ideal farm scale in milk production, the results obtained here indicate that there remains further room for scale expansion. This is consistent not only with the evidence of economies of scale obtained in production function analysis but also with what discussed in Table 2.

4. Conclusions, Limitations and Suggestions

An economic analysis was performed using 121 individual dairy farm records farm in 1981 to identify the problems related to milk production in Korea. The main results obtained in this study can be summed up as follows.

1) There exist considerable gaps in the performance level of milk cows belonging to different size herd groups. Annual per herd milk production converted into 3.2% butter fat equivalent(BFE) is 5,289 kilograms in the 1 to 5 head group; 5,583 kilograms in the 6

to 10 head group; and 6,000 kilograms in the 11 and more head group. By contrast, annual per head operating cost did not show much difference except in cost paid to hired labor. Labor cost increases rapidly as herd size of milk cows exceeds 7 heads that can be well taken care of making most use of family labor in part-time dairy farms. However, the high performance level of milk cows in large size dairy farms turned out to more than counterbalance the rapid increase in labor cost so that the lowest unit operating costs declined as herd size increased.

2) Performance level as well as annual per head operating cost of milk cow also showed substantial differences among farm groups divided by arable land area possessed. Annual per head milk production in farms with less than 0.5 ha of arable revealed 5,197 kilograms while it showed 6,350 kilograms in farms possessing more than 1.0 hectare. Annual per head concentrate cost in the former was 12% higher than in the latter and the opposite trend was true in the case of roughage cost. The large gaps in performance level of milk cows belonging to different groups seem mainly to reflect the differences in quantity of roughages including agricultural byproducts and wild grasses actually consumed. The fact can be regarded as implying the importance of roughage in milk production. Thus increase of good quality roughages in dairy farms seems to enhance the performance level of milk cows.

3) Milk producers turned out to be quite rational in the use of concentrate and traces of under investments were observed for labor and milk cow. The phenomenon of underinvestments was particularly obvious in the case of labor reflecting the competitive relationship in the use of labor between dairy and crop enterprises in part-time dairy farms.

4) Sample farms were found to operate within the range of increasing returns to scale (declining average cost). Thus we can hardly exclude the potential for further scale expansion in part-time dairy farms under the given market conditions. The main reasons for such a phenomenon seems to be ascribable to a capital rationing, labor shortage and low level of technical efficiency in part-time dairy farms. Particularly, labor shortage makes it unpractical for them to expand farm scale over the limit that can be managed mainly using family labor. In addition, indivisibility of labor employment seems to make it difficult for part-time products to achieve simultaneously expansion of farm scale and cost reductions. Adoption of labor-saving technology would greatly mitigate the labor shortage and make possible gradual scale expansion in the future. At the same time, provision of long-term government loans at reasonable interest rates is necessary because scale expansion requires simultaneous investments in fixed capitals sectors.

5) The optimum herd size of milk cows appeared to be 13 heads which is almost two times of the average herd size of 6.7 heads.

This result together with the evidence of economies of scale again strongly points toward a potential of further scale expansion in part-time dairy farms. Thus establishment of proper structural policy to put them on expansion path so that they can operate in the vicinity of oupimum herd size can bring about substantial increase in milk production. In so doing, we can meet effectively increasing domestic demand for dairy products and we can also raise income on part-time dairy farms.

6) The results obtained in this study mainly pertain to part-time dairy farms in which both crop and dairy sectors compete for limited scarce resources. Accordingly, the evidence and implications obtained have to be utilized with such point in mind. Further analysis using data involving specialized and commercial dairy farms is necessary for more comprehensive conclusions.

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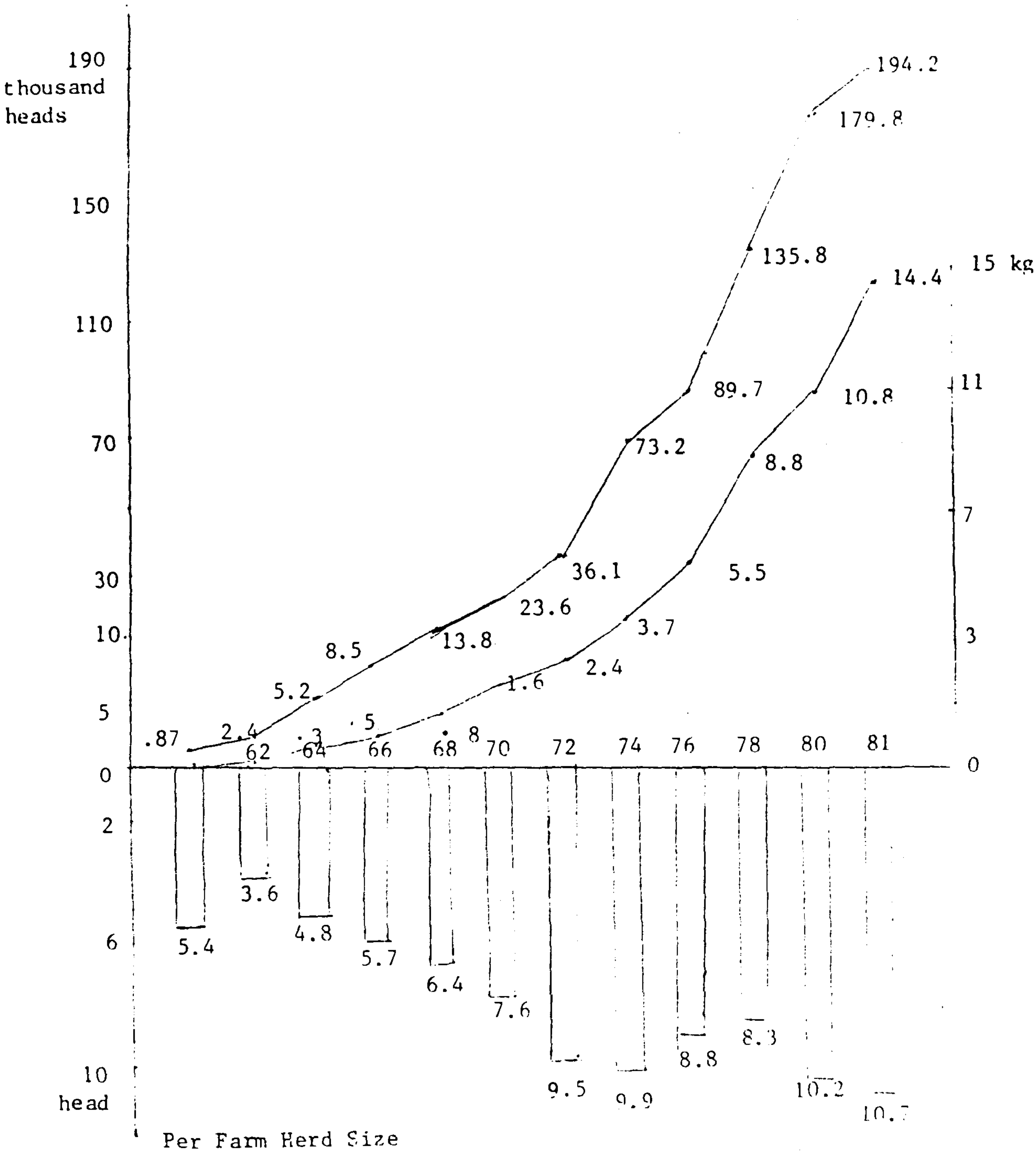
Fig. 1. Trends of Total Number of Dairy Cattle, Per Farm Herd Size and Per Capita Milk Consumption



Source : Dairy Situation Figures (Livestock Bureau, Ministry of Agriculture and Fisheries, 1982)

Table 1. Number of Sample and Herd Size

Regions	Number of Farms	Herd Size[a]
Gyeonggi	48	7.3
Gangweon	13	4.8
Chungnam	26	8.3
Jeonnam	9	4.3
Gyeongsang	25	5.7
Total	121	6.7

a Herd size includes only milk cows excluding dairy calves.

Fig. 2. Regional Distribution of Sample Farms

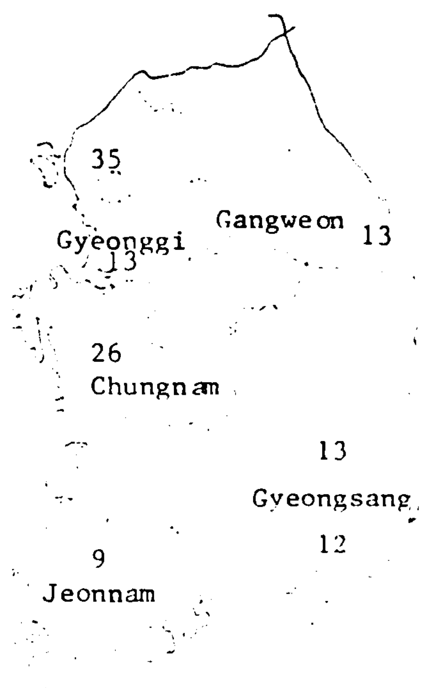


Table 2. Annual Per Head Operating Cost by Herd Size and Arable Land Area

Unit : 1,000 won

Herd Size and Land Area	Milk[a]	Concentrate	Roughage	Miscellaneous Cost	Labor Cost[b]	Machinery[c]	Building[c]	Milk Cow[c]	Cost/kg
Herd Size									
1 to 5 head	5,289kg	593(.50)[d]	73(.06)	108(.09)	17(.01)	69(.06)	63(.05)	260(.22)	.224
6 to 10	5,583	613(.52)	55(.04)	104(.08)	61(.05)	50(.04)	46(.04)	258(.22)	.213
11 and more	6,000	596(.48)	61(.05)	96(.08)	110(.09)	51(.04)	52(.04)	262(.22)	.205
Arable Land Area									
less than 0.5ha	5,195kg	645(.53)	55(.05)	121(.01)	53(.04)	42(.04)	46(.04)	256(.21)	.234
0.5 to 1.0hg	5,472	581(.51)	61(.05)	90(.08)	49(.04)	55(.05)	52(.04)	261(.23)	.210
more than 1.0ha	6,350	575(47)	67(.05)	90(.07)	122(.10)	61(.04)	55(.04)	261(.21)	.194

a Per head annual milk production converted into 3.2% butter fat equivalent(BEF) milk.

b Wages paid for hired labor.

c Includes depreciation and interest.

d Within the brackets are cost ratios.

e The farms classified as 'less than 0.5ha' includes dairy farms whose records for land are omitted or have no particular land for roughage production.

Table 3. Numerical Results of Production Function[a]

Model[b]	Concentrate α_1	Labor Cost α_2	Miscellaneous Cost α_3	Constant α_0	D-1[c]	D-s	D-3	D-4	$\sum_{i=1}^{3} \alpha_i$	R^2
M-1	.4572	.1414	.5445	1.2193					1.1431	.8923
	(6.0)	(1.9)	(6.5)	(3.2)					(22.0)	
M-2	.4533	.2763	.4529	.7296	.3484	.2967	.3333	.2783	1.1825	.9257
	(6.6)	(4.1)	(5.9)	(2.5)	(6.8)	(4.0)	(5.7)	(3.5)	(24.3)	
M-3	.4439	.1603	.5525	-.1831					1.1567	.8897
	(5.8)	(2.1)	(6.5)	(1.0)					(20.2)	
M-4	.4382	.2786	.4782	-.6462	.3143	.2514	.2920	.2784	1.1950	.9114
	(6.0)	(3.9)	(5.9)	(2.0)	(5.7)	(3.2)	(4.7)	(3.3)	(22.3)	

a Estimated using the Cobb-Douglas production function.

b The dependent variables of M-1 and M-2 are quantity of milk converted into 3.2% butter fat equivalent and those of M-3 and M-4 are value of milk

c Variables D-1, D-2, D-3 and D-4 are 1, 0 dummies representing Gyeonggi, Gangweon, Chungnam and Jeonnam, respectively. Thus the constant term in M-2 and M-4 corresponds to that of Gyeongsang province.

d Within the parentheses are t-ratios.

Table 4. Productivities of Factors

Factors	AP[a]	MP[b]	MVP[c]	Opportunity Cost[d]	MVP/DC
Concentrate	9.2^{kg}	4.2^{kg}	$1,142^{won}$	$1,160^{won}$	0.98
Labor Cost	19.3	5.3	1,463	1,160	1.26
Miscellaneous Cost	10.1	4.6	1,257	1,160	1.08

a Average Productivity.

b Marginal productivity.

c Marginal value product calculated by multiplying the unit price 274 wons for one kilogram of 3.2% butter fat equivalent milk in 1981.

d Annual interest rate 16% was applied

Table 5. Results of PCA for Miscellaneous Cost

Eigen Values	Accumulate Contribution Rate	Factor Loadings[a]	
1. 3.2278	64.6%	1. Roughage	.7188
2. .6687	77.9	2. Other Cost	.8793
3. .3986	85.9	3. Machinery	. 7649
4. .3924	93.7	4. Building	.7085
5. .3126	100.0	5. Milk Cow	.8577

a Correlation coefficients between the first Principal Component and five variables.

Fig. 3. Average and Marginal Cost Curves (1,000 won/head)

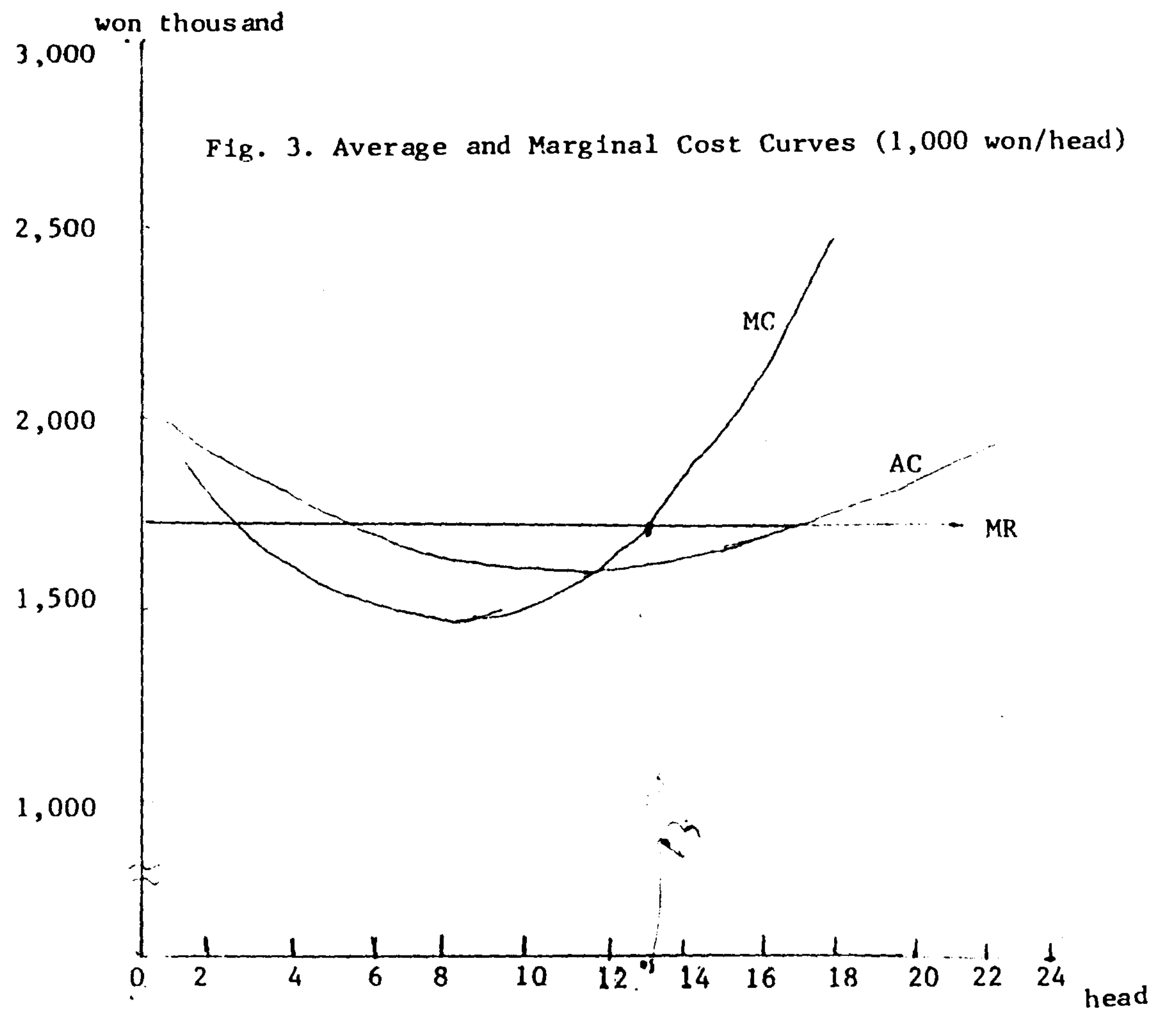
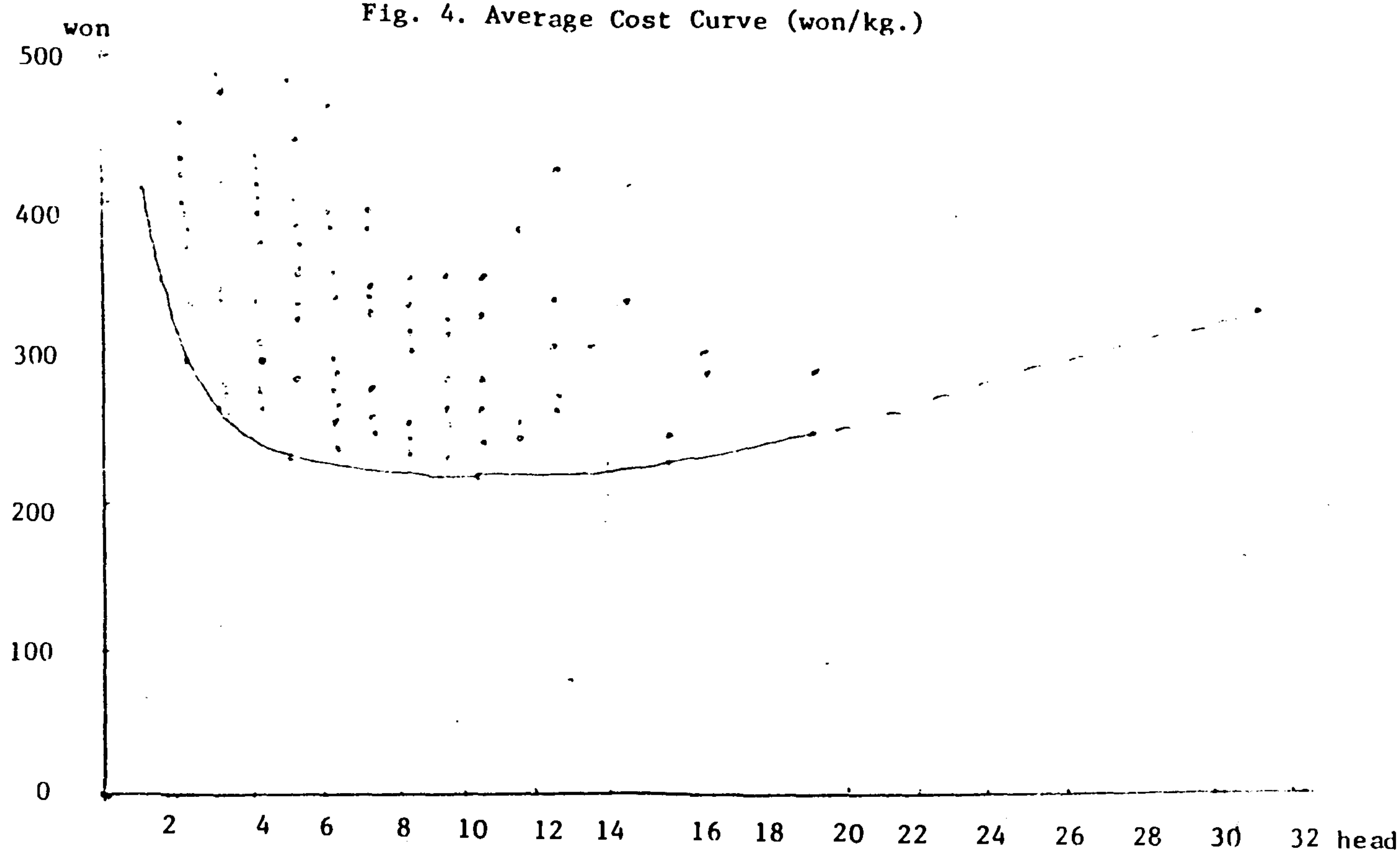


Fig. 4. Average Cost Curve (won/kg.)



Estimation of Milk Production Functions and Substitution Rates in Rations of Korea.

Moo Nam Chung *

1. Objectives

Interests in milk production surface and hay/silage-concentrated feed substitution in the dairy cow ration has been spurred by the recent agricultural development of Korea. The task of this study is to estimate milk production functions and feed substitution ratios in alternative dairy cow rations.

The primary objectives are to establish (1) the rates at which roughages and formula feeds substitute under specific technical conditions and (2) the rate at which feeds are transformed into milk for various production levels and rations. Regarding the former objective, Korean farmers are probably using rice straws and corn silages as roughage now. Concerning the latter the economic potential of substituting roughage for concentrated feed is to be investigated.

2. Experimental Design and Basic Data

The basic experiment for the predictions of this study was conducted at the Livestock Experiment Station of the Rural Development Administration of Korea 1985. The experiment was conducted during 60 days from maximum milk production time which was 60 days after deliveries. The experiment included 24 Holstein cows, formula feed "Chakyoo #2", rice straw and corn silage were fed to the cows during the experimental period. This feed combination is very popular with Korean farmers. The ingredients of these feeds are given in Table 1.

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Table 1. Ingredients of formula feed, corn silage and rice straw

Unit : %

feed	DM	CP	TDN
formula "Chakyoo #2"	87	15.2	71.3
corn silage	28	2.2	18.0
rice straw	85	3.7	35.0

note: 1. DM : Dry Matter
2. CP : Crude Protein
3. TDN : Total Digestible Nutrients

The cows were fed according to the recommended feeding standard. However, about 20 kg of corn-silage was fed. Table 2 shows the feeding levels to each cow every day

Table 2. Average feeding levels by time period

Unit: Kg/day

	days after experiment began						
	10	20	30	40	50	60	average
amount fed							
Formula	9.0	8.4	8.2	7.9	7.6	7.2	8.1
Corn-silage	18.1	19.2	19.0	18.7	19.5	19.1	18.9
rice straw	4.4	4.4	5.2	5.3	5.6	5.5	4.9
intakes in DM							
concentrate	7.8	7.3	7.1	6.9	6.6	6.3	7.0
roughage 1)	8.8	9.1	9.8	9.8	10.2	10.0	9.5
total	16.6	16.4	16.9	16.7	16.8	16.3	16.5
T D N	11.2	11.0	11.1	11.1	10.9	10.5	10.9

Note: 1) roughage includes corn-silage and rice straw in this paper.

The body weights did not change significantly during the experimental period. The average body weight in the beginning was 535 kg/head. It was 525 kg/head at the end of experiment.

3. Derivation of Milk Production Functions.

Milk production is a complex process involving many resources, of which feeds represent but one kind. However, feeds only are involved in the estimation of feed substitution rates or feed-milk transformation ratios.

Two sets of functions were derived from the experimental data: (1) those where a single time period was included and (2) those where time was considered as a variable. However, it is believed that the production functions which include time as a variable provide the most efficient estimates. The time variable allowed for the normal trend in milk output over the lactation period.

Since little is known about milk production functions in Korea, three types of algebraic equations were fitted to the data. A power equation was selected as one of a general type which does not require specification of a single maxima in milk production. The equation might allow reasonable "average" estimates of substitution ratios and transformation coefficients in the midsection of the milk surface. The other two equations were linear and quadratic.

Variables and Regression Equations: Three variables were used to estimate the milk production functions. Two of these are the concentrate (formula) and roughage (rice straw and corn-silage) feeds. The third is time since this variable was found to be closely associated with milk production in the experimental period. Hence, the variables for the functions are:

FCM is production in kilograms per cow of 4 percent fact-corrected milk during the 5-day period.

C is kilograms of concentrate (formula feed) in dry matter during the 5-day period.

H is roughage (rice straw and corn-silage) measured in kilograms per cow on dry matter during the 5-day period.

T is time in one day periods.

The milk production functions for the experiment are shown in equations from (1) to (8) for the linear, quadratic and logarithmic functions, respectively.

$$(1)\ FCM = 71.4112 + \underset{(11.975)}{0.8529^{**}}\, C - \underset{(2,967)}{0.4492^{**}}\, H. \quad R^2=0.685$$

$$(2)\ FCM = 123.6406 + \underset{(5.4273)}{2.0546^{**}}\, C - \underset{(3.1776)}{0.0164^{**}}\, C^2 - \underset{(1.9080)}{3.8071}\, H$$

$$+ \underset{(1.7080)}{0.0378}\, H^2 \qquad R^2 = 0.678$$

$$(3)\ FCM = 45.3949\ \underset{(13.3305)}{C^{0.3948^{**}}}\ \underset{(2.4806)}{H^{-0.2188^{**}}} \qquad R^2 = 0.673$$

$$(4)\ FCM = 46.8325 + \underset{(13.6524)}{0.8837^{**}}\, C + \underset{(.09583)}{0.1790}\, H - \underset{(5.0272)}{0.2168^{**}}\, T$$

$$R^2 = 0.702$$

$$(5)\ FCM = 123.9436 + \underset{(6.3584)}{2.2375^{**}}\, C - \underset{(3.8621)}{0.0178^{**}}\, C^2 - \underset{(2.4789)}{4.4579^{*}}\, H$$

$$+ \underset{(2.6261)}{0.0527^{**}}\, H^2 - \underset{(5.8128)}{0.2376^{**}}\, T \qquad R^2 = 0.741$$

$$(6)\ FCM = 56.7872 + \underset{(6.3577)}{1.8850^{**}}C - \underset{(3.6553)}{0.0129^{**}}C^2 + \underset{((2.1392)}{2.4444^{*}}H$$

$$+ \underset{(2.3989)}{0.0589^{*}}H^2 - \underset{(1.2671)}{0.2188}\,T - \underset{(0.0588)}{0.001}\,T^2 \qquad R^2 = 0.738$$

$$(7)\ FCM = 225.138 + \underset{(0.024)}{0.0330}\,C - \underset{(1.4731)}{0.0098}\,C^2 - \underset{(2.939)}{7.2301^{*}}\,H$$

$$+ \underset{(3.1019)}{0.0699^{**}}\,H^2 + \underset{(1.6401)}{0.0352}\,C.H - \underset{(5.6706)}{0.2314^{**}}\,T \qquad R^2 = 0.735$$

$$(8)\ FCM = 9.4385\ \underset{(14.9807)}{C^{0.4271^{**}}}\ \underset{(1.7647)}{H^{0.221}}\ \underset{(4.6606)}{T^{-0.0722^{**}}}$$

$$R^2 = 0.717$$

+ ( )s indicate t values.

67 to 74 percent of the total variance in milk production is accounted for two or three variables, depending on the function. However, the general forms of equations (5) and (8) might produce more relevant statistics in terms of R^2 and the probability levels of the regression coefficients.

Marginal Equations for Quadratic and Logarithmic Functions: Equations (9) to (14), which are derived from equation (5) and (8), define the marginal or incremental productivity of concentrate, roughage and time, respectively, when one of these factors is a variable and the others are fixed in quantity. Concentrate and roughage indicate diminishing productivity in the logarithmic function since the exponent on both the C and H variables is less than 1.0 in equation (8). Also, since the sum of the exponents is less than 1.0, the function indicates diminishing milk transformation as any fixed ratio of concentrate and roughage is increased in quantity. Otherwise, in the quadratic function, the marginal product of concentrate decreases and increases with roughage with higher levels of roughage feeding. Marginal productivity of roughage was negative in less than 42.3kg but positive over 42.3 kg/5-days feeding levels.

This indicates that the quadratic function may be unsatisfactory for prediction purposes. However, the quadratic function will be continuously analyzed because the effect of roughage has not yet been investigated satisfactorily in Korea.

(9) $\frac{\partial FCM}{\partial C} = 2.2375 - 0.0356C$

(10) $\frac{\partial FCM}{\partial H} = 4.4579 + 0.1054H$ from equation (5)

(11) $\frac{\partial FCM}{\partial T} = 0.2376$

(12) $\frac{\partial FCM}{\partial C} = 4.0312H^{0.221} \cdot C^{-0.5729} \cdot T^{-0.0722}$

(13) $\frac{\partial FCM}{\partial H} = 2.0859\ C^{0.4271} \cdot H^{-0.779} \cdot T^{-0.0722}$ from equation (8)

(14) $\frac{\partial FCM}{\partial T} = 0.6815\ C^{0.4271} \cdot H^{0.221} \cdot T^{-1.0722}$

The time variable has a negative marginal product in both equations (11) and (14). This indicates the decline in milk production by about 0.2 kg/day associated with one day intervals of time beyond the beginning of the experimental period.

4. Marginal Rates of Substitution Between Concentrate and Roughage Feeds

Equation (15) derived from (8) provides the isoquants of the logarithmic function. Equation (16) defines the slopes of the isoquants and, therefore, indicates the marginal rate of substitution of roughage for concentrate. The substitution ratio is predicted to change as roughage to concentrate ratios change. The marginal substitution rate is the basis for coefficients which can serve as the basis for feed evaluation when the entire milk production surface is considered in the evaluation.

$$(15) \quad H = \left(\frac{FCM}{9,4385} \right)^{4.5455} \cdot C^{-1.9326} \cdot T^{0.3267}$$

$$(16) \quad \frac{\partial H}{\partial C} = -1.9326 \frac{H}{C}$$

The isoquant and isocline map in figure 1 is for three levels of the FCM product and three time periods from the logarithmic function. The straight lines denoted as 1.0, 1.5, 2.0, 2.5, and 3.0 are isoclines indicating all feed combinations which give a specified rate of substitution between roughage and concentrate. In other words, 1 kilogram of concentrate substitutes for 2.0 kilograms of roughage for the feed combinations traced out by isocline 2.0.

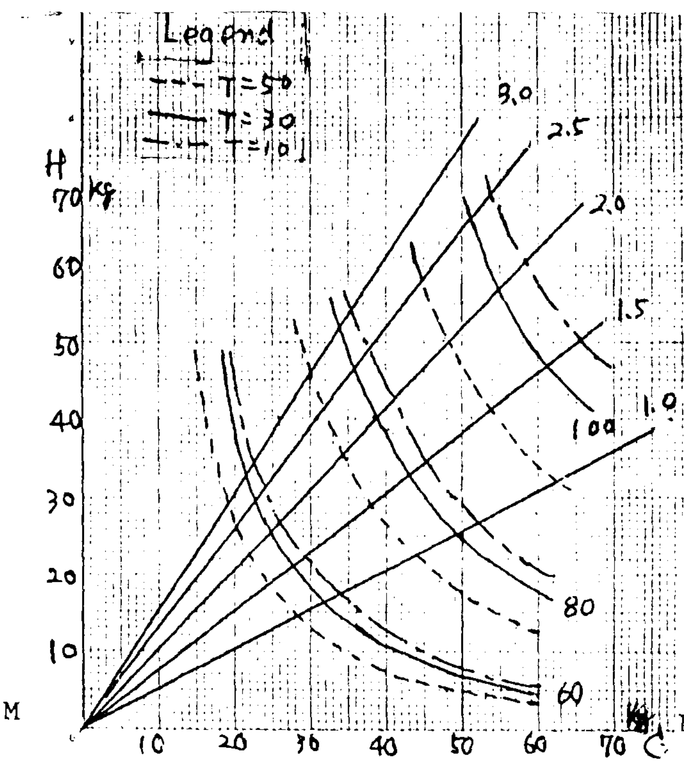

Fig.1. M Kg Logarthmic function

The isoclines shown indicate the paths of least-cost rations for particular price ratios. If the concentrate to roughage price ratio were 2.0, isocline 2.0 traces the least-cost combination of feeds for the various milk levels.

Equations (17) and (18) have been derived from equation (5) and are, respectively, the milk isoquant and substitution rate equations for the quadratic function. The milk isoquants in figure 2 are based on equation 17; equation (18) indicates the slopes of the isoquants at particular points in the feed plane.

$$(17)\quad H = \frac{4.4579 + \sqrt{-6.2544 - 0.4717C + 0.0038C^2 + 0.0501T + 0.2108FCM}}{0.1054}$$

$$(18)\quad \frac{\partial H}{\partial C} = \frac{2.2375 - 0.0356C}{-4.4579 + 0.1054H}$$

The isoquants for the quadratic function (17) appear concave to the origin and can not substitute in less than 42.3kg. of roughage, since concentrate has diminishing returns but roughage has an increasing marginal product as well as a negative marginal product under a 42.3 kg 5-day-feeding level. Isoclines, therefore, have negative slopes and converge at the point of 42.3 kg of roughage and 62.9 kg of concentrate. Since the isoquants for the quadratic function prove to be concave to the origin, feed substitutions are not the appropriate basis for ration evaluation.

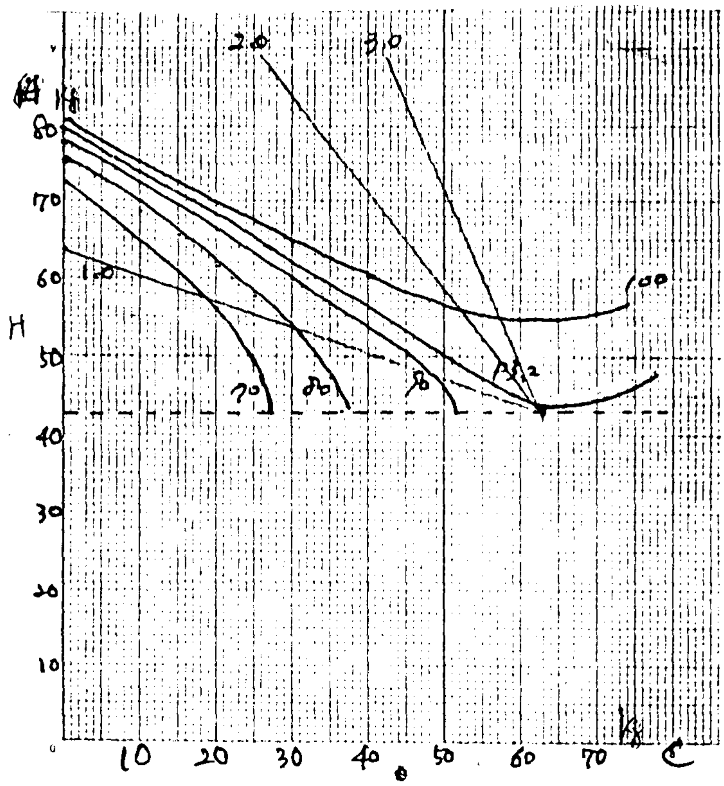

Fig 2. Milk isoquants and isoclines from the quadratic function.

5. Specifications of Economic Optima in Rations

Prediction of the milk production or surface allows specification of the ration which will maximize returns above feed costs. Using the logarithmic function (8) for predictions, equation (16) can be set to equal any concentrate to roughage price ratio with time at previously stated levels, as indicated in equation (19).

$$(19) \quad 1.9326 \frac{H}{C} = \frac{Pc}{Ph}$$

In this case, with equation (19) serving as the basis for predictions, time is set at 30 days for the experimental period, and the concentrate to hay price ratio equal to 2.8 (which was the price ratio at mid-June of 1986). It may be seen that the least-cost combination to produce 80 kilograms of FCM is 34.8 kilograms of concentrate and 50.5 kilograms of roughage with 5-days unit.

Table 3 allows prediction of least-cost rations for particular milk levels at selected times of the experiment. Also Table 4 indicates the least-cost rationing ratio between concentrate and roughage.

Table 3. Estimated optimum feed quantities derived from logarithmic function for selected milk production levels.

day after exp.	price ratio (Pc/Ph)	FCM 70kg		FCM 80kg		FCM 90kg	
		C	H	C	H	C	H
10 day	2.0	28.12	29.10	34.56	35.76	41.44	42.89
	2.5	26.06	33.72	32.02	41.43	38.40	46.69
	2.8	25.07	36.33	30.81	44.64	36.95	53.34
	3,0	24.47	38.02	30.09	46.72	36.09	56.03
	3.5	23.24	42.08	28.55	51.71	34.24	62.02
	4.0	22.20	45.95	27.28	56.47	32.72	67.72
30 day	2.0	31.95	32.56	39.05	40.41	46.83	48.47
	2.5	29.45	38.10	36.19	46.82	43.40	56.15
	2.8	28.04	41.05	34.82	50.45	41.76	60.50
	3.0	27.68	42.96	34.01	52.77	40.79	63.31
	3.5	26.26	47.56	32.27	58.44	38.70	70.08
	4.0	25.09	51.93	30.83	63.81	36.97	76.53
50 day	2.0	33.64	34.82	41.34	42.78	47.58	54.31
	2.5	31.18	40.34	38.31	47.56	45.94	59.44
	2.8	29.99	43.46	36.86	53.41	44.21	64.05
	3.0	29.60	44.58	36.38	54.78	43.63	65.69
	3.5	27.80	50.34	34.16	61.86	40.97	74.19
	4.0	26.56	54.97	32.64	67.55	39.14	81.02

Note : ⇀ indicates the price ratio at mid June, 1986

Table 4. Least-cost rationing ratios between concentrate and roughage for particular price ratios.

Unit : %

Price Ratio (Pc/Ph)	2.0	2.5	2.8	3.0	3.5	4.0
Rationing ratio (C/H)	49:51	44:56	41:59	39:61	36:64	33:67

Using the linear relationships from equation (4), the marginal rate of substitution of roughage for concentrate is 4.9369. This indicates that roughage alone would be economical if the concentrate to hay price ratio were greater than 4.9369 and the roughage to milk price ratio were less than 0.179, since the derivative of milk with respective to roughage by equation (4) is 0.179 while the derivative of roughage with respect to concentrate is 4.9369. If the concentrate to roughage price ratio were less than 4.9369 and the concentrate to milk price ratio were less than 0.8837, concentrate alone would be economical. With a concentrate to roughage price ratio greater than 4.9369 and a roughage to milk price ratio greater than 0.179, milk production would not be profitable from the standpoint of feed costs, alone, other costs disregarded.

Simultaneous Specifications of Rations and Milk Production Levels

In equations (12) and (13), the ration which will maximize return above feed costs is estimated. For example, if current prices were introduced such that the milk price were 354 won/kg, the concentrate were 216 won/kg, and the roughage were 78 won/kg, the maximum return above feed costs could be derived by simultaneous solution of equations (20) and (21).

$$(20)\quad 9.4385\ H^{0.221} \cdot T^{-0.0722} \cdot 0.4271\ C^{-0.5729} = \frac{216}{354}$$

$$(21)\quad 9.4385\ C^{0.4271}\ T^{-0.0722} \cdot 0.221\ H^{-0.779} = \frac{78}{354}$$

By simultaneous solution of the above equations, it is estimated that the optimum ration and milk production level should include 136 kg. of the concentrate and 205 kg. of the roughage with milk production at 195 kilograms for the 5-day feeding period. But the above solution is far beyond the capability of dairy cows. Therefore, maximum feeding for maximum milk production might be optimum feeding level. 41.8 kg of concentrate and 60.5 kg of roughage with 90 kg. of milk production may be suggested as optimum levels in Korea.

Feed and milk quantities derived from equations (12) and (13) in Table 5 represent optimum rations and milk production levels for certain feed and milk price situations.

Table 5. Estimated Optimum Feed Quantities and Milk Production for Various Price Ratios at Mean Day.

Price ratio		feeding level (kg)		FCM Production level (kg)
P_c/P_{FCM}	P_H/P_{FCM}	Concentrate	Roughage	
0.8	0.30	60.3	58.1	104.4
0.85	0.35	47.9	60.1	95.3
0.9	0.40	38.8	45.1	81.7
1.0	0.45	28.5	32.7	66.7

The optimum feed and milk quantities from the quadratic equation (5) may not be derived. However, the optimum concentrate level can be estimated from the equation (9). Under current prices of milk and concentrate, the solution of equation (22) estimates the optimum feeding level of concentrate.

$$(22)\quad 2.2375 - 0.0356C = \frac{216}{354}$$

By the solution of the above equation, it is calculated that the optimum feeding level of concentrate appears to be 45.7 kg per 5-day period. Furthermore, since roughage exhibits an increasing marginal product to milk production, it may be estimated that the optimum ration would be 45.7 kg of concentrate and maximum roughage which is fed to the level of the rest of stomach capacity after concentrate is fed. For example, if the maximum intake capacity of a dairy cow were 102.3 kg, the optimum ration and milk production level would include 45.7 kg of concentrate and 56.6 kg of roughage with 98.4 kg of milk production for the 5-day period under the current price situations.

Milk Production by Concentrate to Total Feeding Ratio

Various types of algebraic equations were used to estimate the milk production functions for the concentrate ratio to total feeds. However, equation (22) was found to give more relevant statistics in terms of R^2, probability levels of the regression coefficients, and characteristics of milk production.

$$(22)\quad FCM = 8.0367 + \underset{(4.4004)}{2.6198^{**}} R - \underset{(2.6720)}{0.0192^{**}} R^2 - \underset{(3.1366)}{0.1065^{**}} T$$

$$R^2 = 0.703$$

* 1. ( )s indicate t values

2. R indicates concentrate ratio to total feeding quantities.

Figure 3. Presents the geometric form of equation (22)

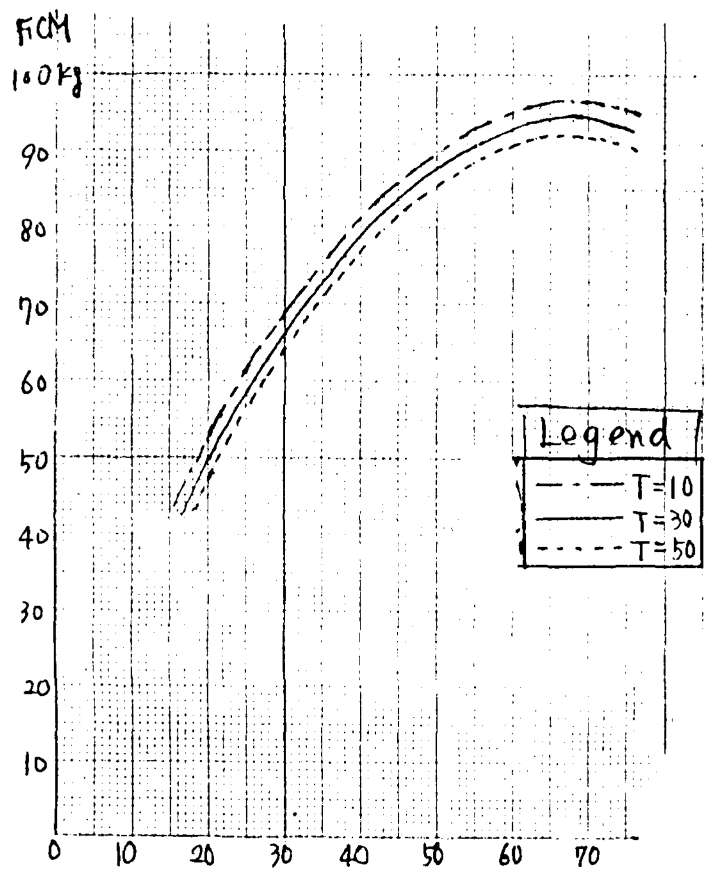

Fig. 3. Milk production for concentrate ratio to total feed.

The marginal milk production function for the ratio of concentrate to total feed is indicated in equation (23). The function allows for diminishing returns and the maximum milk production point at 68.2 percent of concentrate to total feed.

$$(23)\quad \frac{\partial\, FCM}{\partial\, R} = 2.6198 - 0.0384\, R$$

From the equation(23) optimum ratio of concentrate to total feed may be derived Equation (23) can be set to equal a one percent change of concentrate to milk price ratio as indicated in equation (24)

$$(24)\ 2.6198 - 0.384R = \frac{\text{Price of One percent Change of Concentrate}}{P_{FCM}}$$

$$= \frac{\text{Price of one percent of concentrate + Price of one percent roughage}}{P_{FCM}}$$

Under current prices, the optimum ratio of concentrate to total feed is 47.4 percent at 80 kg of total feeding level.

Table 6 shows the optimum ratio of concentrate to total feed at selected total feed levels under current prices.

Table 6. Optimum Ratio of Concentrate to Total Feed under Current Price Situation in Korea.

Total Amount of Feed (Kg)	Optimum Ratio of Concentrate (%)	Ration (kg)	
		Concentrate	Roughage
70	50.0	35.0	35.0
75	48.7	36.5	38.5
80	47.4	37.9	42.1
85	46.1	39.2	38.9
90	44.8	40.3	45.2
95	43.5	41.3	51.5
100	42.2	42.2	57.8
105	40.9	42.9	64.1
110	39.6	43.6	70.4

8. Summary and Conclusion

The task of this study is to estimate milk production functions and feed substitution ratios in alternative dairy cow rations.

Research data were used to predict milk production functions. The experiment for the predictions of this study was carried out at the Livestock Experiment Station of the Rural Development Administration of Korea in 1985. The experiment included 24 dairy cows and was conducted 60 days just after the maximum milk production period. Formula feed "Chakyoo #2" was fed as concentrate and rice straw-corn silage as roughage. 4 percent fat-corrected milk and feed in dry matter were used as the measuring unit.

Regression analyses were used for estimating milk production functions. Since little was known about the milk production function in Korea, three types of algebraic equations which do and do not include time as a variable were fitted to the data. These three functions were a linear, a quadratic and a power function.

A number of general conclusions can be drawn from the analyses.

a. Estimated milk production functions with the time variable were more fitted compared with those without the time variable. The functions with the time variable had 0.67-0.74 in R^2 and most regression coefficients appeared to be highly significant.

b. The marginal FCM product functions for concentrate and roughage, as single variables, indicated that both the diminishing and the marginal product for concentrate was much higher than that of roughage.

However, the result of quadratic estimation indicated marginal product for roughage was increasing but negative in less than 42.3 kilograms for a 5-day feeding period.

Moreover the marginal FCM product for time was negative so that the FCM product decreased 0.1-0.2 kg per day during the experimental period.

c. The FCM product elasticities for concentrated feed and roughage were less than 1.0. Therefore an one percent increase in concentrate or roughage feeding could not create an one percent increase in the FCM product. The sum of elasticities was also calculated to be less than 1.0. This indicates that transformation of feed into FCM may exhibit diminishing returns to scale.

d. The substitution rate of roughage to concentrate was 4.9 in linear estimation, but roughage and concentrate could not substitute for each other in the quadratic equation because of the increasing marginal FCM product for roughage. In the power function, there was a diminishing marginal rate of substitution.

e. Prediction of the FCM production function or surface allows specification of the ratio which will maximize returns above feed costs. The results of power estimation indicated that the combination of 41% of concentrate and 59% of roughage would realize the maximum returns above feed costs under 1986 prices which were calculated to be 2.8:1. However, 47% of concentrate feed and 53% of roughage in a ration was the optimum feeding rate under 1986 prices according to the analysis of "estimation of FCM product for concentrated feed ratio to total feeding amounts".

f. The level of FCM product for maximum returns above feed cost under average prices in 1986 appeared the highest level which dairy cow could produce.

Conclusively, Korean farmers should increase roughage feeding in rations to dairy cows for more economical milk production. The national average rationing ratio between concentrate ~~to~~ and roughage has been approximately 52:48 in Korea. From this study, we can see that this figure is too great percentage.

VII Production of Concentrated Feed

Analysis of Feedstuff Sources in Korea

Young Kun Shim* and Tack Jin Kwon**

7.1 Overview of the Feed Industry

As the demand for animal protein products increases, the market prices of meat and other livestock products now compare favorably with those of food grains. Accordingly, the number of livestock-raising farms and the number of livestock raised have steadily increased.

Expansion of the livestock sector has been stressed in line with agricultural policies that support livestock production and the feed industry. As a result, a considerable increase in livestock production has been attained and this change has affected the economic conditions and the environment of agriculture.

Among the livestock enterprises, only beef production had not been a specialized or commercialized farming enterprise until recently because there were still many farmers who raised native cattle for draft and fattening purposes. This type of production was achieved by feeding mostly farm by-products. Because of Korea's limited land area, a rapid increase in livestock production cannot be achieved by means of intensive feeding with domestic foodstuff, but is only possible by using imported feed grains.

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This is because domestic feed grains or byproducts are not available in quantities large enough to meet the feed requirements generated by increased livestock production. This additional feed requirement is met almost entirely with imported grains. In particular, producers who operate large-scale livestock enterprises exclusively as specialized business use almost no domestically produced feeds but depend entirely on imported grains. Although the relative importance of the livestock industry has grown in agriculture, this has not led to a significant change in the production structure of Korea's agriculture.

Government policy has been oriented toward supplying livestock products in sufficient quantities by sustaining domestic supply rather than through increased imports. In line with this policy of self-sufficiency in meat and livestock products, livestock production has more than doubled in the past seventeen years. From 1970 to 1987, the amount of feed grains imported for manufacturing assorted feeds has increased about 20.4 times, the amount of the home produced materials used for assorted feeds increased by 13.2 times. However, the farm produced materials for concentrated feed and roughage increased only about two-fold.

Once imported, feed grains are processed into assorted feeds to improve feed efficiency and then supplied largely to those who engage in large-scale chicken, hog, and dairy farm enterprises. Relatively small amount are fed to Korean cattle. The reason, the number of native cattle fed by these assorted feeds is small is because locally available rice-straw and by-products of crop farming are also used.

An attempt was made in this study to analyze current developments in the livestock industry in light of changes in production, utilization, and trade in feedstuffs, and changes in the structure of production units in Korea.

7.2 Consumption of Feedstuff

Yearly total consumption of feedstuff has increased by nearly 4.2 times during the last 17 years, from 5.0 million mt in 1975 to 15.9 million mt in 1987. In order to meet this increased consumption, the domestic supplies of concentrated feeds and roughages have increased by 9.3 times and 2.3 times, respectively (Table 7-1).

The proportion of concentrated feeds accounted for 26.4 percent of total consumption in terms of quantity in 1970, but this proportion increased in greatly reaching 61.8 percent in 1987. This trend indicates current consumption of concentrated feeds as feedstuff is much more important than ever before.

Considering the limitation of available resources including the shortage of arable land for pasture or the cultivation of forages and a severely cold winter, the increased feed consumption has depended upon imports of feed grains rather than increased domestic production. In fact, the amount of domestically produced concentrated feed has increased only twofold during the last 17 years and the rate of self-sufficiency has decreased to 28 percent in 1987. This decreasing domestic feed supply is one of the most difficult problems facing the development of the livestock industry in Korea. Assorted feeds using imported stock have become a major factor in the expansion of livestock production on a majority of the farms now raising livestock.

Table 7-1. Consumption of Feedstuff, 1975-87

Unit: Thousand mt

Year	Total	Concentrated Feed						Roughage
		Assorted Feed				Farm Produced Feed		
		Total	Domestic Production	Imports	Self Sufficiency Rate			
1975	5,021	901	489	412	54	550		3,570
77	5,658	1,899	862	1,037	45	499		3,260
80	7,559	3,460	1,410	2,052	41	532		3,565
81	7,299	3,491	1,420	2,071	41	483		3,325
82	8,378	4,420	1,518	2,902	34	503		3,455
83	10,673	5,852	1,752	4,100	30	621		4,200
84	11,890	5,985	1,851	4,134	31	757		5,148
85	13,234	6,451	2,272	4,179	35	855		5,928
86	14,319	7,675	2,339	5,336	30	814		5,830
87	15,873	9,018	2,516	6,502	28	790		6,065

Source: MAFF, Major Statistics of Agriculture, Forestry and Fishery, 1987

Livestock farms can be divided into two types on the basis of the number livestock raised and technologies adopted for raising animals, namely traditional farms and commercial farms.

Traditional livestock farms particularly are defined as traditional crop production farms that raise just one or two Korean native cattle for draft power or 1 or 2 hogs or a small number of chickens. Most of these farms do not purchase much of commercial feed as they mainly rely on by-products of foodgrains such as rice bran, barley bran, broken soybeans and the like.

In addition, rice straw, wild grass, and forage crops are effectively utilized as roughage for feeding cattle. Among the different sources of roughage, rice straw is the most important in terms of the available quantity. Since most of the subsistence farms are very much concerned about the available feedstuff at hand, they cannot easily increase the number of livestock raised in adjustment with changes in market conditions. Thus, most of the recent increases in the number of livestock are due to the increase in the number of farms that raise livestock and the recent entry of large-size farms that operate livestock farms as a specialized business.

Such large-sized livestock enterprises have the advantages of easier access to credit and favorable feed prices due to purchases of large amounts. Favorable prices occur as a result of occasional discounts given to customers who purchase large volumes of feed. Since such large-scale farms are currently engaged primarily in raising poultry and hogs, these enterprises are positioned better than small-sized livestock producers in terms of input costs and the sale of their products.

As a final note, it is important to realize that rice straw is the most important by-product of crop farming. The annual production of rice straw stands at about 7 million tons, about the same quantity as paddy production. The major substances of rice straw are cellulose and hemicellulose which contain sizeable amounts of lignin and silica that are not digestible by cattle. Thus, only about 15 percent of the total rice straw production is used as roughage. Usually such feed is used is in the winter season. Faced with the shortage of feed resources, the livestock industry in Korea needs to increase the effective use of rice straw as roughage and should develop methods to improve the digestibility of rice straw.

Most of the large scale commercial livestock farms are located in the outskirts of urban areas, and they are heavily utilizing assorted feeds for livestock production thus relying to a larger degree on farm produced feedstuff. Commercial farms raise mostly milk cows, beef cattle, hogs, and poultry. The number of such commercial farms has increased rapidly during the last several years changing the structure of the Korean livestock industry. In short, the use of assorted feed has become the major factor in the expansion of the number of livestock on the majority of large-sized farms.

Total consumption of feedstuff has greatly increased. In particular, the total quantity of assorted feed consumed increased by over ten times during the last 12 years, from 901 thousand mt in 1975 to 9,018 thousand mt in 1987. A rapid increase in consumption of assorted feed is the a result of an increase in the number of animals raised only for profit-oriented rather than draft purposes. During the last 12 years, the number of milk cows increased about 5.4 times, while the number of poultry and hogs increased 2.8 and 3.4 times, respectively (Table 7-2).

Table 7-2. Comparison of Number of Farm Households Raising Livestock and Poultry Between 1975 and 1987

Unit: 1,000 head

Livestock	1975			1987		
	No. of House-holds	No. of Lives-tock	Per Farm Average	No. of House-holds	No. of Lives-tock	Per Farm Average
Native cattle	1,275	1,546	1.2	854	1,923	2.3
Milk cows	9	86	9.0	38	463	12.2
Hogs	654	1,247	1.9	303	4,281	14.1
Chickens	1,094	20,939	19.1	269	59,324	220.8

Source : MAFF

During the same period, production of assorted feed increased more rapidly than the increase in the number of livestock. For example, production of assorted feed for hogs, milk cows, and beef cattle increased by 21.9, 9.3 and 50.7 times, respectively. Accordingly, this trend of increased production of assorted feed cannot be attributed solely to the increase in livestock herds. Another reason for the sharp increase in the consumption of assorted feed can be found partly its close relationship to the development of commercial livestock enterprises.

As livestock enterprises become more specialized due to the increased number of entrepreneurial farmers, the use of assorted feed might be more efficient than the traditional feeding practices of utilizing single ingredients and home produced roughage in terms of labor use and feed efficiency. It seems that assorted feed production in Korea developed first in poultry production and has gradually become important for other livestock enterprises as well.

Consumption of different forms of assorted feed by different livestock enterprises has changed according to the stages of development of livestock farming. Until 1975 the feeding of livestock except for poultry remained a minor part of farm production activities. As shown in Table 7-3, 63.2 percent of the total assorted feeds consumed were used for poultry production in 1975. As the feeding of other livestock such as hogs, beef cattle, and dairy cattle shifted to a commercial basis, the proportion of assorted feed used for poultry in 1987 decreased to 32.5 percent. This proportion is still higher than the percentage of assorted feed currently used in other livestock sectors.

Other kinds of livestock and poultry such as rabbits, goats, ducks, geese, and turkeys are also being raised on a small scale. These animals, however, are very negligible in terms of feed consumption and the value of production. In addition, these animals are not of much concern from a marketing perspective.

Table 7-3 Consumption of Assorted Feed by Livestock category, 1975-87

Unit: Thousand M/T

Year	Poultry	Hogs	Dairy Cattle	Beef Cattle	Others	Total
1975	569	135	151	33	13	901
77	1,155	350	266	96	32	1,896
79	2,044	1,130	439	266	2	3,880
80	1,872	769	514	306	1	3,463
82	1,980	1,151	592	693	4	4,420
83	2,246	2,013	710	871	12	5,852
84	2,065	1,987	853	1,072	8	5,985
85	2,310	1,924	994	1,209	14	6,451
86	2,639	2,178	1,209	1,624	25	7,675
87	2,933	2,953	1,404	1,673	54	9,018

Source: MAFF

Regarding trends in the dependence on assorted feed, the data show that the percentage consumption of commercial feeds by poultry is becoming less important. On the other hand, the use of commercial feed for hogs, dairy cows, and beef cattle has increased at a relatively higher percentage rate during the last 12 years. In particular, for hogs and beef cattle the total increases in consumption have been more than 21.9 times and 50.7 times, respectively. A stable consumption pattern has been realized in the case of feed for dairy cattle and its share of total consumption was 15.6 percent in 1987.

The concentrated feeds are consumed mostly by hog, dairy cattle, broiler and egg producing farms which are located on the outskirts of large urban centers. These farms are in general more commercialized and larger in scale when compared with traditional farms in rural areas. Also such larger-sized hog, poultry, and dairy operators are characterized by a high rate of purchase of assorted feeds. Many large-sized farms are organized to factory-type operations, and use high nutrient feeds. On the other hand, the majority livestock farms are small farms scattered throughout the country and these units are still raising livestock with farm produced feedstuff and byproducts without much reliance on commercial feed.

7.3 Production of Feedstuff

The domestic production of feedstuff has increased to some extent in recent years, but it has not kept pace with demand due mainly to the limited land resources in Korea. At present, most of the cultivated land is devoted to growing foodgrains rather than pasture or production of fodder crops. There is only a small acreage presently devoted to permanent pasture and none of the arable land is intentionally put in pasture and only a small amount is now used for fodder crop production.

Domestic production of feedstuff consists mainly of the utilization of the byproducts of foodgrains produced, the collection of wild grasses on hillsides and riverbanks around farm villages. As the number of livestock raised increases, imported feed grains are used to supplement the short supply of domestically available feedstuff.

Available feedstuff can be classified into two types, namely concentrated feed and roughage. The concentrated feed includes manufactured feed and farm supplied feed. Manufactured feed is formulated by feed mills using mostly imported feedgrains and some other local plant materials. Farm-supplied feed comes from on-farm production activities and is fed to livestock mixed with roughage without any special processing by commercial plants.

Roughage may be grouped into two categories based on its quality. Pasture grass, fodder crops, and the green silage of maize provide good quality roughage, while wild grasses and rice straw are very poor in terms of quality. Nevertheless, rice straw is the most important source of feedstuff particularly for Korean native cattle.

As the livestock industry continue to develop on a commercial basis with greater specialization, the expansion of production, and increases in farm size, assorted feeds tend to become more important as feed rations consequently, the relative importance of farm-supplied feed and roughage is decreasing over time.

None of the crops produced on the farm are grown as specialized feedstuff, and thus the sources of concentrated feed at the farm level are the by-products of foodgrains cultivated for human consumption. Among the most important by-products are various kinds of brans used for making assorted feeds. Rice straw is also very important as a roughage for Korean native cattle. In addition, soybean cakes, oilseed meals, fishmeal, and some other poorer quality foodgrains have used as feedstuff.

Most domestic production of maize and sorghum is devoted to feeding animals, but production of these feedgrains was only about 161 thousand metric tons and accounted for only 2.9 percent of the total grain used for feeding livestock in 1987. Recently, a small portion of barley production has been utilized as feed because the price has declined, but so far barley has made a negligible contribution to livestock feed ration and it is questionable whether it will continue to be used as livestock feed. Soybeans are one of the important grains for the human diet, so only the grains of low quality such as the crushed beans and soybean meal byproducts remaining after oil extraction are used for animal feeding.

In addition, an attempt has been made to increase domestic forage crop production through the double-cropping of winter rye and barley sown as second crops right after the rice harvest in the fall. These crops are then harvested in the spring before the beginning of rice transplanting the following year. The government has encouraged the cultivation of these forage crops as a way to increase the utilization of paddy land by growing more than one crop during a year. Of course, the main product of paddyland is rice, and thus second crops should not lead to decreases in rice yields due to a delay in rice transplanting. Since rye and barley are harvested as green forage, wild grasses need not be harvested for feeding livestock. The current livestock feed problems suggest the desirability of planting more forage as second crops on paddy land. However, forage crop production is expanding at a very slow rate, even though the government provides assistance to cover the costs of seeds and part of the fertilizer cost.

In another policy measure, the government has tried to encourage farmers to develop pasture on hillsides, but this has not been very successful. There are significant technical problems such as steep slopes, poor soil. Because the hill side is steep, the soil quality is poor, quality and cold winters that hamper the growth of grass. Thus the mountain areas seem to have little potential value as pasture or for other farming purposes. In conclusion, the attempts to increase domestic livestock feed production through the utilization of additional forages and feedgrains produced as second crops on the paddy lands and through the reclamation of new lands for pasture on mountain sides have not been successful, at least up to their point in time.

Rice straw is one of the most important roughage feeds for native cattle which are used as draft animal on Korean subsistance farms. Since rice is the principal crop in Korean agriculture, there is plenty of rice straw to feed these Korean cattle, particularly in the winter season. Since untreated rice straw is very poor in feed quality, farmers usually boil it down after adding some rice bran and broken soybeans during the winter months when wild forage are not available. Usually the cooked rice straw is fed to cattle two-times a day, morning and evening. These hot meals are easily digested and help to provide warmth in the cold weather. In other words, there is no specially dried grass or hay other than rice straw available for Korean cattle during the cold winter. The introduction of milk cows and beef cattle has recently brought about the need to ensile wild grasses, corn stems, and the vines of sweet potatoes. But only a very small number of farms have constructed facilities for ensilage thus far.

Both green silage and dried hay are composed of wild grasses rather than forage crops grown on the cultivated land during the frost free period from April to September. During winter, rice straw is the most important roughage for Korean native cattle. In conclusion, it is possible to say that the increase in the number of animals raised both by commercial firms and traditional farms in recent years relies heavily on commercial feed which is formulated from imported feedgrains rather than from the feedstuffs produced by farmers.

Increases in feed production were brought about by a considerable increase in the number and production capacity of feed manufacturing factories under the support of policy programs. The first formula or assorted feed mill was constructed on a small scale by the government through the Seoul Livestock Cooperative in 1958. The number of feed mills has increased since 1962, and there are now 80 feed factories in Korea with a greatly increased production capacity of 21,815 mt per day (Table 7.4). The operation rate of the mills averaged 138 percent of plant capacity in 1987.

Table 7-4. Production Capacity and Operation Rate of Feed Mills, 1987

Unit : mt

Classification	Number of Plants	Production Capacity	Capacity Per Day	Actual Production in 1987	Operation Rate
Livestock Cooperatives	18	1,063,500	3,545	1,872,756	176
Privately Owned	62	5,481,000	18,270	7,145,473	130
Total	80	6,544,500	21,815	9,018,229	138

Source : NLCF

The regional distribution of feed mills is decentralized in order to serve local livestock farms. Out of 80 factories currently in operation, 62 factories are privately owned and are organized under the Korean Feed Association and 18 factories accounting for 16.3 percent of the total production capacity are registered under the Livestock National Cooperatives Federation.

The primary feed is manufactured in meal form and is bagged for delivery to farms. The feed mill business has been regulated by the government through measures which specify the construction and operation characteristics of new feed mills and through the rationing of feedgrains imported as raw materials. These regulations provide a basis to ensure that the same quality of animal feed can be produced continuously in existing plants and helps to prevent overproduction of feed manufactured from imported materials.

The local supply of feed, particularly concentrated feed has to be supplemented by imports. Increased consumption of assorted feed has accelerated the reliance on the procurement of feedgrains from abroad. The quantity of these imports totaled about 442 thousand mt in 1975 and increased to 5,649,000 mt in 1987, an increase of 11.8 times during the last 12 years. The imports are composed chiefly of corn which accounted for 60.0 percent of the total feedgrain imports in 1987. Thus the increase in imports of feedgrains has resulted primarily from increased imports of corn. In addition, wheat bran which is a by-product of the milling of imported wheat, is one of the important sources of concentrated feed in Korea. The relative importance of imported corn among the several kinds of feedgrains imported has changed much since 1975. For instance, the quantity of imported corn has increased from approximately 390,000 mt to 3,291,000 mt over a twelve-year period, an increase of about 8.4 times, but the relative importance of corn as a feedgrain import has decreased from 93.5 percent to 60.0 percent of total imports during the same period.

The raw materials used for manufacturing assorted feed consist primarily of imported grains. In 1987, about 62.5 percent of the composition of assorted feed was imported grains, while wheat and barley bran and vegetable protein accounted for 14.6% and 14.3% of the total respectively. (Table 7-6).

Table 7-5. Import of Feedgrains, 1975-87

Unit: Thousand mt

Year	All	Total		Corn		Other Grain	
		Production	Imports	Production	Imports	Production	Imports
1975	442	25	417	3	390	22	27
76	750	23	727	3	695	20	32
77	1,062	35	1,027	7	983	28	44
78	1,583	38	1,545	23	1,541	15	4
79	2,440	43	2,397	26	2,297	17	100
80	2,077	69	2,008	49	1,979	20	29
81	2,086	73	2,013	52	1,922	21	91
82	2,831	54	2,777	40	2,353	14	424
83	3,895	99	3,796	54	3,518	45	278
84	3,949	191	3,758	38	2,381	153	1,377
85	4,095	346	3,749	56	2,365	290	1,384
86	4,617	72	4,545	55	2,802	17	1,743
87	5,649	161	5,488	39	3,291	122	2,197

Source: MAFF

Table 7-6. Use of Different Raw Materials for Assorted Feed, 1975-87

Unit: 1,000 mt

Year	Grain	Brand	Vegetable Oil Meal	Animal Protein	Inorganic Substances	Other	Total
1975	442	262	98	50	53	9	914
80	2,077	685	395	122	184	22	3,486
81	2,078	689	447	94	179	24	3,510
82	2,078	661	569	119	217	43	4,439
83	3,895	667	832	127	280	70	5,871
84	3,095	784	737	133	874	81	6,005
85	4,095	1,000	848	124	298	103	6,468
86	4,617	1,330	1,094	144	351	157	7,693
87	5,649	1,324	1,293	150	412	210	9,038

Source: MAFF

Business returns of feed manufacturing firms were depressed in 1980. However, since 1981, the industry has recovered substantially in terms of financial structure, activity, productivity, and performance with the help of stable prices of imported grain. In 1987, the average operation rate of feed factories reached 138 percent of production capacity.

The income statements of the feed manufacturing business at the cooperatives indicate that they earned an average gross profit of 14.6 percent of total sales and that net profit after tax deduction was 1.4 percent of sales. The privately owned factories appear to operate at satisfactory levels in terms of net profit.

Feed manufacturing firms are now operated under a stable condition in terms of current ratio, cash ratio, and liability ratio. The production activity of the firms has increased continuously so that this industry appears rather prosperous when compared with other industries in terms of capital turn-over and other indicators. If feed manufacturing firms are trying to improve further in their operation, it would be led to have a reduction in the cost of production mainly through improvements in their facilities.

Labor productivity has been increased through such actions as reductions in the labor force, but the value added per unit of labor remains only 31 to 39 percent of that obtained by other manufacturing industries. The proportion of the costs of raw materials to the final cost of goods manufactured is comparatively high compared with other manufacturing industries, implying that the price of feed ingredients is the main determinant of the price of assorted feed.

7.4 Prospects of Feedstuff Supply

Both population and individual incomes have increased in Korea. In order to cover the increasing demand for meat and other animal products, the government is forecasting meat consumption for the year 1991 based on the assumption that the growth rate trends in both population and real incomes continue.

The resulting forecast for 1991 estimates consumption at 793 thousand mt, an increase of 34.0% compared with 592 thousand mt for 1985. This indicates that meat consumption per capita in 1991 is going to increase by about 23.6 percent as compared with the 1985 consumption level. On average, that is an annual increase of about 3.9%.

The estimated total meat consumption is based on an expected increase in the consumption of beef from 120,000 to 172,000 mt, while pork consumption is expected to increase from 346,000 mt to 460,000 mt, and in the case of chicken, consumption is expected to climb from 126,000 mt to 161,000 mt. In terms of the total tonage of meat consumption, pork will remain the most important meat product accounting for 58.0 percent of total consumption. Accordingly, beef and chicken will account for 21.7% and 16.1%, respectively of the total meat consumption in 1991.

In order to cover this expected increase in demand for meat, the government has put forth a plan aimed at increasing the numbers of various kinds of livestock by the year 1991. This plan projects a decrease in the total number of native Korean cattle, both milk cows and beef cattle, 2,553 thousand head in 1985 to 2,094 thousand head in 1991, a decrease of 18.0 percent (Table 7-7). On the other hand, dairy cows are estimated to increase substantially in numbers from the present 390 thousand head to 683 thousand head, an increase of 1.8 times. Also, hogs, and chickens are estimated to increase at a rather rapid rate , a 57.6 percent increase for hogs and 27.6 percent increase for chickens.

Table 7-7. Government Planned Increase in Number of Livestock, 1985-91

Unit : 1,000 Head

Livestock	1985	1986	1987	1988	1989	1990	1991
Korean Cattle	2,553	2,370	2,174	2,201	2,150	2,111	2,094
Dairy cows	390	437	483	531	581	631	683
Hog	2,853	3,347	3,600	3,700	3,948	4,213	4,495
Chicken	5,108	5,610	5,803	5,789	6,025	6,283	6,516

Source: MAFF

However, the projected rate of decrease for native cattle seems to be a low estimate, as the rate of decrease may be more rapid due to importation of beef at a low price. This is the case even though native cattle remain important to Korean farming from the point of their utilization as draft animals, and given the current high proportion of native cattle as a fraction of the total number of livestock in Korea. The projected total of 2.1 million head in 1991 means only one animal per farm on average. In the course of farm mechanization, the use of native cattle for draft purposes declines, but they have the advantage of being able to feed on low quality roughage and other farm-produced feedstuff.

Because of substantial projected increase in the number of hogs and chickens, a plan to supply increased quantities feedstuff is needed, and this has been drafted by the government (Table 7-8). The estimated requirements for assorted feed are expected to increase from 7.3 million mt in 1985 to 8.8 million mt in 1991, an increase of 20.5 percent during the next six years.

Table 7-8. Supply Plan for Feedstuff, 1980-1991

Unit: 1,000 mt

	1985	1986	1987	1988	1989	1990	1991
Assorted feed							
Domestic materials	2,272	2,339	2,161	2,227	2,289	2,351	2,416
Imports	4,179	5,336	5,466	4,712	4,984	5,262	5,548
Self-sufficiency rate(%)	35	31	28	32	31	31	30
Farm produced	855	814	790	805	809	817	823
Sub-total	7,306	8,489	8,417	7,444	8,082	8,430	8,787
Roughage	5,928	5,830	6,065	6,454	6,842	7,257	7,689
Total	13,234	14,319	14,482	14,198	14,924	15,687	16,476

Source: MAFF

Farm supplied concentrated feed is estimated to remain at a steady level of 0.8 million tons since it is not possible to increase feed-grain production in the near future. In an attempt to expand roughage feed supplies, the government has launched a special program for pasture development and the production of second crops on rice paddy land by providing subsidies and institutional loans. Even in the presence of such programs, the production cannot be increased as much as planned because production costs have already increased and the farmers now have fewer economic incentives. If feed prices continue more consistently upward in tandem with the increasing numbers of dairy cows, farmers will have more incentives to produce forage crops such as rye and barley on paddy land as second crops after the rice growing season. The composition of roughage mostly rice straw in the total supply of feedstuff in 1985 was estimated at about 55.2% and will decrease to 53.3% in 1991 according to government projections. It is clear that roughage will remain an important source of animal feed.

According to government plans, feedgrain imports will increase from the 1985 figure of 4.2 million mt to 5.5 million mt in 1991, a 32.8 percent increase during six years. Planned feed imports will consist of corn, soybean, fish meal, and soybean cake among others. Corn has been the major item composing 60.0% of total imports in 1987. In comparison with the 93.5% share for corn imports in 1975, the relative importance of corn decreased substantially during the last 12 years, but the annual amount of corn imports increased about 8.4 times during the same period.

The total quantity of feed imports will constitute only about 30% of the total supply of feedstuff in 1991. However, the imported feedgrains will be the major source of assorted feed accounting for 69.7% of that total and thus it will be impossible to raise increased numbers of livestock without continued importation of feedgrains to Korea. From this point of view, the livestock industry appears risky and uncertain because domestic feed production remains quite limited and the health of the livestock industry depends on the price of feedgrains in the international market. Thus external factors may easily influence the local livestock industry and may lead to price fluctuations our a wide range in both the domestic markets for feedstuff and livestock products.

Table 16. Plan for Feedstuff Imports, 1980-1990

Unit: 1,000 mt

Year	Maize*	Soy-beans	Soybean cakes	Fish Meal	Other	Total
1980	2,145	310	77	39	10	2,581
82	2,940	412	129	50	14	3,554
84	3,740	530	180	78	21	4,548
85	4,186	590	215	93	21	5,107
86	4,540	638	232	105	21	5,535
87	5,362	735	283	96	21	6,496
88	5,597	783	305	108	21	6,813
89	6,115	848	350	120	21	7,453
90	6,629	916	367	132	21	8,065

* includes wheat and sorghum.

There needs to be a change in the system so as to provide flexibility to counteract the price changes in the international grain markets. Channels of procurement also need to be simplified so that a number of private trading firms can get involved in purchasing grain contracts only in the spot market but also in the future market. It is also necessary to diversify the imported ingredients to include other grains such as sorghum and rye. Expansion of the sources of imports in terms of exporting countries is also a desirable strategy for stabilization.

As demand for feed increases with the expansion of livestock enterprises, a stable increase in feed supplies is necessary to sustain sufficient livestock production. The government plans to support both the building of new feed plants and the expansion of existing older plants with small production capacities. As of the end of 1987, there were 80 plants nationwide with a total plant capacity of 21,815 mt per day. Taking into account the expected demand for feed, and, in particular, for concentrated formula feed, it will be necessary to increase the number of plants further by 1991.

If all the new plants go into operation as planned, total production will reach 8 million mt and will match the total projected feed demand for 1991. The achievement of such targeted production levels will require support from the government. Government support would include such programmes as the provision of long-term institutional loans, the levy is a special tariff rate on imported feedgrains, tax exemption for feed manufacture, the establishment of storage facilities in rural areas, and so on.

From a technical viewpoint, production levels must remain near plant capacity in the coming years. However, many of the smaller plants need to technical upgrading, and remodeling if they are to continue to operate current levels. Even if the feed plants produce 8 million mt in the coming years market prices may not be stable all the time because of continued reliance on imports whose prices are sometimes beyond the control of the Korean government. To achieve price stabilization in the market, it may be desirable to develop more local sources of feedstuff in addition to negotiating long term contracts with some reliable grain exporting countries.

Livestock producers may also have to exercise control over feed consumption by adopting technical improvements in the utilization of feeds at the farm level. Farmers need to adjust their feedgrains according to changes in the prices of feed. Wide dissemination of technical information on the efficiencies of production and use of proper kinds of mixed feed rations is an important device to prevent excess feed consumption.

On the supply side, excess competition to obtain larger amounts of raw materials which are allocated on the basis of production capacity will result in excessive investment in production facilities. The livestock industry will continue to rely heavily on imported feedgrains. It is difficult to expect that market improvements will lead to rate of self-sufficiency in the domestic supply of feedstuff necessary for the projected future increases in the number of livestock.

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An Economic Analysis of Livestock Production and an Investigation of Feed Requirement

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I. Introduction

The agricultural sector in Korea has affected and been affected by Korean economic growth. This relationship has produced changes at the farm level. Specifically, the farm labor force has experienced a rapid decrease. Advances in mechanical technology have speeded up the farm mechanization process; the purpose of cattle raising at the farm level has been increasingly geared toward beef production rather than draft with beef as a by product. Collectively, these characteristics plus an increasing demand for livestock products and government initiatives promoting diversified farming and cattle raising at the farm level, have made cattle raising one of the major sources of income for farm families.

However, basic information about livestock raising is presently lacking. Farmers, farm leaders, and government officials are uncertain as to exactly what production activities for livestock raising at the farm level are taking place and how much feed will be required for the future. Accordingly, there is a strong need for basic information about the livestock production related activities of Korean farmers.

1.1 Objectives of the Study

This study is designed to provide information on the animal

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production related activities of Korean farms. The objectives of the study may be summarized as follows :

1. Review the production related activities of major animals in the small farm rice economy.
2. Find the determinants of cattle raising in consideration of the rapid change in the use of cattle.
3. Investigate feed requirements in particular the appropriate forage crops for cattle raising.

1.2 Data and Analytical Procedures

All data for this study were derived from farm survey data. Farm surveys were conducted with interviews using pre-prepared questionaires at a total number of 544 livestock farms throughout Korea in 1983. A livestock farm is defined as a farm whose large animal holding is more than one head whatever its major source of agricultural income.1/

Simple and/or cross-tabulation analyses were employed to find out the general livestock production related activities at the farm level. Multiple regression analysis based on time series data was used for estimating or finding the supply function of beef in Korea. A synthetic firm budgeting method was also introduced to estimate the feed requirement in Korea.

1/ Livestock Cooperative Federation ordinance defines livestock farms as follows :

Large	: 1 head or more large animals (cattles)
Medium size	: 3 heads or more medium animals (pigs)
Small size	: 20 heads or more small animals (chickens)

1.3 Description of the Sample Farms

Because Korean farm production is typified by homestead production aimed primarily at farm family consumption, the paddy type of land cultivation predominates. The average cultivated land in sample farms was 1.82 ha which included 1.13 ha of paddy. This is much higher than the national average of 1.09 ha. This indicates that the livestock farms are, in general, large land size holding farms and that animal feed comes mainly from agricultural by products. Only 2% of sample farms owned pasture with 0.7 ha. on average.

The quality and quantity of labor input for farming in sample farms are better and larger than those of general farms. Sample farm operators, on average, had graduated from middle school. Their average age was forty-six with a low coefficient of variation. It may be anticipated that livestock farmers compose the highest farming income class in Korea. Under the agricultural transition from subsistence farming to mixed and diversified farming, successful entrepreneurial pursuits and the like are the most important means of increasing personal income. A connection with rising industries and the utilization of new technologies depend heavily upon for the degree of human capital resources.

The total farm labor input per household on the sample farms for farming was much higher than on the average Korean farms. The number of family members on the sample farms also was slightly higher than on average farms. The survey revealed that labor input was 468 days/year (average Korean farms ; about 200 days/year) and their family included 5.6 persons (national average : 4.97). These figures indicate that livestock farms require more year-long labor input particularly family labor for farming even though 60% of the sample farms had power-tillers, the principal source of power in Korea. Labor shortages affects the decreasing hired laborers and, therefore, only 13% of farm laborers were the hired labor in 1982. Combining crop and livestock production requires year-long use of family labor. It does, however, allow complementarity of labor sharing. Korean native cattle raising is the most popular business in Korea. 77% of sample farms have Korean native cattle, but, only 15% of them have dairy or beef cattles (see table 1). This may be because : (1) farmers are very familiar with Korean cattle raising and feeding : (2) Korean cattle can be fed with agricultural byproducts : (3) dairy and beef cattle raising is closely connected with the government import policy : and (4) Korean native cattle can be used for draft purposes.

Table 1. Animal holdings of sample farms

	Number of farms(%)	Average holdings(head)
Korean native cattle	77	2.3
Dairy cattle	7	16.6
Beef cattle	8	2.8
Pigs	30	5.2
Chicken	29	53.6

The sale of livestock products on the sample farms composed a large portion of farm income. This means that the livestock industry has become a major side-business on livestock farms. Livestock product sales on the sample farms accounted for 28% of farm income but on average Korean farms only accounted for 16% of agricultural gross income in 1982.

II. Animal Production Activities in Korea

Korean native cattle Cattle have been raised primarily for transport and draft power with beef as a byproduct . Korea has had a high effective demand for beef, but has consumed little of it and produced rice instead because rice production made the best use of very limited natural resources.

Now, however, cattle raising has become complementary to the business of crop farming and cattle production has become part of mixed farming enterprises since farm mechanization has been accelerated in Korea. Almost 50% of sample farms raise cattle for complementary enterprise by using crop residue. However, about 40% of them primarily raise cattle for draft purposes (Table 2).

Table 2. Purpose of cattle raising

	1st choice frequency	2nd choice frequency
Draft	39%	12%
Byproducts can be used as feeds	5	26
Increasing cow price	4	9
Reasonable calf price	5	18
Abundant roughage	1	14
Side business	46	21
Total	100	100

This situation above indicates that agricultural production has diversified and that cattle raising has become a business enterprise.

Most farmers who raise Korean native cattle currently think dairy cattle raising is the most profitable business in the livestock industry. 77% of the sample farms voted for dairy cattle, 15% and 8%,respectively, chose Korean cattle and feeder cattle, as the most profitable businesses.

However, about 65% of farmers surveyed raise Korean cattle instead of dairy cows because the Korean native cow is technically easy to raise and because home-product feed is available. Thus, it anticipated that dairy cow raising will the most popular type of raising if dairy cow raising techniques are disseminated to farm level.

Table 3. Reasons to raise Korean native cattle instead of dairy or beef cattle

	Frequency
Easier raising	38%
Home-product feed available	26.2
Easier to buy calf	25.3
Money constraint	10.5

The sources of feed for Korean cattle are changing from crop residue to purchased feed. 78% of the farms purchased formula feed and brans of rice and/or barley in 1983. On the average, for formula and brans they respectively spent about 240,000 won and 80,000 won a year .2/

2/ i$ is equivalent to about 800 won in 1983

This indicates that farms are trying to raise Korean cows as feeder cattle for business purposes. However, the cattle were actually only fed 1.32kg per day on average, although recommended amounts of daily feeding for bulls are 2-3kg for effective fattening. The shortage of arable land for cultivating hays, the poor quality of feed from the straw of high yielding rice varieties, and the acreage shrinkage in barley cultivation all point to a need to buy more commercial feeds. In addition, the surveyed data showed that all cattle were raised in traditional barns at the farm level. This indicates that cattle fattening conditions are still bad and will require further improvement in the future.

Beef price determination is very complex in consideration of the biological constraints inherent in cattle raising. Thus, government administers beef prices to promote economic development and to meet perceived welfare needs of both producers and consumers. Specifically, the Korean government controls beef prices with a maximum price ceiling. The general experience regarding beef price control in Korea has been unfavorable in terms of stimulating beef production.

Sample farms answered that the price of calf was expensive and adult cow price was chief (see table 4). The price of calf was almost 80% of the adult price in 1983. A government subsidy to 16,000 farms for cattle production in order to induce farm income source diversification. Also has to be considered, however, the price of adult cow went down about 20% compared with the previous year although beef prices were kept constant. This situation above could be partly due to marketing channel complexities.

Table 4. Evaluation of current Korean cow price

	Very cheap	Cheap	Moderate	Expensive	Very expensive
Calf	2%	3	21	46	28
Adult	7	42	31	18	2

* The reasons for above answers

	Frequency
Low beef price	18%
Lower limitation of disposal age	11
Large No. of Korean cow raising	10
Larger Korean cow raising households	10
Middlemen	26
Selling seasonality	15
Others	10

83% of sample farms sold their cows to local markets, and the rest of them sold to neighbour farms. The market channel for cattle in Korea involves movement from the production unit to a local market and then to a central market. The cattle then pass through an abattoir to a central meat market and finally to a butcher shop. Throughout the marketing channel, the middlemen-the people responsible for all the functions between the farm gate and the consumer-may be reaping undue profits from both the farmer and consumer through one or a combination of factors such as inefficiency, duplication of efforts, illegal influencing of prices, and non-competitive buying and selling practices.

Beef cattle : Beef cattle raising is a relatively recent phenomenon in Korea. The beef cattle raising experience of selected sample farms only averaged seven years. 2.2 heads were generally held initially. The government has recently emphasized raising of beef cattle as a farm business in order to meet national meat demand (Table 5). However, beef cattle raising has been limited because of difficult fattening techniques and problems of disease control.

Table 5. Importation of beef cattle

Unit : head

'70	-	'72	278	'72	1,096
'73	1,210	'74	96	'75	-
'76	-	'77	794	'78	20,000
'79	6,031	'80	14	'81	17,694
'82	30,000	Total : 77,213			

The selected beef farms purchased their cattle at 276kg of weight on average and paid about $1,500. Farms increased cattle weight by 188 kg/head annually. This increased weight was valued at approximately 664,000 Won.

The buying and selling activities of beef cattle on the selected beef farms depended mainly on the local market. Only 18% of farms purchased their beef cattle from livestock cooperatives and only 20% of them sold their cattle to central markets through livestock cooperatives. 11% of their current cattle had been home-bred. Farms indicated that they would like to keep 33% of their current cattle breeding. Local market sold cattle were heavier in weight than cattle sold through livestock cooperatives. Specifically, local market sold cattle averaged 471 kg/head in weight but cattle sold through livestock cooperatives averaged 453 kg/head.

60% of the selected beef cattle farms raised beef cattle instead of native or dairy cattle because of their faster growth and greater weight at maximum weight (see Table 6).

Table 6. Reasons to raise beef cattle instead of Korean native and dairy cattles

	1st choice frequency	2nd choice
Faster growing	50%	16%
Greater weight than Korean native at maximum weight	4	48
Loan available from livestock coop	10	12
Higher price of calf	10	7
Roughage available	3	13
Feeding available only with farm byproducts	14	4

Beef raising farms depend mainly upon formula feed for cattle fattening. 91% of the beef raising farms purchased formula feeds from shops 8 kilometers away. This feed cost approximately 425,000 Won on average for 95 packages in 1983. They purchased in cash 16 packages of formula feed at one time. This indicates that beef cattle raising is a major farm business instead of a mere side activity.

However, beef cattle were fed only 1.8 kg daily on average though 2.5-3.0 kg were recommended. Only 35% were raised in remodeled barns; 65% were still raised in traditional barns. Improvements in feed amounts and growing conditions are required for effective beef production in Korea.

Dairy cattle and milk production : The milk industry has become one of the most profitable industries in Korean agriculture. In 1982, about 22,500 farm households (1.1 percent of the total farm households) had milk cows. Two-third of them had more than 5 heads of milk cows. One-third of them raised more than 10 head of milk cows. This means that dairy farms have become specializers in milk production.

The selected farms are, in general, motivated to raise dairy cows instead of Korean or beef cows because of economic considerations. Almost half of them were raising dairy cows because they thought dairy cow raising was more profitable than other types of raising (Table 7).

Table 7. Motivation to raise dairy cows

More profitable than other animals	49%
Influenced by other farms	9
Milk marketing security	19
Holding of confinement and equipments	8
Recommendation from livestock coop. or rural extension workers	15

The dairy farms learned their dairy cow raising and milk production techniques from other dairy farms and rural extension workers. 50% of them acquired their techniques from other farms, 27% from rural extension workers and the rest from schooling or training at agriculture or livestock cooperatives.

The money market for purchasing cows is very tight in Korea. 26% of dairy farms borrowed money for buying dairy cows from livestock cooperatives and 12% borrowed money from relatives or friends (see Table 8).

Table 8. Sources of the money to buy dairy cows

	Average amount per household	Interest rate	Financial distribution
Loan from cooperatives	4 million won	9.6	33.7
Relatives or friends (private loan)	2.8 million	7	10.6
Self financed	2.7 million	-	55.7

This situation indicates that the money constraint is one of the major reasons inhibiting the expansion of the dairy cow business. The surveyed data indicated that this money constraint and a shortage of forage were the major difficulties for the dairy cattle industry in Korea (Table 9).

Table 9. Reasons making it difficult to raise dairy cattle

Higher price of adult dairy cow	17.8%
Difficulty in buying a good calf	13.3
Money constraint	22.3
Forage shortage	22.3
Higher price of feed	13.3
Milk price instability	11.0
Low profitability in dairy cattle raising	0

The feed ratio between purchased formula and home product was 65% : 35% of the total required feed amount. Home-product feed was composed of a variety of items : Wild forages accounted for 60% of this feed ;

agricultural byproducts for 20.1% ; fodder crops for 16.6% ; and forage crops for 3.3%. Those mean that milk production remains still family labor intensive and side-business purpose.

Agriculture and livestock cooperatives covered only half of the formula feed selling market. They sold 50% of total required formula feed for dairy cattle and accounted for 50% of trade at local markets. 41% of dairy farms purchased their formula feed on credit from agriculture or livestock cooperatives.

Formula feed composed a large portion of variable cost. 56.4% of variable cost for milk production was the cost of formula feed (Table 10). This implies that the dairy farms are not only concerned with milk production but also cattle age. The average age of disposal of a dairy cow was 6 years with an average weight of 679 kg. The price of the carcasses was about 2,000,000 Won.

Table 10. Ratio of variable cost for milk production

Formula concentrated feeds	56.4%
Labor	9.2
Roughage	12.2
Medical treatment	6.0
Others	16.2

Almost all raw milk produced by farms was collected and transported by the milk processing factories. Most farms received money for raw milk every other week. 90% of them received their milk-selling money every other week ; 5% received it weekly ; and 5% received it on a monthly basis.

No farm received cash immediately at the time of sale. The average distance from the farm to the milk selling place was 1.8 kilometers. Farmers sold 21 kg of milk at one on average.

If money and forage crops were available the farms surveyed desired to expand their dairy cattle to 22 head on average. Reasonable milk prices and the prices for dairy cow carcass make milk production profitable in Korea.

Hog : The hog industry has been very unstable in Korea. The price of hog products has fluctuated seasonally and/or yearly. Because the hog industry takes a relatively short time to adjust production patterns, the hog supply curves-which in effect express the relation between price and quantity produced-show relatively short-run responses. Moreover, hog raising techniques are not hard for Korean farmers.

The surveyed farms had 11 years of pig raising experience on average. They had increased their pig holdings little by little for the last four years. By 1983, they had 10 heads per farm on average. About 70% of number of their current pig holdings were homebred. The rest were purchased at local market. This indicates that the young pig market has not developed in Korea.

Hogs are generally sold at a weight less than 90 kg/heads on average. The survey data revealed that feed costs and other economic considerations were the main reasons to sell hogs before they reached 90 kg in weight (see Table 11).

The farms spent 40% of their feed cost (in value about 9,600 won) monthly for feed purchasing on average in 1983. They paid mainly in cash for hog feed. Full credit and partial credit were available from

Table 11. Reasons to sell hog before 90 kg/head

	1st choice frequency	2nd choice frequency
Economically favorable	50%	36%
Urgently need of money	29	9
Higher feed cost after 70kg	12	55
Repayment of feed credit	5	0
Repayment of debt	4	0

local markets, livestock cooperatives, and middlemen (see Table 12).

Table 12. Payment of feed for hog

	Credit	Cash	Partial credit	Total
Market	33%	53	14	100
Livestock co-op.	39	50	11	100
Middlemen	12	62	26	100

III. Resource Allocation for Cattle Production for Draft and Side-Business Purposes

The resource allocation decision may be different according to the purpose of cattle raising. A criterion for resource use for draft or side-business purposes may be developed from the value of a resource in farming. This is illustrated in figure 1. Indifference curves labeled Uo and U_1 are drawn for the choice between income and farm resource allocation. The relevant budget constraint consists of income from two sources. The curve, F, represents income from farming with draft cattle, and M is the earnings function from farming with a cattle raising business as a side activity. The marginal value of resources for farming with draft cattle (the slope F) falls as more resources are devoted to farming; while the marginal value of resources for farming with the cattle raising business is further decreasing but relatively flat and is shown by the slope of M. If cattle are raised for draft purposes equilibrium is Lo where the marginal value of resources in draft cattle raising just equals the slope of Uo. But if cattle are raised as a side business, optimal farming resource allocation is L_1, at the tangency between M and U_1. Total farming income is $ABHL_1$ in figure 1-2. A necessary and sufficient condition for this result is that the marginal earnings from farming with cattle raising as a side-business is greater than from farming with cattle raising for draft at Lo the resource allocation in draft cattle raising.

The above illustration implies that side-business cattle raising has the advantage of not only increasing income but also of greater utilization of farming resources, and therefore, beef production would expand steadily in Korea even though the number of cattle cannot be increased greatly in the future.

3.1 Endowed factors affecting cattle production

Cattle production has evolved as the result of a host of factors, some of which are stimulants while other are constraints. The production situation is not static, but changes over time in response to technological, political, and economic forces. An examination of the factors that stimulate or constrain cattle production should help us to anticipate the current condition and future situation of cattle production in Korea.

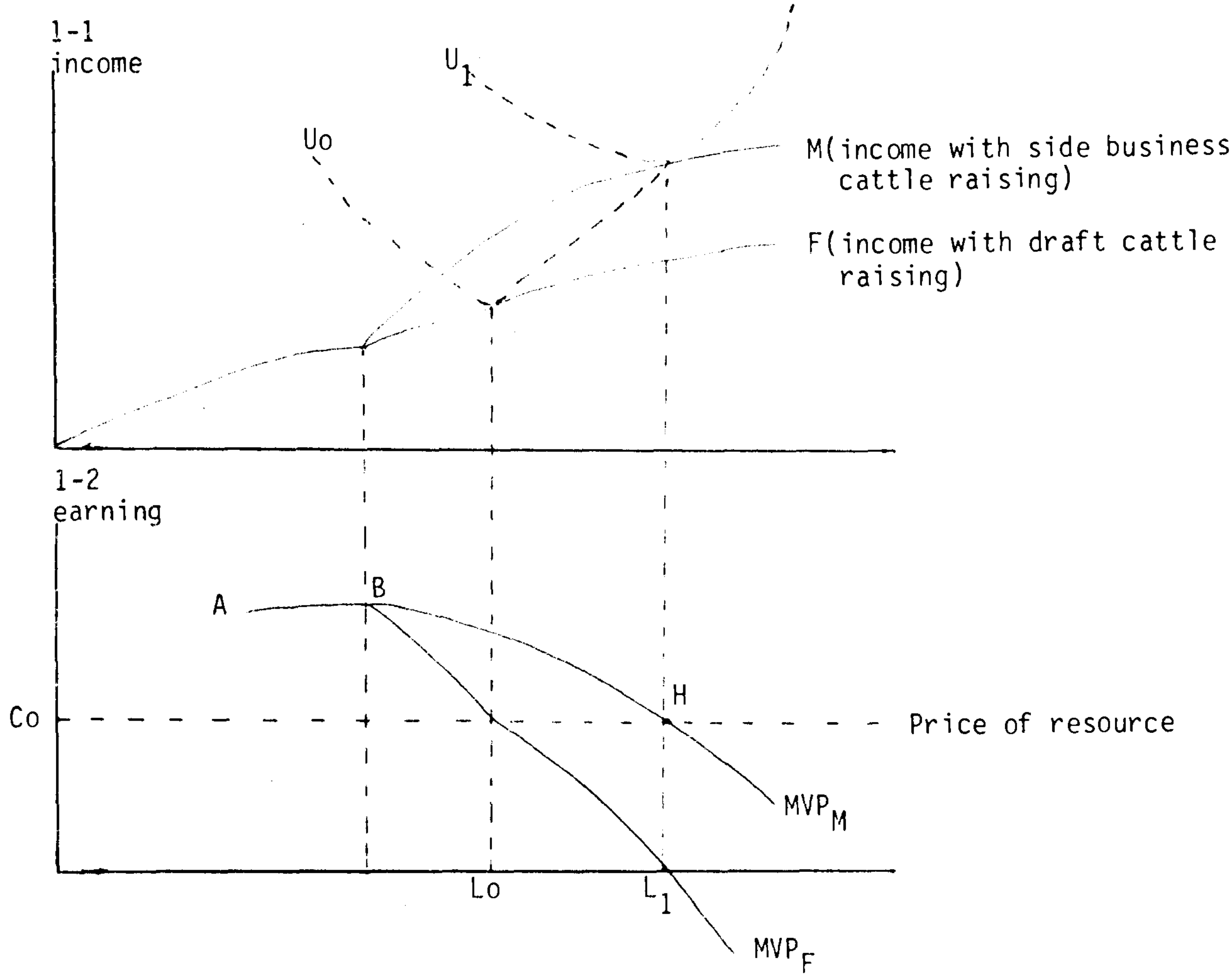

Fig. 1. Illustration of resource allocation

Land characteristics and land size act as prime determinants of cattle production in Korea. Because larger land size holdings produce larger amounts of agricultural byproducts , cattle production heavily depends on land size holdings. Furthermore, in the future, poor land will likely be used for livestock production, whereas highly fertile land will be devoted to crop production. The law of comparative advantage will strongly dictate which commodities than can be produced in certain areas in Korea in following years.

Social conditions such as population density, land resource distribution, and the availability of farm labor also strongly affect livestock production. If farmers have little alternative use for their family's labor, a higher total net return can be realized from cropping than from cattle raising. The return per hour of time invested will probably be lower from cropping than from cattle raising but the total return will be higher. Otherwise, if farmers face a labor shortage, a higher net return can be realized from cattle raising.

Production complementarity occurs in many farming areas. Combining crops and livestock has the advantage of providing a source of employment during the slack winter months. The draft-beef all-purpose cattle have proved to be excellent for complementary beef and crop farming. These livestock producers also frequently sell out before pregnancy as a means of marketing farm products and byproducts .

Location is another factor influencing cattle production. Location advantages include topographical and economical considerations which have an impact on cattle production. In some regions, cattle raising may be preferable to other regions because of superior sanitation, better transportation, and lower input costs.

The level of effective demand of livestock products is a regulator of cattle production. If demand were great and attractive prices prevailed, cattle production could be greatly expanded.

Government policies are among the most important factors influencing cattle production. The government interferes with the free market to influence cattle prices. Frequently, retail or wholesale prices of some or all cuts are fixed. While relatively high prices will lead to greater returns for cattle raisers and will likely lead to expanded output, some consumers may have to curtail their consumption. Discontent over high prices is politically disruptive, especially when trying to improve the nutritional level of the lower-income population. Government policy also affects the stability of cattle production since it may create or preclude a favorable investment climate. Cattle production requires substantial investment on which the returns may be deferred for several years because the industry is tied to the biological cycle of its product.

Human capital is another important factor affecting cattle production. Under the transition of cattle raising from draft to business purposes, successful entrepreneurial pursuits increased income. A connection with raising livestock at a large scale and the utilization of new technologies depends heavily upon human capital resources.

In this paper, only endowed factors such as land size, the operator's education and experience, the availability of family labor are examined to see whether they affect cattle production. Time and cost limitations are the main restraints against extensive reflection upon and a more intense examination of all factors mentioned above. Regression analysis is used for this study.

3.2 Stepwise Regression Analysis

In order to analyze the endowed factors affecting livestock production, a stepwise regression model was utilized. This method is very helpful in finding the factors which have the ability to explain the variability of a dependent variable. The limitation of this method is that it assumes that a single best set of independent variables exists.

IV. Analysis of Korean Native Cattle Production

Data for 390 sample farms were utilized in this analysis and the results are summarized in Table 13. The variables included in the analysis are listed as follows :

Y = yearly increased value from Korean cattle raising

X_1 = age of manager

X_2 = education level of manager

X_3 = family labor input for farming (unit : day)

X_4 = cultivated paddy field (unit : $3.3m^2$)

X_5 = cultivated upland (unit : $3.3m^2$)

X_6 = pasture area holding (unit : $3.3m^2$)

X_7 = forest area holding (unit : $3.3m^2$)

X_8 = Korean cattle raising experience (year)

The manager's education level is converted into arbitrarily graded numbers as follows :

less than elementary graduation : 1

elementary graduation : 2

middle school graduation : 3

high school graduation : 4

junior college graduation : 5

college or university graduation : 6

Table 13. Linear regression analysis of Korean cattle production

Variable	bi value	F value
X_1 (age)	879	0.00
X_2 (education level)	130,234	0.06
X_3 (family labor input)	-887	0.165
X_4 (paddy holding)	1.3	0.01
X_5 (upland holding)	-3.6	0.121
X_6 (pasture holding)	-420	0.05
X_7 (forest holding)	190	0.682
X_8 (experience)	-56,359	1.669

All analyzed variables seem to have little effect on increasing the value of Korean cattle. The results indicate that the null hypothesis that the independent variables were not related to the dependent variable was valid in all cases above. This may imply that human capital and/or farm wealth do not affect Korean cattle productivity. So, Korean farms, even livestock farms are raising Korean cattle not for business purposes but for draft or because of tradition.

V. Beef Supply Response

Theoretical specification of a supply function for cattle is the same as for any other supply function. If we abstract from uncertainty, assume that farms maximize profits like a competitive industry, and assume given fixed technological conditions of production, we may show that the output is related to prices of the product, and to the cost of variable factors of production. A simple, but frequently sufficiently complete statement of the supply equation for statistical analysis ignores other prices and relatively unimportant costs. Accordingly, an appropriate simplified linear supply equation for cattle can be written as

$$S = a + bP_{t-1} + cI_{t-1}$$

Where

S is cattle slaughter (current)

P_{t-1} is beef-feed price ratio (lagged one year), and

I_{t-1} is the number of beef cows (lagged one year)

Lagged prices are used because cattle production decisions are made prior to the marketing year and the lagged price is a reasonable and frequently employed proxy for expected price. Korea has prohibited cattle slaughter until the weight of cattle is more than 350 kilograms a head.

In reality, there are no available data for beef costs of cattle production because byproducts and/or home-made feeds have mainly been used for cattle raising in Korea. Thus, real prices of beef are employed as a proxy for the beef-feed price ratio.

The cattle slaughter or domestic beef supply series used in this study are derived from related published data. A constant price of beef based on 1980 figures is used for prices.

Results from the statistical analysis are reported in Table 14. The regressions in Table 14 are for the years 1964-1983. The beef-supply function yields the equation.

$$S = -76,994.58 + 8.739\ P_{t-1} + 69.737\ I_{t-1}$$

The price elasticity estimated from the equation was indeed very high (0.619). The effect of including trend as a variable in the analysis shows

$$S_t = -3,749,421.24 + 1.761\ P_{t-1} + 59.419\ I_{t-1} + 1,881.666\ T$$

Inclusion of the trend variable changes the magnitudes of both price and inventory coefficients, and the price elasticity. This may imply that an increase in cow inventory beyond that which is explained by prices could reflect overall increases in efficiency in beef production.

VI. Feed and Forage Land Requirements for Cattle Production

In order to approximate the feed requirement and required minimum forage grass land for cattle raising as a side business in Korea, non-parametric economic engineering analysis by the use of budgeting techniques was employed. Budgets were developed using available estimates of the optimum nutrient requirements and of hypothetically optimally converted to feeds and grass lands for cattle raising. This technique may not be designed to explain actual farm behavior nor to estimate all the possible economic advantages and disadvantages of feed consumption. This technique is appropriate to determine the

Table 14. Beef-Supply Regressions, 1964-1983

Dependent Variable	Constant	Regression Coefficient: Beef-price P_{t-1}	Regression Coefficient: Cattle inventory I_{t-1}	Trend	F value	R^2	d^b	Elasticity with respect to price
Domestic beef production (S)	-76,994.58	8,739 (5.512)	69,737 (4.920)		48.2	92	2.4*	0.619
S	-3,749,421.24	1.761 (3.466)	59.416 (4.231)	1,881.666 (2.003)	39.2	94	1.8**	0.125
S	7,557.40	12,131 (5.615)			31.5	80	1.2***	0.860
S	-6,534,122.12	-1.148		3,340.421	25.0	86	0.9***	-0.081

Note : 1. Numbers in parentheses are t-values

2. Durbin-Watson Statistic : (*) no significant serial correlation
(**) test inclusive
(***) significant at the 0.5 probability level

3. Unit : (S) M/T, (P) won/kg, (I) 1,000 heads, respectively

optimal amounts of feed and grass lands for certain amounts of cattle production, but not to determine obsolete technologies, or substandard management practices.

Assumption : To facilitate the budgeting process, the following assumptions are made for this analysis :

1. Beef of Korean cattle holdings are estimated at 1.6 million heads nationally and each beef of Korean cow respectively weighs 350 kg or 400 kg.
2. Cattle has to be fed continuously to assure an increase of 0.06 kg daily.
3. Dairy cattle holdings are estimated at 300,000 heads and each dairy cow weighs 500 kg or 600 kg.
4. Milk production is 12 kg/head daily with 3.5% fat content.
5. Productivities of forage crops are calculated to be 30 and 6 tons per hectare respectively in green and in dry at the farm level (national average).

6.1 Selected feed combinations and requirements

The nine and the seven feed combinations for feeder and dairy cattle , respectively, used as a basis for deriving feed requirements are given in Table 15. All of the feed used in this study is currently available for cattle feeding in Korea, and those combinations may include almost all the possible feed combinations available at the farm level.

Table 15. Selected feed combination

Feeder cattle	R.S + Forage crop + F
	R.S + Wild grasses (dry) + F
	R.S + Wild grasses (green) + F
	R.S + Soybean fodder + F
	R.S + Maize ensilage + F
	Wild grasses (green) + F
	Maize ensilage + F
	Corn stem + F
	Forage + F
Dairy cattle	Forage + F
	Forage + Maize (Rye) ensilage + F
	Wild grasses (green) + F
	R.S + Forage + F
	R.S + Wild grasses + F
	R.S + Maize (Rye) ensilage
	Maize ensilage + F

* R.S and F indicate Rice straw and Formula feed respectively

Feed requirements for meeting the required assumptions were derived from the Standard Livestock Feed Requirement published by the Livestock Experimental Station of the Office of Rural Development. [3] This book considers the adequate feed requirements for the balanced nutrition of cattle. The sources of feed combination and their shares

3/ Office of Rural Development, Standard Livestock Feed Requirement 1983, Suweon, Korea are modified based on current situations. An unbalanced supply of nutrients restricts cattle growth and fattening, and also possible to market of earlier due to cutting off growing period.

Table 16. Required daily feed of the selected feed combinations to increase 0.6 kg/head/day feeder cattle weight to a weight of 350 or 400 kg

Unit : kg

Feed combination	Daily feed requirement		
	A	B	C
R.S (A) + Forage(B) + F(C)	2.6 (2.3)	2.6 (2.3)	3.9 (3.9)
R.S + Wild grasses(day) + F	3.6 (2.9)	0.9 (0.7)	3.9 (5.1)
R.S + Wild grasses(green) + F	1.0 (0.9)	11.7 (10.0)	3.1 (4.2)
R.S + Soybean fodder + F	3.6 (2.9)	0.9 (0.7)	3.9 (5.1)
R.S + Maize(Rye) ensilage + F	1.0 (0.9)	16.9 (14.4)	2.3 (3.5)
Wild grasses(green)(B) + F(C)	-	14.6 (12.5)	2.8 (4.0)
Corn stem (B) + F(C)	-	4.5 (3.6)	3.6 (4.8)
Maize ensilage(B) + F(C)	-	21.0 (18.0)	1.9 (3.1)
Forage(B) + F(C)	-	5.2 (4.5)	1.9 (3.0)

* ( ) indicates the required daily feed for a weight of 400 kg.

Table 17. Required daily feed of selected feed combinations for producing 12 kg of milk per head with 3.5% fat content for a dairy cow with a weight of 500 or 600 kg.

Unit : kg

Feed combination	Required daily feed		
	A	B	C
Forage(A) + F(C)	7	-	6.9 (7.7)
Forage(A) + Maize ensilage(B) + F(C)	7	10	4.4 (5.3)
Wild grasses(B) +F(C)	-	30	4.7 (5.4)
R.S(A) + Forage(B) + F(C)	5	20	6.1 (6.9)
R.S + Wild grasses + F	4	20	5.4 (5.9)
R.S + Maize(Rye) ensilage + F	5	10	7.4 (7.8)
Maize(Rye) ensilage(B) + F(C)	-	25	6.7 (7.1)

* ( ) indicates required daily feeds 600 kg of dairy cow

6.2 Allocation of feed combinations at the farm level

Feed combinations at the farm level are derived from the basis of the desired feed combinations using a farm's available feed resources such as rice straw. Dairy cattle are classified by regions(3). Reasonable feed combinations are predicted according to regional feed resources. The allocation ratio of feed combinations is given in Tables 17 and 19.

6.3 Feed Requirements and Required forage lands from Budgeting Results

Feed requirements for cattle raising : The feed requirements for 1.6 million head of feeder cattle and for 300,000 head of dairy cattle from budgeting results is in Tables 18 and 20. Feed requirements by the selected feed combinations is presented in Tables 19 and 21.

Table 18. Yearly feed requirement for 1.6 million head of feeder cattle

Unit : 1,000 M/T

Items	Feed requirement	
	To maintain 350kg	400kg
Rice straw	1,360	1,163
Forage crops	850	750
Wild grasses (dry)	105	81
Wild grasses (green)	853	740
Soybean fodder	26	30
Maize (Rye) ensilage	541	462
Corn stem	131	105
Formula feed	1,830	2,465

Table 19. Yearly feed requirement by the selected feed combinations

Unit : 1,000 M/T

Feed combination	Allocation ratio	Requirements		
		A	B	C
R.S(A) + Forage(B) + F(C)	50%	759 (692)	750 (672)	847 (1,139)
R.S + Wild grasses(dry) + F	20	420 (339)	105 (82)	456 (596)
R.S + Wild grasses(green) + F	10	58 (53)	683 (584)	181 (245)
R.S + Soybean fodder + F	5	105 (85)	26 (20)	114 (149)
Wild grasses(green) (B) + F(C)	2	-	171 (146)	33 (47)
Corn stem(B) + F(C)	5	-	131 (105)	105 (140)
Maize(Rye) ensilage(B) + F(C)	2	-	245 (210)	22 (36)
Forage(B) + F(C)	3	-	91 (79)	33 (53)

* 1. ( ) indicates the required yearly feeds of 400kg of feeder cattle weight.

2. allocation ratio is modified from current regional feed resources.

Table 20. Yearly feed requirement for 300,000 heads of dairy cattle

Unit: 1,000 M/T

Rice straw : 399, Forage : 849, Maize(Rye) ensilage : 657

Wild grasses : 296, Formula feed for 500 kg of weight : 727

Formula feed for 600 kg of weight : 808

Table 21. Yearly feed requirement by the selected feed combinations

Unit : 1,000 M/T

Feed combination	Allocation ratio	Requirement		
		A	B	C
<u>Mountainous area</u>				
Forage(A) + F(C)	5%	38	-	38 (42)
Forage(A) + maize(Rye) ensilage(B) + F(C)	20	153	219	96 (116)
Wild grasses(A) + F(C)	5	164	-	26 (30)
<u>Hillside</u>				
R.S(A) + Forage(B) + F(C)	30	164	657	233 (260)
R.S + Wild grasses + F	6	26	131	35 (39)
R.S + Maize(Rye) ensilage + F	10	55	110	81 (86)
Maize(Rye) ensilage(A) + F(C)	4	110	-	29 (31)
<u>Plains</u>				
R.S + Rye(italian ensilage + F)	20	153	219	188 (206)

* ( ) indicates yearly feed requirement on 600 kg of dairy cattle.

Collectively, yearly feed requirements for cattle raising in Korea may be summarized as follows :

Rice straw	:	1,759,000 M/T
Forage crops	:	1,699,000
Wild grasses	:	1,254,000
Soybean fodder	:	26,000
Maize(Rye) ensilage	:	1,198,000
Corn stem	:	131,000
Formula feed	:	3,273,000
Total	:	9,340,000 M/T

6.4 Required forage grass land

Based on the above assumptions Korea would need a minimum of 170,000 hectares of grass lands in order to produce the required forage crops to raise 1.6 million head of feeder and 300,000 heads of dairy cattle

This calculation assumed that the forage crops could be used in the green stage for 6 months and then used as hay for the remaining months of the year.

Korea has about 2.8 million hectares of forest area which have slope gradients of less than 30^{o}. About 1.1 million hectares (40%) may be available for forage crop cultivation. By 1983, Korea had developed only 66,000 hectares, and planned to develop 10,000 hectares more as pasture lands in 1984. However, about 100,000 more hectares of forest lands or hillside slopes need to be developed as pasture land in the near future in order to meet the projected demand for forage crops for cattle raising.

VII. Provision for Livestock Production

Livestock farms in Korea would like to expand Korean native cattle production to increase their income. 84% of the sample farms reported that the livestock industry was the most profitable industry in agriculture. However, 53% of them showed a preference for Korean native cattle raising for its high income earning potential and 61% would like to expand Korean cattle raising in the near future (see Table 22). These results imply that Korean native cattle may be easier technologically to raise than other cattle. But, according to farmers money and labor constraints restrict their expansion in Korea (Table 23).

Table 22. Reaction of livestock raisings

Items	Anticipated higher income	Profitability	Expansion plan
Korean native	53%	27%	61%
Dairy cattle	10	57	17
Beef cattle	5	8	12
Pig raising	8	4	8
Crop production	24	4	2

Korean cattle fattening and milk production industries will steadily grow even though farms currently face some constraints.

Table 23. Constraints on livestock expansion

Money constraint	50%
Labor constraint	18
Less profitable because of higher feed costs	13
Lower price of livestock products	6
Byproduct constraint	3
Risk of cattle raising (price and diseases)	10

VIII. Summary and Conclusion

The structure of Korean agriculture has dramatically changed during the last two decades. Because of the relatively low income-earning potential in agriculture, and the expanded opportunities for non-agricultural pursuits, labor has shifted from the agricultural sector. This trasition has caused a labor shortage within agriculture as a result of a sharp decline in the number of farm household members as well as a considerable decrease in the agricultural population. This labor shortage has promoted increases in agricultural wage rates and has increased dependency on the supplementary labor force composed of old people and women. The labor shortage and the rapid increases in farm wages have inevitably accelerated government initiatives toward the mechanization of agricultural production. The farm mechanization has helped change cattle raising purposes from primarily draft with meat as a by-product to primarily meat production.

This study was designed to provide basic information about livestock production related questions in Korean agriculture. A total number of 544 livestock farms was surveyed throughout the country in 1983. The sample farms have, in general, relatively larger land size holdings and higher quality human capital resources than on the average.

The survey data indicate that Korean native cattle are the most popular livestock on Korean farms because their raising requires relatively familiar and easy technology. However, most farms even livestock farms raise cattle with traditional feeding and raising methods. This may be because many farming resources particularly management are not devoted to cattle raising. After all, income from cattle raising still composes only a small part of a farmer's total income. The enlargement of cattle holdings on family farms may be utilized for inducing the balanced nutrients supply and the reasonable and effective fattening of the cattle, and therefore, the increase of farmer's management allocation to the cattle is required.

Price supports rather than production subsidies for cattle raised by family farms may be effective policy to assure an adequate number of cattle. Korean experience in 1983 indicates that the subsidy for the calf purchasing resulted in unreasonably high calf prices and as a consequence made the cattle raising industry unprofitable. Price supports for cattle production should stimulate increasing cattle production and the devotion greater management inputs to cattle raising. Not only Korean cattle but also imported beef cattle have extremely serious management problems. In fact, almost all imported cattle raised by family farms could not develop because of the traditional raising method used. The imported beef cattle did not grow fast or well enough enough on the family farms. The purpose of beef cattle importation, however, is to introduce qualified and faster growing cattle to Korean farms in order to meet increasing meat demand. In 1983 Korea imported 67,706 heads of beef cattle and they were disseminated in lots of one or two to selected farms. Moreover, external capital constraints, biological stresses in particular the summer wilting problem of forage crops, and marginal land usages for cattle raisings are critical limiting factors militating against the expansion of cattle holdings at the farm level in Korea.

Improving marketing channels may be effective in promoting cattle raising. In recent times, the price of meat did not go down even though the price of adult cattle dropped considerably. However, it must be noted that feed supply channels are relatively well organized by the private sector.

Agricultural by-products have been the main source of cattle feed in Korea. However, many livestock farms purchase formula feed and/or brans of rice and barley from market. This may be because of decreasing barley cultivation and the difficult in use as cattle feed of straw from the high yielding Indica/Japonica rice variety. About 50% of paddy fields have been cultivated in the high-yielding Indica/Japonica rice variety in Korea since the mid-1970s.

The milk production industry has become one of the most profitable industries in Korean agriculture. Most of the dairy cattle raising farms concentrate their farming activity on dairy cattle raising. Many farms have more than 5 head of milk cows. This indicates that milk production will be grow fast at the farm level if technological and monetary constraints are solved. If this occurs, increased production of milk in future can be anticipated. A milk program for rural school children may be effective in mountainous areas. This program will not only stimulate the spreading of the dairy industry but also improve rural health.

Dairy farms primarily use formula feed for feeding dairy cows. This results in the shortening of the time of selling dairy cows although milk production per head is higher in the short-run. Dairy cattle require a certain amount of roughage for balanced nutrition for effective long-run milk production and for expending time of milk produce. In view of this, dairy farmers have improved their management ability and economic knowledge concerning cattle raising.

The endowed factors did not affect livestock production in Korea. The results show that livestock raising in Korea still depends mainly on traditional raising and feeding methods, despite the relatively high human capital involved.

The results of the supply analysis from the time series data domestic beef production indicated that the lagged real prices and inventory changes affected a high fit of the equation (R^2 = 92) and the trend variable improved little the fit (R^2 = 94) of the equation. However, the trend variable has a much higher coefficient than the other variables. From Korean farmers reaction and response, this indicates that beef production is the growing industry. The elasticities with respect to real price show 0.619 and 0.125 with the trend variable. These indicate also that farmers respond sharply to real beef prices and anticipated beef prices.

Budgeting analysis indicate that Korea needs at least 170,000 hectares more of cultivated forage grass in order to meet forage requirements for balanced cattle nutrition. This implies that the government should develop about 100,000 hectares of forage grass land on hillside slopes in the near future. Because of soil erosion, a cultivation method for hillside slopes for such forage grasses should be established.

VIII Local Livestock Markets

Byung-Chan Cho*

By law, livestock markets can only be established by local governments. The Law on Livestock Cooperatives stipulates that livestock markets are managed by the livestock cooperatives under the supervision of the province and county administrative offices. In principle, all kinds of livestock including cattle, horses, swine, sheep, rabbits and poultry are brought to the livestock market for sale.

8.1 Distribution of Livestock Markets

In 1987, there were 314 livestock markets while livestock cooperatives in counties numbered 158, which means that each cooperative ran and managed about two livestock markets on the average. The expenses of operation of such livestock markets is covered by a commission imposed on livestock transactions.

From ancient times in Korea, livestock markets have been held every five days at specific places in rural areas. These five-day markets are held at the sub-county or township levels. Generally speaking, one large township market and the surrounding four smaller township markets make up the 5-day cycle, each market occurring on a different day.

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On these market days, rural people throng to market to sell their farm products which include not only livestock but also various grains, vegetables etc. or to purchase daily needs. Selling of raised livestock or the purchase of calves and piglets are made at these markets. This has been a very convenient system for those farm households having something to sell or buy. The rural markets were also places where up-to-date market information was available on various items.

In olden times, when roads were not developed and transportation was limited, there were a very large number of such rural markets of various sizes across the country because of the need for villagers to be as close to such markets as possible. As shown in Table 8-1, there were 667 such markets across the country in 1964.

Table 8-1. The Distribution of Livestock Markets by Province and by Year

	1964	1974	'80	'85	'87
Seoul	1	1	-	-	-
Kyung-gi	67	56	40	30	30
Kangwon	65	50	38	24	22
Chung-nam	50	49	47	27	27
Chung-buk	51	50	41	31	27
Jeun-buk	45	43	34	24	24
Jeun-nam	79	67	52	37	39
Kyung-buk	162	130	109	81	74
Kyung-nam	131	110	88	68	67
Jae-ju	15	15	14	4	4
All	667	571	463	326	314

Source : National Livestock Cooperative Federation

Later, however, as urbanization progressed, rural markets served as collection points for the shipment of livestock by truck to cities. This need meant that the area covered by ~~a~~ the market needed to be larger than before, because an adequate number of animals had to be collected to ensure efficient use of transportation services. Consequently, the number of such markets has been gradually reduced to 314 by 1987.

Although many rural markets, have been consolidated and farmers have fewer difficulties in marketing their products to distant urban markets, 170 markets or 54.1 percent of a total of 314 livestock markets were still small in size and handled less than 3,000 head of cattle per year. In these small markets on average, only about 40 head of cattle were transacted each market day.

Table 8-2. Number and Size of Cattle Markets in 1987

Total Number of Cattle Marketed	Total Number of Markets	Percent
Less than 3,000	170	54.1
3,000 to 6,000	64	20.4
6,000 to 10,000	33	10.5
More than 15,000	47	15.0
Total	314	100.0

Source: NCLF

By contrast, in 1987, only 15 percent of the total markets handled more than 150 heads per day of operation. In short, the size of cattle market in terms of total transaction, was very small.

Since markets should have adequate marketing facilities necessary for increased transactions, there should be an increase in the volume of goods handled at the consolidated markets, if they are to be used effectively. Therefore, it seems desirable that further consolidation of rural markets continues and that the remaining markets grow larger in size in the future.

Most of the actual transactions in these markets concern cattle. Hogs and other animals usually are traded outside the market at the farm gate or next to the livestock market in order to avoid the fee for using the market place.

When cattle were used for draft purposes in farming, the distribution of cattle was commensurate with the distribution of farm households because a single cow or ox was enough for two farm households on the average. When such cattle grew old, they were sold off and calves were purchased. In this case, farmers involved in transactions both cattle sale and purchase a calf at market.

Lately, the introduction of farm machines that replace draft cattle has reduced the need to raise cattle for farming. So, in as much as farm households today may have different motives for raising cattle --- much cattle is raised for beef production and some farmers with small operations still use draft animals--- there are some regional differences in the number of cattle raised.

Specifically, more cattle are raised in areas where wild grasses are easily available, where there are large dry fields on sloping lands, and where there are many smaller sized farms. If this distribution is taken into consideration, it is only natural to conclude that the demand for livestock marketing services will differ by location. But, the general trend will be that the number of livestock markets will continue to decline due to the following reasons in the foreseeable future.

When the livestock cooperatives function as effective organizations, further strengthening the livestock marketing infrastructure, farmers will be able to directly deliver their livestock to local co-ops and then the coops deliver cattle to the slaughterhouses of cooperatives in cities. In this case, it will not be necessary for farmers to go to market to sell their livestock. In addition, it also is possible that meat processing plants in urban areas will send their purchasing agents to farm villages to procure cattle and then make their own shipping arrangements to their plants in order to secure raw materials at lower costs.

Given this possibilty, the number of livestock markets would be reduced substantially in rural areas. An optional number of markets, would be retained based on sufficient volumes of transactions that would cover operation costs of the market. This would necessitate reorganization of the existing small-scale livestock markets.

8.2 The Facilities of Livestock Markets

In accordance with the Livestock Market Law, every livestock market must be equipped with an office room, fenced grounds, adequate pest control equipment, a water-supply system, a dung and rubbish treatment lot, and scales. Our survey, however, showed that a large number of livestock markets in the local areas were not equipped as required by law.

Generally speaking, most of the local markets are not well equipped with modern facilities, only a small office room, some small and large scales, and simple holding facilities for animals that allow transactions to take place. Much has to be done to improve the facilities of livestock markets, connecting goods, and location of markets.

A survey on the use of scales for different types of livestock marketing was made. The survey indicated that beef and dairy cattle transactions involved the use of scales more frequently than transactions involving draft animals. Weighing of native cattle is not very common at the local livestock market. Only a low percentage seems to be weighed.

The relatively small number of scales in use may be explained by the fact that farmers are not accustomed to using them for transactions. buy cattle in order to use them as draft animals. Farmers pay more attention to the cattle's farm work capability rather than weight. Therefore, the price per head is determined by shape, eating habits, power capacity, age, and weight. In this transaction, accurate weight measurements seem less important to farmers causing a decrease in the use of scales.

However, whenever cattle are purchased for slaughtering, the buyers are heavily concerned with the weight of the animal rather than other outward physical characteristics since heavier cattle yield a higher percentage of meat carcass. Thus, the buyers like to rely on the weight measurement by scale. This shows that buyers and users use different criteria for judging the economic value of cattle.

8.3 The Volume of Transactions

During 1987, 1,838 thousand head of cattle and 169 thousand hogs were brought to the livestock markets as shown in Table 8-3.

Table 8-3, Annual Number of Cattle and Hogs Brought to and Sold at All Livestock Markets

Year	Cattle			Hogs		
	Brought to Market	Sold at Market	%	Brought to Market	Sold at Market	%
	......(000)			......(000).........		
1970	2,224	1,289	58.0	663	475	71.6
72	2,423	1,500	61.9	894	643	72.0
80	2,478	1,750	70.6	407	266	65.4
81	2,072	1,566	75.6	347	252	72.7
82	2,067	1,540	74.5	381	269	70.5
83	1,846	1,333	72.2	400	267	66.7
84	2,022	1,519	75.1	314	213	67.8
85	2,074	1,559	75.2	216	154	71.1
86	2,235	1,669	74.7	172	126	73.2
87	1,838	1,422	77.7	169	128	75.7

Source: MAFF

The data on cattle marketed by year indicates no clear trend, as the number of cattle brought to market fluctuated greatly by year, and also varied by province. As a general trend, the total number of cattle and hogs brought to market tended to decrease year after year. Considering that the number of cattle and hogs raised by farmers is increasing, the existing livestock markets are not fully utilized for marketing these products and appear to be less attractive for farmers because they must bring livestock to market by themselves.

As a matter of fact, the number of cattle and hogs driven to market per market day is not very large. In addition, all cattle driven to market are not always sold due to unsuccessful price negotiatons between sellers and buyers. In 1987, the rate of cattle transactions was about 77.2 percent out of all cattle brought to market and 75.7 percent of the hogs were sold. The hog transactions at market are small compared to cattle transactions.

Cattle transactions at the markets have a seasonal pattern due mainly to the farming cycle, since native cattle are still used on the farm as draft animals. Many farmers like to sell off these cattle after cultivation in the summer. Farmers then buy a calf again in the spring. As shown in Table 8-4, the largest numbers of cattle were marketed in September.

The monthly fluctuations in cattle transactions are closely related to the labor requirements of general crop farming. Farmers must keep draft cattle from just before spring seed sowing until right after the season of peak labor. During the peak labor season, some livestock markets in the farm areas are not open due to the short supply of cattle for marketing at this time.

Table 8-4. Number of Cattle Transactions by Month, 1987

Unit: Head

Month	Head of Cattle Marketed		Head of Transactions		Percent
	Total(A)	Percent	Total(B)	Percent	B/A
Jan	153,630	8.3	116,647	8.2	75.9
Feb	137,357	7.5	105,218	7.4	76.6
Mar	161,185	8.8	125,212	8.8	77.7
Apr	159,450	8.7	122,170	8.6	76.6
May	124,731	6.8	95,123	6.7	76.3
June	135,178	7.3	103,184	7.3	76.3
July	143,817	7.8	109,489	7.7	76.1
Aug	165,284	9.0	126,149	8.9	76.3
Sept	192,280	10.5	149,461	10.5	77.7
Oct	135,890	7.4	105,853	7.5	77.9
Nov	158,205	8.6	122,693	8.7	77.6
Dec	171,702	9.3	137,936	9.7	80.3
Total	1,838,055	100.0	1,418,636	100.0	77.2

Source : NLCA

The survey also showed that the number of cattle purchased at livestock markets increased as the number of cattle brought to the markets increased. In the case of Cheju Province, the total number of head sold at the market was larger than the number marketed by local farmers. This meant that much of the market supply was shipped from other provinces. However, in terms of market surplus, the transaction percentages show no significant correlation.

As for the method of hog transactions, only 2 percent of all livestock slaughtered in the year was sold at the local livestock market. The remaining 98 percent of transactions were made conventionally, sold at the farm gate without being brought into the markets.

8.4 Service Charges for Middlemen

Since most cattle are sold based on the value judged by physical appearance, it is necessary to have a third party mediate the terms of the trade between the seller and the buyer. The third party must be a well-experienced and impartial person. The livestock market law stipulates that cattle sales may be made with the help of a commission man who is licensed by local authorities. On average, there were approximately 13 brokers at a livestock market.

In order to cover the operation costs and to maintain the facilities of livestock markets, several methods have been devised to facilitate the collection of charges. One is called an entry fee and is based on kinds and age of livestock and amounts to 300 won per head of cattle. Another fee is collected whenever transactions are made between buyers and sellers at the market. The livestock market authorities such as county government officials, livestock cooperative staff members and managers of privately established markets are allowed to charge a legally-fixed fee from the buyer of livestock.

As an illustration of these fees, a charge is levied based on the weight and kind of animal. As shown in Table 8-5, if the live animal weighs less than 220 kg, the fee is 2,500 won. For cattle weighing over 380 kg, a fee of as much as 6,000 won might be required. For the middle group, weighing 220-380 kg, a fee of 4,500 won pêr transaction is levied.

Table 8-5. Basis for Transaction Fee at Livestock Market, 1987

Kind of Livestock	Body weight (Kg)	Charge per Head (Won)
Korean Native Cattle	Less than 220	2,500
	220 to 380	4,500
	More than 380	6,000
Dairy Cattle	Calf	10,000
	Milking Cow	20,000
Hog	Piglet	250
	Hog	650

Source: NLCA

For each transaction one authorized commission agent is usually involved to assist in price negotiations between buyer and seller. In return for his efforts in consummating a transaction, he is allowed to collect a legally-fixed proportion amounting to 30 percent of the fee collected from the transaction by the market authority. As a matter of fact, his return from each transaction is rather small in view of the time he spends trying to arrange the transaction. In general, the commission agents are most likely engaged in the transaction process at the market as a part-time business as the income from the market at the official rate cannot meet subsistance requirements.

The survey showed that a considerable number of cattle were sold at the farm gate to assemblers, who visit individual farms. In this case, the assembler offers a certain price to the farmer; if a farmer finds the price acceptable a trade would take place. The trading partners bear several considerations in mind. For example, the farmer does not have to drive the cattle to market himself. He also will not have to pay entrance or transaction fees at the market. The fees for cattle transactions, however, are not high. In fact, the go-betweens have difficulty making ends meet without making several transactions per day at different markets.

Some go-betweens buy cattle directly from farmers at the farm gate, and sell cattle at the market a number of days later in order to increase their margin. This type of commissionman functions as a merchant or assembler and a jobber as well.

After payment of the commission fee based on the charge levied at livestock market, the remaing 70 percent is put into a special account covering market operation costs including salary for the manager and other workers, utility charges.

installment of additional facilities, renovation or maintain costs, and the like. As shown in Table 8-6, the total amount collected from all livestock markets was about 5,746 million won at the end of 1987.

Table 8-6. Transaction Fee Collected by Livestock Market Authorities

Unit: Million Won

Year	Cattle		Hog	
	Total Amount Collected	Average Fee per Head	Total Amount Collected	Average Fee per Head
1970	692	537	15	31
75	1,811	985	25	49
80	5,956	3,403	61	228
81	5,315	3,395	58	230
82	6,543	4,249	76	283
83	5,408	4,057	75	280
84	5,879	3,870	63	294
85	6,046	3,877	47	304
86	6,501	3,895	39	309
87	5,706	4,014	40	312

Source: NLCF

At present, the amount levied for transactions of hogs traded at all livestock markets is small compared that to that levied for cattle transactions, so hogs provide negligible market revenue. As a consequence, the amount levied in transaction fees is insufficient to pay for the operation of markets in many places. Further aggravating the revenue problem is the fact that the number of cattle marketed in local small-sized markets is declining relative to the number of hogs marketed. In addition, the percentage of transaction per number of cattle and hogs marketed still remains at the 70 percent level.

As a matter of fact, there is no possibility to improve marketing facilities through the fees collected for livestock transactions at intermediate marketing stages. Bearing this in mind, it is desirable that supporting programs be activated by local authorities, including the merger of small, inefficient market units and the authorization of commission fees to improve market facilities.

This means that the livestock markets in Korea still retain many of the old habitual methods or practices of transactions, and thus there is a considerable amount of room for unfair transactions by dealers in the marketing of livestock as live animals.

8.5 Marketing Channels for Cattle and Hogs

Knowledge of the channels through which live cattle and hogs are assembled in rural areas and shipped to the slaughterhouses in the consuming cities and the channels through which meat is distributed to end users is important. This knowledge is necessary as a basis for the improvement of the marketing system and the reduction of marketing costs.

Recently, the tonnage of live animals shipped has greatly increased, but marketing facilities in both the central consuming cities and the local assembling areas have not been expanded to keep up with the increase in the amount of trade. Although there are numerous small dealers who handle the marketing of cattle and hogs, only recently has an organizational structure emerged under pressures of an increased volume of transactions. It seems that there are numerous inefficiencies, structural weaknesses, and unfair trade practices-inherent in the system. So it is important to compare available channels with proposed improvements.

Whether crop producing farmers or specialized farming enterprises raise livestock, the available production resources should be reasonably distributed. The method of livestock marketing cattle also directly affects the incomes of farm households.

In the conventional marketing channels, there are too many stages. The assembly of cattle and hogs in production areas can be classified into three methods: - marketing by both livestock and agricultural cooperatives, assembly by livestock dealers, and direct shipment by producers.

When native Korean cattle reach a weight of over 350 kg, farmers think of selling the animal. As shown in Table 8-7, 38.7 percent of the total cattle sold at market weighed less than 400 kg. Native Korean cattle have a relatively smaller body weight and weight gain is slower than beef cattle, nevertheless, the government recommends sale at the weight of 450 kg.

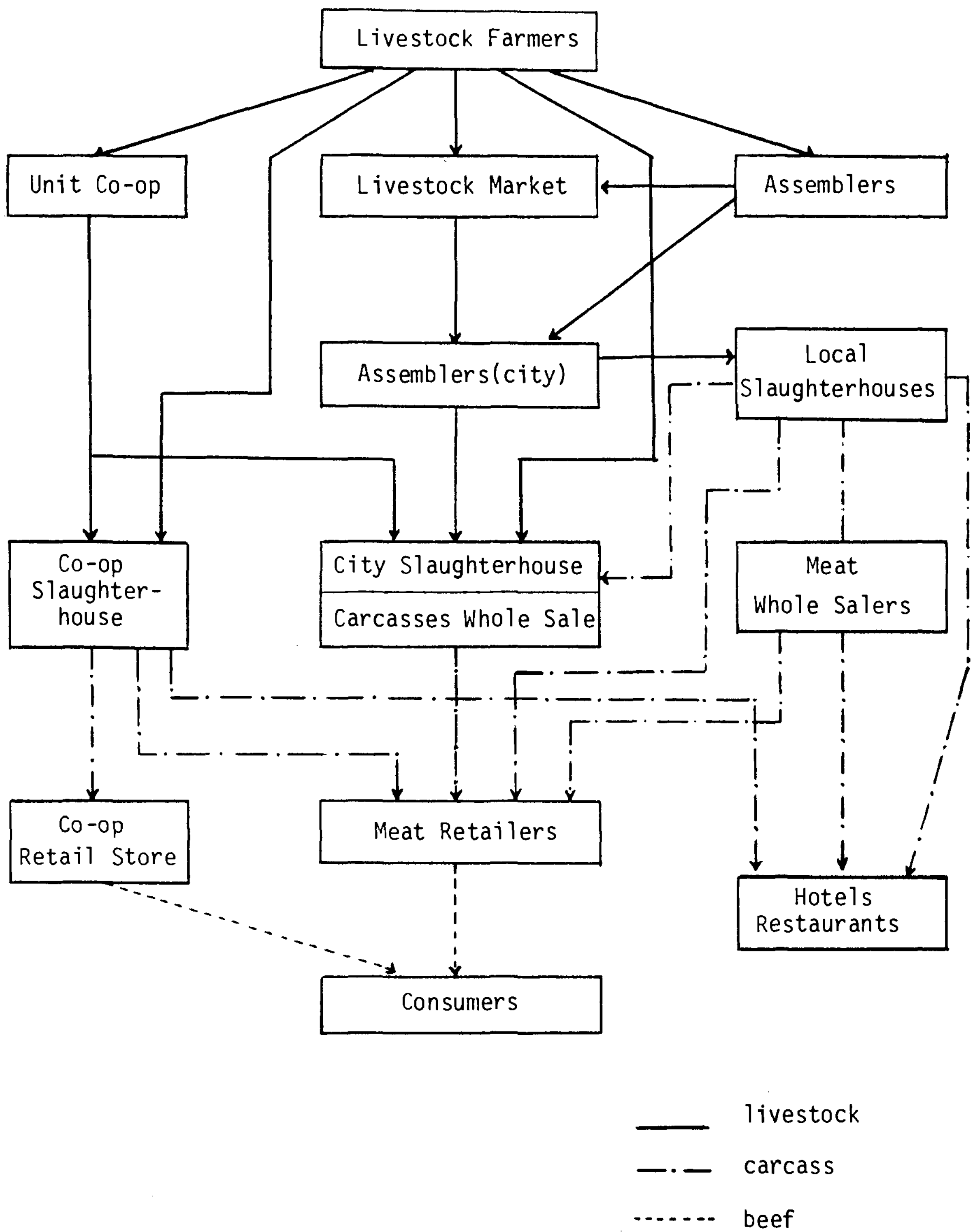
Table 8-7. Cattle Weights Sold at Wholesale Meat Market in Seoul, 1987

Live Body Weight (Kg)	Carcass Weight (Kg)	Auctioned Volume (Head)	Percent
Less than 400	Less than 200	81,970	38.7
400-449	200-224	30,288	14.3
450-499	225-249	37,278	17.6
500-549	250-274	31,135	14.7
Over 550	Over 275	31,134	14.7
Total		211,805	100.0

Practically, however, 53.0 percent of the total number sold was marketed at the weight of less than 450 kg. If farmers were to market cattle after fattening up to the recommended weight, this would increase carcass weight by 24 kg per head on average, and this would eventually yield about 12,785 mt, if we assume that 53.0 percent of the total cattle were slaughtered in 1987. This means that the increased weight for slaughtering brings the same effect as producing about 57,000 heads weighing 450 kg per head. If we conclude, that a shortage of beef will be experienced in the near future, then it seems worthwhile to increase cattle weight before slaughtering.

At the local markets, farmers sell cattle or calves to other farmers, local assemblers, or dealers. The cattle purchased by the local assemblers in farm areas are then re-sold to farmers or other large assemblers at a later time in the same market or at nearby markets. As shown in Figure 8-1, the assemblers then ship the livestock to consuming cities where slaughterhouses process them into carcass form. In addition, livestock cooperatives involved in marketing ship animals from farm areas to the slaughterhouses in consuming areas.

Figure 8-1. Marketing Channels of Cattle



4.2 Hogs

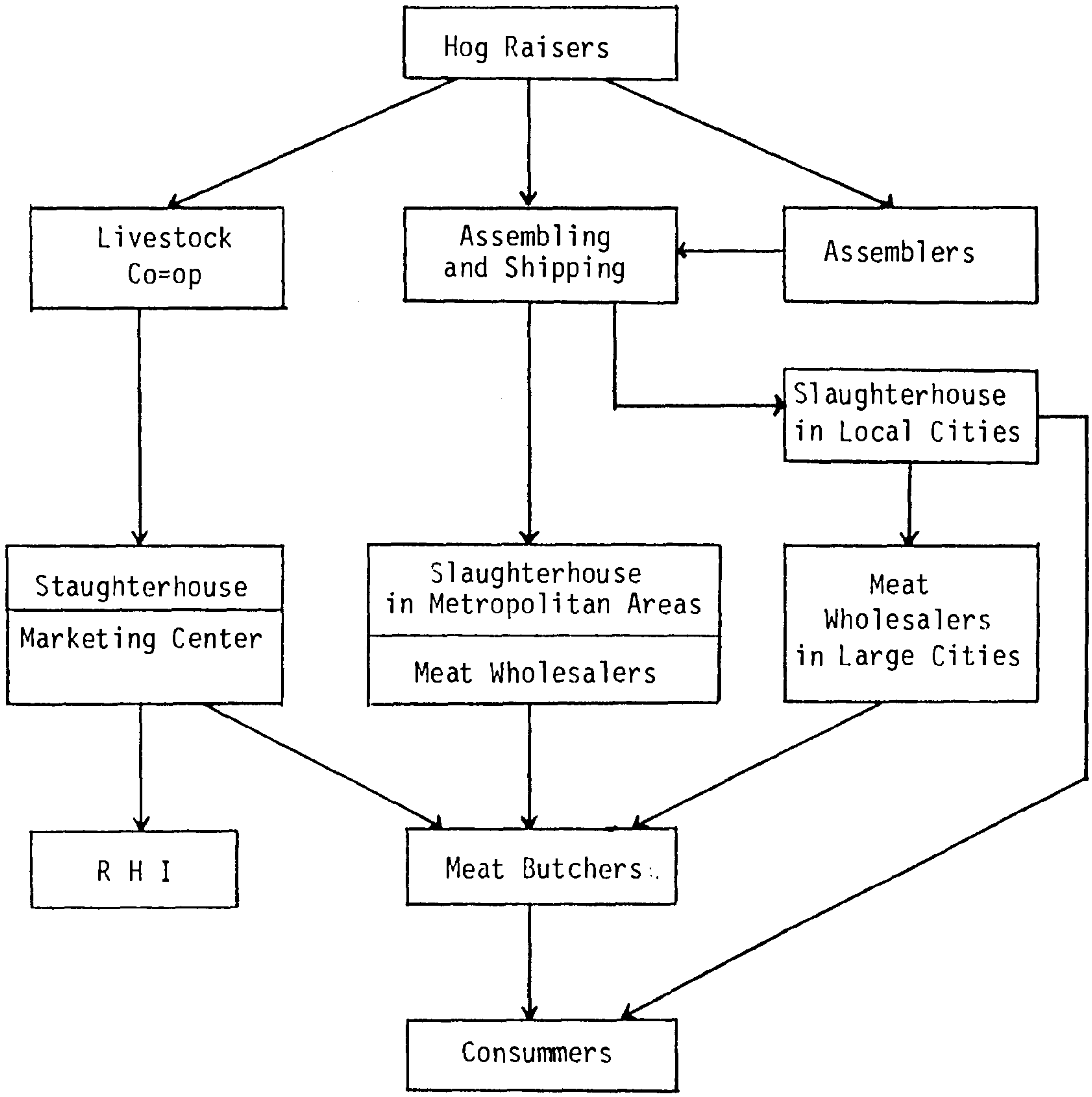
Marketing channels for hogs are very similar to those for cattle in terms of marketing stages and agents involved, but differences are found in the relative importance of different marketing channels. Traditional farms raise just one or two head of cattle or hogs as a side-line business to supplement their cropping enterprises, and thus they often market only one or two hogs or several piglets per year.

Recently, some commercial enterprises have been raising a large number of hogs. These type of firms reap benefits from mass transactions entered into directly with central assemblers or wholesalers. In such transactions, some marketing processes and agents are eliminated.

Due to a rapid increase in the demand for pork, the conventional side-line production of hogs by traditional farms is insufficient to meet domestic needs. It is not easy to cover the shortage with imports since pork cannot be stored for over six months even in the cold storage. This market situation has caused a steady rise in the market share of specialized hog producers. As a result, the relative importance of marketing channels seems further to change in the years come.

Hogs are generally sold to hog assemblying dealers at the farm gate. Using this marketing service, it is not necessary for the sellers to pay transaction fees at livestock markets. However, some market transactions occur whereby farm households

Figure 8-2. Marketing Channels of Hog



purchase piglets and breeder stock since these markets offer a wider choice than simple farms.

Table 8-8 Supply Channels of Cattle and Hog to Wholesale Meat Market, 1987

Market Channel	Cattle		Hog	
	Total	%	Total	%
Livestock Cooperatives	138,375	33.2	709,726	25.7
Agricultural Cooperatives	171,964	41.3	880,498	31.8
Marketed by Farmers	51,296	12.3	690,421	25.0
Brought in by Merchants	54,478	13.1	445,774	16.1
Other	419	0.1	40,364	1.4
Total	416,532	100.0	2,766,683	100.0

Source: NLCF

A survey conducted in 1987 showed that the shipments of cattle made through the livestock cooperatives and agricultural cooperatives channels accounted for 38.9 percent and 41.3 percent of the total, respectively. While those made through merchants and direct shipment by farmers accounted for 13.1 and 12.3 percent, respectively.

In the case of hogs, direct shipment by producers included those who marketed hogs based on contract with assorted feed producers under vertical integration arrangements. The proportion of case of shipment through vertical integration is not large in terms of its present share of 25.0 percent to total shipments, and the method is expected to increase in the days ahead as feed producers compete with one another in efforts to secure their markets. Both livestock and agricultural cooperatives shared 57.5 percent of total supply to wholesale market in 1987.

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IX. Structure of Meat Markets

Young Kun Shim*

After livestock have been shipped from the farms and the local markets to the slaughtering plants for processing, wholesale and retail operations function to move the meat to consumers in towns and cities.

The roles of the wholesale market stipulated by law are (1) to link the producer and the consumer using the most efficient channels, thereby eliminating unnecessary marketing costs, (2) to supply quality meat through the use of modern slaughtering plants which are equipped with good sanitary facilities, (3) to increase tax revenues from livestock slaughter and the sale of meat at designated marketplaces and (4) to maintain fair and stable meat prices the year round by insuring a steady supply of meat stored in modern facilities.

Under the present system, live cattle or live hogs are taken from production areas to large cities where they are slaughtered and auctioned to end-users. As a matter of fact, the law prohibits any shipment of beef and pork in the form of carcasses instead of live animals from the local areas to Seoul.

This prohibition is designed to guard against possible spoilage or unsanitary conditions that may result from the shipment of car-

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casses or cut meat. It also is designed to prevent possible illegal transactions that may occur without official inspections.

9-1. Slaughterhouses for Livestock

In Korea, slaughter of cattle either purchased from the market or bred on the farm requires that one get permission from the relevant office in the region. In addition, all cattle must be slaughtered at public slaughterhouses after obtaining permission to slaughter and after an official inspection. The main functions performed by the slaughtering plants are to kill and dress all livestock arriving at the wholesale market.

As of the end of 1987, the number of slaughterhouses totalled 184 across the country. Approximately 25 percent of these slaughterhouses had modern facilities while 71 percent either had outdated facilities or were without any cold storage or refrigeration facilities. About 3 percent of the total had only simple slaughtering facilities.

In 1987, the total numbers of cattle and hogs slaughtered were about 1,005,000 head and 6,476,000 head, respectively. As shown in Table 9-1, these numbers have been increased greatly as compared with the figures in 1970. The increase rates of slaughtering cattle and hogs were 3.6 times and 10.5 times, respectively.

Although the 184 slaughterhouses have different plant capacity and business volume, the average number of slaughtering by each plant was only 15 head of cattle and 96 head of hogs per

Table 9-1. Slaughter of Cattle and Hog by Year

Unit: 1,000 Head

Year	Cattle			Hog		
	All (Total)	Female	Male	All (Total)	Female	Male
1970	283	122	161	617	362	255
75	470	233	237	850	462	388
80	531	200	331	2,005	1,145	860
81	389	104	285	1,832	886	946
82	303	50	253	2,450	1,188	1,262
83	317	48	269	3,683	1,777	1,906
84	458	143	315	5,071	2,582	2,489
85	746	268	478	4,970	2,446	2,524
86	1,086	567	519	5,096	2,540	2,556
87	1,005	467	538	6,476	3,215	3,261

Source : MAFF

slaughterhouse per day. In the case of three slaughterhouses in Seoul, the number of slaughtered cattle and hogs was 230 head of cattle and 1930 head of hogs per plant per day.

Generally, the number of cattle slaughtered was still small compared with their capacity. In fact, it is reported that the operating rate of the slaughterhouses was very low and thus it is difficult to operate slaughterhouses efficiently.

In the past, various controls were introduced with a view to increasing the number of cattle due to the chronic short supply of beef. Under controls designed to maximize breeding potential, female cattle younger than six years old and bulls of less than 350 kg live weight could not be slaughtered. Since a few years ago, however, the age and weight limits placed on the slaughter of female cattle has been lifted in order to reduce the number of cattle bred in the belief that the number of cattle being raised was too large.

After abolishing the age limitation for slaughtering female cattle the proportion of oxen slaughtered has decreased substantially. For instance, the total number of cattle slaughtered was 317,412 head in 1983, --- 84.8 percent oxen and the remaining 15.2 percent female. However, the proportion of oxen slaughtered decreased significantly to 53.5 percent in 1987.

When slaughtering occurs, permission must still be obtained from a market authority. A government official inspects the live animal beforehand. In addition, all cattle must be slaughtered in public slaughterhouses. This procedure makes it possible to obtain accurate information on the number of cattle slaughtered on a daily basis nationwide.

When per capita incomes were very low, most people could eat beef and pork only on special days or holidays. Until recently, the consumption of meat in small quantities throughout the year resulted in the fairly constant pattern of the slaughter of cattle and hogs by months and seasons (Table 9-2).

Table 9-2. Cattle and Hogs Slaughtered by Month, 1987

Unit: Head

Month	Cattle		Hog	
	Number	Percent	Number	Percent
Jan	111,713	11.1	472,759	7.3
Feb	75,898	7.6	426,329	6.6
Mar	82,284	8.2	503,260	7.8
Apr	73,652	7.3	462,232	7.1
May	71,847	7.1	478,713	7.4
Jun	70,029	7.0	491,678	7.6
Jul	73,023	7.3	522,237	8.1
Aug	75,846	7.5	588,616	9.1
Sept	92,731	9.2	597,729	9.2
Oct	96,077	9.6	590,656	9.1
Nov	78,669	7.8	617,498	9.5
Dec	103,329	10.3	723,915	11.2
Total	1,005,098	100.0	6,475,622	100.0

Hogs and chickens are raised using by-products from crop farming and a small amount of purchased feed. When hogs grow large enough, they can be sold to dealers at markets or sold to dealers who visit farm households. By regulation, the slaughter of hogs should be reported to administrative authorities. However, such reports are rarely made because it is customarily understood that hogs and chickens can be slaughtered in the rural areas without official permission. The meat of hogs and chickens slaughtered in the rural areas is most often consumed by farm households.

As a result, it has been difficult to determine the total number of hogs and chickens slaughtered. Lately, however, these statistics have been collected on a more regular basis as enumerators are dispatched to rural areas to gather survey information. Hence it is now possible to estimate the slaughter of hogs and chickens more accurately. In 1987, statistical figures on livestock slaughter show that about 6.5 million head of hogs were slaughtered that year. However, it is difficult to know the percentage of slaughtered hogs consumed by farm households.

As a matter of fact, there are no regulations that prohibit the slaughter of hogs in urban areas. On the contrary, in the case of chickens, slaughter is prohibited in the urban areas for sanitary and esthetic reasons. In other words, authorities recommend the slaughter of chickens in production areas or in local cities with subsequent shipment to cities using cold storage facilities. However, the unit transportation costs for chickens are often high due to need for shipment in the form of live animals in as much as consumers prefer to buy live chickens rather than slaughtered ones. The majority of consumers prefer to buy live chickens at retail shops and then request the butcher to slaughter them at the shop.

Taking this factor into account, the enterprising chicken raisers are often new entrants from non-agricultural sectors who locate in areas adjacent to cities. This old layer or broiler production relies heavily on assorted feeds produced near urban areas, rather than on by products from crop farming, further enhancing the new producers' locational advantage.

These new enterprises thus have important advantages in terms of supply and market information enabling them to reduce marketing costs. In the case of hogs, too, live animals are sometimes shipped from production areas to consumption areas before they are slaughtered at slaughterhouses in city areas.

The fee paid for slaughter is not high with charges depending on the body weight. In the case of cattle, the slaughter fee is around 15,000 won per head. No slaughterhouses can be operated or opened with the revenues obtained from a capacity operation rate, and is a problem to be solved.

The problem is that compared with the number of livestock to be slaughtered, too many small and large slaughterhouses exist. Another problem is that recently built modern slaughterhouses were constructed on the assumption that such modern facilities would drive nearby existing slaughterhouses out of business thereby increasing their operation rate considerably.

The belief that modern facilities could attract more clients seems to have been based on the notion that they can offer more sanitary slaughtering services at the same slaughter fees. But, clients are more concerned about slaughterhouse location than sanitary conditions and plant facilities. If modern slaughterhouses are located farther away from producing areas than the existing ones, it costs more to transport live animals than sending carcasses from local areas.

In addition, even if their livestock were slaughtered at local slaughterhouses that have old facilities, they are able to sell without any problem relating to the place of slaughter. Under the current system, local authorities cannot close down small-scale slaughterhouses simply because modern large-scale slaughterhouses have recently been constructed.

Of course, if large-scale slaughterhouses can secure enough animals to enable them to be operated at full capacity, the unit cost of slaughtering will be lower than that of small-scale slaughterhouses. Currently, such large scale slaughterhouses cannot be expected to increase significantly the volume of livestock handled. This situation arises due to the fact that slaughter fees are the same amount within a range of weights as determined by the authorites , and thus an increase in handling can be profitable only when compensation exists for additional transportation costs necessitated by longer distance hauling of animals and carcasses.

To open a slaughterhouse, permission should be obtained beforehand from the relevant local authorities. If a single office had control over all the slaughterhouses in the country, it would be easy to prepare a schedule for the number of livestock to be slaughtered. Under the present system, however, about 45 percent of the total slaughterhouses are controlled by local authorities, 6 percent by the livestock cooperatives, and the remaining 49 percent by private firms. In other words, despite a limited number of livestock to be slaughtered in a year, many slaughterhouses set up their own business expansion programs without regard for overall market conditions. The owners of large slaughterhouses believe that a good slaughtering facility is a competitive advantage and will attract the business of existing small-sized slaughterhouses.

Thus, a study on the countrywide distribution of slaughterhouses needs to be made. Such a study must take into account such factors as the current cattle production conditions and transportation facilities of respective producing areas.

From the preceeding discussion one can conclude that to effectively utilize the country's limited resources and scarce capital, the government should regulate slaughterhouses in a way that allocates facilities and their location to ensure a high operation ratio. Indeed, excessive competition among business concerns will only lead to excessive marketing expenses, not reduced marketing costs.

9.2 Seoul Wholesale Market

The Seoul Meat Wholesale Markets were established in accordance with the Central Wholesale Market Law and they are supervised by the Seoul city administration. The law requires that all the beef and pork consumed in the Seoul area be distributed through the wholesale meat market by auction. There are three wholesale markets in Seoul including two privately owned markets and one market operated by the National Livestock Cooperative Federations.

Each market operates a slaughterhouse which has modern facilities, a group of auctioneers, and a large number of local assemblers. Three packing plants in Seoul are now competing against each other. The operating expenses are covered by collecting fees from the slaughter of live animals. Although these plants are located in residential areas, sanitary conditions and carcass handling including skinning and crating practices are quite satisfactory.

Seoul has a population of about ten million, -- about one quarter of Korea's total population in 1987. The citizen of Seoul consumed about 34.2 percent of the beef and 31.2 percent of the pork to consumed nationwide in that year. These statistics show that the relative quantity of meat consumption in Seoul was larger than that of other Koreans owing to better income levels and different eating habits in the Seoul metropolitan area.

The total supply of beef to Seoul amounted to 343,859 head of live cattle slaughtered in 1987. As shown in Table 9-3, the proportion of this beef supplied by wholesale markets was about 61.6 percent, while shipments from local markets accounted for 28.9 percent in the form of carcasses to retail outlets, even though this shipment is prohibited by law in view of possible sanitary problems. The remaining 9.5 percent of the supply was released from the stock of imported beef and beef previously stockpiled by the government to stabilize market prices.

Table 9-3. Total Supply of Beef to Seoul by Source, 1977-87

Unit: Head

Year	Total Supply		Precent by Source		
	Quantity	Per Day	Wholesale market	Carried from local market	Release from stock
1977	110,526	325	59.4	15.2	25.4
80	199,999	612	74.4	6.4	19.2
81	210,000	644	48.5	6.4	45.1
82	267,497	839	28.1	5.9	66.0
83	293,089	958	25.5	8.3	66.2
84	223,261	736	50.9	19.7	29.4
85	265,775	860	63.8	26.5	9.7
86	357,244	1,232	57.7	26.1	21.2
87	343,895	1,131	61.6	28.9	9.5

Source : NLCA

There are several marketing channels through which cattle are received for slaughter in Seoul. The first channel is that of country dealers and local assemblers who act as consigners for meat wholesalers and bring live cattle and hogs from local markets to the slaughterhouses in Seoul for processing into carcasses and other byproducts within a few days of sale since there are no fattening facilities available. The second important channel is the assembly of animals at local livestock cooperatives and shipments to the packing plants operated by NLCA.

Upon arrival, live cattle are weighted and are slaughtered within a couple of days and farmers receive payment shortly thereafter.

When farmers market their cattle through the cooperative channel, they are paid immediately the price is received for the carcass at the auction market and by-products are sold. Therefore, the amount received by farmers depends largely on the auction price at wholesale market on the particular market day based largely on the quality of the carcass. Before auction, the government inspectors examine carcasses for to ensure consumer safety and stamp the carcasses with a the sale ring that is used by auctioneers to determine quality.

After slaughtering the animals, the carcasses and by-products are sold in the form of fresh meat. By regulation, these products can be sold only at auction market that opens once or twice a day to auctioneers authorized by the city government. Thus, consumers and retail butchers are not allowed to buy meat directly from wholesale markets, but it is possible to buy beef through auctioneers or commissioned buyers.

These auctioneers distribute carcasses at the request of retailers, processing firms, and major meat end users such as restaurants and institutional users. For this service, they receive handling charges from customers in addition to the auction price of carcasses. Imported carcasses of beef, however, are distributed to retail meat shops based on their orders at prices set by the government and thus imported meat is not required to be sold through auction.

The Seoul wholesale meat markets supply about 61.6 percent of the total meat supply to Seoul city. As shown in Table 9-4, total quantity of supply by the three packing plants has increased 3.2 times for beef and 5.0 times for hog during the last ten years. At present, the market share of the three slaughterhouses and the Seoul wholesale meat markets to the total consumption nationwide is very large.

Table 9-4. Supply of Beef and Pork by Seoul Meat Wholesale Markets, 1977-87

Unit: Head

Year	Beef		Pork	
	Total	Average per Day	Total	Average per Day
1977	65,777	206	351,315	1,101
80	148,746	455	558,050	1,707
81	102,128	311	554,590	1,650
82	75,204	235	684,142	2,148
83	74,677	244	1,034,807	3,382
84	113,703	371	1,352,118	4,485
85	169,677	548	1,278,547	4,173
86	206,234	680	1,318,968	4,362
87	211,805	697	1,761,033	5,786

Source : NLCA

There are no grade standards or other good ~~god~~ means of communicating animal or carcass values to producers, auctioneers, commissioned buyers, and retailers. Since quality factors are not known to consumers, yield of saleable meat is the major factor which determines the value of carcasses. At the auction market, beef carcasses with known carcass weight were easily eyeballed by wholsalers or auctioneers to assess their merit.

Because milk cows and beef cattle have more fat then native cattle, the prices of their carcasses are relatively cheap. However, the retail price is the same for all kinds of beef. Therefore from the retailers' point of view, the strategy is to buy cheaper carcasses rather than the carcasses of native cattle and sell them as native beef to increase their income.

Taking into account the preference of consumers for tender meat, retailers usually offer a little higher price for the carcasses of heavier live weight for the same age animal or prefer female cattle to oxen. This perception among retailers influences the auction prices at the wholesale market depending on the kind of meat supplied and the demand situation.

Of course consumers are aware of quality differences only after tasting the beef. Thus, retailers must be concerned with this consumer reaction if they are to maintain a prosperous business over the long run.

In terms of the market share of different types of cattle at the Seoul wholesale meat market. Korean native cattle and milk cows were the principal kinds and accounted for 49.3 percent and 45.2 percent, respectively. Beef cattle were originally imported in 1980, but their market share in Seoul was only 5.5

percent in 1987 as shown in Table 9-5.

Table 9-5. Kinds of Cattle Sold at Seoul Wholesale Meat Markets, 1987

Unit : Head

Kind of Cattle	Sex		Total	
	Female	Male	Number Total	Percent
Korean Native	60,661	45,851	106,512	49.3
Milk cow	33,539	64,150	97,689	45.2
Beef cattle	7,939	3,978	11,917	5.5
Total	102,139	113,979	216,118	100.0

Source: NLCF

When the domestic production of beef fails to meet demand, beef is imported because domestic supply cannot be expected rapidly within a short period of time. Since beef imports have not been liberalized, the government determines the amount of beef to be imported taking into consideration market demand and supply conditions. Except for the special-purpose beef used exclusively by hotels, beef imports are executed by the National Livestock Cooperatives Association.

Imported beef and domestic beef are auctioned to designated auctioneers at the wholesale markets in cities. This beef is then supplied to retail shops and other large consumer outlets. A portion of beef imported by the government is sold at a fixed rate to packing firms where the beef is packaged into small-sized boxes to preventing cheating on weight and quality by retailers. This factory packaged beef is sold directly to consumers through those shops which deal exclusively in imported beef or those run directly by the Livestock Cooperatives.

The amount of beef imported increased steadily to the point in 1983 where imports covered an amount equivalent to 42.8 percent of the total domestic beef consumption. This figure has, however, fluctuated annually (Table 9-6). One reason for this fluctuation has been that imports were affected by changes in consumer demand which is inturn influenced by the overall economic situation. But, a more important reason has been the lack of an accurate estimate of supply shortages. For example, the fact the some over 40,000 tons were imported in both 1978 and 1982, while less than 1,000 tons were imported in 1976 has been attributed more to a mistaken estimate of domestic supply than to changes in domestic production or consumer demand.

However, such beef imports have produced heated arguments about their effectiveness in terms national economic impact. Many policy makers argued for the import of calves or younger live animals that could fatterned in Korea, rather than the importation of beef as a final product. Based on this idea, live cattle were imported in 1977 because it was thought that the domestic base for breeding cattle was weak, and consequently, live cattle needed to be imported to ensure longterm stability in the beef supply. Since it takes a long time to breed and fatten cattle, beef production cannot be increased easily and quickly in the fact of rising market prices.

Table 9-6. Imports of Beef by Year

Year	Import		Carried over to the following year (mt)
	Quantity (mt)	Total Cost	
1976	694	438,000	-
77	6,323	4,511,000	2,166
78	44,435	36,551,000	6,157
79	31,747	37,862,000	10,571
80	-	-	3,695
81	24,716	50,048,000	4,481
82	41,508	86,433,000	979
83	50,192	115,423,000	827
84	23,995	55,077,000	8,273
85	-	-	3,930
86	-	-	-

Source : NLCF

Imported beef carcasses were selling at lower prices than native cattle or even milk cows due mainly to the preference of consumers for native cattle and because the government prevents price increases in beef even during periods of short supply. Many consumers believe that the imported beef has high fat content compared with the leaner carcasses of native cattle.

If price controls were removed, a potentially wide market for cheaper imported beef may develop, especially among low income people. In addition, domestic beef production will be not cover the increasing trend of consumption and greater quantities will likely be imported in the future.

9.4 Retail Meat Markets

In Korea, there are 15,000 meat retailers across the country. The number of employees per butch shop averages 3.08 persons, and the average annual sales of these shops amount to 15,220,000 won each. That is an average sales of 5.02 million won per employee. The number of butchers has decreased lately because many retailers have gone out of business after their business volume dwindled due to competition with supermarkets. In fact, meat can be purchased anywhere at the same price because meat prices are controlled by ceilings set according to the kind of meat.

In the case of pre-packaged meat, in particular, consumers do not need to go to butchers to buy meat. They can easily obtain it when they buy groceries at supermarkets. Yet, the services of butchers are still in demand as witnessed by the fact that many consumers still patronize butchers whenever they need specific cuts of meat or certain kinds of meat. Such consumers can have their specific needs met better at butcher shops and they can expect special services from the butchers they patronize. In order to improve the management of existing butcher shops, efforts should be made to increase the business volume, install sanitary facilities like those at supermarkets, and ensure the realization of economies of scale.

Insufficient domestic supply to match market demand was expected to occur only a short-term basis. Increased production would remedy short-term shortages of livestock products. However, various problems arose in conjunction with an increase in the amount of meat supplied to the market. In particular, the problems occurred at the retail trade level as proper hendling of an increased volume of trade became problematic in circumstances where there was no improvement or expansion in the conventional market structure, facilities, and methods of transaction.

Today, the amount of meat marketed is increasing substantially. Yet, transaction methods remain conventional. For example, the grading system presents a major problem. In the conventional method of beef transactions, slaughtered cattle were sold to butchers in the form of carcasses. Butchers then sold to customers the portion and amount of beef that the customers wanted. There was no need to grade beef because butchers sold cuts based on demand. If the portion asked for was not avalable, another portion would be bought.

But, portions in high demand by all consumers are not always available. Under such circumstances, those consumers such as restaurant operators, who regularly purchase relatively large amounts of beef from the butchers, are the only ones able to obtain needed portions, while other ordinary consumers who buy beef from time to time choose cuts of meat from available stock at the time they visit the butcher shop.

Given the situation above, there are three basic reasons for the necessity of a meat grading system. First, price differentiation according to quality would be encouraged. Second, this price discrepancy would ensure more balanced demand and supply. Third, a grading system may encourage livestock producers to become more concerned with quality.

Currently in Korea, beef is retailed both in small packages and by preferred cut. However, regardless of the cut of beef purchased the retail price is the same for a given amount.

In fact, most Korean housewives have difficulty distinguishing beef cuts merely by looking at the product. Korean meat dishes comprise a small portion of any meal and are often served with a mixture of vegetables or in soup. However, consumers can distinguish taste and obvious quality differences between tough and tender beef, preferring the tender cuts. This is frequently cited as the reason for their dislike of frozen imported beef.

Consumers usually associate tender beef with young or female cattle. However meat plays such a small role in most Koreans' meals, it is quite possible that most consumers are not much experienced and not even aware of the different sources of fresh meat such as older, younger, female, etc.

Since consumers often cannot distinguish between different types of beef, retailers are able to sell all types at the fixed price. They do not need to fear the loss of customers due to any inherent quality differences between different portions. This fact may enable retailers to cheat customers providing different portions from those requested by buyers. The reason for retailing beef at the same price regardless of cut is to keep retailers from charging excessive prices for specific portions.

In fact, the major concern addressed by the undifferentiated pricing policy is that there should be no market price increase due to the failure to match demand with domestic production. And, it was out of this concern that authorities were content to supply the amount, rather than the quality, demanded by consumers. However, in view of the expected future purchase behavior of consumers, a system allowing price differences based on quality needs to be instituted. This system may take root if retailers are allowed to engage in competitive pricing.

In the future, quality differences will become more important as consumer consumption increases and tastes become more refined. The continuation of a fixed price which makes no allowance for quality differences, and a retail system which does not identify quality, will become sources of consumer dissatisfaction with the beef marketing system.

4. Marketing Channels for Meat

In the course of marketing from producers to consumers, the form of the commodity is changed from live animals to meat carcasses and other by-products at slaughter, and finally into boneless fresh meat at retail shops. This naturally leads to changes in the economic value of the commodity. Therefore, the structure of meat marketing may become differentiated to the extent that excessive marketing expenses are entailed.

As income and population grow in urban areas, the shipment of livestock has to be increased continuously in order to meet the demand for meat. However, since the unit transportation cost is high for transporting live livestock to Seoul from distant local markets, and since it is expensive to dispose of waste substance arising from slaughter, it is desirable to set up modern slaughter-houses in production areas, so livestock could be slaughtered and shipped to consumption markets in the form of packed carcasses or cut meat.

In particular, as expressway networks have been expanded, and as transport vehicles equipped with refrigeration and cold storage facilities have become available of late, there is enough economic infrastructure for slaughter, storage, and processing to be done in producing areas. Moreover, communications networks have been developed to facilitate transactions between cities and local areas, while payment settlements, too, can be done easily using banking "on-line" systems.

As necessary as it is to improve the current system of meat marketing from producing to consuming areas, that is not the only aspect of meat marketing that deserves attention. The actual retailing of meat to consumers is also important.

Marketing costs constitute the difference between the sale price received by livestock farms and the retail price paid by consumers. Therefore these costs include the expenses needed to perform the various marketing functions such as transportation, storage, processing and the profits for those persons who work in marketing. In other words, the price received by farmers is the balance obtained when marketing expenses are deducted from the retail price. Of course, these expenses change according of farm products and the storage, transportation, and processing costs incurred.

A survey of marketing costs made by the National Livestock Cooperatives Federation showed that a farm household share of 35.8 percent and a marketing share of 14.2 percent based on the total price of meat of slaughtered cattle taken by dealers from rural markets to the wholesale market in consumption areas.

The survey showed that when farm households sold their cattle through the marketing channels of the Livestock Cooperatives, the share of farm households was 87.9 percent which is slightly higher than the amount received through the sale to dealers. By contrast, a survey made by Korea Rural Economics Institute calculated the farm households' share as 80.3 percent in the case of sale of cattle to individual dealers. In either case, the fraction of the price received by farm households was more than 80 percent of the retail price, a sizable share. It must be noted that at the time of these studies there were no service price fluctuations.

Looking into the marketing costs for eggs at three marketing stages —producers' price, wholesale price and retail price — it can be said that the cost of marketing eggs from producers to wholesalers in consumption areas has steadily declined as large scale shipments have incurred and have been modernized through improved shipping and packing methods. However, the marketing costs in consuming areas has tended to increase year after year.

As a result, total marketing costs have increased, while farmers' shares of the retail price, that is, the amount obtained by deducting marketing costs from retail prices in cities, has decreased. In consequence, even if the marketing costs from the producing areas are reduced further, the price farmers receive cannot be increased unless there is a substantial increase in retail prices because of the increasing marketing costs in wholesale and retail markets. Therefore, reduction in marketing costs in wholesale and retail markets needs to be the focus of improvements in the marketing system.

Eggs, as a commodity, differ in nature from other farm products. Since eggs are often sold together with other farm products, they are retailed at grocery stores, grain outlets, and butcher shops. Consumers' individual purchases at one time do not involve large amounts. But, since deliveries are requested by consumers and eggs must be packed carefully, these marketing demands contribute towards the larger marketing costs incurred by retailers.

The marketing of livestock products centers, of course, on physical handling. But, improvements on the physical side must be accompanied by supportive programs such as marketing finance and insurance. In particular, the activities of transportation, packing, and processing are important. Marketing agents or organizations should also be able to make collective decisions based on accurate information about current transactions in the market. However, it is very difficult for livestock farms to be involved in direct marketing activities due to their small operational size.

Consequently, it is important to introduce marketing strategies for farmers that utilize organized, group cooperative activities. However, a series of difficulties will be encountered in these attempts.

First, under a farm policy that regulates the entry of non-farm capital into the livestock industry, organized activities or the development of sideline businesses by traditional farms need to be supported by the government.

Second, in the past agricultural policies were focused mainly on increasing production. Thus policy makers seemed to be concerned only with the achievement of self-sufficiency for certain products regardless of the producing unit. It is important that the basic policy targets be aimed at farmers who are responsible for most of the production.

Third, past intervention policies by the government in marketing activities or in the determination of market prices in Korea were aimed largely at controlling the market through various laws and regulations rather than improving marketing facilities to ensure smoother marketing acitivities and reduce marketing expenses.

Such intervention represented short-term and piecemeal policy measures taken in the belief that market and price stability were most important policy goals. No marketing improvements can be expected under such short-term policy measures because in the case of cattle, for instance, it takes two to three years to yield livestock products. Thus it is hoped that in future the government will play a more positive role in promoting marketing improvement by implementing a long-term plan.

9-5 Price Levels of Meat

When prices of meat and livestock products are determined by the market mechanism, both supply and demand factors work interactively to clear the market. The supply of livestock products tends to show a cyclical movement due to the physiological characteristics of livestock and to producers' managerial strategies based on price expectations. The demand for livestock products varies according to consumer behavior which is influenced by many factors, including, in Korea, the seasonal peak consumption periods such as the traditional holidays of Korean Thanksgiving and the New Year celebrations (both in solar and lunar calendars).

In the past, when the consumption of livestock products and their share in food expenditures were small, the price variations of livestock products had little impact on general commodity prices in terms of the price index. Now, however, the situation is different because as incomes increase and the consumption of meat rises. Thus, livestock products are believed to be highly income elastic relative to other agricultural products in Korea.

When price indices are calculated to determine the impact of the prices of meat and other livestock products in light of the relative importance as food items in the Korean diet, the method of weighted value is used. Such a method is based on the weight assigned to the transaction of a specific item in the total transactions of the base year.

In the consumer price index for a ing a base of 1,000 for all commodities, the weighte reals and meat were 136.9 and 41.3, respectively as shown in Table 9-7. The weighted value of other livestock products including milk and eggs were 16.6. Considering the fact that the weighted value of all food in the index is 411.3 and that the weight of meat and livestock products in the consumer price index is 57.9, it can be said that livestock products are now getting an important component in the Korean diet.

Table 9-7. Yearly Average Consumer Price Indices in Urban Areas, 1970-86

1980 = 100

Year	All Commodities	Foodstuff			Other Products
		All	Grain	Meat	
Weight	1,000.0	411.3	136.9	41.3	588.7
1970	22.2	19.5	19.2	16.9	25.2
73	29.0	26.9	30.5	25.0	31.4
75	45.2	45.2	54.5	37.4	45.2
77	57.4	59.5	67.3	61.8	55.6
79	77.7	79.0	82.0	78.4	76.6
80	100.0	100.0	100.0	100.0	100.0
81	121.3	127.5	128.4	143.5	117.0
82	130.1	130.7	132.8	155.9	129.7
83	134.5	132.4	133.9	160.3	136.0
84	137.6	134.4	136.9	161.8	139.8
85	141.0	139.4	142.4	158.9	142.0
86	144.2	141.0	143.5	151.1	146.5

Source: The Bank of Korea, Economic Statistics Yearbook, 1987, pp236-239

In this regard, unstable prices of meat and livestock products have an impact not only on general commodity prices but also on producers' income and consumers' household expenditures to a greater extent than before. This is one of the main concerns promoting the governmental policy of price stabilization for meat at a substantial costs. However, the prices of meat are fluctuating widely between months or years under the influence of change in supply and demand conditions.

1. Meat Prices at Wholesale Market

The livestock industry in Korea has expanded rapidly within a short period of time, but it has yet to establish firm roots as a healthy industry. Anyhow stable price levels of meat and livestock products are becoming more important concerns for both producers and consumers.

Since 1976, the prices of beef and pork at wholesale markets in Seoul tended to increase continuously in pork by 1981 and in beef by 1983 (Table 9-8). Thereafter both prices were decreased steadily year after year. However, the degree of price fluctuations between years for beef and pork were not same levels or trend because of the differences in the adjustments of supply to change in the market demand.

When the prices of meat or live animal are rising chicken and hog production could be increased within a short period of time. Unlike beef, chicken and pork could be supplied in greater amounts to match market demand, and minimize price fluctuations.

Table 9-8 Wholesale Prices of Meat by Year, 1976-86

1980 = 100, unit kg, carcass

Year	Beef		Pork		Chicken	
	Prices	Index	Prices	Index	Prices	Index
1976	1,707	47.7	936	59.4	821	63.1
77	2,371	64.9	991	62.9	904	69.5
78	2,729	76.3	1,459	92.6	1,010	77.6
79	2,818	78.8	1,076	68.3	882	67.8
80	3,577	100.0	1,576	100.0	1,301	100.0
81	4,834	135.1	2,559	162.4	1,629	125.2
82	5,437	152.0	2,527	160.3	1,461	112.3
83	5.927	165.8	2,198	139.5	1,386	106.5
84	5,723	160.0	1,894	120.2	1,583	121.7
85	4,384	122.6	2,341	148.5	1,563	120.1
86	3,875	108.3	2,436	154.6	1,476	113.5

Source: NLCF, Materials on Price, Demand and Supply of Livestock Products, 1987

The price levels at wholesale markets are not directly regulated by the government and thus they are more likely to vary based on the demand and supply conditions. It means that there is no ceiling or control for unit wholesale prices, but they may be affected by retail prices that are directly regulated by the authorities. The degree of price fluctuations among beef, pork and chicken was not varied by year. In some years, both beef and pork prices increased, other years indicate that pork prices decrease when beef prices increase. Chicken prices were more stable than those of beef and pork.

The domestic production of beef could not be expanded within a short period of time to meet unexpected demand increases, the government adopted measures to import both beef and live cattle. Based on this policy, a considerable number of calves were imported and distributed to interest farmers for fattening to a certain weight.

In this regard, many policy makers argued that the import of beef as a final product would be more effective compared to the import of calves to be fattened in Korea. However after considering the relative benefits of importing calves or young animals, live cattle were imported as shown in Table 9-9.

Table 9-9 Imports of Livestock, 1974-87

Unit: Head

Year	Milking Cow	Beef Cattle	New born Chicks	Hog
1974	5,463	194	77	845
75	777	-	47,070	5
76	1,545	1	3,677	248
77	12,393	582	-	-
78	21,942	10,636	487,576	1,602
79	16,250	8,138	442,466	1,428
80	4,462	204	131,272	30
81	14	17,695	233,666	569
82	9,682	39,770	266,245	712
83	11,047	67,706	402,764	2,059
84	11,265	18,230	239,140	219
85	1,239	27	354,322	701
86	9	-	393,751	1,176
87	11	-	404,480	820

Source : National Animal Quarantine Service

As shown in Table 9-9, the amount of beef cattle imported steadily increased to the point where 57,465 head of cattle were imported during two years, 1981 and 1982. Subsequently 67,706 head and 18,230 head were imported in 1983 and 1984, respectively. The cost of the total imports over this four-year period was about 84 million US dollars.

Imported beef cattle were was sold to farmers at much lower prices than that of native ones, because the aim of releasing imported beef cattle to farmers was to supply additional beef to keep the stable price levels, otherwise the price would be hiked due to the shortage of beef supply. That is why the government made a conscious effort to build a sound production base for supplying enough beef to match consumer demand.

However, excessive importation of live beef cattle caused the price of calves and adult beef to drop to the point where production costs were no longer covered. This resulted in the plummeting of domestic cattle prices and further weakened the domestic base of cattle production. It also caused loss of income to farmers. This was due in part to an over-estimation of the demand for imported cattle. In addition, beef was imported in larger quantities than the market demanded, and resulted in the dramatic price drop. So, imports of both live animal and beef must be curtailed to cover only the shortage of them at the market.

To adjust for this problem and to maintain a reasonable beef price level, the government employed another policy device of stoctpiling to manipulate the market through the purchase of oversupplies of beef and subsequent release from stockpiles when prices reached levels judged to be too high, but this measure was not as effective as originally planned.

As an evidence, the price levels of beef at wholesale markets were not stable even within a year. The degree of monthly fluctuation was quite different between years. As shown in Figure ~~11~~9-1, the range of price fluctuation between years was quite large and also there were not any trend of price fluctuation between months. Monthly fluctuations of beef might owning rather to the change in demand conditions than those of supply shortages.

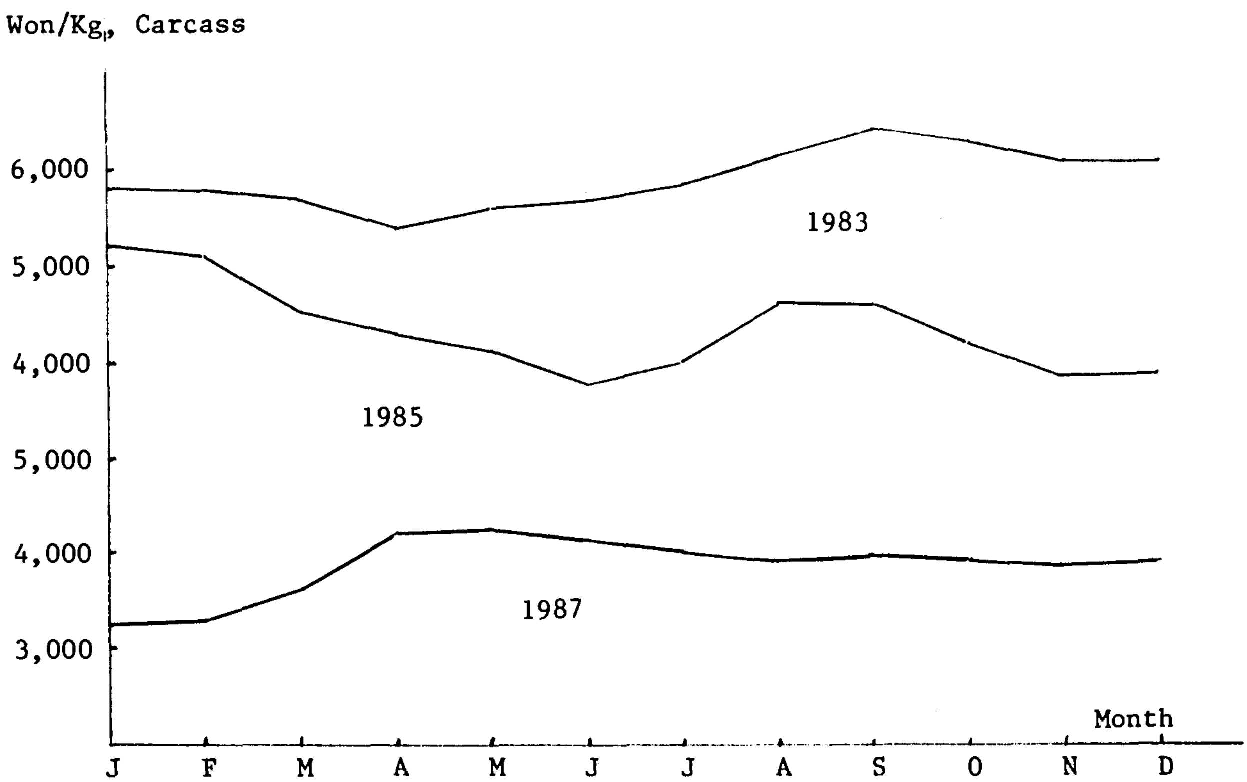

Fig. 9-1. Changing Wholesale Prices of Beef by Month in Seoul

In relation to the government's stockpile policy, we can single out several problem areas for consideration. First, stockpiling requires a huge amount of capital in order to manipulate the market prices through the process of purchasing and releasing of meat. Stock meat must be handled carefully to reduce any quality deterioration, but it cannot be stored for long periods like food grains. The maximum storage period for frozen beef is approximately one year in the existing facilities. When we consider that stored beef cannot be released when prices remain stable for over one year, then investments in stored beef may be lost and high storage charges will be incurred.

Second, if the government purchases excessive amounts thereby maintaining stable prices, there would be a possibility of further increases in production in succeeding months. This will result in oversupplies of meat to the market. Particularly in the case of chickens, it is easy to increase the production in the short-run using more commercial feeds. As a result, the surpluses in chicken may mount rapidly. For these reasons, stockpiling appears to be a problematic solution to livestock market imbalances as a long run measure.

9.2 Meat Prices at the Retail Markets

In the past in Korea, meat retail prices were determined by a cartel-like system in which the butchers' association, formed in 1956, set retail prices. There was no control of such cartel pricing by the government. As meat prices continued to increase in later years and their impact on general commodity price grew, a grading sales system was introduced in 1969 as a means of controlling meat wholesale prices.

However, retail prices were left to be determined through setting by butchers. The grading sales system proved unsuccessful because it only served to entice butchers into illegal or unfair transactions as they were able to take advantage of the lack of clear understanding of meat grades on the part of consumers.

Beginning in 1975, the government began to enforce an administrative guidance price system, a system of controlled prices. This new method was successful in controlling prices at retail markets to a certain extent, but proved to be an unsatisfactory device in terms of protection for producers and consumers. Hence to supplement the system, the so-called price stabilization zone system was established in 1977.

This zone system allowed market price fluctuations within a certain range. The lower ceiling was based on producers' production costs and the upper ceiling pegged to consumers' household expenditures. However, this sytem, too, was not successful because it was manipulated in situations where the government failed to supply enough meat to adjust effectively market conditions through proper control of exports and imports.

To illustrate this problem in more detail, when market prices increase beyond the upper ceiling, there is a need for imports to make up for a short supply. When market prices fall below the lower ceiling, the excess portion of supply should be purchased for stockpiling.

As the increasing importance of livestock products in consumer food purchases, the government has paid more attention to control retail price through setting a fixed level from time to time in force. As a result, quite stable prices between months have been maintained at retail market during the past several years as shown in Table 9-10.

Table 9-10. Annual Average Consumer Prices and Monthly Price Indices of Beef, 1982-86

Unit: Boneless, won/500g

Monthly	Average Price and Monthly Price Indices by Year			
	1982	1984	1985	1986
Average Price	3,716	4,158	3,527	3,198
January	96.0	101.3	114.4	93.2
February	96.6	101.4	110.6	93.1
March	96.7	101.8	109.3	92.1
April	95.4	96.4	105.0	97.4
May	94.9	100.8	101.1	105.6
June	96.7	97.4	96.8	106.1
July	96.5	99.8	97.1	104.2
August	98.1	100.2	100.0	102.5
September	103.2	100.6	98.9	102.6
October	107.2	99.9	93.5	102.3
November	108.6	99.3	93.5	100.8
December	110.1	96.5	87.0	100.3

Source: National Livestock Cooperatives Federation

In contrast to this price policy, no effort was made to control the prices of transactions at local livestock markets and the prices of carcasses at the wholesale market in consuming areas. Therefore, these prices tend to fluctuate more than the retail prices. Since, the retail price was regulated by the government without much taking into account the price increases in the wholesale meat market, retailers were not allowed be pass higher wholesale costs on the consumer and thus saw their profit margins decrease. As a means of escape from this administered price system, the retailers sold low-quality portions of beef with excess fat to maintain the same level of return from the retail transactions.

To forestall illegal practices by retail butchers, a so-called linked price system has been in force since 1980. The view that both production and wholesale prices should be reflected in retail prices motivated the adoption of this system. In this system, the retail price was determined by taking into account not only changes the price of live animals in the production areas, but also the price of carcasses. At the same time, marketing costs and retail margins are also considered.

A linked price is determined through a committee meeting convened by a local authority only when economic conditions occur necessitating more than 3 percent change in the consumer price index. However, since there are frequent fluctuations in market prices for all commodities, it was difficult to convene a meeting every time such fluctuations occur. So, unless there was a sharp price change, there were not frequent adjustments in retail prices. Moreover, even when livestock prices declined in production areas or carcass prices decreased sharply at wholesale market, retailers were not apt to make corresponding down ward changes in retail prices immediately.

As a matter of fact, the linked price system was exercised as a price control device, but its impact has not been substantially different from past price systems. Nevertheless, the linked price system has also been applied to pork since 1980. In spite of the introduction of this system, when the price of live hogs rose in production areas, retail prices also promptly surged. By contrast, however, when live hog prices dropped, the decrease in retail prices was very small and lowered retail price adjustment were made very late in the market.

All such measures by the government were designed to bring about stable price levels for beef, pork, and chicken and thus reduce monthly price fluctuations. The effect of the price stabilization program in 1987 is shown in Table 9-11.

Table 9-11. Average Consumer Prices for All Cities by Month, 1987

Unit: Won/500g

Month	Beef Boneless	Pork Boneless	Chicken	Egg/10
Jan.	2,980	1,808	1,639	523
Feb.	2,977	1,775	1,584	487
Mar.	2,945	1,619	1,542	484
Apr.	3,114	1,680	1,608	502
May	3,376	1,859	1,721	506
Jun.	3,394	1,840	1,678	479
Jul.	3,331	1,701	1,654	465
Aug.	3,277	1,532	1,583	465
Sept.	3,280	1,465	1,370	508
Oct.	3,272	1,473	1,280	516
Nov.	3,224	1,346	1,304	485
Dec.	3,208	1,289	1,405	489
Average	3,198	1,616	1,532	492

Source: NLCF

On the other hand, when the prices of carcasses decreased, retailers benefited as they still received the same price from consumers and increase in profits or presumably were able to sell better quality beef. As shown in Figure ~~1~~91-2, the wholesale and retail prices changed in a similar pattern with some time logs, and kept on a certain price difference that goes to retailers as business returns.

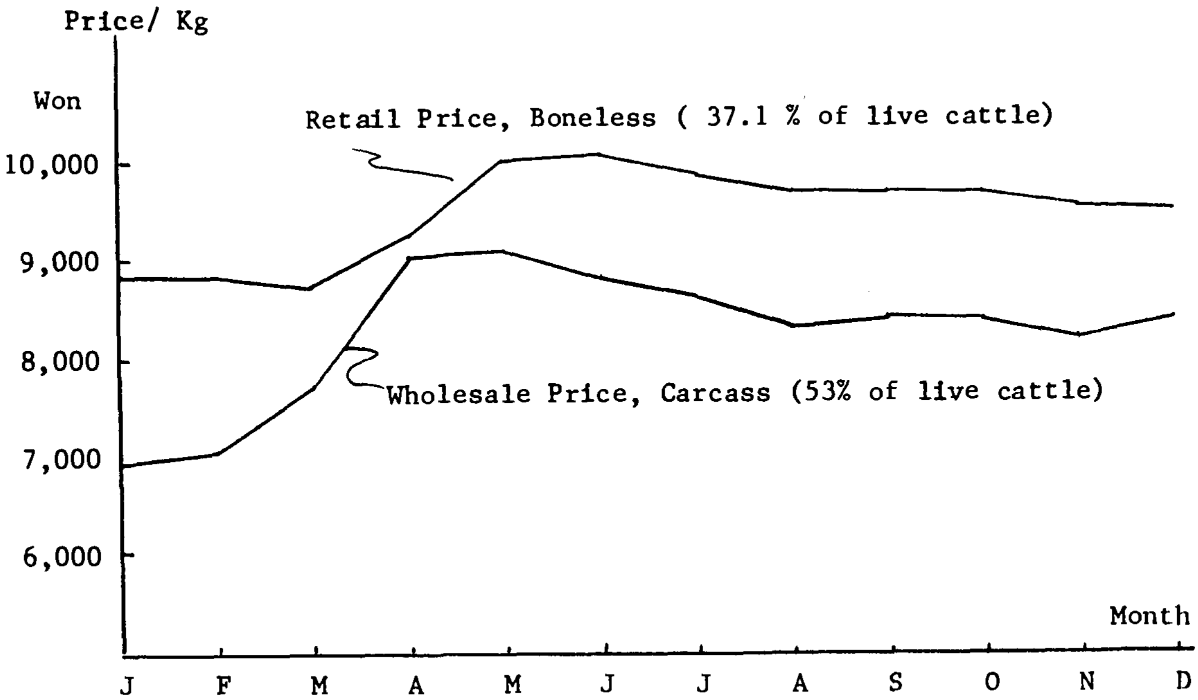

Fig. 9-2. Price Margins between Wholesale and Retail Sale Prices in Seoul, 1987

The degree of difference between wholesale price, and retail prices and its variations would implicitly indicate an effectiveness of marketing structure or marketing efficiency. If there exists large fluctuating gaps continuously between retail price and wholesale price, then retailers would take excessive profits. In this view, the retail business must be somehow better than that of wholesalers' one in terms of receiving possible windfall gains from price drops in wholesale and local markets.

Regarding the price levels between different kinds of meat including beef, pork, and chicken at retail market, wide fluctuations in relative price levels have occured from year to year as shown in Table 9-12.

Table 9-12 Comparison of Average Consumer Prices between different kinds of Meat by Year, 1974-87

Unit: Won/500g

Year	Beef Boneless won/500g (A)	Pork Boneless won/500g (B)	B/A	Chicken won/kg (C)	C/A
1974	653	351	53.8	412	63.1
75	744	496	66.7	556	74.7
76	1,063	666	62.7	672	63.2
77	1,380	685	49.6	815	59.1
78	1,730	981	56.7	956	55.3
79	1,929	905	46.9	880	45.6
80	2,410	1,014	42.1	1,212	50.3
81	3,232	1,763	54.5	1,583	48.9
82	3,716	1,710	46.0	1,522	41.0
83	4,118	1,604	39.0	1,363	33.1
84	4,158	1,401	33.7	1,642	39.5
85	3,527	1,761	49.9	1,711	48.5
86	3,117	1,919	61.6	1,613	51.7
87	3,198	1,616	50.5	1,532	47.9

Source : NLCF, Materials on Price, Demand and Supply of Livestock Products, 1985, pp 76-81, 1986, p.75, 1988, p.69

It is also noted that the price ratio of pork and chicken to beef prices are not always the same between years due largely to increases in the price levels in the respective years and the possible substitution between the kinds of meat.

This data indicate that a rise in beef prices does not increase supply significantly in the short run which may lead to price instability. By contrast, the demand for pork and chicken seems relatively stable in spite of price increases in pork and chicken that stimulate more elastic production responses. Thus, price stabiliaation in the beef market seems more difficult to achieve because increased market supply requires a longer time period.

A survey by the Korea Rural Economics Institute showed that 62.8 percent of the consumer respondents would change their purchasing behavior if beef prices rose by 5 to 10 percent. Of the total households questioned, 17 percent replied that they would reduce their pork consumption if pork prices increase by 5 to 10 percent. The ratio of pork to beef prices per unit reached 66.7% in 1975, but it dropped to 33.7% in 1984. In case of chicken, there was a similar trend between the price ratio of beef and chicken. In 1975, the price per unit of chicken had reached 74.7% of the price of beef, while that ratio dropped to only 33.1% in 1983.

If we assume that the consumptions of meat follows a fixed seasonal pattern in the short-run, then price fluctuations are mostly dependent upon supply factors. The supply of meat is then a function of their own prices, the prices of related (complements and substitutes) livestock products, input prices, and so forth. However, this section is not intended as an analysis of factors influencing supply and demand for meat and livestock products. Rather, the aim is to present the trends of price fluctuations of meat both in the short-term and the long-term.

In the case of milk, the government regulates the price indirectly by setting the retail price to take into account such factors as production conditions, the demand and supply situation, and other economic conditions. The government also influences the milk market by providing subsidies when the production cost of milk exceeds the price set by the government. In addition, the government grants loans to improve livestock farm management.

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X. Analysis of the Retail Meat Shops

Young Kun Shim*

10.1 Introduction

As income and population have grown, particularly in urban areas, conventional dietary preferences which center on grains and vegetables are changing gradually toward western patterns with increase in animal protein relative to cereals or vegetables. During the last sixteen years (1971-87), consumer demand for meat including beef, pork, and chicken has increased from 170,861 mt to 668,770 mt. Accordingly, the meat consumption rose at an annual rate of 18.2 percent. In addition, the consumption of fresh milk has increased by 21.7 times during the same period.

From 1971-86, the consumption of meat per capita increased from 5.2 kg to 15.8 kg, and thus the annual meat consumption per person rose at an annual rate of 12.8 percent.

This increased demand for both meat and milk has caused a sequence of new adjustment problems not only in traditional farming, based primary on crop production, but also in marketing as a number of marketing problems have emerged in relation to the increased volume of transactions. For example, the tonnage shipment of meat and livestock products to meet consumer demand has increased greatly. However, the meat market is not yet

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adequately developed and the marketing facilities and other infrastructural investments that may improve distribution have not been sufficiently expanded.

The regularity of food consumption patterns requires the provision of a regular, stable, reliable supply of food including grains, meat,and livestock products throughout the year. However, present marketing functions are not efficient, and thus marketing costs are expensive in comparison with the level of services provided. Also the markets are often unstable. An important policy goal is reasonable food prices without erratic fluctuations. An effectively functioning market can help to reduce costs and to stabilize prices for both buyers and sellers.

Prices are affected not only by simple supply and demand relations, but also by various costs arising in the process of marketing of commodities from producers to consumers. In particular, meat and livestock marketing requires large amounts of capital because assemblers purchase live animals at the farm level and then ship them to slaughterhouses located in consuming areas. After the livestock is slaughtered meat carcasses are distributed to numerous retailers through auctions at wholesale markets. Simply put, livestock sold by farmers is changed during the course of its distribution into a completely different meat product. Such product transformation involves various processing and services which naturally incurs costs. For this reason, the marketing of meat is relatively more expensive than that of grains. In addition, meat marketing is more complex as different marketing agents and different marketing channels are used depending on the type of livestock products.

Presently, all functions related to the marketing of live animals are accomplished by a large number of small-sized farmers and merchants. If these small transactions could be aggregated into large-scale transactions through a cooperative, marketing costs could be reduced substantially. If this occurred, the producers' share of the market price would be increased. Consumers would be able to obtain meat at cheaper prices. In other words, a reduction in costs through efficient marketing would benefit both producers and consumers.

Therefore, the invariable wish among all farmers and consumers is to see the establishment of an effective marketing system through which consumers can purchase meat with satisfactory freshness and dependable quality at cheaper prices. The producers would also receive a better price when they market live animals. The time has come to discover which marketing system would best serve to meet the interests of both producers and consumers.

Since most meat retailers are very small in size with small capital investments, it is difficult to improve marketing facilities because large capital investments are required. In addition, suitable and systematic marketing structures have not yet developed. As the quantity of meat to be marketed increases, the number of merchants or butchers is also increasing because of the pressure to handle an increased volume. However, the existing retail meat outlets have not increased substantially in their scales of operation. As a result, there are numerous allegations of inefficiency and structural weakness. Thus, marketing is certainly an important component of the livestock industry and thus requires serious study.

Against this backdrop, this study analyses the performance of meat retail shops in improving marketing functions and it also examines the appropriatness of other changes in meat markets so as to increase efficiency.

10.2 Management of Retail Shops

1) General Overview of Retail Shops

The retail meat market has a complex structure because of the complex characteristics of meat as a commodity that determine marketing steps and procedures. Meat is a highly perishable item. In the course of cattle transactions from the producer to the consumer, the form of the commodity changes, e.g., cattle are slaughtered into beef carcasses which are later cut into small portions for sale at retail shops. The marketing functions involved from the point of initial production until meat reaches the hands of the consumers are performed by a number of persons at various stages at the processing and marketing chain. Meat retailers in consumption areas are required to store purchased carcasses of beef as part of their operational inventory for short periods.

The carcasses arriving at retail stores must be cut into smaller portions for consumer sales. Accordingly, meat retailers not only distribute meat, but they also process meat for sale to customers. For this reason, retailers have the opportunity to obtain profits from their retail business, as well as wages for the services they provide in turning carcasses of meat into boneless fresh meat, and then for distributing cut and packaged meat.

A survey conducted by the National Livestock Cooperatives Federation has shown that the business profit from the sale of imported beef that is pre-packed in 600 gram packages at packing factories before distribution to retailers averaged 9.9 percent of the retail price. This is 2.9 percent more than the 7 percent margin for handling fees paid during the retail sale of prepackaged beef. However, when we consider the fact that the 9.9 percent profit margin includes the operators' wages incurred during the processing stage, the profit margin is by no means excessive.

Because the transaction units of cattle and hogs is far larger than the units of consumer purchase, even livestock farms purchase meat in small amounts for home use from retail shops, instead of using their own livestock. Of course, restaurants purchase large bulk quantities, but they seldom purchase amounts equivalent to a whole animal. Instead, they buy selected parts of the carcass. In order words, contrary to the case of ordinary farm products where large users often deal directly with wholesalers, meat is purchased from retailers in most cases. In terms of the number of meat dealers, there are only three authorized slaughterhouses in Seoul, the capital city with a population of over 9 million. Usually also there is one slaughterhouse in each local city. This means that meat wholesalers are relatively small in number, while there are a tremendous number of retailers. This is partly because the retailer himself does the deboning work.Consumers like this practice as it is a sign of the meat's freshness, but the amount of each purchase per consumer is usually quite small.

In general, retailers are small in size and are scattered throughout the city. Since meat is highly perishable item, the customers of individual shops often live within walking distance. In addition, the retail beef price is determined by the government, so profits can be increased only by increasing the number of customers and volume of sales. From this business perspective, the retailer must improve his selling methods to increase the number of customers in the neighborhood of his shop. According to official data at the end of 1986 there were 35,125 meat retailers in Korea. When retail shops directly operated by the agricultural cooperatives and the livestock cooperatives were included, this number stood at 17,632.

The total number of retail shops has increased substantially in the past several years since meat has been imported into Korea. With the passage of time these relatively prosperous shops have remained in operation while others have gone out of business. The number of new shops has surpassed the number of those that have closed. Many of the new shops mainly retail pre-packed beef which is distributed by the National Livestock Cooperative Federation. This type of store can be opened relatively easily. Only a small amount of capital is required and no specific skill is required since there is no butchering of meat to meet the buyers' request. This means that most of the retail shops which opened recently are selling mainly imported beef, while older shops are selling locally produced beef. The rate of increase in the number of stores may slow down in the near future because the profitability of meat retailing is considered relatively small compared to the capital and labor input requirements of other comparable small business.

Dut to lack of information, there is no way to know how many retail shops have been opened or closed annually. It seems that there is considerable turn over in the retail business, particularly with advent of a number of small shops selling pre-packed beef.

Compared with other retail businesses, historically butchers formed a rather distinctive social class which limited entrants into this occupation. From feudal times, only people who belonged to the specialized lowest social rank of "Backehung" could operate such a business. Outsiders would have found it difficult to enter meat marketing. Recent social and cultural changes, however, have enabled other interested persons to enter the meat selling business.

2) The Status of Retail Meat Shops

Retail butchers in Seoul numbered 8,559 and about 24.4% of the total number of butchers at the end of 1986. If one considers stores that are operated directly by the National Livestock Cooperatives Federation, the total number of butcher shops in Seoul was 3,967 or 22.5 percent of the national total. There were more butchers per capita in Seoul than the per capita national average. The reason seems to be that meat consumption per capita is relatively high in Seoul because there are many households with relatively high incomes. Of course, the number of butchers are not evenly distributed based on the number of households or the income levels of Seoul districts. Generally, there are too many butchers in supermarkets, apartment complexes, or department stores. But, a majority of these shops are small and are operated as family businesses. Among the small-sized stores on the fringes of the Seoul metropolitan area, many also deal in other farm products and miscellaneous goods.

In order to analyze the business performance of small-scale retail meat shops, using in particular business volume and sale practices as indicators, and to explore the various avenues toward improvement of retail activities, 80 retail butchers were surveyed in Seoul. In anticipation of less than cooperative responses among old and large retail butchers, due to their possible lack of understanding of this kind of survey, the stores surveyed were mostly those that deal in imported beef and thus work with the National Livestock Cooperatives Federation. Before the survey was undertaken, a solicitation letter of cooperation was sent to retailers in advance by the National Livestock Cooperatives Federations. Students were then sent to individual shops to interview head butchers. In the course of the analysis of the survey data, questions emerged about the accuracy some items. However, the information obtained through the field survey was considered worthwhile inasmuch as the survey was the first of its kind ever made in Korea regarding the business and chracteristics of retail meat shops.

The average number of family members who operated the 80 meat retail shops was 4.1 (Table 10-1). The shop owners operated 81.3 percent of all stores surveyed and the rest 18.7 percent rented - in the stores. The average age of shop owners was 42, and the average experience of store operation was 5.7 years among male owners and 4.3 years among female owners. The relatively short duration of their business enterprises is indicative of the fact that many shops surveyed were recently opened to deal in imported beef. Among those retail meat shops which sell non-imported beef, many have been operated by the same family for a long period of time, some of which have been in business for several successive generations.

Shop owners worked at their shops 12.7 hours per day on the average, while their family members put in about 4 hours of labor per day. Twenty-six shops, 32.5 percent of those surveyed, had one employee other than family members. In circumstances such as these where materials, facilities, and equipment are designed to save manual labor, the number of employees is indicative of the scale of the shops. Therefore, the fact that there were few employees shows that the meat shops are small in scale, and are operated mainly using family labor. However, it should be remembered that it is somewhat difficult to employ outside workers in this business since people do not wish to work at retail meat shops for the same wage offered in other sectors due to a bad perception about work in meat shops. In fact, even uneducated youth from rural areas tend to shun employment at butcher meat shops. This tendency may reflect lingering ideas about the low social prestige of this occupation, as mentioned earlier.

The retail meat shops selected for this survey included 37 in residential areas, 31 near arcades, eight in apartment complexes, three in areas with many restaurants, and one in a factory area. The average duration of business at the present location for the shops surveyed was a mere 3-6 years. This means that many of these stores have opened recently.

Table 10-1. Business Hours, Years of Experience, Age and Sex of Butcher Shop Operators

Sex	Store Operator			Average Hours of Business per day
	Number	Age	Years of Experience	
Male	65	42.1	5.7	12.8
Female	15	40.8	4.3	12.1
Average		41.8	5.5	12.7

Meat retailing alone may not generate enough profits comparable to other small businesses because of the small volume of transactions per day. Therefore, 42 of the 80 stores surveyed dealt in other commodities such as vegetables, fruits, general foodstuffs, and salt in addition to meat. The floor space of those shops dealing exclusively in meat stood at 33.0 square feet on the average, while the average floor space of those dealing in other commodities averaged 21.5 square feet. In only two shops did respondents reply that they expanded the space of their shops since opening because the volume of business had increased.

Although meat shops themselves were small in size, they had invested a considerable amount of capital in purchasing such necessary facilities and equipment as cold storage facilities, scales, telephones, bicycles, display stands, and meat cutters. In addition to this investment, they required an average 3,500,000 won per shop as operating capital to purchase meat. Retail meat shops require relatively greater funds than other retail shops which deal in farm products. In particular, the cold-storage display stands made from glass panes which are designed to entice people to buy meat are not needed in other retail shops. This is one of the items which requires a relatively large amount of funds and is required in the meat retailing business.

3) The Sale of Meat at Retail Shops

As for the types of meat sold at the shops surveyed, beef and pork were the primary commodities offered for sale, but same shops sold chicken as well. The average volume of beef, pork, and chicken sold per day at each store was 65.2kg, 28.2kg, and 5.8kg, respectively. The amount of each purchase by individual consumers was small, so butchers kept a rather low level of operational inventory on hand.

Koreans prefer to consume different kinds of meat on a seasonal basis. Beef and pork sales are greatest in the winter, followed by autumn and spring. Summer sales are the lowest. By comparison, chicken sales are largest in the summer, followed by spring and autumn. People consume the least amount of chicken in the winter. The survey was conducted during the summer at a time when beef and pork sales were relatively low, while sales of chicken were higher than in other seasons, even though chicken was sold only in a few of the shops surveyed. Table 10-2 below compares average sales figures for the 80 shops, according to the different kinds of meat.

Table 10-2 Total Quantity and Number of Meat Sales Per Day by Kind of Meat in the 80 Butcher Shops Surveyed.

Kind of Meat	Number of Sales	Quantity of Sales	Average Weight Per Sale
Beef	77.3	65.2^{Kg}	843^{g}
Pork	37.8	28.2	746
Chicken	4.2	5.8	1,381

The average sale at one time was 843 grams for beef and 746 grams for pork. The largest single sale of beef was almost 10 kilograms and that of pork 6 kilograms on the average. There were many cases in which beef or pork was purchased in amounts of 150 to 200 grams at 1,000 to 2,000 Won. The total quantity of sales per day depended more on the frequency of transactions than the amount purchased at each indivicual sale, since consumers tended to purchase similar amounts when patronizing the shops.

All the butchers surveyed dealt in both beef and pork. However, the quantity of individual pork sales was generally half that of beef. In general, the pork price was set at about 60% of the beef price, but high income people are concerned only about the taste of the meat. As stated earlier, the sales ratios between beef and pork are affected by seasonal fluctuations in consumption. However, summer pork consumption seems to have been reduced recently by the sale of pre-packaged beef. Under a government policy to stabilize beef prices, the price of an equivalent amount of pre-packaged imported beef was set 20% higher than that of pork. This price was 70% of the price of an equivalent amount fo domestically produced beef.

The total amount of consumption of pork for the nation as a whole was about 2.5 times of beef in 1983. However, monthly consumption for both pork and beef was not even throughout the year. In the months of June through August, the consumption of meat dropped to low levels. This means that the amount of beef and pork sold during the month of July was less than the monthly average. In other words, the survey was conducted when the demand for meat was relatively low.

The month when the sales of beef was highest was January. In December, sales for pork were highest. The amounts transacted in the two months of January and December were respectively 2.3 and 1.7 times than to those for the summer months when the smallest sales were registered. The seasonality of sales differs between individual shops also. This is due more to differences in meat consumption patterns among the customers of each meat shop than to any differences in the methods of sale on the part of the shop operators.

In general, meat retailers know something about their customers' preferences, because most customers reside in the neighborhood of the retail shops. To maintain their patronage, meat retail shops sometimes sell meat to customers on credit. Fifty-five shops, 68.8 percent of those surveyed, sold meat on credit to restaurants, neighborhood residents,and other regular patrons. A credit sale was generally settled within 10 days. However, credit sales were far smaller than cash sales. Credit customers generally had stable permanent occupations. They were office workers, civil servants, teachers, merchants, and so on.

Retailers cannot overcharge since retail prices are determined by the government. However, the control of meat prices is different in nature from the control of prices of other farm products. Retailers prepare boneless fresh beef and pork for sale to consumers by deboning the carcass of the cow or pig they purchase. This work is a form of processing, and is different in nature from the ordinary processing in which standardized goods are produced from a specific amount of materials.

The differences arise because in the course of processing, the quality of the specific meat commodity sold can be altered depending on how much fat or low quality meat is mixed with higher quality meat when the customers' orders are filled.

Generally, consumers may not be familiar with the quality of meat and are unable to discern precisely quality differences in various cuts of meat. The only thing they know are the names of some of the basic cuts of meat such as loin, sirloin, ribs, etc. When wholesale prices of meat carcasses increase, retailers mix more fat and low quality meat with higher quality meat, because they are not allowed to charge more than the given retail prices. Therefore, although consumers pay the same price for their purchase of meat, in reality they pay a higher real price because they have unwanted fat or low quality meat included in their purchase.

Differences in meat quality are determined in part by the location of the cut. There is room for cheating to occur according to how the the butcher cuts the carcass, although the technical criterion by which quality differs can be discerned. With either beef or pork, the quality of the meat from the rib area is relatively easy to discern. But for, say, roasted beef which is used for Korean cooking, it is hard to tell by appearance or taste which cut of meat was used, as the meat is sold in thin slices. Meat retail shops, however, cannot ignore competition from the other meat retail shops in their area. Therefore, they have to pay some consideration to the quality of the meat they sell, and, at the same time, they must find some way of selling all cuts of meat. Retailers cope with government retail price controls in order to maintain profit margins by reducing weight or reducing the quality of meat, i.e., by cheating. They take advantage of the system under which meat prices are administered by changing the form of the meat before selling it to consumers.

Retailers have a problem in that demand for specific cuts by consumers does not always correspond with supply, which is dictated in a fixed ratio by the type of animals available. When asked if they encountered difficulty in selling certain cuts demanded in the amounts requested, 54 shops, or 66.3 percent of the total surveyed, replied that they did (Table 10-3). The reasons cited for this difficulty were that the quantity of the cuts demanded were in short supply; large amounts of unsalable residue was left over in the process of cutting; and that it was very laborious to cut meat in the manner requested.

It is by no means easy to cut the portions demanded in the exact weight which customers wish to buy. Because of this situation, 54 shops said that the current retail method of meat cutting is inconvenient. They were then asked whether they would like meat supplied in pre-packaged form. This change would definitely free retailers from the trouble of cutting specific portions of meat. It was interesting to note that only 28 of the 54 shops favoured such a change. The number advocating the pre-packaged system was unexpectedly small, considering the fact that nearly all of the surveyed shops had experience with selling pre-packaged beef supplied by the Livestock Cooperative, and that many of them were still selling such pre-packaged beef. As for the reasons for their negative attitude toward pre-packaged beef, it was evident that consumers are prejudiced against pre-packaged beef, and that it would be all the more difficult to offer the exact cuts demanded by customers.

Table 10-3 The Tally of Replies to the Question "Do you have any Difficulty Cutting Meat According to the Consumers' Demands"

Response	Number of Responses	Percent
Can't furnish all the parts consumers' demand	24	45.3
Difficult to cut the exact amount of meat which the consumer is willing to pay for	15	18.3
Left over fat after selling meat	9	17.0
Cutting meat is often not an easy job	5	9.4

By contrast, those who favored the pre-packaged system said it would be good because they would not have to go to the trouble of cutting, weighing and wrapping meat; explaining about the quality of each cut when they sell it; and having to deal with possible complaints from customers regarding the quality of meat.

If retailers do deal only in pre-packaged meat, they will receive only a specific handling fee depending on the amount they sell. They seem to believe that they can earn larger profits by purchasing the carcasses of meat and selling portions after they debone and mix the various parts. In addition, most of the shops seem to believe they can better secure customers by meeting their demands with diverse cuts of meat, only obtainable through their personal butchering services. Also retailers seem reluctant to adopt other retail methods because the present method is a long-held custom, and it is profitable.

Once the meat is sold, it is taken by customers to their homes. Some stores delivered meat to patrons who ordered by telephone or asked for delivery, regardless of the amount. Others only delivered meat when the purchase was more than 6 kilograms. Such large purchases were not common.

4) The Purchase of Meat by Retail Shops

Since meat retailers purchase different types of meat from different sources, meat as a whole has a very complex marketing structure. But, individual types of meat have comparatively simple marketing channels. In the case of imported beef, for example, there are two alternate marketing channels; the National Livestock Cooperative Federation imports meat and distributes it in the form of carcasses to retailers; or the Livestock Cooperative and several other packers pre-package it and then distribute it to retailers. Therefore, the supplies of imported beef come either from the Livestock Cooperative or from the processors mentioned above. By contrast, domestic beef, pork, and chicken are supplied to retailers by private merchants and farmers directly or indirectly through wholesale outlets. (Table 10-4)

Retailers procure their order for beef, pork, and chicken over the telephone from either the Livestock Cooperative or the pre-packaging firms. When retailers want to purchase meat from wholesale markets, they need to work through auction bidders who are authorized auctioneers at meat wholesale markets or through a middleman merchant. No shop among those surveyed purchased live cattle or hogs at livestock markets and had them slaughtered at slaughterhouses for retailing.

Table 10-14. Replies to the Question "Where do you purchase the meat which you sell?"

Place of purchasing	Beef		Pork	Chicken
	Native	Import		
Livestock co-op	-	60	60	24
Slaughterhouse	14	-	8	27
Meat packer	-	10	10	-
Wholesaler	12	-	2	4

In the shops surveyed, the meat was delivered to retailers either by the Livestock Cooperative, pre-packaging firms, or auction bidders depending on what kinds of meat were purchased by the reailers. Only seven of the shops surveyed brought their purchases to their shops from the wholesale market of slaughterhouse. The frequency with which retail shops purchased meat was generally once every two to three days. A less common frequency was of once every five days (Table 10-5).

Table 10-5. The Frequency of Meat Purchasing by Retail Shops

Frequency	Beef		Pork	Chicken
	Native	Import		
Every day	-	7	-	-
Every 3 days	-	40	8	3
Every 5 days	6	23	51	31
Every 15 days	4	-	21	10

Some shops replied that they procured meat every day from either pre-packaging firms or other nearby meat retailers. These were generally small-scale retailers who dealt in other commodities as well and for whom meat selling was a side-line activity.

Purchases by retailers were settled in several ways. The Livestock Cooperative received advance payment. Other sources were paid at the time of the transaction or within five days. The credit period is short since meat, a highly perishable item, is sold in a few days at the retail level and payment is settled as soon as it is sold (Table 10.6). Therefore, it may be said that all meat transactions are settled either in cash at the time of the transcation or on short term credit because of the special nature of meat as a perishable commodity.

By comparison, grain dealers have to keep a larger operating inventory. Meat dealers on the other hand, should sell their goods quickly without much build up in inventory. However, meat retailers require relatively larger amounts of fixed investment for their storage facilities than do grain dealers. As a result, grain retailers require relatively large amounts of capital to store grains for long periods and rather smaller amounts for other special storage facilities.

Table 10-6. Replies to the Question "How do you pay for meat you purchase?"

Method	Beef		Pork	Chicken
	Native	Import		
Advance	-	58	52	22
Immediately after purchase	4	7	7	11
Within 5 days	2	9	12	6
Within 10 days	-	6	8	5

As for the question concerning purchase preferences between carcasses or pre-packaged beef, 81.7 percent of the retailers surveyed said they prefered carcasses. This suggests that meat retailers believe they can reap greater profits by cutting carcasses into boneless fresh meat for sale rather than selling pre-packaged meat for a specific handling fee.

At retail meat shops, the average total inventory of beef was 196.5 kilograms; 73.4 kilograms was beef from Korean native cattle and the remaining 123.1 kilograms was beef from imported cattle. Thus, inventories of imported beef were on average 67.7 percent greater than those of domestic beef. The inventories of pork and chicken were 53.3 kilograms and 5.1 kilograms, respectively, much smaller than beef inventory. Given that the amount of total operating inventory is roughly euqal to three days' sales on average. These inventory statistics indicate the small scale operations of meat retailers in Korea.

5) Management Returns in Retail Shops

Meat retail businesses were mostly small-scale shops. However, and average operating fund of 3,550,000 Won per shop was needed in order to pay a key money advance as a condition for selling imported beef. Thus, meat retail shops require a considerable amount of capital, but the meat retail business is being looked upon as somewhat promising by small-scale merchants with considerable funds.

As a concrete example, only 23 of the retailers surveyed purchased already established meat shops when they first entered the business. The remaining 57 opened new shops and had to obtain the necessary facilities by themselves.

The average sales of beef and pork per day were 65.2 kilograms and 50.4 kilograms, respectively. No acurate figure of profits accruing from such sales could be obtained. With the exception of pre-packaged beef, it was difficult to determine the amount of profits. This is because profits differ depending on how the carcasses are cut and sold at retail shops. One obvious observation was that when retailers sell pre-packaged beef supplied by the Livestock Cooperative, they are assured of receiving a fixed rate handling fee equal to 7 percent of their sales. Most retailers believed that the profits from cutting carcasses into boneless fresh meat for sale are more than 7 percent handling fee on sales of pre-packaged beef.

For example, suppose that daily beef sales per shop were only 65.2 kilograms of imported beef at a price of 3,200 Won per 600 grams which includes the 7 percent handling fee. In order to obtain a to get similar amount of net revenue from the sale of pork retailing would have to sell 50.4kg at a price of 2,100 Won per 600 grams. The combined net revenue per day, would be 24,341 won for the beef and 12,348 won for the pork. When we assume that shops are open 29 days per month, the total monthly gross revenue would be 1,063,981 won.

The average monthly operating cost per store was 276,763 won (Table 7). The charge for electricity to power large refrigerators and automatic meat cutters accounted for 47.3 percent of the total cost. The share of wages for employed workers represented 16.7 percent, while the cost of wrapping paper and water were 5.0 and 4.4 percent, respectively. Telephone charges accounted for 4.4

percent of the total expenditures, and miscellaneous expenses were another 22.2 percent.

Table 10-7. The Average Amount of Operating Expenses Per Month at Retail Shops

Cost Items	Total Expenses	Percent
Electric charges	131,000	47.3
Water charges	12,250	4.4
Wrapping papers	13,775	5.0
Telephone	12,088	4.4
Wage for hired labor	46,125	16.7
Other	61,525	22.2
Total	276,763	100.0

The net revenue acquired from the sale of meat was roughly estimated to be 787,218 won per month at each shop for the sale of pre-packaged beef, since the operating cost per shop was 276,763 won per month for the domestic beef and pork. Shop owners believed that as their shops handle more carcasses of meat, their revenues increase. This amount is not large taking into account the fact that the cost figures used did not include the interest on facilities investment and operating funds, rent for the shop, and remuneration for the labor of the shop owner and his or her family members.

Although meat retailing does not generate large profits, it is still considered as a viable enterprise for a person with a relatively small amount of independant business funds. This is because employment opportunities are limited in Korea.

When asked if the profits earned from their meat business were enough to meet their household expenditures, 20 percent replied that they were not. By contrast those who replied that profits were sufficient represented only 3.8 percent of the total. Another 23.7 percent said they had no difficulty meeting their household expenses with their business profits, while the a remaining 42.5 percent said that they barely managed to make both ends meet. These replies however, were not based on any clear criterion. Only 42.5 percent of owners said that they would consider switching their business. In other words, more than half of the meat retailers planned to continue in the business.

When asked what they thought about the present prices of meat from the dealers' perpective, most of the respondents replied that they considered the price of beef is adequate. The next largest group said the prices of imported beef were too cheap. The smallest group said the price of imported beef were too expensive. It is interesting to note that the responses of these groups differed depending on the type of meat they sold. More retailers thought the price of imported beef was too cheap rather than too expensive. In contrast, more retailers thought the prices of pork and chicken were too expensive rather than too cheap.

According to 81.3 percent of the retailers, the price of imported beef was reasonable. According to 6.2 percent and 12.5 percent respectively, it was too expensive and too cheap. Those who thought the price of pork was appropriate accounted for 61.3 percent of the total respondents, a little lower than in the case of the imported beef. Those who felt pork was too cheap and too expensive represented 16.3 percent and 22.5 percent, respectively. Feelings about the prices of meat were not unanimous among all the shops. In fact, 12.5 percent of all retailers thought the price of imported beef was too cheap and 22.5 percent of them believed that the price of pork was too expensive. These responses indicate that the price gap between the imported beef and pork is rather small. It seems that this price differential is something that has to be reviewed from a policy standpoint.

Table 10-8. Replies to the Question "What do you think about the present prices of meat?"

Response	Beef	Pork	Chicken
Cheap	12.5	16.3	11.4
Reasonable	81.3	61.3	57.2
Expensive	6.2	22.5	31.4

The most common difficulty reported in the operation of meat retail shops was that seasonal sales fluctuations resulted in an unstable business. The next most common complaint was that profitability was low and that retailers could not offer some cuts of meat in high demand in sufficient amounts. Other difficulties included maintaining the freshness of meat; collecting credit; high taxes in comparison to profits; and National Livestock Cooperative Federation demands for advance payment which added to financial problems. The characteristics of meat as a commodity and the seasonal fluctuations in consumers' demands do make retail profitability unstable. If profitability is low and business unstable, it is unlikely that marketing improvements will be brought about by the retailers themselves.

10.4 Direction of Future Improvements in the Meat Retail Market

It is only in recent years that people began to consume meat in large amounts, with meat becoming a more important food in Korea. In parallel with the growing national income, people's dietary patterns began to change toward western model of higher animal protein consumption.

The major change in food consumption has been a decline in grain consumption per capita, by 19.9 percent during the last sixteen years. This is due mainly to a substantial decrease in the consumption of barley. On the other hand, per capita consumption of vegetables, fruits, meat and other dairy products, and fish has increased sharply in the same period.

Meat consumption increased steadily since 1970, however per per-capita consumption of 15.7 kg of boneless meat among Koreans is still low compared with Japan 35.4kg and Taiwan 55.8kg of carcass basis in 1987. Meat consumption in Korea is expected to continue to increase, until it at least reaches the present level of consumption in Japan or Taiwan.

To meet increasing market demand, there should, of course, be more domestic production and increased imports from abroad. But, the question of marketing is just as important. Increases in national income generally result from urbanization or industrialization. To feed the urban and industrial population, much more food must be shipped to urban and industrial areas from production sites and the points of import. Only when this occurs in an effective and efficient manner can the cost of marketing be reduced, and both farmers and consumers obtain maximum benefits.

Retailers need to keep the carcasses bought from wholesalers in cold storage for a specific period of time and then cut and sell the carcass in small amounts in response to the demand of a large number of consumers. Therefore their function is the processing and selling of the meat at the final retail marketing stage. In this connection, the profits of meat retailers include not only the margin which accrues from the retail of the commodity but also a profit margin that arises from the processing of the meat, i.e., cutting carcasses into small parts and deboning the meat. For a large number of small-sized meat retailers it is not easy to increase these profit margins. It is difficult to generate any cost reductions other than those arising from economies of size. In other words, while reduced marketing costs are desirable, no marketing cost reductions can be expected with the present marketing structure.

In order to reduce the current inefficiency of retail meat marketing facilities, this study now explores some possible directions for the meat retail business in the future.

(1) A new type of marketing structure can be envisioned which facilitates the direct participation of farm households producing

livestock. For example, the profits generated by mass transactions can captured by producers if the livestock is shipped through the different levels of Livestock Cooperatives. Livestock can be collected from the many producer farm households and delivered to the market via the National Livestock Cooperative Federation. In this way a single shipping outlet would replace the present inefficient channel of numerous small outlets. This would be a more convenient form of transaction and would reduce the costs of shipping the product to the market. It might also result in greater profits since the timing of shipments could be adjusted more effectively in response to market conditions.

Of course, no economic benefits can be gained merely through a quantitative increase in the volume of transactions. Investment in various technical facilities is required for effective marketing functions at either the present or an increased volume. Even if the Livestock Cooperative assembles and ships a large number of livestock, there will be no significant cost reductions unless modern slaughtering facilities and large cold-storage rooms and trucks are available. This may be the reason why the majority of farmers show little interest in channeling their shipments through the Livestock Cooperative, as they know that they will be no better off due to inefficiences elsewhere in the marketing channel.

(2) A growing number of people favour some form of production marketing integration to stabilize profits. More specifically, to reduce the risks in the production and marketing there should be

vertical integration. The number of livestock farms, processors, wholesalers and retail levels should be integrated. In this way business returns can be stabilized.

When integration occurs in the livestock sector, benefits will be realized. For example, with the expansion in management size, uniform hybrid livestock can be raised. Of course, modern technology must first be introduced and advantageous prices established for the purchase of feed and the sale of livestocks for such benefits to be realized. There is some possibility that problems will arise in setting contracts regarding livestock production between farmers and livestock enterprises. Another problem might occur if livestock enterprises reap excessive returns due to unexpected increases in the price of fattened animals. This latter problem could be solved by returning part of such excessive profits to the producing households.

(3) As an alternative to integration, cattle and hogs fattened to market might on the farm can be collected and slaughtered at modern slaughterhouses in rural areas and supplied to cities in large freezer-equipped vehicles. Another method would be to prepackage meat in small amounts for direct delivery to meat retail shops. In either case, reductions in marketing costs can be expected in comparison with the present system whereby livestock is shipped to cities for slaughter and distribution. The major problem with this program lies with the purchasers, for it creates a new marketing channel and, therefore, presents a challenge to the existing system.

(4) Livestock producer organizations can engage in direct sales by operating meat retail shops in consumption areas. Here, the problem is to ensure that sales are large enough to meet the expenses incurred in the maintenance of such shops. Meat retail shops are generally small in size and are family businesses. Most of them are not in a position to expand due to a lack of capital for additional facilities to handle larger volumes. The most important considera- tion for retailers is the maintenance of a high degree of freshness for consumers who purchase meat in small amounts at their neighbor- hood meat shops. If meat is to be sold by producers directly to consumers, standardization would have little appeal unless the quality of meat of various cuts and weights can be displayed correctly, and sold at different prices depending on cut and quality. This improved service should find support among consumers. Still, it would take a long time for consumers to appreciate the benefits they would gain by purchasing meat from such a direct sale shops.

In addition, these direct-sale shops must have better sanitation and retail facilities than ordinary meat shops and must possess large amounts of capital for use as operating funds. It would of course be difficult for direct-sale shops to secure sales in amounts large enough to generate profits to meet such capital requirements. Especially if direct sales shops are specialized exclusively in beef and pork, they would face a greater disadvantage in securing customers than shops dealing in more varied types of meat.

To increase the sales of direct retail shops, unlike ordinary meat shops these new ventures should also sell processed meat, such as ham, bacon and sausage. In addition, they should make serious efforts to provide more honest transactions in terms of quality and weight than those provided by ordinary shops. Finally, careful consideration should be given to the selection of store location with perhaps the best place being the corner of supermarkets. The careful selection of qualified managers is also important.

The plan outlined above would contribute indirectly to improving the current retail meat market situation by providing necessary competition, thus inducing other meat retailers to increase their marketing efficiency.

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XI . Policy Implication for Livestock Industry

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Throughout Korean history, rice and other grains have been the most important staple foods. Because arable land is limited in size as compared to population, Koreans had to utilize the land for production of staple foods rather than livestock products. Raising livestock on farms has not traditionally been a back-yard business.

A rice-oriented farming system was established as the basis of Korean agriculture. It is often said that the Korean people enjoy rice above all other foods since Koreans eat rice all the time. However, it is not that they like rice more than livestock products. Rather, livestock products represent a luxury item as far as low-income people are concerned. As a matter of fact, low-income people need to keep down their living costs and so eat rice and other grains in place of expensive meat and milk.

The general trend is that the most Koreans, even though their staple food is rice, eat more meat and livestock products as their incomes increase. In the past, the per capita consumption of farm products, particularly cereals, steadily increased as per capita incomes increased to about $500 dollars on the average. Recently with increases in average incomes above $500 per capita level,

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consumption of animal protein such as meat and livestock products has doubled in the past 10 years. Projecting from this experience, it can be assumed that the relative share of animal protein in the diet of Koreans will continue to increase in the years to come.

However, the extent of such increases in consumption will not reach Western levels due mainly to the small physical size of Koreans, their unfamiliarity with a meat-oriented diet, and lack of knowledge about different cooking methods. In other words, even if incomes grow substantially in Korea, the meat consumption of the Korean people will remain far lower than Western levels.

Previously, livestock in Korea was not an enterprise but rather a farmer's sideline business on the traditional crop-oriented farms. Farmers needed to raise Korean cattle mainly for draft uses. Before utilization of farm machinery, on average, one draft cattle was required for every two farms. Raising of hogs and chickens was also done in relatively small numbers for household consumption and for sale. Feeding livestock utilized small portions of coarse grains and the by-products of crop farming rather than commercial feeds.

Recent increases in the demand for meat and livestock products created higher price levels, and encouraged farmers to raise more livestock than ever before. It is said that livestock production in Korea has reached a turning point now because farmers have started to raise livestock mainly for sale rather than for on-farm use. However, the expansion in the number of livestock by the traditional farms could not keep pace with the increasing demand for livestock products due mainly to the shortage of capital to be invested, unstable price levels for livestock and farmers' unfamiliarity with large-scale livestock raising.

This situation attracted the entry of livestock farms organized by non-agricultural sector entrepreneurs. These new types of farms have been established solely on a commercial basis. Thus, they raise large numbers of livestock and benefit from economies of scale. So, even though relying on commercial feed, they produce meat and livestock products at lower costs than traditional farmers who raise a small number of livestock as a sideline business using by-products. In particular, raising hogs and chicken in the suburbs of large cities has been a profitable enterprise for such entrepreneurs.

Increasing demand for commercial feed, generated mainly by these new types of livestock farmers, created a number of large factories for feed processing. These are becoming prosperous enterprises in terms of increasing volumes of business. To supply materials for these factories, about five million tons of feedgrains have been imported every year.

Korea needs to further develop the livestock sector if self-sufficiency is to be reached. Of course, such development in the livestock sector cannot simply be attained as a matter of course in the economic development of a country. In consideration of this and the fact that greater development of the livestock industry means greater stabilization in meat supply and other livestock products and an ability to keep pace with possible increases in consumption in the future, livestock policy is going to be very important in Korea. The following policies and ideas should be considered.

12.1 Development of Feed Sources for Ruminants

The securing of domestic feed sources is a must for the livestock industry. Since all kinds of feed resources are scarce as compared with needs in the livestock sector, feedgrains including corn and soybean meal are mostly imported for processing as assorted feeds. So far, the import of feedgrains used as assorted feeds has not faced problems with sources of supply, but rather problems of limitations of foreign exchange. So, it is necessary to think about additional domestic supplies. For cattle production, forage crops, grasses, and roughages as well as concentrated feeds produced in Korea can be used. Grains other than corn could also be used because the price levels of millet, barley, oats and potatoes are cheaper than corn. In addition, it would be possible to import such coarse grains based on their relative price levels.

However, if feedgrain sources are limited to corn, Korea must import a certain amount every year since it is difficult to increase corn production due to the small amount of arable land devoted to corn production. However, if barley can be used as a feedgrain through the reduction of production costs, Korea would be able to produce a considerable amount of feedgrains. Also, the potential for the development of other feedstuffs would be increased.

Historically, barley has been used as a staple food in Korea, and it has been an important grain next to rice. However, as income has increased in the course of economic development, the consumption of barley per capita has steadily declined year after year, and now barley is regarded as an inferior food grain. On a long term basis, therefore, barley would be used not only as a foodgrain but also as a feedgrain if price decreases occur.

In many developed countries, barley is already used as a feedgrain and only a small fraction of it is used as food. By using surplus barley as a feedgrain, Korea would be able to sustain the production of barley and increase the utilization of idle paddy fields by returning to the traditional rice-barley double cropping system. The use of barley as a feedgrain would be highly significant in that it could substitute for imported corn.

Besides barley, the cultivation and use of sweet potatoes as feed has to be studied on a long-term basis. Since the yield of sweet potatoes per acreage is higher than that of any other crop in terms of nutritive substance, the development of the method of its use as a feedstuff could contribute much to the increase in self-sufficiency in livestock feeds.

It also is important to increase the efficacy of rice straw utilization which is often used as a roughage for feeding cattle. Since rice is the most important product in terms of amount of production and value, rice straw is also the biggest by-product of farming. Its use therefore would be very helpful in decreasing the production costs of cattle.

Since roughage like rice straw is bulky compared to its nutritive value, it is costly to transport or to transform it for use on other farms. However, it is convenient for use by farmers when available as a result of their own farming operations. Indeed, rice straw has been used as roughage, particularly for feeding native Korean cattle and milk cows, and constitutes an extremely important element in sideline businesses of traditional small farms since these farms do not have even small plots of pasture due to the limitation of arable land.

In regard to cattle production as a business enterprise, the amount of rice straw produced cannot meet fully the feed requirements because of difficulties in nutrient elements. Those farms engaged in cattle raising as an enterprise must have access to a considerable area of pasture if profits are to be realized. For this, pasture land should be increased through reclaiming hill and forest land so as to meet the shortage of roughage and save labor by letting the cattle graze.

The development of pasture is technically possible on some mountain or forest lands. However, this would require a huge amount of investment in order to put parts of idle or mountain lands into pasture. Therefore this type of development can be achieved on a significant scale only with supporting policy initiative because of the large capital investment requirements. If favorable policies do not exist, pasture areas cannot be expected to be developed.

12.2. Price Stabilization of Livestock Products

In order to encourage livestock production by traditional farmers, price stabilization is required. Usually the price of livestock products is determined by the quantity of supply and demand at the market. One feature of transactions in agricultural products is that producers are in the position of price takers, and thus farm producers can only determine the amount of products to be marketed at a given price level. It means that farm producers are less able to set price levels than the producers of general industrial products who are essentially price makers.

So, if the price of livestock products is too low or market prices are unstable, it becomes difficult for individual farms to make production decisions. As a result, total production nationwide becomes unpredictable, which in turn makes the price of products unstable. A vicious circle of instability of price and production will occur. In particular, producers of livestock face is more difficulties in controlling production than crop producers. Since the number of livestock cannot be easily adjusted within one season or year, the degree of price changes is usually bigger and lasts longer than that of other farm products.

Because of this special nature of livestock farming, price stability is essential to ensure stable production. To achieve this goal, it is necessary to establish a price stability zone that limits the scope of price fluctuations within a specific ranges. Such price targets enable producers to adjust their produc tion based on the price levels within the stability zone established. As a result, such stabilization policies should help offset any losses in farm income resulting from price changes which stem from transitory imbalances between demand and supply. In addition, producers have more accurate ideas about possible price fluctuations making it easier for them to make rational production decisions.

The price stability of livestock products, in addition to having the effect of stabilizing demand and supply, is important in rationalizing the livestock production of individual farms through minimizing production costs. When livestock prices fall to stabilize and undergo deep fluctuations, we have experienced widespread liquidation of herds. In the hog market, for example, when market price fails to exceed production costs, many small-scale producers of hogs as a sideline business cannot survive the market downturn, and thus most small traditional farms tend to sell their animals at the same time. This leads to further price slumps and economic losses for small-scale producers. However, large scale commercial hog producers can continue production for a long time even under such conditions.

Price fluctuations are especially likely to take place in cattle and hog markets since these animals have longer physical development periods and marketing cycles than chickens for example. The farm enterprise is supposed to engage in livestock raising as a rational economic production activity. If farmers must indulge in speculative transactions in order to take advantage of price changes, management cannot be stabilized. On the other hand, if the prices of livestock became stabilized, producers would try to seek earnings by reducing the production costs of livestock products. Such efforts would lead to the development of improved farm practices and they would contribute to solidifying the livestock industry as a healthy component of the Korean agricultural sector. Therefore it is necessary to have a systematic policy device to ensure the stability of prices.

12.3. Expansion of Livestock Production by Traditional Farms

With the great increase in the demand for livestock products due to income increases, Korea has been faced with the problem of a supply shortages. As a result, possible changes in the structure of the livestock industry have debated quite extensively. Since the livestock industry in Korea has traditionally taken the form of a sideline or backyard business activity on farm households, the question is whether to maintain the industry in the same form as a sideline business, or to operate it as a form of enterprise on a larger scale.

Another issue is whether farmers should switch their sideline business into full-time livestock farming operations. At one point, emphasis was strongly placed on livestock raising as an enterprise. This was based on two ideas. One, the management of livestock raising should be rationalized instead of being undertaken as a sideline business of farm households. Two, the adoptation of new technologies is important in livestock raising.

Recently, the poultry and pig-raising sectors which depend wholly on imported feeds have increased in number. For this, a number of livestock entrepreneurs from non-agricultural sectors have entered this business. The total production of these farms accounts for a large share of the production of chicken and hogs.

When we take into account most farmers are becoming knowledgeable about how to manage livestock farming properly and the fact that in order to fulfil the role of the livestock industry in the national economy, namely the stabilization of market prices. However, other social and economic goals such as boosting farm household incomes and utilizing idle farm resources, suggests that the livestock industry in Korea should stress production by existing farm households rather than the entry of new large-scale commercial farms. Stabilization of market prices and increasing knowledge of livestock management skills would promote traditional farm household production.

Market supply by traditional farms is still very important in terms of their shares in cattle production. Other factors are also very important when considering the contribution of traditional farms to livestock production. These farms are utilizing available idle resources such as the by-products of cropping, wild grasses and other under utilized natural resources. Considering that most Korean farms only have a small amount of land, livestock raising can increase farm income through the more effective use of farm labor. Thus the difference in income levels between the people in farm and non-farm sectors can be reduced. The problem with this situation is that the further expansion of livestock numbers by traditional crop farms will not be easy in the foreseeable future.

One of the major changes in the course of economic development is the fact that the managerial scale of livestock raising expands. Such a change is due to relative changes in the prices of various inputs necessary for the production of livestock products. For one thing, if labor costs increase, it is necessary to increase the number of livestock per worker in order to reduce the unit cost of wages.

Therefore, it can be said that the management intensification in the livestock industry is an inevitable phenomenon emerging in the course of economic development. Yet, questions remain about whether full-time livestock farms are necessary specialization within a capitalistic economy.

The question of whether to raise livestock as a full-time business or a sideline business depends also on market conditions such as price levels and on the kinds of livestock. If there are available resources left unused and idle at farm households, sideline livestock raising could be a very desirable business since it would be possible to increase the number of livestock raised without additional cash expenses.

Such forms of livestock raising by traditional small farms presently prevail in cattle production throughout the country. A farmer can easily raise one or two head of cattle with the by-products of farming or wild grasses with utilization of family labor. So, the production of native cattle as a sideline business could be one of the most appropriate types of livestock farming to increase farm income. Of course, this does not mean that small farm herd sizes can be expanded indefinitely. The optimum number of cattle for farm households can only be determined in light of its resources, namely, available feed and labor. An analysis of production costs in this study showed that the optimum number of cattle raised per farm is seven or eight head.

In hog and poultry raising, however, we do not have data about the optimum numbers for efficient utilization of the idle resources of traditional farm households. Usually the greater the numbers of livestock, the less the unit costs of production. However, most farm households are not in a position to enlarge hog and poultry production due mainly to a lack of capital, lack of skills, limited availability of improved breeds, low market price levels, and so on.

If policy choices are to be formulated in relation to the goal of enabling the livestock sector to serve as a means of increasing farm incomes, positive efforts should be made by the government to exempt tariff for importing feedgrains to supply cheaper assorted feed, institute loans at low interest, extended services for livestock farming, arrange for the distibution of improved breeds, and exercise some control over the new entry farm by outside entrepreneurs.

Such support is needed to make livestock production a viable industry and an attractive sideline business which will help to foster on-farm livestock production. If livestock production on traditional farm households is left to compete with commercial farms without policy help, traditional farm households will be unable to diversify into livestock production as a means of boosting farm income.

The interrelationship between on-farm livestock raising as a sideline business and livestock raising as an enterprise is important one. Livestock production as an enterprise complements on-farm livestock production in the areas of development of new techniques and demand expansion, but both types of enterprises compete with each other on the supply side in the battle for market shares.

Until now, however, production of beef and milk was not large enough to meet demand and thus the shortages were met with imports. This situation produced no keen competition between the two types of livestock raising farms. In contrast with this situation, in the pig and poultry sectors, prices may plummet due to competitive over-production. So, price stability requires some production controls.

Usually small farms tend to sell off their livestock as early as possible when the prices are decreasing. However, livestock production on large-scale funded with large capital by businessmen in the non-agricultural sectors are able to maintain production levels while losing money in the short-term. They, however, often benefit from price hikes when the market improves. That is why the selling of livestock production in the commercial sector is required in order to protect small livestock producers and discouraged them from liquidating the animal assets when prices fall.

12.4 Improvement of Marketing for Livestock Products

Of equal importance is the improvement of marketing. In general, livestock producers sell their products at farm level and do not take part in the marketing of the products. There is an independent organization which is operated by farmers to deal with the transactions in livestock products. Producers, however, do their own marketing. However, most livestock producers are involved only to a small extent in market supply, since they believe that cooperative marketing does not help obtain a better price in the market. In order to improve their marketing activities, an important step would be an efficiently-operated producer cooperative.

Without involvement in marketing activities through cooperatives, it is difficult to adjust farmers' production to market demand. Particularly in the case of livestock products, market sale rather then more consumption takes precedence. In this view, it is desirable to operate effective cooperatives to link production with consumption and to stabilize market prices. Considering there are over 100 livestock cooperatives nationwide, it is important to further strengthen their marketing functions to help them receive better prices for members.

Especially in the poultry and hog farms which face chronic overproduction problems, it is necessary to improve marketing functions of the cooperatives so that producers can adjust their production to market demands. To complement this program, the large scale of commercial farms should develop or expand the markets for their products rather than dumping their products at existing market outlets. It is important to note that such commercial farms share over 70% of the total market supply and thus they can exert significant power over price levels if they act cooperatively.

To adjust the quantity and type of livestock products to meet seasonal demand functions, it is necessary to have adequate storage facilities. In this regard, the milk processing industry shows considerable development. However, meat and poultry processing industries are still at a rudimentary stage. Since the processing of livestock products is extremely important in the marketing of perishable livestock products, establishing a greater number of efficient livestock processing industries could be part of a major livestock policy program. This is an important area that needs to be further developed.

In addition, the method of selling meat should be improved in a way so that the quality of meat can be distinguished by grading. Despite the fact that the quality of meat differs depending on its cut, all meat is sold at the same price. Since there is no grading system is distinguish cut of meat in the current sale of meat at butcher houses., the motivation to improve quality is lacking. Differentiating products by grading serves to create different qualities of meat. This could contribute to the expansion of the meat market as well provide better information for consumers.

Demand for many livestock products, especially beef, will increase in the coming years. Marketing savoir-faire will be increasingly important. For the improvement of marketing activities, the government has traditionally relied on through various laws and regulations rather than on expansion of marketing facilities to ensure efficient marketing functions and reduce marketing costs. With such a kind of intervention alone, we cannot expected efficient markets and price stability because longterm measures are required to improve the marketing of livestock products. For instance, in the case of cattle, it takes two or three years to yield a certain weight to be marketed. Therefore it is hoped that the government will play a more positive role in marketing improvement by implementing a long-term plan.

12.5. Increased Supply of Beef from Milk Cows

There are many persons who contend that the cattle raising for milk instead of draft cattle or beef cattle is more desirable because of the anticipated increase in consumption of milk associated with income growth. However, the problem is that the pace of milk consumption increase has already slowed down and no significant expansion of consumer demand can be expected. Infact milk is not a customary food in the Korean diet, although it is a good food with high nutritive value. In general, the young generation likes milk more than the old generation, and thus it is easily expected to increase in the number of milk cows further. However, people tend to avoid the beef of milk cows because it does not taste as good as that of native cattle.

In view of the shortage of available livestock resources, it might desirable to raise cows rather than native cattle in order to supply of milk and beef through slaughtering unproductive old milk cows and young male cattle. To this end, a low price separate from that of Korean cattle should be established. Under the present system in which the price is the same for all kinds of beef, it is natural that consumers prefer the most the better tasting Korean beef cattle.

Feeding efficiency is important not only Korean native draft cattle, but serious efforts also need to be made to reduce costs of feedstuffs which comprise the highest portion in the production costs of milk. To this end, it may be possible to plant forage crops or pasture grasses on paddy fields as the second crops after the rice harvest in fall. So long as domestic beef production depends wholly on the commercial feeds manufactured from imported grains, production costs will remain much higher than the international market price.

Since the price elasticity of beef is higher than that of other meat, a weakness exists that if beef is supplied at an excessively high price, other meats or foods could be substituted for beef. Therefore, instead of relying on the market prices of their livestock to increase income from livestock production, farmers should try to help expand the consumption of beef. If expansion of income-elastic beef sales will occur only through lower prices, then livestock industry profits can only be obtained through reduction of production costs. So, it would be worthwhile to develop cost reduction practices through the utilization of idle domestic resources and improved breeding practices.

12.6 Extension Services for New Farming Practices

Since the livestock industry began as a sideline business incidental to crop farming, many farmers are not experienced in livestock management techniques. A comparison of the managerial returns from livestock raising by traditional farms shows that there is a wide range of differences which depend on the ability of the managers. Farmers who are raising livestock should be knowledgeable enough to earn money from the business under competitive market conditions.

In order to achieve such levels of managerial skills, traditional farmers must be trained in new farming techniques by the extension agents working at the farm level. Unfortunately, the extension service is presently better qualified to guide farmers in crop production. Thus, it may be necessary to recruit livestock specialists as field extension workers. In order to meet the increasing demand for specialists in the livestock sector in the future, the rural guidance workers should make available professional knowledge about livestock farming.

It is also important to strengthen the guidance programs relative to other activities currently emphasized by the National Livestock Cooperatives Federation. Presently, only one department is charged with technical guidance at the Federation. Since guidance services are one of the core activities of the cooperative movement, they must be further envigorated not only for better livestock farming but also for the growth of cooperatives themselves. Once a suitable numbers of well qualified extension workers are available, more possibilities will exist for the widespread dissemination of new practices to farmers.

At the same time, there are many other things to be developed to improve the livestock farming operations of traditional small farmers. In particular, professional and technical knowhow for the creation of pasture land on the hillsides is still difficult. In order to strengthen the relevant research work in this area, some specialized research organization devoted to study of pasture development is needed.

Many trials must occur before any new farming technologies is introduced and adopted. There will be some errors and even some failures. Therefore, the role of research organizations cannot be overemphasized in their efforts to minimize such technical innovation problems.

Much technical research on agriculture cannot in reality be undertaken in private organizations. Much research is only appropriate for public institutions. If new technology appropriate for the livestock industry can be marketed through private channels too, it can be developed by private organizations. However, since the development of many farming practices are but nature non-marketable goods, the common practice is for public organizations to develop and disseminate such expertise in the interests of the wider public.

Thus, in the development of professional knowhow about the livestock industry, there should be a distinction made between professional livestock specialists employed by livestock farms and the recruitment of experts by public sector research organizations charged with developing and disseminating new practices in livestock farming.

The development of the livestock industry, of course, serves to secure an uninterrupted supply of livestock products. It also leads to a more complete utilization of domestic resources. In consideration of this and the fact that the greater development of the livestock industry means greater farm incomes, livestock policy is very important in Korea.