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Symposium on the Prospects for Industrial Meat Processing in Developing Countries

Vienna, Austria, 13-17 October 1975

DEVELOPMENT OF MEAT PROCESSING INDUSTRIES IN VARIOUS COUNTRIES[1/]

N. E. Wernberg*

*Consulting Engineer to the Meat Industry, Copenhagen, Denmark

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Organisation des Nations Unies pour le développement industriel

Colloque sur les perspectives du traitement industriel de la viande dans les pays en voie de développement

Vienne (Autriche), 13-17 octobre 1975

DEVELOPPEMENT DES INDUSTRIES DU TRAITEMENT DE LA VIANDE DANS DIVERS PAYS

Résumé[1/]

N.E. Vernberg*

L'auteur fait brièvement l'historique de l'industrialisation du traitement de la viande, commençant par les Etats-Unis d'Amérique et ses grandes usines de conserves et poursuivant par le développement des abattoirs coopératifs dans les pays scandinaves ainsi que l'introduction de l'abattage à la chaîne dans les abattoirs municipaux européens.

L'auteur parle de la tendance actuelle à optimiser la taille des abattoirs industriels, avec implantation dans les régions d'élevage d'installations de traitement préliminaire des sous-produits, d'équarrissage et de conservation, les produits étant ensuite expédiés vers les centres de traitement et de consommation. S'agissant des pays en voie de développement, l'auteur fait valoir l'énorme potentiel d'un bétail qui

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1/ Les vues et opinions exprimées dans le présent document sont celles de l'auteur et ne reflètent pas nécessairement celles du Secrétariat de l'ONUDI. Le présent document est la traduction d'un texte anglais qui n'a pas fait l'objet d'une mise au point rédactionnelle.

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This paper describes briefly the historical development of the industrialization of the meat trade, starting in the U.S.A. with the large meat packing plants, followed by the development of farmers' co-operative slaughterhouses in the Scandinavian countries, and the introduction of industrial slaughtering lines in European municipal abattoirs.

The author mentions the modern trend towards optimum size of industrial slaughterhouses with preliminary by-product processing and carcase cutting and packing plants placed in livestock producing areas for shipment to processing and distribution centres in consumer areas.

With regard to the situation in developing countries, the author emphasizes the enormous potential of livestock which is so poorly exploited, and recommend country-wide studies of experts for surveying the existing situation regarding production of livestock and reporting existing facilities for and methods of slaughtering, processing, and marketing meat and by-products. The studies should include projections for future livestock production and meat consumption, and should give recommendations regarding locations and capacities of regional slaughterhouses, meat processing factories and markets to be maintained or established. They should also advise on the most suitable type of layouts and plant to be introduced. The author includes in the appendixes to his paper typical layouts of meat processing plants as well as an extract of a country-wide study in a developing country. He also mentions two extreme case studies.

Finally, he is evaluating the future development in various parts of the world based on statistical information concerning meat production given in F.A.O. Agricultural Commodity Projections 1970-80. This evaluation is concluding in a prediction of the possibilities for establishment of meat processing industries in the three economic classes of countries of the world, and of the investments required in this field.

est si mal exploité, et recommande que des experts fassent des études par pays pour examiner la situation en ce qui concerne la production de bétail et les moyens et méthodes d'abattage, de traitement et de commercialisation de la viande et de ses sous-produits. Les études devraient comprendre des projections relatives à la production de bétail et à la consommation de viande, ainsi que des recommandations concernant l'implantation et la capacité de traitement des abattoirs régionaux, des usines de traitement de la viande et des débouchés à créer. Les experts devraient aussi donner des avis sur l'implantation et les installations convenant le mieux. L'auteur inclut dans les annexes de son étude des plans d'implantation types pour des usines de traitement de la viande ainsi qu'un extrait d'une étude faite sur un pays en voie de développement. Il cite aussi deux études de cas extrêmes.

Enfin, l'auteur évalue l'évolution future dans diverses régions du monde en se fondant sur des données statistiques concernant la production de viande qui figurent dans les projections de la production agricole faites par la FAO pour 1970-1980. Il conclut cette évaluation par des prévisions des possibilités de créer des industries de traitement de la viande dans les pays rangés dans les trois classes économiques et des investissements nécessaires dans ce domaine.

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We regret that some of the pages in the microfiche copy of this report may not be up to the proper legibility standards even though the best possible copy was used for preparing the master fiche

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INTRODUCTION

Meat processing comprises not only the primary operation of slaughtering, but all operations necessary for preparing the meats and processing the slaughterhouse by-products, edible as well as inedible, ready for sale on the various markets.

Meat processing comprises in this context all raw materials originating from the slaughtering of domestic animals as cattle, swine, sheep and goats, poultry and rabbits. The industrialization of these processes has primarily been developed in the industrialized parts of the western world over the last century. Considering the world market as a whole, one must, however, admit that the preparation and processing of meets and slaughterhouse by-products still to-day most places must be characterized as a handicraft serving a retail trade.

The scope for an industrialization in this trade is, therefore, enormous, but the realization requires a foregoing development of social and economic standards as well as a break-down of many traditions, of which the religious traditions are the most difficult to bypass.

I. MEAT INDUSTRIES IN DEVELOPED COUNTRIES

The first revolutionary principle of industrialization started in the meat trade with the introduction of line-slaughtering in American meat-packing houses in Chicago about 150 years ago. Here the carcases were elevated to suspension from an overhead rail along which they were conveyed from operation to operation, passing a team of stationarily positioned operators. It is told that this principle of industrial operation was later copied by Henry Ford, when he developed the automobile industry. It is a fact that this principle in the meantime became basic in most other industries. The meat industry has in other words been pioneering in this respect.

The original type of American meat-packing houses developed gradually into very large industries, located in consume centres, being the larger cities, like Chicago.

The animals were brought to these centres from distant producer areas, to begin with on the hoof, later by railways and lorries. The animals were slaughtered in the industrial lines. The dressed carcases were shipped whole, in halves, or in quarters, or they were in some cases broken down into suitable wholesale fresh-meat cuts, all for distribution by means of refrigerated trucks or refrigerated railway wagons to central markets or other distribution centres in consumer areas. Local butchers were the buyers and took care of the cutting up, the trimming and down-breaking of the carcases as well as the portioning for the retail trade.

The large slaughtering capacity in these centralized plants raised naturally the problem of developing efficient and economical utilization of large quantities of by-products, such as meat trimmings, bones, fats, red and white offal, glands, hides and pelts, blood, hair, horns and hooves, confiscates, etc. The American packing houses became, therefore, also the first to industrialize the processing of the large quantities of such raw materials into all sorts of edible products, like canned meats, sausages, fats, tripes, casings, pharmaceutical products, and of the inedible products such as blood, bone- and meatmeal for animal fodder, technical fats for soap works, hides and skins for tanneries, etc.

The largest of the American meat-packing houses disposed of so great quantities of raw materials from by-products that they found justification for establishing their own separate departments for manufacturing the final products, such as margarine, glycerine, gelatine, leather, medicine, etc.

The pattern of large scale meat-packing houses is, however, no longer pursued in modern development of meat processing industries. It is to-day considered more economical and practical to place the slaughterhouses in or close to the livestock producing areas in order to save increasing expenses in transporting livestock and to avoid the detrimental effects on the quality due to strenuous transport prior to slaughtering. This consideration is naturally leading to certain limitations in the capacity of slaughterhouses, which not always will have sufficient quantity of by-products to justify the operation of individual departments for processing of final products.

The advanced application of refrigeration is to-day making it more economical

to transfer the products rather than the livestock from producers area to the consumers area.

The decentralized slaughterhouses located in livestock producing areas, are consequently concentrating their operation on producing so-called primal cuts of meat packed in plastic films and kept in cardboard boxes under constant refrigeration during the transport and storage on the way to distribution centres in consumer areas. Many by-products are in a similar way pre-conditioned and packed at the slaughterhouses for shipment to the various industries for final processing in the most economical size and type of plants. These industries can then be located where it is considered most practical and economical.

Such pattern in the modern development of meat processing industries is to be found to-day not only in U.S.A. but also in Europe and in other industrialized areas of the world. The system of farmers' co-operatives developed in the Scandinavian countries, has especially been suitable for an industrial development along these lines. It must, however, be admitted that the Scandinavian co-operatives to begin with decentralized the slaughtering to such a degree that the capacity of the individual slaughterhouses at to-day's standard is no longer economical. The farmers' co-operatives in the Scandinavian countries are, therefore, to-day in the process of merging several small co-operatives into larger units, establishing from their point of view larger, specialized slaughtering units, from which raw materials are supplied to central units for meat packing, canning and sausages manufacture, hide and pelt preparation, casing grading and packing, edible fat rendering, inedible by-product rendering, etc.

The approach to this pattern of development has been somewhat different in other European countries. In U.K., Germany and France, most of the slaughtering has been carried out by retail butchers in large municipal abattoirs during centuries, and in many cities, especially where these municipal abattoirs were destroyed during the last war, they have been re-established. The modern system of processing, distribution and marketing meat products has, however, within the last decade radically interrupted the traditional system of operation in public abattoirs by individual retail butchers. The operation of slaughtering is to-day widely transferred to large meat wholesale companies, who have

requested the public abattoirs to be modernized with industrial slaughtering lines and adequate refrigeration, enabling them to compete with the private or co-operative meat companies, who have already established industrial type of slaughterhouses in producer areas.

Appendix I is illustrating a modern public abattoir with industrial slaughtering lines and pre-chilling tunnels. Many of the municipal abattoirs in the larger cities of Europe have now been forced to modernize their plants in this way, in order to satisfy the requirements of the wholesale operators.

In conclusion, it is expected that the development of meat processing industries in the developed countries will follow the above-mentioned pattern: New slaughterhouses of optimum capacities will primarily be established in livestock producing areas supplying fresh meat products to distribution centres in consumer areas, and pre-conditioned raw materials from meat cutting and by-products will be transferred to centrally located specialized industries, where they might be situated most economically.

In this context, it is important to mention that the planning of new meat processing industries more and more has to respect the increasing demands of public health regulations, environmental and social requirements of modern societies, as well as the vital economical considerations in connection with establishment of the plant and the cost of production for all markets to be served.

It is obvious that the great variation in requirements and local conditions under which a meat processing industry has to be established, leads to essential differences in plant layouts and methods of operation. It is by no means possible to design a standard pattern for this kind of industry, that will fit everywhere. Each project has to be designed individually to serve the particular combination of requirements, characteristic for the type of project, and the special local conditions to be respected in design and operation. It is e.g. not feasible to expect success from a typical mechanized American type of meat packing plant erected in a country, having different categories of animals to be slaughtered, different products to be manufactured and marketed, different labour situation, different economical and social standards, and different traditions to be respected.

The same applies to the establishment of Scandinavian type of co-operative slaughterhouses in countries where neither the producer nor the consumer are educated for operating co-operative organisations to mutual benefit of all members.

Several costly failures have unfortunately been experienced in attempts to transfer successful pattern of meat plants from highly industrialized countries to less developed countries. The mistakes are either due to the planners' lack of careful pre-studies of the local conditions and requirements, or due to lack of educated or trained people to operate, maintain and manage the new type of plant once it is established.

The worst that can happen - and unfortunately has happened - is to establish a certain type of modern mechanized plant and then try to operate such plant by traditional, old-fashioned methods. Pattern of plant design and organisation of plant operation have to fit like hand and glove. It is, therefore, necessary either to design a new plant for a certain system of operation, or to adjust the organisation of operation to the modern type of plant established.

II.

MEAT INDUSTRIES IN DEVELOPING COUNTRIES

In spite of the fact that the developing countries dispose of the greatest sources of livestock for meat production, meat processing industries have so far scarcely been developed in these countries. Only few industrial types of slaughterhouses and meat processing factories have primarily been established for serving export purposes. The bulk of the meat and by-products is still produced and distributed locally in the same primitive manner by retail butchers as it has been customary for centuries.

The few industrial types of slaughterhouses in the developing countries have mostly been established by foreign wholesale meat companies, interested in obtaining inexpensive raw materials as a basis for selling certain processed meat products to those developed industrialized countries requiring importation to cover their home consumption.

This trade has so far not been able to expand, mainly due to the fact that the

public health authorities in the importing countries are extremely reluctant towards importation of meat products from areas of the world where the health condition of the animals is doubtful, and the veterinarian inspection unreliable. Restrictions in this connection are so far limiting the development of an export-import trade between the livestock producing developing countries and the industrialized countries interested in meat import.

There is no doubt that a great need for improvements and better utilization of the livestock production exists in many developing countries, first of all for covering the increasing demand for protein within these countries, but also for covering deficits in many industrialized countries.

The off-take rates in livestock for slaughter are generally very low in the developing countries, largely because of the old-fashioned mentality of the farmers, who count their wealth in the number of cattle and sheep which they own, irrespective of the quality of these animals. If they sell out for slaughter, they feel they are reducing their private wealth. This is the main reason why so many old aged animals are brought to slaughter in these countries. The religious traditions, especially the prohibition against slaughtering female animals e.g. in India, are of course serious obstacles to bypass if the meat production should be increased as basis for an industrial development.

Nevertheless, it is a fact that many of the developing countries have the greatest potential of livestock for meat production, and that they could increase their possibilities enormously through properly organized livestock production in connection with the development of an adequately efficient meat processing industry under reliable veterinarian supervision.

The development of such an industry should of course take advantage of the experience gained by the meat processing industries in the developed parts of the world, but it should have to adjust itself to the special conditions and requirements prevailing in the countries where such industries should be established.

A new meat industry in developing countries should, therefore, be based on careful surveys and studies on a country-wide basis. Such surveys and studies

should be carried out by a team of experts on behalf of the government interested in a development of this kind in their country. These experts should first of all survey the existing situation regarding production and marketing of livestock and regarding existing facilities for and methods of slaughtering, processing and marketing meat and by-products.

The report should include projections for the future livestock production, and conclude in recommendations for future improvements. The report should also include projections for future meat consumption and recommend locations and capacities of regional slaughterhouses, meat processing factories and markets to be maintained or established, and it should advise on the most suitable type of layouts and plants to be introduced.

Appendix II is showing a typical layout of a slaughterhouse in a developing country, where pig slaughtering for religious reasons has to be kept separated from slaughtering of cattle and sheep.

The main purpose of the report is to serve as a guide for the development with a view eventually to obtain the most efficient complex of livestock production and meat industries covering the country. The realization of projects which do not fit into the national scheme, e.g. because of wrong choice of location, capacity or layout in relation to the supply of livestock on one side and to the marketing of products on the other side, has in more than one instance been detrimental to the success of the national development.

Furthermore the report should include recommendations regarding operation and management, and in this context suggest suitable education and training programs for personnel of all categories required. No instrument is of much value if one does not have the qualified people to play it.

Numerous country-wide studies of this kind have been carried out on behalf of F.A.O., Danida, and other aid organisations, e.g. in Greece, Malaysia, Singapore, Sri Lanka, India, Jordan, Cyprus, Zambia, Lesotho, Peru, Nigeria, Columbia, and Brazil.

An extract of a recent report of this nature to the Government of Sri Lanka is given as an example in Appendix III.

III. EVALUATION OF FUTURE DEVELOPMENTS

In order to evaluate the possibilities for future developments of meat processing industries in various countries, the author refers to statistical information concerning meat production, given in F.A.O. Agricultural Commodity Projections 1970-1980, issued in Rome in 1971.

A. STATISTICAL INFORMATION

One hundred and thirtytwo countries of the world have here been grouped in three economic classes:

Economic Class I (the so-called developed countries)

including North America, Western Europe, Oceania and a few other countries such as Japan, Israel, and South Africa.

Economic Class II (the so-called developing countries)

including North Western Africa, Western Africa, Central Africa, Eastern Africa, Central America, Caribean Islands, South America, Near East in Africa, Near East in Asia, South Asia and East-Southeast Asia.

Economic Class III (the so-called socialistic or centrally planned countries)

including U.S.S.R., East Europe, China, Mongolia, and Cuba.

The total human population, the production, and the demand of meat in tons, consumption in kg per capita in 1970, with projections for 1980 in the three different groups, can be seen in Appendix IV.

This statistical information is giving the average meat production and consumption within each of the three groups of countries. From the summaries for the individual countries one can see, naturally, great variations from country to country. Some countries have a great surplus for export to other countries within the same group. The per capita consumption per year varied e.g. in Class I countries in 1970, from 13.8 kg in Japan, 27.1 kg in Portugal, 48.8 kg in Denmark, 114.6 kg in U.S.A. to 136.3 kg in Australia.

Even greater variations are to be found within the Class II countries. Here the meat consumption in 1970 per capita per year in South Asia (India) is as low as 1.7 kg, and in Uruguay as high as 110.4 kg. The variations in Class III countries, were, apart from China and Mongolia, remarkably small. U.S.S.R. had 46.4 kg per capita per year, while the 6 Eastern European countries varied from 42.4 in Rumania to 69.9 kg in the German Democratic Republic.

We may regard an annual meat consumption figure per capita of 40 kg to be a satisfactory minimum meat content of a sound diet today, providing of course that meat has not been substituted by other sound protein foods such as fish and certain vegetables. This happens to be the case in Japan, where they seem to survive in relatively good condition, in spite of the low annual meat consumption of 13.8 kg per capito. This statistical information is now used to evaluate the possibilities for slaughterhouse planning and construction in the years to come.

8. THE SITUATION IN ECONOMIC CLASS I COUNTRIES

The situation in the economic Class I countries is that the majority of the appr. 50 million tons of meat produced in these areas is produced in industrially or publically operated slaughterhouses under relatively efficient meat inspection. The standard of the individual plants varies from the most advanced type of meat industries to rather inefficient and unhygienic old abattoirs of capacities ranging from 1000 to about 75,000 tons of meat per year.

If we assume that the average size plant would be for 10,000 tons per year (corresponding to 150,000 pigs or 40,000 heads of cattle) and that each plant would have an average working life of 25 years, then we would have to plan and construct 200 new plants or completely renew 200 existing plants every year, just to maintain our present capacity and standard. The expected increase in production of about 13,000,000 tons during the 70's or 1,300,000 tons per year requires in addition the planning and construction of a further 130 new slaughterhouses or equivalent extentions to existing plants. Altogether, we would every year have to plan and construct 330 new slaughterhouses with an average annual capacity of 10,000 tons of meat.

Assuming that the construction of a slaughterhouse for a 10,000 tons per year capacity would cost 2 million US$, we are faced with a total investment per year in the Class I countries of 660 million US$.

We are of course here generalizing just in order to get a rough picture of the magnitude of investment required in this field, and in this particular area. It has to be emphasized, that this investment does not include meat processing plants, but only ordinary slaughtering plants with the traditional departments for by-product utilization and dispetch of fresh meat. Neither does this investment include site costs and working capital. The characteristics of the development in Class I countries are that slaughtering is gradually being concentrated to industrial type of plants with optimum capacities. This is a logical result of the investments being made in mechanization, and other labour saving measures, as well as the improvements in livestock transport, and distribution of products with prolonged keeping quality by the introduction of the cold chain.

The optimum capacity of a slaughterhouse depends naturally upon many factors, which vary from place to place, such as the location of livestock production in relation to the consumer areas.

C. THE SITUATION IN THE CLASS II COUNTRIES

The situation in the Class II countries is that relatively small quantities of the appr. 20 million tons of meat produced in these areas are passing through industrial type of slaughterhouses or public abattoirs having reliable meat inspection facilities. The few industrial type of slaughterhouses have as mentioned before been established to serve export purposes, and are financed by meat companies who are interested in obtaining inexpensive raw materials as a basis for selling processed meat products to the Class I countries.

There are only a few public abattoirs and meat industries which are comparable to Class I country plants regarding construction, equipment and method of operation. These plants are to be found in some of the larger cities, and efficiency of meat inspection is doubtful.

The bulk of the meat produced in Class II countries with exception of a few places or a few specific plants, is not at all acceptable for human consumption according to the standards of Class I countries. Most of the meat exported from these areas is, therefore, either produced in special plants licensed by the veterinarian authorities of the importing countries, or produced as fully sterilized canned meat (corned beef) under special inspection.

The fact that consumption of meat in these countries is not causing greater problems is partly due to the consumer buying warm meat, tripe and other offals and thoroughly fry or cook the product within 24 hours from slaughtering. This naturally requires that the livestock is brought to the place of consumption, and in many big cities this results in livestock transport of up to 1000 km which causes great practical difficulties and resultant losses on the hoof.

By far the majority of slaughtering is carried out in very primitive public slaughterhouses, in villages, on open slaughtering slabs of concrete or clay, or behind the small retail butcher shops on banana leaves. The use of refrigeration under these circumstances, and the climatic conditions in sub-tropical and tropical countries, is practically impossible, as the cold chain is missing, and chilled meat spoils quicker than warm meat in a warm atmosphere.

The only methods of conservation under such conditions are salting and/or sundrying, which are practised in many of these areas.

One will fully appreciate the inefficiency and tremendous losses with which the meat trade has to operate in these countries. It is no wonder, that the average annual per capita meat consumption only reaches 10 to 11 kg, compared to 80 kg in the Class I countries.

Statistical information predicts that the Class I countries will have a shortage of 2,344,000 tons of meat in 1980, and the Class III countries will at the same time be short of 651,000 tons. Is it at all feasible to expect the Class II countries to let the others have any meat, when they are so far behind in production themselves? and have they the potentiality in the way of producing the necessary livestock?

Many developing countries have really enormous herds of livestock. The world

population of beef and veal was in 1970 (F.A.O. statistics) 1,225 million head, of which 729 millions were in the Class II countries and only 266 millions in Class I countries. India alone had 230 millions, whilst Pakistan had 50 millions, Argentine 52 millions, Brazil 92 millions, Ethiopia 23 millions, Mexico 25 millions, just to mention some of the countries in this group with great livestock potential. In comparison the U.S.A. had 112 millions and Western Europe altogether 95 millions.

Out of the world population in 1970 of 1,485 million mutton and lamb, 718 millions were to be found in the Class II countries, of which 181 millions were in Africa, 180 millions in South America, and 357 millions in Asia. No exact statistics on the pig population are available, but such figures are hardly of interest in this context as pig production in Class II countries is known to be as low as 10% of the world production, mainly due to the fact that pig meat is excluded in Mohammedan countries.

Now - why is the production of meat in form of beef, mutton and lamb so low in Class II countries, when these countries have more than half of the livestock population of the world? It is because of the very low off-take rate, and also to some extent because of the lower carcase weight. In 1970, the yearly off-take rate of beef and veal in Class II countries was only 8.8%, against 36.5% in Class I countries, and 18% in the world as a whole. The average carcase weight was 107 kg in Class II countries, against 209 kg in Class I countries.

There are other reasons, some less valid than others, for these tremendous differences, but if the off-take rate and carcase weight in the Class II countries could be raised up to the world average, it would result in more than doubling the present meat production.

It is, therefore, a fact that the Class II countries have an enormous potential of livestock for meat production.

To illustrate the problems which we are up against in this connection, the author would like to relate to you the story of a slaughterhouse project in Goa, India.

F.A.O. requested in 1966 the author to organize and carry out a feasibility

study of a slaughterhouse for utilization of the old useless cattle, which create such a problem to the Indian farmers. Of the Indian cattle population of 230 million head, at least one third - i.e. 80 millions - is too old to serve any productive purpose. The Indians mostly for religious reasons in 14 of the 17 states are not supposed to slaughter these cattle. Few farmers are interested in feeding them, when they more or less are useless, and they let them stray to find their own food, even into cultivated fields or green-grocer shops in towns. It is considered by ortodox Hindus inhuman to chase them away.

Goa, the former Portuguese colony, has an isolated location and a mainly catholic population, therefore no aversion to slaughter. This area was chosen by the Indian government for the erection of a test plant. One company Chicago had expressed an interest in buying the whole production of corned beef or cooked frozen beef from such a plant, and four of their experts (a livestock buyer, a production manager, a marketing expert and an economist) joined our own team of two planning engineers and one veterinary in the field study.

We visited villages and provincial towns in the neighbouring states, and found it easy to secure cheap deliveries of useless bullocks and buffaloes through local cattle dealers. Our veterinary investigated the health condition of the 10-14 years old animals and found that they were meagre, but surprisingly free of decease, probably due to the fact that only strong and healthy animals reach such an age in these countries.

We planned for a grazing area in Goa, close to the site selected for the plant, so that animals arriving on the hoof, could be rested and reconstituted for a period prior to slaughter. We test-slaughtered some of the animals in the local public abattoir, and found that the meat yield per animal was low, but of very suitable quality for production of corned beef. The meat from the buffalo was generally found to be in good condition and could be used with advantage for cooked frozen buffalo beef.

The slaughterhouse was planned for 300 head per day, with rail-dressing and warm deboning on the rail for direct processing into corned beef without refrigeration. Only buffalo carcasses were to be chilled, prior to cutting beef

intended for pasteurization, freezing and packing for export in refrigerated containers. The whole project, incl. necessary working capital, was estimated to require an investment of 4 million dollars. At the price levels valid in 1966, the yearly net profit was calculated to be $ 800,000.

We were dreaming about putting up a number of this kind of plants, so that we could do away with the 80 million useless cattle, which at an off-take rate of 20 millions per year would yield a net profit of 200 million $ per year. The director general of F.A.O. in Rome as well as the minister of agriculture in the central government in New Delhi, and many other top people in India were very enthusiastic about the scheme. Unfortunately political intrigues started regular riots against slaughtering of animals, and the central government was forced to postpone the project.

The author would also like to mention an experience from a F.A.O. survey of the existing meat industry in Brazil, which was carried out two years ago. Here the problems are of an entirely different nature.

The field team included one slaughterhouse technologist, one meat processing technologist, one by-product technologist, one marketing expert, one local agronomist, and one veterinarian. Some 50 different slaughterhouses and meat factories were inspected, most of them located in consumer areas. The bulk of the livestock comes from the distant facendas in the western and northern parts of the country, some of which having up to 100,000 head of cattle in areas as big as Switzerland. The total livestock population of the country today is supposed to be about 100 million head of cattle with a yearly off-take rate of only 10 to 12 millions, and 55 million mutton and lamb with a yearly off-take rate of 6 to 8 millions, and 65 million pigs with a yearly off-take rate of only 10 to 15 millions. These figures are very difficult to verify, mainly because of the difficulties in registering homeslaughter, but it is beyond doubt that the off-take rates are unreasonably low, leaving tremendous scope for increased meat production in this country.

The present government has been in uninterrupted power for more than 10 years, and the political stability has resulted in launching of very daring and advanced plans for developments in the agricultural sector as a whole, but in particular in the meat industry.

The meat inspection department of the federal ministry of agriculture in Brazilia has now officially taken over the complete responsibility of livestock and meat inspection in the whole country, overruling all former regulations in the individual states. This department has issued very detailed instructions for location, planning, construction and operation of all new slaughterhouses in Brazil, and they are granting a very limited period of dispensation to all existing slaughtering facilities, to comply with the new regulations. They are at the same time launching extensive programs for eradication of contageous livestock decease.

As they are short of veterinoriens and other competent personel to enforce such a program on a country-wide basis, they have started the program in the state of Rio Grande do Sul to begin with, and they have already declared this area to be a zone free of contageous decease. About 500 slaughtering facilities in Rio Grande do Sul - which is one of the most developed agricultural areas in Brazil - have had to close down as they could not fulfil the new requirements in time. The remaining slaughterhouses, which have been modernized in compliance with the new regulations, have taken over the slaughtering from the many plants being closed. This is naturally resulting in a rationalization of the whole meat industry in the area.

The federal meat inspection authorities in a near future plan to start the same procedure in the neighbouring states of Santa Catharina, Parana, and Sao Paulo, and so forth, until the whole country is under full control. In the meantime, they naturally have to establish strict control of the movement of livestock and meat products between the individual states. They also have to encourage the education of veterinarians and lay inspectors in order to have sufficient staff to enforce this ambitious scheme.

The new regulations, which are detailed with plans and instructions, cater for an efficient meat inspection, fully up to the U.S. and E.E.C. standards, and in some respects even more advanced.

One thing is theory, another practice, and the big question is of course, to which extent and how soon Brazil will be able to reach their goal. At present a maximum one fourth of slaughtering is carried out in compliance with the new federal inspection regulations, and only one third of the federal inspected

plants have licences to export, meaning they are accepted by the importing countries' veterinarian authorities. Today a maximum of 5% of the meat production in Brazil is exported.

In this light - there is a long way to go before Brazil can become the important supplier of meat to the world market which the government dreams of. Nevertheless, the federal government is supposed to have obtained very considerable loans from the world bank, putting them in a position to offer economic aid to all new slaughterhouse projects complying with the new regulations.

Many of the large old slaughterhouses, located in the consumer areas, are taking advantage of this situation and are planning to establish new modern slaughterhouses in the producing areas, and they then either convert their old plants in the cities into processing factories for home consumption, or close them down.

The government is aware that the average annual meat consumption of about 30 kg per capita is on the low side, and that the demand is further increased by the high human population growth rate of 3% per year in Brazil. They are, therefore, forcing the development of the vast Amazonian region by fantastic schemes for agricultural development, including livestock production, with the establishment of several large modern slaughterhouses.

Providing the present political stability can be maintained during the next 10 years, it is likely that the government might well succeed in developing Brazil into one of the worlds largest producers of meat. They will probably more and more replace their home consumption of beef by mutton and pork, so that they can concentrate their export on beef, for which there is the best future on the world market.

The author has tried to illustrate two situations - in India and in Brazil - and would say that the conditions in all other developing countries fall more or less between these two extremes. There are vast undeveloped areas not only in South America and Asia, but also in Africa, offering great opportunities for increased meat production. Only a few of these countries today, without help from the developed countries, are capable of establishing a production of meat either to cover their own demand or for export. Primarily, it is a question of establishing the most suitable livestock production, and secondly the appropriate

slaughtering facilities which on one side are suited for the local demand and on the other suited for export, provided local demand permits an export surplus.

The present situation regarding slaughtering facilities in Class II countries is that a maximum of 10% of the 18 to 20 million tons of meat produced in these countries are produced in industrial or public slaughterhouses of such a standard that the authorities in the developed countries would accept import from these areas.

If all slaughtering in these countries were to be carried out in accordance with the standard required by the developed countries, it would be necessary to build new slaughterhouses to handle at least 15 million tons of meat annually. It would hardly be possible to concentrate the slaughtering in these countries to plants of an average annual capacity of 10,000 tons. An average capacity of 3,000 tons would be better to cover the vast areas and scattered population in many of these countries. This does not of course exclude the establishment in certain areas of a few slaughterhouses with capacities up to 50,000 tons of meat per year or more.

If we now assume that the average size plant would be for 3,000 tons per year, then we would have to plan and construct 5,000 new slaughterhouses of 3,000 tons' capacity. If we allow 10 years for the realization of such a program, it would mean 500 new slaughterhouses of this size every year. Considering the projected increase in production per year of about 2 million tons, we would need to build a further 650 new slaughterhouses, in other words, altogether 1,150 new slaughterhouses with an average capacity of 3,000 tons per year, requiring an investment of about 700 million US$ per year.

D. THE SITUATION IN THE CLASS III COUNTRIES

The situation in the Class III countries is not quite clear to us. All we know is, that the centrally planned countries apparently have been more or less self-sufficient with regard to meat production, as there have been relatively small quantities of meat or meat products exchanged with the other countries.

Apart from China and Mongolia, the meat consumption per capita in the Eastern

European countries has, according to F.A.O. statistics, been in line with the consumption per capita in Western Europe. With regard to the planning of slaughterhouses, we know from experience over the last 10 years, that U.S.S.R. has bought 25 complete new slaughterhouses in Sweden and Denmark of the most developed technical standard. How many copies they have produced since then, we do not know, but they are actually talking about buying a lot more complete slaughterhouses and meat processing plants in a near future from the western countries.

Poland has also recently placed orders in Western Europe and in U.S.A. for a few very large meat packing plants. Hungary, Czechoslovakia, and Rumania have, as far as we know, built several new industrial type slaughterhouses, copying the West European and American technique, and in some details developed their own techniques. It is, therefore, reasonable to accept the same criteria for evaluation of required planning and construction of new slaughterhouses in the Class III countries as for the Class I countries.

Most of the appr. 30 million tons of meat produced per year in these countries is probably produced in industrial type of slaughterhouses of a reasonable technical standard, and under an acceptable meat inspection. The average size plant can be set for a capacity of 10,000 tons per year, with a plant life of 25 years. This would require the planning and construction of 120 new slaughterhouses per year. The projected increase in meat production per year is stated to be about 1 million tons during the 70's.

This increase will, therefore, require 100 new slaughterhouses, bringing the total number of new slaughterhouses to be built per year in the Class III countries, up to 220, requiring an investment of about 400 million US$ per year.

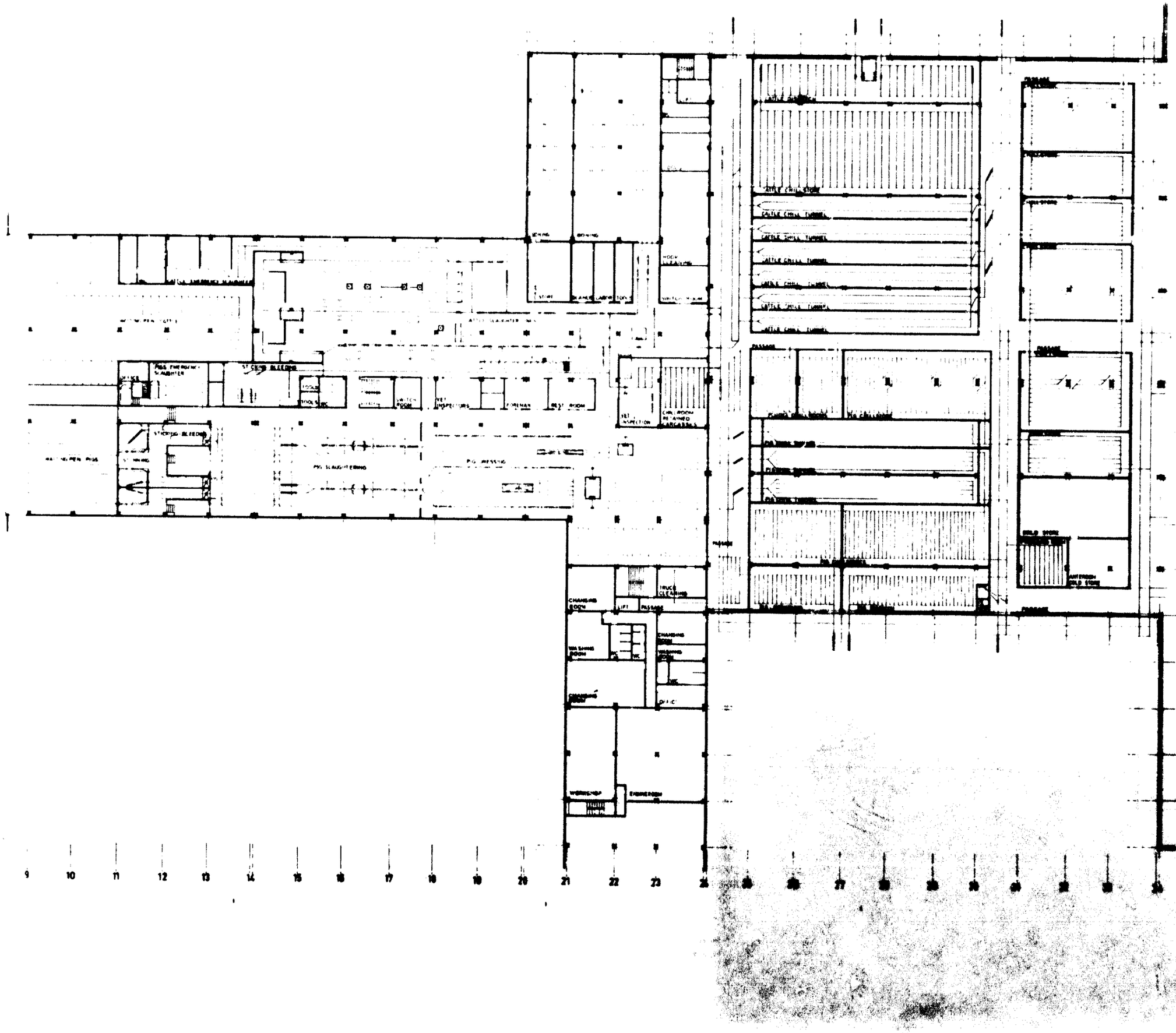
IV. CONCLUSION AND RECOMMENDATION

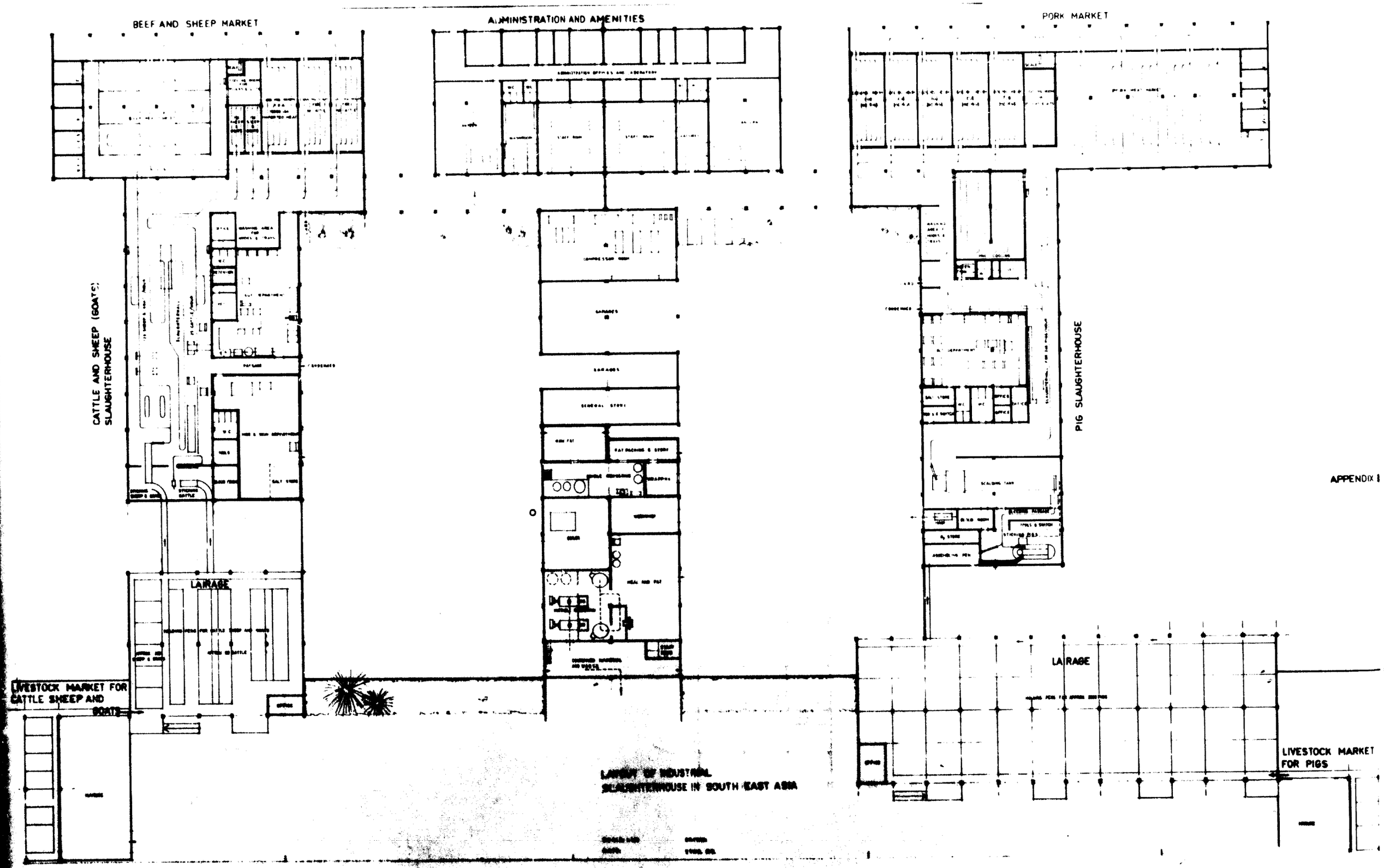
The author has in this paper tried to give an overall picture of the existing development in various countries of the world, and has upon this background, tried to predict the future need for planning and construction of new meat processing industries, alternatively modernization of existing plants.

The conclusion, based on certain assumptions, is that the biggest scope for future development of meat processing industries is to be found in the developing countries. They have a tremendous need and potentiality for an increased meat production, first of all to raise their own standard of living. Certain of these countries will also be able to develop a surplus for a profitable export to the heavily populated industrial countries, who are today facing a demand exceeding their own production, especially with regard to beef products.

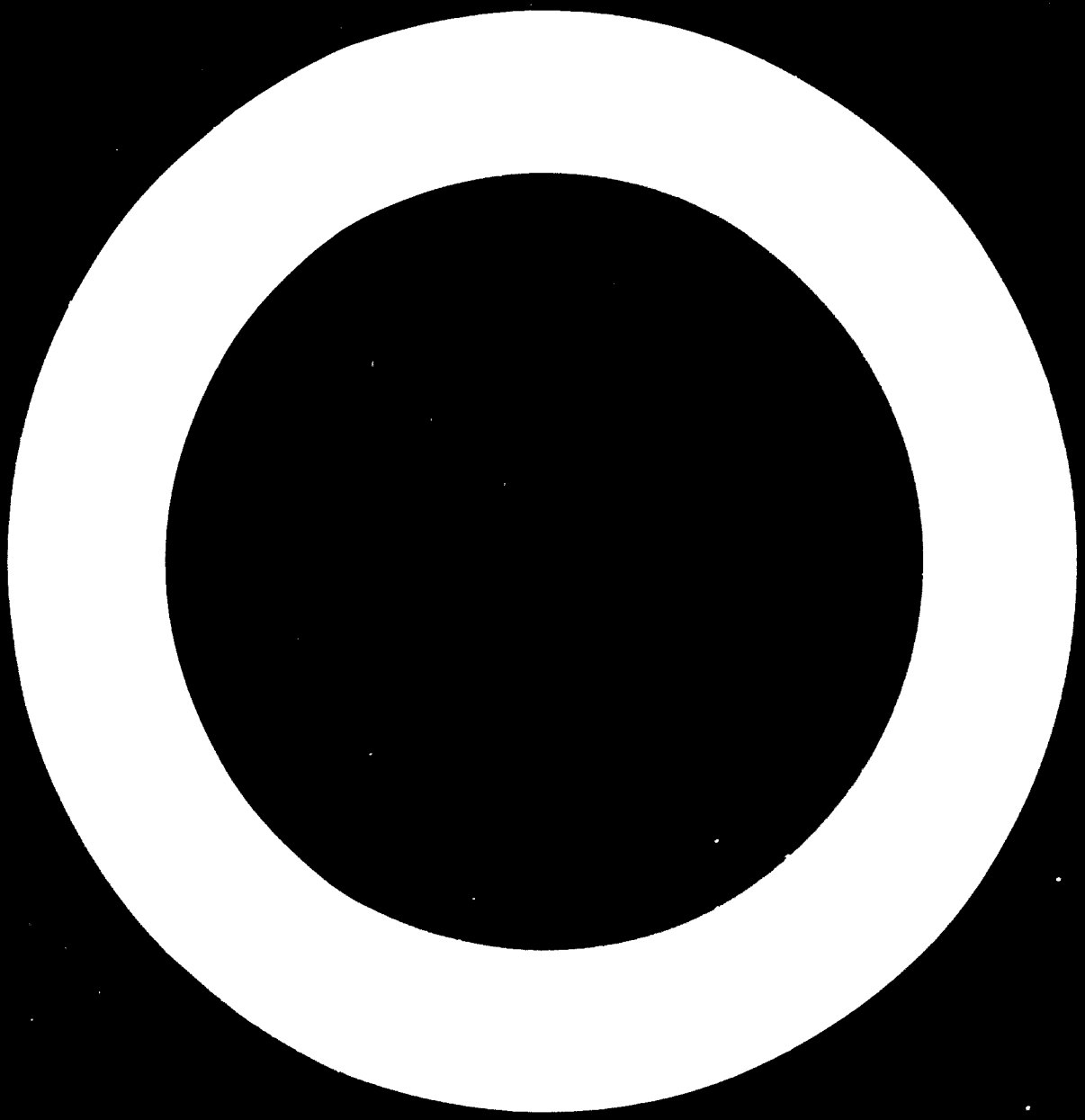
Whether it is possible to speed up the development as desired, largely depends upon the political stability in the world, and the willingness of the rich countries to help the poor. So far, meat is an important product for the diet of most people, and the demand is definitely increasing with the increase in standard of living, in spite of the fact that meat can be substituted by much cheaper sources of protein.

Development of new meat processing industries should always be based on national plans for such development, elaborated by impartial experts. These plans should be based on careful studies of the livestock situation and the meat (by-products) marketing possibilities. They should advise on the most appropriate locations, capacities and type of layouts for the individual plants, with a view to eventually obtain a country-wide industry with an overall balanced capacity for serving the interests of the nation efficiently and economically, thus avoiding the wasteful establishment of plants which are not suitable for the local requirements.


MEAT MARKET
APPENDIX I
LAYOUT OF INDUSTRIAL SLAUGHTERHOUSE IN EUROPE


BEEF AND SHEEP MARKET
ADMINISTRATION AND AMENITIES
PORK MARKET
CATTLE AND SHEEP (GOATS) SLAUGHTERHOUSE
PIG SLAUGHTERHOUSE
LAIRAGE
LAIRAGE
LIVESTOCK MARKET FOR CATTLE SHEEP AND GOATS
LIVESTOCK MARKET FOR PIGS

APPENDIX I



APPENDIX III

EXTRACT OF REPORT TO THE GOVERNMENT OF SRI LANKA:

"Feasibility Study of Establishment of Abattoirs in Sri Lanka" - June, 1973

PRESENT SET-UP

Livestock Production

The livestock production areas of Sri Lanka can be divided into 3 distinct zones. The northern part of the island, called the dry zone, is the major source of livestock supply, being a surplus area from which livestock for slaughter is delivered to other areas. The south-eastern part of the country is self-sufficient in livestock supply for slaughter purposes, satisfying the region's own demands. The south-western part, containing the cities of Colombo and Kandy, is the most heavily populated area of the country. This area is not self-sufficient and is supplied with livestock from the other areas, particularly from the dry zone.

The increase of population in Sri Lanka and the change in diet habits, requiring more beef meat, have during the last years not been met by an equivalent increase of livestock production. It is, therefore, reasonable to assume that the national livestock herd has probably been depleted.

Apart from the decline in the national herd from a meat point of view, this has also created a critical situation for the farmers, as cattle - particularly buffaloes - are extensively used for ploughing and transport purposes, etc. Because of the nature of the farming land, where the fields are arranged on terraces, buffaloes are the only possible means for agricultural work. Lack of buffaloes for this purpose means that the ploughing work has to be carried out manually.

An estimate of the total livestock population of Sri Lanka is shown in the table below together with the average liveweight of each category (source: Five Year Plan):

		Number x 10^3	Liveweight per Unit in Lbs
1.	Water buffaloes	760	600 - 700
2.	Sinhala cattle		300 - 350
3.	Indian cattle, bulls		700 - 900
4.	- - cows	1650	600 - 700
5.	Indian Sinhala bulls		450
6.	Crossbred cows		400
7.	European breeds		900 - 1000
8.	Goats and sheep	805	40 - 70
9.	Pigs	124	150

Of the livestock, Items 2, 3, 4, 5, 6 & 7, it is estimated that appr. 80% are of Sinhala (domestic) breeds, and 20% of exotic breeds. Appendix 1 shows the cattle and buffalo population of Sri Lanka divided in the zones. Appendix 2 indicates the human population of Sri Lanka. From these tables it will be seen that livestock has to be moved from the breeding areas in the north to the most populated areas around the cities of Colombo and Kandy in the southern part of the country.

The present livestock production of Sri Lanka is estimated by the Livestock Development Board, as follows:

	Per Annum	Average[x] Per Day	Maximum Per Day
Meat cattle	320,000	1060	1200
Buffaloes	60,000	200	300
Sheep and goats	160,000	530	700
Pigs	88,000	290	400

x) 300 slaughter-days per year.

As there are no seasonal peaks the delivery of livestock to abattoirs is almost constant through the year.

Livestock Marketing and Transportation

Present regulations are designed to hinder theft of cattle and to ensure that only healthy animals lawfully acquired are being slaughtered. Branding of cattle, certificates of ownership, etc., are control measures which were introduced under the Animals Act of 1958.

Branding on a regular basis is not carried out and the majority of the cattle population is unbranded. Consequently, transfer of cattle from the farmer to the abattoir is difficult, involving expensive procedures. Payment to the cattle breeder for livestock is very low and unable to stimulate production.

The present deficit of cattle available for slaughter leads to a great number being delivered illegally to the abattoirs. There are currently 137 registered abattoirs in Sri Lanka, and most of these abattoirs are very small. There is a much greater number of unregistered abattoirs in operation, and effective control of actual slaughtering is virtually impossible.

All registered abattoirs are operated by local authorities, and licensed butchers are entitled to slaughter their livestock using their own employees. Wholesale butchers have agents purchasing livestock directly from the farmers. Livestock is transported by rail and road, and the rail and road network is of comparatively good quality throughout the whole Sri Lanka, and the livestock transportation is carried out reasonably efficiently.

Present Abattoirs

Existing abattoirs have been constructed by, and are owned by the local authorities. The abattoirs in Colombo and Kandy are supervised by veterinary surgeons. Other registered abattoirs are supervised by Public Health Inspectors. Unregistered abattoirs are not supervised in any way.

Colombo Abattoir operates 6 days per week. As butchers working in the abattoirs usually are Muslims, the slaughtering operations follow ritual procedures, involving that the slaughterings start at sunrise, and the normal working hours of the abattoirs are from 06.00 to about 09.00-10.00 o'clock, depending on the number of animals to be slaughtered. Livestock arriving at the abattoir is held in covered lairages holding about one day's slaughter, where ante-mortem inspection is carried out.

There are separate buildings for slaughtering of cattle, sheep/goats and pigs. The cattle slaughter building has a concreted floor and concrete walls to a height of app. 2 metres. Apart from a simple roof, the building is otherwise open, so that birds, insects, rodents, etc. have full access to the slaughter area. There are no partition walls between the various sections of the abattoir building, which in principle has an area for slaughtering, another area for inspection and a third area for rendering of inedible products.

Live cattle are led directly into the slaughterhall, where they are placed on the floor. By means of a rope the legs are tied so that they cannot move. The cattle are positioned so that they face the direction of Mecca, and the throat is cut. The blood runs onto the floor and is collected in a pit and then pumped to a blood rendering cooker. Much blood is wasted as it is washed away in the floor drains. All slaughtering and dressing operations, incl. de-hiding, take place on the floor. Because of unskilled labour and the lack of proper tools, a very high percentage damaged hides is the result.

The carcase is then hoisted to an overhead slide rail and pushed to the inspection and weighing section of the abattoir. Heads are removed from the carcase and follow the carcase to the retail butcher. The head is not further treated in the abattoir, and the tongue is not removed. Thoracic organs are also dispatched together with the carcase, and they are packed together with casings in the emptied paunch. Abdominal intestines are emptied in the abattoir, but no further cleaning or processing takes place. Forelegs and feet are not treated at the abattoir, but horns and hooves are collected. Only blood, some low grade hooves and bones are returned to the abattoirs from retail butchers for processing into feed and fertilizer stuffs.

Carcases of live stock which have been rejected because of disease or other reason are also rendered. All other by-products arising from slaughter are used for human consumption. The abattoir is equipped with water pump and outlets for clearing-down purposes. Rendering of inedible materials is carried out in rendering cooker heated by a steam boiler. The rendering plant also includes a centrifuge for treatment of cracklings from the cooking process and a mill.

Under these conditions it is no exaggeration to state that slaughtering takes place in an extremely insanitary and unhygienic way, which reduces the yield and also the keeping quality of the meat and increases the risk of product contamination. No facilities for chilling or freezing of meat products are available at the abattoirs.

Pigs are being slaughtered in a separate building under similar conditions. No scalding tank is installed so that the pigs have to be sprayed with water during the scraping process, which is carried out manually. Sheep and goats are slaughtered in a third building, in principle roughly the same set-up as mentioned above for cattle.

The abattoir in Kandy is of a very simple construction, actually only consisting of a concreted floor covered by a roof without any external walls. The same concept of construction of abattoirs has been used for all other abattoirs in the country.

Poor quality of meat products and yields of by-products are the direct results of inefficient slaughtering operations. This is particularly apparent in the high percentage of damaged or totally lost hides and pelts resulting in a great

loss, not only for the abattoir trade, but also for tanners, and finally loss of potential foreign currency earnings.

The Ceylon Leather Industry Corporation has found that out of the monthly output of 25,000 hides only 5-6,000 hides are suitable for chrome tanning. However, out of these 5-6,000 hides only 2-3,000 could be manufactured into finished leather of export quality. Appr. 95% of all hides are damaged by cuts during flaying. The extent of damage varies from the loss of a small percentage in some areas to rendering the whole hide useless for leather manufacturing purposes. Other usual damages seen on hides are caused by branding in a wasteful manner, thick marks, barbed wire damage, bad curing, etc.

The difference in value of low grade damaged hides and damage-free hides based on leather prices, is appr. 2 Rs per sq.ft. If all hides (25,000 units per month) and not only the current 25% were available for manufacture of "upper" leather, this would add appr. 300,000 sq.ft. to the export quality production. This increase in the monthly production value would amount to appr. 600,000 Rs. The economic importance of improving the quality of hides and pelts recovered is evident, and construction of new abattoirs must take this into consideration.

Another by-product, which is at present to a certain extent wasted, is casings. Casings are sold by the retail butchers direct for consumption, or some butchers clean the casings themselves and fill with minced meat. However, much is lost on the way, and no casings are properly cleaned. At the same time sausage manufacturers are actually importing casings, particularly sheep casing for their production. Although it is estimated that local production of casings would not satisfy the national demand for these products, even if all available casings were treated properly and utilized, it would certainly involve a higher degree of self-sufficiency for the country, and therefore savings in valuable foreign currencies.

Present Meat Marketing and Distribution

Wholesale butchers deliver quartered cattle, sheep and goat carcases to the retail butchers at their stalls at the municipal markets. No lorries are equipped with refrigeration. Lorries are mostly operated and maintained by the wholesale butchers. Outside the Colombo and Kandy area retail butchers provide their own transport for meat.

Only licensed persons, authorized for the purpose, are allowed to purchase meat from the registered abattoirs and sell this from market stalls approved for the purpose. As no meat produced at the abattoirs is chilled or frozen, all meat and other meat products such as paunches, hearts, livers, etc., are sold fresh and "warm" on the day of slaughter.

As the meat trade in larger municipalities is dominated by a limited number of wholesale butchers - and in the smaller towns in the hands of a few retail butchers - and as furthermore the price of livestock is not controlled in any way by law, the butchers have a strong position, paying the farmers a very low livestock price and increasing the profitability of their own businesses. Meat prices are controlled by the government. There are two price rates. One rate for meat on the bone and another rate for meat without bones. There is no control at all of offal prices. The price of mutton is about double that of beef meat, and is also controlled by the government.

PROJECTION OF FUTURE LIVESTOCK PRODUCTION AND MEAT CONSUMPTION

Considering the critical condition of supply to the rapidly growing population of Sri Lanka with animal protein, the government has decided to increase the national herd production. A Livestock Development Board has been appointed for the purpose of implementing detailed plans for this development. The steps to be taken by the Livestock Development Board would include:

Prevention of slaughtering of breeding livestock.

Purchasing livestock for slaughter from the farmer at a number of new purchasing centres.

Paying on liveweight basis a price which would be an incentive for increasing production of livestock.

Implementing full control of the livestock herd and its transport.

Establish close control of abattoir operations by concentrating slaughtering to a limited number of abattoirs under full control.

Control of the sale of meat regarding both quality and price.

At present no national basis exists on which to base a projection of future livestock production development, as much depends on the success of the

Livestock Development Board's implementation of their program. However, it is expected that an increased production of meat would more likely arise from an increase in the liveweight of slaughter animals than from an increased number of livestock delivered to the abattoirs. An estimate of the annual meat demand is shown below (source: Five Year Plan):

	Human Population $\times 10^3$	Beef Demand $\times 10^6$ lbs	x) Per Caput lbs	Mutton Demand $\times 10^6$ lbs	x) Per Caput lbs
1970	12,400	62.3	5	15.33	1.23
1972	13,022	65.1	5	16.01	1.23
1975	14,654	73.3	5	18.02	1.23

x) 65% of the population of Sri Lanka are vegetarians.

RECOMMENDATIONS FOR DEVELOPMENT

General Concept

All existing abattoirs in Sri Lanka are in an unhygienic, uncanitary and inefficient condition, causing great economic loss to the agricultural sector as well as to abattoirs, tanneries, etc. In order to stop illicit slaughter of breeding livestock and to bring slaughtering under adequate control, it is recommended that a number of new abattoirs should be established.

The construction of the new abattoirs should be carried out to obtain the best possible economical yield under the conditions given. The following major aspects should be taken into consideration in determining the new abattoir set-up:

1. Transportation of livestock primarily from the dry-zone area, and also from the coconut triangle to the heaviest populated areas in the Colombo-Kandy region.
2. Distribution of meat products in a warm state to market places will prevail in foreseeable future, so that meat products must be distributed and consumed on the day of slaughter.
3. It is of the utmost importance for the economy of the country that the new abattoir set-up includes for by-products from the slaughtering operations, particularly hides, skins, casings, etc., to be recovered and treated as efficiently as possible.

4. The increased tourism in Sri Lanka has resulted in an increased demand for tenderised good quality meats. Facilities for the preparation of these product types should be included in the new abattoirs best suited for the purpose in order to save valuable foreign currency for these products, which would otherwise have to be imported.

The general set-up of new abattoirs in principle is a two-sided problem. The establishment of abattoirs for the heavily populated Colombo-Kandy areas, which can be supplied by a small number of large abattoir units, on one hand and the supply of smaller towns and rural areas, for which a number of smaller sized abattoirs located in these areas are required, on the other.

To achieve the best yield and economic feasibility from abattoir operation and by-product treatment, large abattoir units are desirable. This type of abattoir can well be located in the Colombo-Kandy area, as appr. 65-75% of the total meat consumption of Sri Lanka is concentrated in this area. The daily meat consumption in 1972 for Colombo-Kandy area is summarized below:

	Colombo City Units	Colombo Suburban Area 30 miles radius Units	Kandy City Units	Kandy Suburban Area 30 miles radius Units
Cattle	170-200	170-200	85-100	85-100
Sheep & Goats	170-200	170-200	80- 90	80- 90
Pigs	30- 60	30- 60	15- 25	15- 25

Daily slaughtering in this table accounts for appr. 50% of the total slaughtering in Sri Lanka. Of the remaining 50% it is estimated that appr. 25% is consumed in the smaller towns and rural areas of the northern and eastern parts of the country, further 25% in the south-west part, north and south of the Colombo-Kany axis.

Examinations to establishment of more exact statistics for the consumer centres and other areas are currently being prepared by the Livestock Development Board, so that the precise location of new abattoir sites can be determined accordingly.

Four abattoirs located in the Colombo-Kandy area would be able to supply appr. 75% of the consumption of meat. The distribution radius for these abattoirs would vary from 30 to 50 miles. However, the bulk of meat distributed would be delivered within a 25-30 mile radius.

Two of these plants situated 25 miles north and south of Colombo would serve the

city of Colombo as well as the heavily populated coastal areas up to a distance of 75 miles north and south of Colombo city. Inland distribution could be carried out appr. halfway to Kandy (about 30 miles). One abattoir would be situated in Kandy, serving this town and the surrounding areas up to a radius of 50 miles. In the direction towards Colombo the delivery distance would be appr. 25 miles. The fourth abattoir would be located in Nauo Oya, supplying towns and rural areas in the tea triangle.

This first stage would account for the demands of Colombo-Kandy regions and would result in 65-75% of the slaughtering being performed in modern, efficient abattoirs. The second stage, comprising 25-35% of the slaughtering of Sri Lanka would involve the construction of a number of smaller abattoirs in the minor populated areas of the country.

As the first stage concerns 65-75% of the slaughtering and, therefore, has a decided influence on the feasibility of the abattoir operation and related industries, the implementation of this stage would have priority. These large abattoir units, when operating, could be utilized as training centres for the staff of the smaller abattoirs.

Although the smaller abattoirs constructed in stage two cannot feasibly be provided with such efficient equipment as the larger units, if the staff operating these smaller abattoirs are properly trained, these plants can also be expected to run on a profitable basis. However, correct management, labour skills, etc., would play a decisive role as to the economic operational results of the smaller abattoirs.

Program for New Abattoirs

The abattoirs to be constructed in stage one serving the Colombo-Kandy region, should be provided with facilities so that slaughtering can be carried out under full veterinarian control, and hence under hygienic and sanitary conditions. These new abattoirs should be provided with modern equipment of simple and robust construction which should be installed so as to achieve the highest possible yield with regard to meat and by-products. Consequently, these abattoirs should have capacities which ensure the economic and practical feasibility of operation.

The improvements of slaughtering procedures should include correct de-hiding of cattle, sheep and goats by mechanical devices, so avoiding damage to hides and skin. Furthermore, abdominal intestines, i.e. paunches and casings, should be properly processed by modern machinery. Heads should be deboned at the abattoir, and the horns collected for sale. Head bones should be rendered into bone meal. Legs should be scalded and scraped, hooves removed and collected for separate sale. Blood should be collected and dried for blood meal. Thoracic intestines should be separated at the abattoir, and the inedible material collected for rendering into meat meal.

New abattoirs should be equipped with sanitary installations for cleaning and sterilizing purposes. As there is an increasing demand for high quality beef from the developing tourist industry located in hotels along the coast in the Colombo area, facilities should be established for maturing of the best available beef meat.

The bulk of meat products from the new abattoirs is foreseen to be distributed to market outlets in a warm condition. Considering the need of concentrating slaughtering to a limited number of comperatively big abattoirs, the distribution radius from these abattoirs in some directions will be up to 50 to 60 miles. In order to ensure that the quality of the meat products is maintained during the time of dispatch and distribution, the abattoirs should be provided with air-conditioned hanging hall for carcases and edible by-products, and lorries should be insulated and equipped so that a low air temperature can be maintained.

New abattoirs constructed in stage two should also include facilities to enable slaughtering to be carried out under health control and also under hygienic and sanitary conditions. It is, however, readily apparent that these low capacity abattoirs cannot economically be equipped with costly modern equipment, and accordingly the design of these abattoirs should be based on rather simple but sanitary equipment.

Location and Capacities of New Abattoirs

From Appendix 2 - Population of Sri Lanka - and Appendix 1 - Cattle and Buffalo Population - it can be seen that 4 abattoirs in the Colombo-Kandy region with a distribution radius of from 30 miles up to a max. of 50 miles can supply the south-west part of the country, which would comprise appr. 75% of the population.

Selection of abattoir site locations should be made, bearing the following in mind:

1. Religious objections in some areas as to abattoir operation.
2. Distribution radius for meat and other products of 30 to 50 miles.
3. Sufficient supply of potable water.
4. Availability of recipients for liquid effluents.
5. Reliable supply of electricity.
6. Direct railroad connection for supply of livestock.
7. Availability of labour.

The following towns have been selected for the construction of abattoirs in stage one:

Kochchikade (26 miles north of Colombo)
Kalutara (27 - south - -)
Kandy
Nanu Oya

The abattoirs in Kalutara and Kochchikade will supply Colombo and towns along the coast as well as rural areas within a 50-mile radius. The abattoir in Kandy will serve Kandy city, town and rural areas up to the 50-mile radius. The abattoir in Nanu Oya will serve the towns in the area as well as rural districts up to the 50-mile radius.

Daily slaughtering in the above abattoirs are estimated to be as follows:

	BEEF		SHEEP & GOATS		PIGS	
	Average	Max.	Average	Max.	Average	Max.
Lowcountry:						
Kochchikade	200	250	150	200	40	60
Kalutara	200	250	150	200	40	60
Midcountry:						
Kandy	200	250	160	180	40	60
Upcountry:						
Nanu Oya	200	250	150	180	40	60

The locations of abattoirs to be constructed in stage two have not yet been selected. The following towns and areas have been considered as probably suitable locations:

	BEEF		SHEEP & GOATS	
	Average	Max.	Average	Max.
Matara	50	60	25	30
Jaffna	40	50	50	60
Mannar	20	25	20	25
Vavuniya	20	25	20	25
Talawao	20	25	20	25
Trincomalee	40	50	50	60
Polonnaruwa	20	25	20	25
Batticaloa	40	50	50	60
Kalmunai	20	25	20	25
Puttalam	20	25	20	25

Slaughtering of pigs is limited to a very small number, less than 5-10 units/day.

Abattoir Specification

The abattoirs in Kalutara, Kochchikade, Kandy, and Nanu Oya, should in principle follow the general design program given below:

Stables

Stables should be capable of holding one day's slaughtering of the various species. Facilities for ante-mortem inspection and weighing of live animals should be provided for. Livestock foreseen arriving both by railway and road.

Cattle Slaughtering Hall

Cattle stunning, not presently practised, should be used if acceptable to Muslim Ritual Slaughtering Authorities. Rotating-type retaining slaughtering pens should be installed for the purpose.

Dressing of carcases should be "on the rail" utilizing working platforms and lift platforms to obtain correct working heights. For efficient operation of

the slaughtering line mechanical hide-puller, powered hand tools, and moving top viscera inspection tables should be installed.

Hanging Hall

Air-conditioned hanging hall with a holding capacity of one day's slaughtering should be built. The carcases to be held in the hanging hall on overhead rails. Also edible offals and tripes, head meat and feet are to be held in the hanging hall awaiting dispatch.

Chillrooms (Only to be installed at abattoirs in Kalutara and Kochchikade).

Chillroom should be provided for hanging of appr. 10% of the daily slaughtering for 48 hours. The first grade deboned vacuum-packed beef meat chillrooms should be built to hold appr. 5% of the beef slaughtering for a period of 8 to 10 days. Chillrooms should also be provided to hold edible fat and salted casings, etc.

Sheep and Goat Slaughtering Hall

Sheep and goats slaughter should take place on a grating above the blood collecting trough. After slaughter, sheep and goats should be bled off on the rail. First operations of dressing should be performed utilizing the dressing cradle system. Mechanical pullers should be used for removing the pelt from the carcase. A table with trays should be installed for veterinarian inspection of abdominal viscera. Thoracic viscera should be inspected while hanging by hook on a separate rail.

Pig Slaughtering Hall

Pigs should be electrically stunned before killing. In order to achieve proper scraping of the pig carcase, a scalding tank and scraping machine should be provided for. Remaining hair and carcase should be removed by gas fired manual singer. Installations should be made for veterinarian inspection of abdominal and thoracic intestines.

Hides and Pelt Department

Wet brine system should be used for curing of hides. The system should include a wet brining vat taking one day's [illegible] and brine sterilization

tank. Sheep pelts should be cooled on racks before curing. Storage area for two weeks' production should be available.

Abdominal Viscera Department

Paunches emptied of contents should be properly washed, scalded, and scraped in a machine. Machines should also be provided for cleaning of casings. Casings to be used for sausage manufacturing should be sorted, calibrated, bundled, and salted.

Thoracic Viscera

Red offals should be separated and hung on hook on trucks in the hanging hall.

Cattle Head and Feet Department

Cattle heads should be split mechanically. Brains and meat removed for edible purposes. Headbones collected for inedible rendering. Feet should be scalded, hooves removed and collected. After scalding, feet should be scraped.

Edible Fat Rendering Department

Edible fat originating from separation of abdominal and thoracic intestines is to be washed before rendering in an autoclave cooking kettle. The fat is refined in a settling tank before being packed in cans. The finished products are kept in chillstore.

Inedible Materials Rendering Department

Inedible materials are collected in closed containers. The material is charged into dry-melter for pressure-cooking, sterilization and drying. After cooking, cracklings are strained in a percolator before being processed in a basked centrifuge. Meat is milled and packed in bags. Inedible fat is refined in settling tanks and filled into drums for dispatch.

Beef Meat Processing Department

Chilled first grade beef meat is deboned and the primal cuts are vacuum-packed

in plastic film. The packed meat is placed on racks in chillroom for maturing over 6 to 10 days.

Boilerhouse, Refrigeration Compressor Room, etc.

Offices for Administration

Veterinary Offices, Laboratory, Etc.

One of the abattoirs should be provided with facilities for education of veterinarians, butchers, etc.

Staff Rooms

Garages, Portner's Lodge, Etc.

Managing Staff Residences

Effluent Water Treatment Plant

The effluent water purification plant should comply with local regulations, and secure that the effluent water will no contaminate the recipient, or be of danger to the public utilizing the water of the recipient.

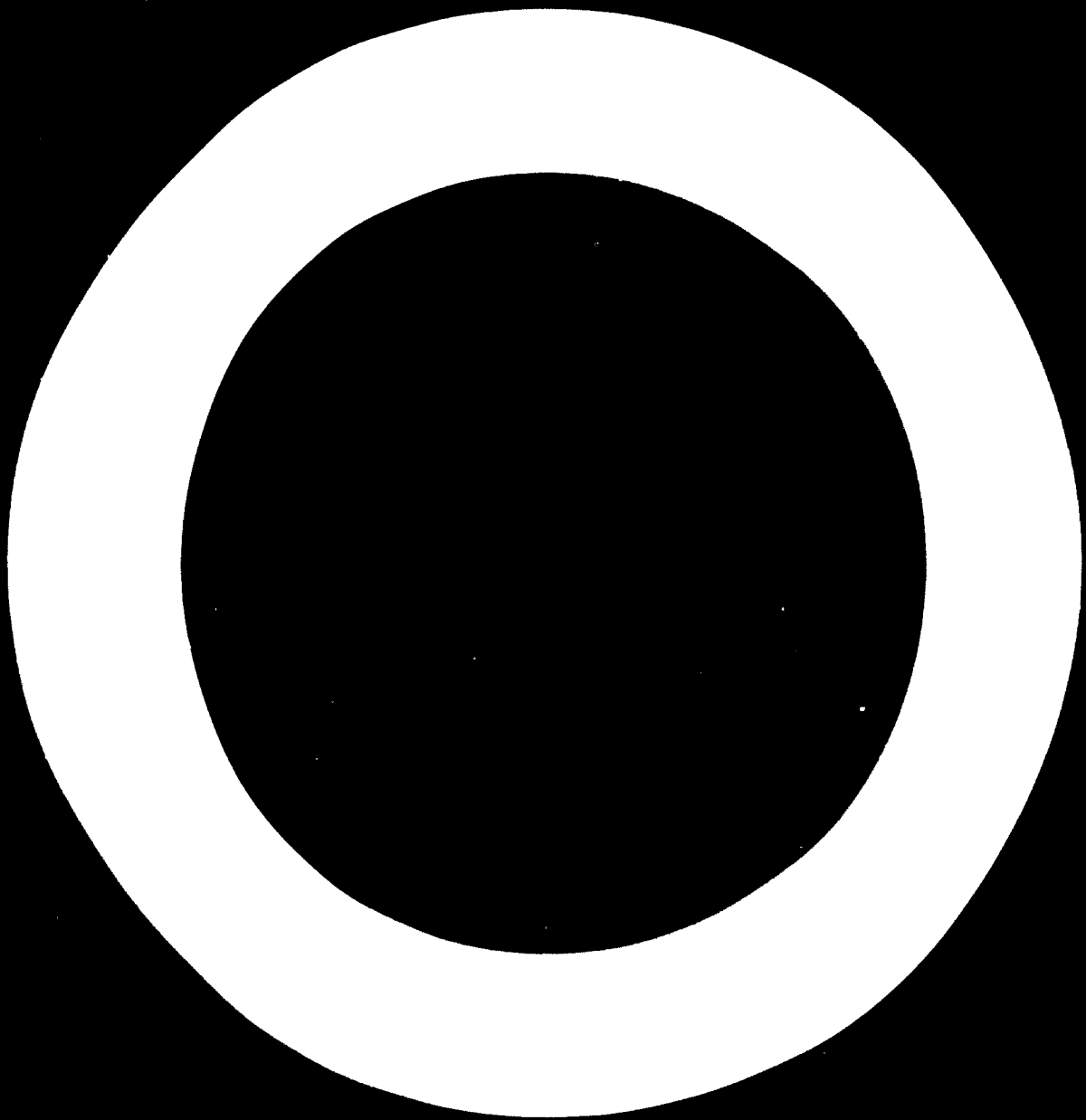


Table 3 - Total meat [1]: Production, consumption and balances, 1964-66 average, 1970 and projections for 1980

	1964-66 average				1970				1980			
	Production	Net trade (exports (-))	Consumption		Production	Balance (exports (-))	Consumption		Production	Balance (exports (-))	Demand	
			Total	Per caput			Total	Per caput			Total	Per caput
	(. . . Thousand tons . . .)			(. . kg . .)	(. . . Thousand tons . . .)			(. . kg . .)	(. . . Thousand tons . . .)			(. . kg . .)
[illegible]	83 045	- 338	82 707	24.7	98 684	- 216	98 468	26.5	131 237	2 136	133 373	29.3
[illegible]	41 668	850	42 518	61.5	49 113	1 146	50 259	69.5	62 101	2 343	64 445	80.0
[illegible]	21 144	628	21 772	101.6	24 718	856	25 574	112.8	30 638	1 384	32 022	126.2
[illegible]	1 787	- 70	1 717	87.6	2 114	- 44	2 070	96.5	2 718	23	2 741	110.2
United States	19 357	698	20 055	103.1	22 604	900	23 504	114.6	27 920	1 361	29 281	127.9
[illegible]	16 312	1 075	17 387	50.8	19 014	1 125	20 139	56.6	23 877	1 951	25 828	67.4
[illegible]	9 084	653	9 737	53.6	10 672	660	11 332	60.2	13 645	1 072	14 717	72.5
Belgium-Luxembourg	586	- 11	575	58.7	758	- 29	629	62.6	857	- 86	771	72.9
France	3 291	46	3 337	68.4	3 630	187	3 817	75.3	4 502	62	4 864	88.6
Germany, Fed. Rep. of	5 063	539	3 602	61.0	3 652	520	4 172	68.4	4 608	690	5 298	81.5
Italy	1 239	411	1 650	32.0	1 365	627	1 992	37.2	1 941	921	2 862	49.4
Netherlands	905	- 332	573	46.7	1 267	- 545	722	55.4	1 437	- 515	922	63.5
Other western Europe	7 228	422	7 650	47.5	8 342	465	8 807	52.6	10 232	879	11 111	61.6
Austria	483	12	495	68.2	542	- 22	520	70.3	608	8	616	79.2
Denmark	1 053	- 825	228	47.9	1 052	- 812	240	48.8	1 119	- 841	278	52.2
Finland	166	2	168	36.4	224	- 6	218	46.0	226	47	273	55.1
Greece	208	85	293	34.3	255	125	380	42.4	353	186	539	56.3
Ireland	489	- 311	178	61.9	567	- 364	203	69.1	706	- 460	246	78.5
Norway	132	1	133	35.7	151	- 1	150	38.6	158	23	181	42.2
Portugal	198	13	211	22.9	245	15	260	27.1	306	71	377	36.3
Spain	814	89	903	28.6	1 206	114	1 320	39.7	1 624	380	2 004	55.1
Sweden	397	- 20	377	48.7	440	- 28	412	51.4	434	34	468	54.7
Switzerland	277	63	340	57.2	348	- 22	426	67.7	423	107	530	75.1
United Kingdom	2 333	1 490	3 823	70.0	2 515	1 485	4 000	71.4	3 146	1 434	4 580	77.0
Yugoslavia	659	- 181	478	24.5	773	- 124	649	31.5	1 099	- 114	985	43.1
[illegible]	2 576	- 938	1 638	116.9	3 143	-1 080	2 063	134.4	4 192	-1 622	2 570	137.2
Australia	1 759	- 441	1 318	115.7	2 148	- 446	1 702	136.3	2 848	- 699	2 149	140.5
New Zealand	817	- 497	320	121.8	995	- 634	361	126.4	1 344	- 923	421	122.7
[illegible]	1 636	85	1 721	14.3	2 238	245	2 483	19.2	3 392	630	4 025	27.1
[illegible]	94	27	121	47.2	114	35	149	51.6	154	63	217	60.6
Japan	759	86	845	8.7	1 190	240	1 430	13.8	2 002	493	2 495	21.4

Table 3 - Total meat 1/ : Production, consumption and balances, 1964-66 average, 1970 and projections for 1980 (cont.d)

	1964-66 average				1970				1980			
	Production	Net trade (exports (-))	Consumption		Production	Balance (exports (-))	Consumption		Production	Balance (exports (-))	Demand	
			Total	Per caput			Total	Per caput			Total	Per caput
	(. . . Thousand tons . . .)			(. .Kg .)	(. . . Thousand tons . . .)			(. .Kg .)	(. . . Thousand tons . . .)			(. .Kg .)
ECONOMIC CLASS II	15 561	- 741	14 820	9.7	18 723	- 833	17 890	10.2	27 516	- 858	26 658	11.6
Africa	2 384	- 81	2 303	9.3	2 749	- 108	2 641	9.4	4 104	- 138	3 966	10.5
Northwestern Africa	283	12	295	9.9	357	2	359	10.5	550	2	552	12.0
Western Africa	694	12	706	7.1	800	- 9	791	6.9	1 211	1	1 212	8.0
Central Africa	204	- 23	181	5.7	233	- 29	204	5.8	319	- 25	294	6.7
Eastern Africa	1 203	- 82	1 121	13.0	1 364	- 74	1 290	13.3	2 024	- 116	1 908	15.0
Latin America	8 296	- 809	7 487	30.7	10 139	-1 003	9 136	32.5	14 401	-1 601	12 800	34.2
Central America	1 102	- 162	940	16.5	1 370	- 196	1 174	17.5	2 272	- 341	1 931	26.5
Mexico	858	- 111	747	17.5	1 060	- 113	947	18.8	1 757	- 207	1 550	21.8
Caribbean	398	79	477	22.7	465	90	555	23.7	615	140	755	25.8
South America	6 796	- 726	6 070	36.5	8 307	- 897	7 410	38.8	11 514	-1 400	10 114	40.4
Argentina	2 609	- 613	1 996	89.1	3 347	- 700	2 647	109.8	4 166	-1 176	2 990	107.5
Brasil	2 332	- 36	2 296	28.4	2 752	- 70	2 682	28.7	4 290	- 205	4 085	32.9
Paraguay	138	- 36	102	50.3	163	- 41	122	51.5	231	- 55	176	53.1
Uruguay	401	- 106	295	98.0	462	- 138	324	110.4	578	- 206	372	114.5
Near East	1 664	24	1 688	11.7	1 905	82	1 987	12.0	2 746	433	3 179	14.5
Near East in Africa	512	20	532	11.9	559	39	598	11.7	838	66	904	13.2
Near East in Asia	1 152	4	1 156	11.6	1 347	44	1 391	12.2	1 908	367	2 275	14.9
Asia and Far East	3 217	125	3 342	3.7	3 930	196	4 126	4.0	6 265	448	6 713	5.1
South Asia	1 082	5	1 087	1.7	1 183	10	1 193	1.7	1 839	59	1 897	2.2
East and Southeast Asia	2 135	120	2 255	8.2	2 748	188	2 936	9.3	4 427	389	4 816	11.6
ECONOMIC CLASS III	25 816	- 447	25 369	22.5	30 848	- 529	30 319	24.6	41 619	651	42 270	28.9
Asian centrally planned economies	12 873	- 277	12 596	15.8	14 424	- 285	14 139	16.0	20 540	238	20 778	19.2
China (Mainland)	12 389	- 226	12 163	15.9	13 859	- 239	13 620	16.1	19 721	252	19 973	19.2
U.S.S.R. and eastern Europe	12 943	- 170	12 773	38.4	16 424	- 244	16 180	46.4	21 079	413	21 492	55.9
U.S.S.R.	7 827	127	7 954	34.5	10 232	168	10 400	42.9	13 163	858	14 021	52.0
Eastern Europe	5 116	- 297	4 819	47.3	6 189	- 417	6 189	54.6	7 916	- 445	7 471	54.9
Bulgaria	389	- 66	323	39.4	494	- 85	409	48.2	664	- 99	565	62.1
Czechoslovakia	749	59	808	57.1	912	53	965	66.7	1 074	117	1 191	77.8
German Dem. Rep.	984	34	1 018	59.8	1 172	24	1 196	69.9	1 384	- 22	1 362	77.9
Hungary	599	- 105	494	48.7	722	- 163	559	54.1	878	- 171	707	65.3
Poland	1 631	- 183	1 448	46.0	1 921	- 202	1 719	52.3	2 502	- 243	2 259	62.9
Rumania	715	- 36	679	35.7	912	- 48	864	42.4	1 335	- 47	1 288	54.1

Note: Production data are in terms of carcass weight excluding offals and slaughter fats.
Trade data represent the estimated carcass weight equivalent of meat (fresh, chilled, frozen, prepared and canned) and of live animals.

1/ Beef and veal, mutton and lamb including goat meat, pig meat and poultry meat.

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