OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

FAIR USE POLICY

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

04965

United Nations Industrial Development Organization

Distr.
LIMITED

ID/WG.157/22
31 August 1973

ORIGINAL: ENGLISH

Workshop on Leather Industry Development
in Developing Countries

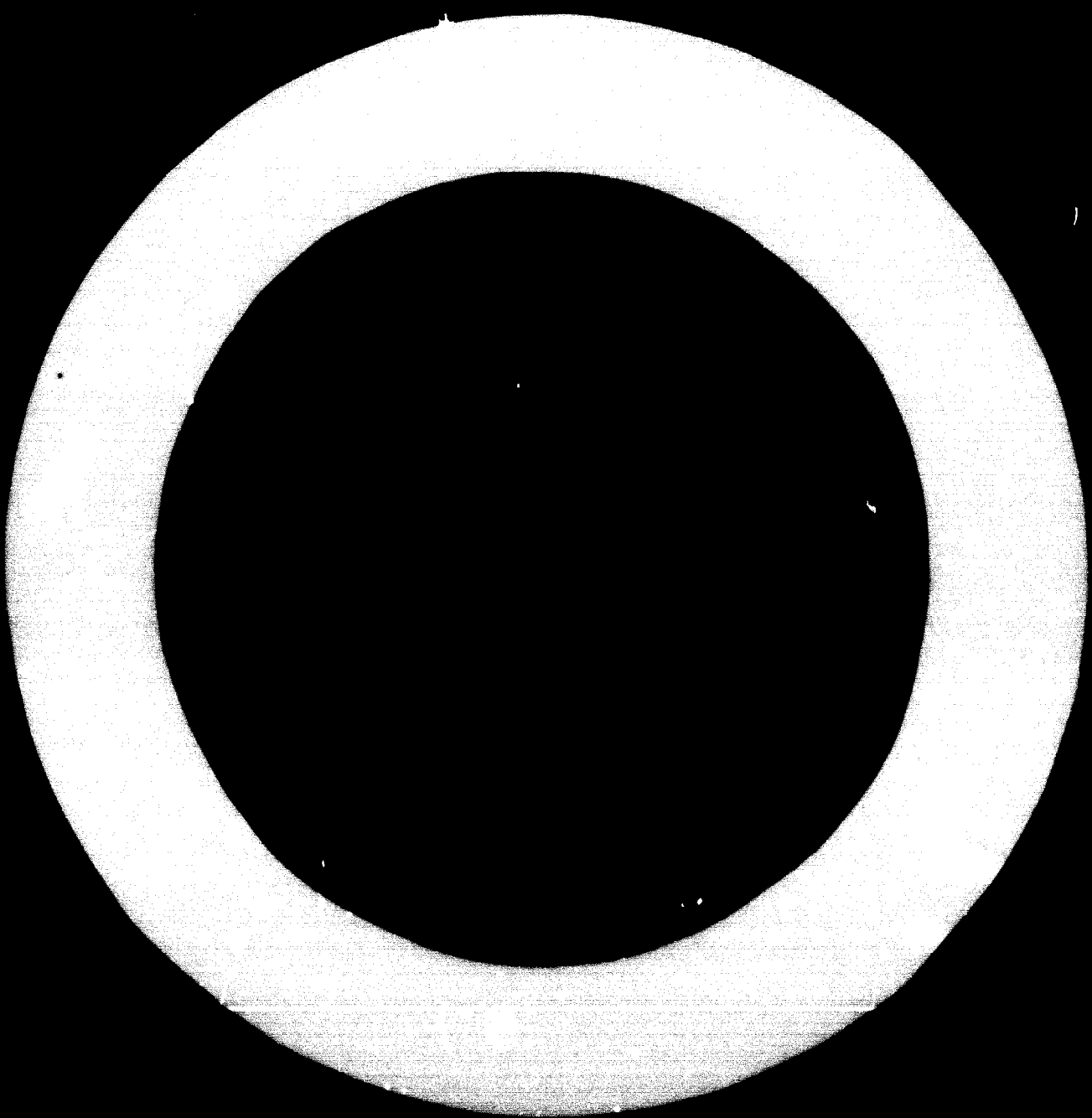
Vienna, Austria, 27 August to 1 September 1973

THE PROFITABLE UTILIZATION OF BY-PRODUCTS FROM THE LEATHER AND ALLIED INDUSTRIES

prepared by

Food and Agriculture Organization, Rome

id.73-6018



Introduction

In dealing with meat and meat byproducts it may be worthwhile, at the outset, to define these and other related terms as precisely as possible so as to avoid ambiguity in later discussion. Meat in the context of this paper refers to the carcass and carcass products of slaughtered animals and lean meat stands for carcass devoid of fat and bone. Edible portion of the carcass therefore constitutes lean plus fat, whereas non carcass components utilized for human food are classified as edible offals. These two constituents together make up edible meat. The remainder of the slaughtered stock comprising the inedible portions of the carcass plus the inedible offal is designated as meat byproducts or the 'fifth quarter' of the animal. However, the distinction between the edible meat and its inedible byproducts is rather arbitrary depending upon a variety of factors like the general economic and social condition of the people, their eating habits and dietary practices, religious beliefs and sentiments, the status of animal health in the area, degree of control and standards of veterinary and public health inspection, as well as the structure and system of working of the abattoir industry. Since these parameters vary to a large extent from country to country it is patently obvious that what goes as a meat byproduct in one place under conditions of relative affluence need not necessarily be so in another of comparatively modest means. Increased affluence generates demand for meat which is more quality oriented and as a result certain parts of the animal are declared inedible and hence become unsaleable for human consumption. Indeed higher the income of the consumer the higher is the percentage of potential edible offal which is used for inedible purposes. Based on the currently accepted norms of veterinary and public health inspection and control it is generally recognized that on an average 55% of the live weight of the cattle accounts for the edible portion with the inedible byproducts like hides and skins, blood, bone, intestines, hair, horns, hooves etc. Constituting the rest of

../..

the 44%, the shrinkage and loss being of the order of one percent only. The corresponding average dressed yields of hog and sheep carcass are 70 and 47 percent respectively.

The basic problem in the field is the salvaging and effective disposal of these animal byproducts from the over-all considerations of economy, health, hygiene and sanitation. In most of the primary producing countries the full potentialities for the development of these byproduct resources are yet to be realistically worked out. In contrast to destructive disposal of these valuable materials constituting a downright waste at considerable recurring cost of labour, transport and conversion plant services, their optimum use, re-use and recycling as raw materials for a number of secondary ancillary industries will convert them into a positive source of profit revenue. Whereas wastes of such valuable natural resources breeds poverty, their conversion into useful wealth generates affluence. Waste of any sort is therefore a costly luxury a developing country can ill afford and yet the science of effective waste disposal on an economically viable scale has been neglected so much so that the non/mal utilization of potentially valuable animal byproducts still constitutes a veritable 'drain' on national wealth in most parts of the developing world. India for instance loses annually US$ 70 millions for not utilizing optimally her animal byproducts.[1] Besides, such wastes have other implications as well - they keep the cost of the concerned primary product viz meat relatively high and to that extent restricts its competitive capacity particularly in the international market much to the detriment of the country's economy. Meat is a high cost food item and failure to optimally utilize its byproducts tends to make this meat production cost still higher thus pricing it out of the purchasing power of the majority of the country's most needy consumers. Indeed, rational utilization of the resultant byproducts may well be a major factor in the over-all profitability of the meat producing industry.

The market for meat, particularly processed meat, is a dynamic growth area in high income countries and developing countries should be quick in exploiting this situation by pursuing the possibility of exporting such meat to the sophisticated markets. Production with this end in view,

../..

1/ Indian Hides and Skins Improvement Society News Letters 1970

however, has to be systematically planned and should be large enough to take full advantage of the economics of scale and byproducts utilization. Better utilization of byproducts will be immediately reflected in the increased return per animal and to that extent will give additional incentive to the primary meat producer i.e. the stockowner. It is only through these pre-planned supporting economic measures that a nascent meat industry in a developing country can reasonably hope to manufacture products of high quality at costs comparable to those in developed countries and thus expands its share of world trade in processed meat.

Primary processing and utilization of animal byproducts constitute an important agro-industrial manufacturing sub-sector of the livestock industry affording considerable shift in processing from developed to developing countries, but is often the most neglected and technically the least efficient. This is mainly because in the majority of cases management resources and physical facilities are overwhelmingly deployed towards maximisation of prime carcass meat output and the optimum utilization of byproducts typically takes a very secondary place in the scale of priorities for production planning. As a general rule the less developed the economy the greater this disparity in emphasis appears to be. This is most unfortunate because it is precisely in a developing economy that such a need for effective economic utilization of the byproducts is the utmost in as much as it is essentially a labour intensive industry oriented towards export promotion and diversification as well as import substitution and given a significant improvement in its technical performance would not only accelerate the optimum utilization of the indigenous raw materials within the country but also stimulate development of a number of vitally important ancillary processing industries, thus creating additional employment opportunities particularly in the small scale sector.

However, a qualifying minimum throughput is required for ensuring the full benefit of the economics of scale in byproducts utilization. An annual throughput of at least 30-40 thousand animals is required to make processing of byproducts economical through getting up a mass production line as opposed to individual slaughtering[2]. Thereafter the unit cost of production continues to decline at least until some 100,000 animals

../..

2/ S.K. Barat, Ethiopia Mission Report 1971

are processed annually. Although it may not be quite possible to fully utilize these byproducts in many of the slaughtering establishments in the developing countries mainly because of limited throughput, it is nevertheless felt that with the provision of elementary facilities of handling, cleaning and washing and application of rather rudimentary technology much of this potentially valuable raw material may be salvaged and through preliminary preservation and treatment in the place of production could be rendered technically well worthwhile for subsequent transport and storage, pending fuller scientific processing at convenient centres.

Principal Byproducts

The possible economic utilization of some of the principal animal byproducts for various end uses is briefly discussed below.

Hides and Skins

In normal times hides generally account for 5-10 percent of the total value of the animal with skins contributing approximately 25 percent of the same. In case of small animals particularly byproducts may well provide as great an income as the sale of dressed carcass. Weightwise, on the other hand a good beef type cow or steer hide will average approximately 7 - 7.5 percent of the live weight, whereas the corresponding figure for a sheep skin will be around 3-4 (percent).[3/] Hides and skins are by far the most important among the commercially exploited animal byproducts and their conventional end-use utilizations are too well known to need further elaboration here. Recent researches however have laid emphasis on non-conventional applications of hides and skins and have sought to explore possibilities for newer uses of collagen derived from them. Apart from the commercial production of reconstituted collagen sheets for artificial sausage casings, considerable success has been achieved in the preparation of a number of collagen derived surgical materials including catgute, semi-permeable membranes, implants and grafts and artificial aorta. Another line of contemporary investigation relates to the possible use of hide and skin collagen as a basic material for

../..

3/ Indian Hides and Skins Improvement Society News Letters 1969

nutritionally balanced human foods through adequate modification and reinforcement of the naturally deficient essential amino acids. Hide collagen can also be used as functional additive and protein supplement - as meat binder, extender, vegetable protein texturizer or components of high protein synthetic meat.

Intestines

Mammalian small intestines as raw material for sausage casings constitute another important slaughterhouse byproduct of very considerable export potentiality. Each cattle yields 140' of these intestines while each goat and sheep contribute a length of 65 feet. 3/ Sausages, as a class of convenience food are becoming increasingly popular all over the world, some 4 billion pounds being annually consumed in the USA alone. In most of the Western World as much as 10% of the total meat consumption is in the form of sausages. Sausage eating has also come in a big way in Japan with a current annual consumption of 107,000 tons, necessitating an import of 4 million hanks of animal casings. Japan's consumption of sausages is expected to rise to 210,000 tons by 1977, when its requirement for animal casings will be almost doubled to 8 million hanks. 4/ This gives some idea of the world demand for animal casings. The sub-standard traditional methods of curing of these intestines by wet salting as are currently in vogue in most of the developing countries however fail to meet the highest requirements of sanitation and hygiene prescribed by the food regulations of the sophisticated importing countries. An improved method of processing the intestines in the dry, ready to wet condition and in a completely sterilised form, if necessary, has been recently developed. This process, which is capable of producing animal casings of the highest standard is amenable to easy implementation in a developing country particularly in the small scale sector. Besides being used as sausage casings, the processed intestines can also be advantageously utilized as the starting material in the manufacture of surgical sutures, sports guts, musical instrument strings etc., all of which in addition to having an assured domestic market, are capable of becoming ace foreign exchange earners for the country.

../..

3/ Ibid.
4/ S.D. Kourkoulis - Private Communication 1973

Other organs, glands and tissues

Since a long time, physiologically useful substances of benefit to human beings have been found in many of the animal tissues and a large number of glandular derivatives, biological compounds and other clinical products have been prepared from them. In this context, several of the organs, glands and tissues like pancreas, ovaries, thyroid, para-thyroid, pituitary, suprarenal, bile, testes, stomach and stomach linings are of interest to the pharmaceutical industry for the preparation of a number of useful derivatives extracts and enzymes like desiccated bile, cholesterol, pituitary, pancreatin, trypsin, pepsin, rennin, D-Catalase, hyaluronidase, deoxyribonuclase and cytochrome-c. The concerned raw materials are, however, extremely time and heat sensitive and for retaining their potency need sophisticated facilities for collection, preservation and processing. The economic viability of commercially exploiting some of these substances will depend on a number of factors, principal among these being the scale of availability, proximity to processing centres and the relative price of alternate and substitute materials in the market.

Hair, wool and bristles

Wool and such specialised hairlike mohair from angora goats, Pashmina or Cashmere from Cashmere goats, llama and alpaca hair, camel hair as well as ordinary goat hair of suitable quality may be adequately scoured, processed, bleached and dyed or in other ways modified to meet the varied requirements of their ultimate end uses. In case of cattle, hair from tail and ear is of particular commercial interest, the body hair which constitute approximately 2 percent of the soaked weight of the hide in the tannery are mostly wasted. Pig bristles particularly from native pigs and hogs have considerable value and find ready markets abroad. Pedigree pigs however produce hair instead of bristles and these are mostly wasted. On an average some 4-6 oz of bristles can be obtained from each pig.[3]

There is a good demand for the coarser variety of hair and wool for use in carpets and carpet backing and for making insulation and automotive felts. All other waste hair and wool can be made into a pre-digested nitrogenous concentrate with approximately 14 percent nitrogen for use in hop farms, vine yards and for other sophisticated horticultural crops.

3/ Ibid.

Ruminal and stomach contents

Because of their very nature and bulk these byproducts create a major public health hazard/and sanitary problem in slaughterhouses. Their effective disposal through economic utilization is therefore doubly desirable. The contents on drying can be used to a limited extent in poultry feeds as a substitute for bran and also in calf rations as a source of desirable ruminal flora. The rest of the material, however, can be suitably composted for use in an adjoining garden or orchard or more advantageously utilized along with other slaughterhouse wastes and sweepings for the generation of methane gas within the premises for the necessary heat and light.

Blood

By and large blood constitutes 1/11 - 1/14 parts of the body weight of the animal. Reckoning an average yield of ten kgms of blood from each cattle and one kgm from each goat and sheep it is expected that each large animal will yield approximately 2 kgms of dry blood with small animals contributing some 200 gms each. In terms of blood meal of 10 percent moisture content it is generally assumed in commercial production that small animals and cattle yield approximately 5-6 and 6-7 kgms per 1000 kgs of their respective live weights.[1/3/] The extent of economic loss where blood is not utilized at all can therefore be easily imagined.

Apart from its main use as blood meal and nitrogenous concentrate which will be referred to later, preparations of soluble blood extract in presence of anti-coagulants have wide industrial applications as adhesives particularly in plywood industry and for crown corks, as a clarifier for various industrial extracts, as a stabilizer in bituminous emulsions and insecticidal and fungicidal sprays. Besides it is extensively used in the finishing of leather and in the manufacture of fire extinguishing foams and moulded ceramics with foam structure. Other specific applications of blood includes its use as the source material for albumin for printing and pharmaceutical industries, blood charcoal for gas absorption, solvent recovery, and as decolorising agents for a number of industries, including cane sugar, rubber, pharmaceuticals, oils and fats and alcoholic beverages,

1/ and 3/ Ibid.

.../...

sterile whole blood and serum, blood plasma and blood cells for the preparation of a host of pharmaceutical derivatives, ensymes and chemicals.

Bones

Bones account for approximately 15 percent of the weight of dressed carcass in case of cattle, ranging from 12 percent for healthy animals to as much as 30 percent for the more bony ones. In small animals like sheep and goat they represent about 20-30 percent of such weight. The organic and inorganic constituents in bone are generally present in the ratio of 1 : 2, and it is generally reckoned that each cattle on an average yields 13.5 - 18 kgms of bone meal, that from the goat and sheep being 1.8 - 2.8 kgms only. The organic component representing 33-36 percent of the total weight mainly consists of ossein the mother substance for high class glue and gelatin whereas the inorganic portion is principally composed of calcium (32.6%) and phosphorus (15.2%).5/ In places where chlorine disposal is a problem or where hydrochloric acid could be made available cheaply, conversion of bones into ossein and recovery of dicalcium phosphate as a byproduct may prove economically worthwhile. In this context it would therefore seem preferable to export bones in the form of ossein rather than in the conventional form of bone meal, bone grist or crushed bone. Processing of ossein into high grade photographic and pharmaceutical gelatin will be the ultimate stage of utilization of this valuable byproduct. A considerable amount of neatsfoot oil having important use as a precision lubricant can be recovered from the fresh shinbones of animals. Each cattle may yield up to a pint of such oil which may be subsequently made foot or stearin free. Bone marrow usually contains 95 percent of pure fat.5/ Sinews could be separated from bones and salvaged both for export as such and for making glue and technical gelatin for printing, paper, textile, match, mineral and wood processing industries. Other useful products derived from bone include calcined bone and bone char, both of which have wide industrial applications.

Horns and hooves

Like bone, these are also compounded into meal which has much the same use as the bone meal, although it commands a better price. Intact horns

5/ Utilization of Animal By-products, FAO 1962

.../...

have other uses in the export industry and fetches a high price. Horn pith or horn core, the frontal portion of the horn has a high casein content and yields high grade gelatin. As such this should be separated from the horns and sold for the specific purpose. Horns and hooves can also be converted into a pre-digested nitrogenous concentrate along with other waste keratinous fibres.

Fats, tallow and dripping

Animal fats are yet another extremely important industrial raw material having linkages with soap, margarine and fatty acid manufacture, and with the tyre industry where it is used as a lubricant for the moulds. Fat is the starting material for a number of special chemicals including wetting agents and quaternary ammonium compounds. In many developing countries, however, these are not salvaged from indigenous sources to the maximum possible extent although substantial quantities of the same continue to be imported at considerable cost of valuable foreign exchange. Animal fat is also converted into shortenings through deodorization, and blending with beef fat and subsequently stabilised by anti-oxidants. The low grade fats and greases unfit for human consumption can be advantageously mixed into poultry feed and stock rations for increasing their palatability and calorific value. It is therefore economically desirable that every bit of worthwhile fat particularly the caul, mesenteric and abdominal fat is recovered from the carcass. Considerable amount of fat can also be salvaged from fleshings and glue stock.

Useless meat, hides and skins trimmings and other carcass wastes and appendages

All these miscellaneous carcass remnants not used otherwise are converted into composite carcass meal preferably through dry rendering. Depending upon its composition, such a meal will have an average protein content of 55-60 percent suitable for use as protein supplement in feed formulations.

Major areas of optimum utilization

In addition to some of the specific end use utilization of individual animal by-products as discussed above, there are three major areas of their

.../...

optimum utilization of particular interest to developing countries. These generally relate to inedible meat and meat byproducts in composite form derived both from domestic and wild life sources:

1) As protein supplement in feed formulations - one of the major constraints that stands in the way of livestock/poultry/piggery development programme today is the lack of adequate feedstuffs and concentrate with the required amino acid profile at an economic scale and price. The most costly component of these feed formulations is the protein supplement needed to ensure the optimum amino acid balance. Utilization of inedible slaughter-house offals and wastes with their total protein content up to 85 percent as a source of this protein therefore affords attractive economic possibilities. Unlike animal proteins, vegetable proteins markedly lack some of the essential amino acids, vitamins, minerals, trace elements and the unknown growth factor and are thus nutritionally deficient and cannot therefore by themselves constitute balanced feeds. Their admixture with blood/bone/meat meals rich in calcium, phosphates, vitamins and such essential amino acids like lysine, tryptophane and methionine therefore ensures the desired level of nutrition and adequately reinforce the carbohydrate components in feed formulations. Direct feeding of bone meal to growing cattle increase the rate of growth of young stock nearly twofold and ensure astonishing gain in weight and milk production. Additions of animal fats as a concentrated source of energy in rations having ensured feed conversion ratios that were impossible to achieve a few years ago. It is through such use, reuse and recycling of animal byproducts that the protein cycle is kept going putting into circulation more proteins for the benefit of the stock, stock owners and consumers.

2) As the raw stock for petfoods - the growing demand for certain slaughterhouse byproducts and wastes by rapidly expanding processed petfood industries affords an opportunity for long term trade expansion with the concomitant earning of valuable foreign exchange to countries with developing meat industries or substantial wild life resources. It is estimated that the current annual value of petfood sales is of the order of $1000 millions in North America, around $200 millions in West Europe and $35-40 millions in Australia. The industry expects a doubling of the market by 1977 and a doubling again by

.../...

1985. [6] A recent study by the New York Stock Exchange shows that Americans are now spending more to feed pets than to feed babies. The survey reveals that 28 percent of US households own at least one dog and 22.6 percent have one or more cats. The pet products are reported to yield retail profit margins between 40-50 percent.[7] Current uses of animal products of all kinds by the worldwide petfood industry are estimated to be around one million tons per annum. Animal byproducts and offals like lung, spleen/melt, tongues and tongue roots, liver, heart, tripe, kidney, trachea, maws, udders, bibles (omasum), breeding bags, uteri, cap ends, stomachs, blood, bones and tallow as well as particular grades of carcass meats for which human consumption markets rarely exist and which often are, for a variety of reasons, simply thrown into a digester or rendering plant or even discarded constitute the basic raw material for petfoods. The current and prospective demand for such animal products by the International petfood industry is sufficiently great to warrant a much higher value than that usually obtained otherwise for these offals.

3) As phosphatic and nitrogenous concentrate for livestock and agricultural development

Many of the arid and semi-arid areas of the developing world where most of its livestock is born and bred have soil and pasture which to a large extent is chronically deficient in phosphorus and calcium, and because of the lack of these minerals animals sustained on these pastures are unable to make full use of the food available. As a result these animals are puny and undersized, slow maturing, breeding irregularly and bearing dead and weak offspring; and of course all these mean less milk and meat production and increased susceptibility to infectious diseases and parasitic infestations. Such continued deficiency has other adverse genetic implications on the quality of the national herd. Luckily, however, this phosphatic deficiency in livestock can be easily remedied by feeding phosphates and the best form of such phosphates is sterilised bone meal made from bones available locally. Ironically enough, countries which suffer from such chronic phosphorus deficiency frequently export vast quantities of bones instead of using them locally to improve their soil, pasture and livestock.

As a source of nitrogen, concentrated organics made up of hoof and

6/ M.B. Dale, FAO 1972 - Private Communication
7/ New York Stock Exchange Survey 1971

.../...

horn meal, tankage (meat and bone), dried blood etc and containing as much as 14 percent nitrogen are in great demand. Unlike the inorganic salts these release nitrogen rather slowly spread over a long period and as such are capable of heavy application without any harmful effect on the working property of soil. In addition, these organics being more resistant to leaching than their easily soluble inorganic counterparts are better suited for irrigated tracts. Their residual effects remain in the soil long after the first crop and it is mainly because of this reason that despite their cost they are so much sought after for high value crops. Some of these concentrated organics often contain considerable amount of bone and depending upon its quantity, the insoluble phosphoric acid content may be as high as 15 percent or even more. The effect of phosphate on the soil is to assist the early growth of seedlings, hasten maturity and improve root and seed development and in general increase agricultural production by 25-30 percent.

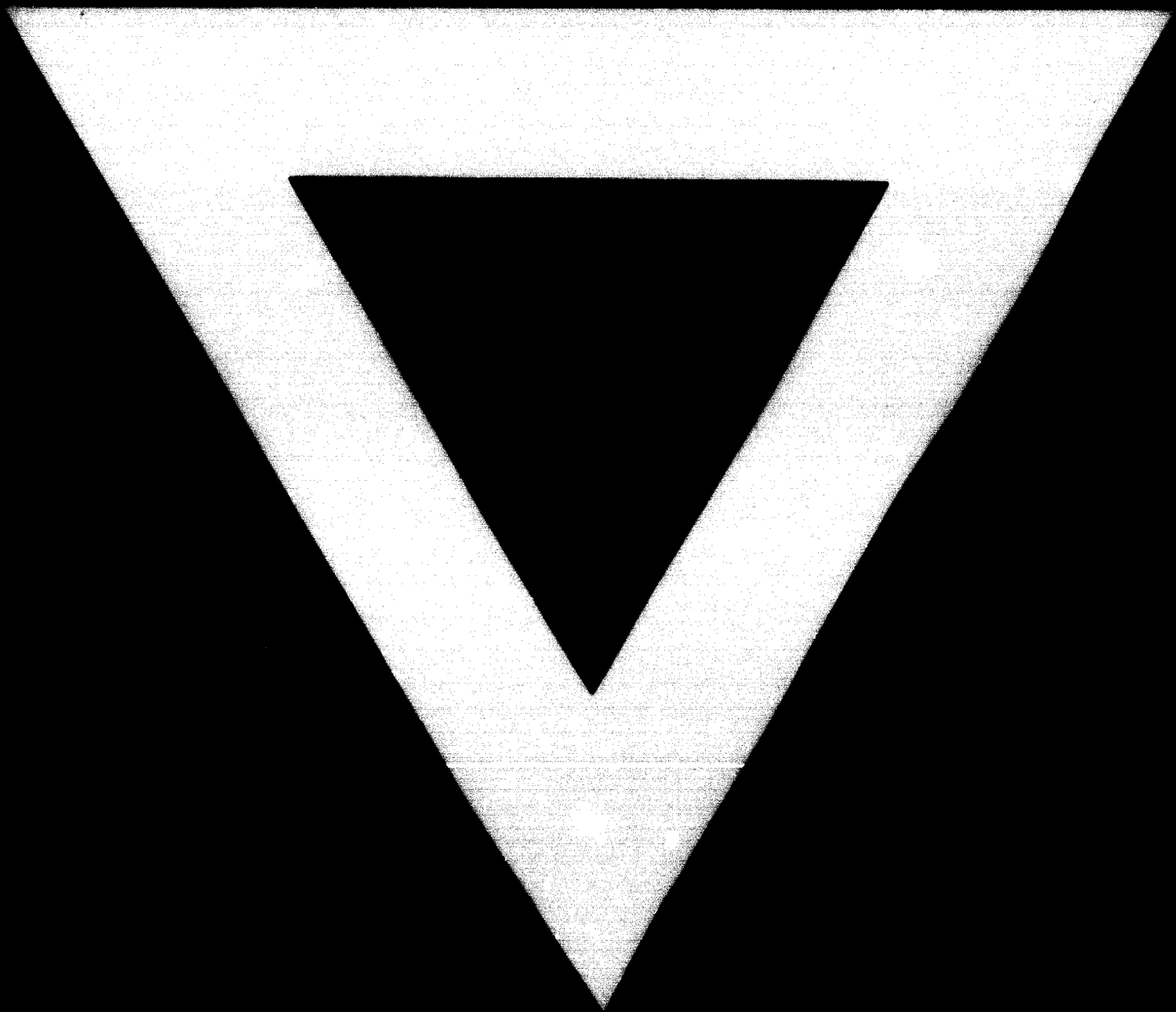
Conclusion

In most developing countries, however, the approach toward livestock development often lacks integrated planning leading to wasteful but nevertheless avoidable losses of a whole range of valuable animal byproducts. This has resulted in a 'paradoxical situation' in as much as the very countries in dire need of proteins both for human and animal nutrition are also the ones which make least use of them from their own readily available potential sources. Thus it is not uncommon to find a developing country wasting valuable slaughterhouse blood down the drain at one end and importing blood meal and blood derivatives at the other at considerable expense of its scarce foreign exchange; exporting crude bones at nominal costs while importing expensive cattle licks and rock phosphates; throwing slaughterhouse offals to jackals and vultures and at the same time continuing to import protein and other nitrogenous concentrates at great cost; selling hides and skins in the raw uncured condition, while repurchasing the same from abroad as finished leather and leather products. From every

.../...

techno-economic consideration therefore it is essential to salvage all useful animal byproducts for processing them for a wide range of their end uses.

In view of the possibility to increase the national nutrition level, G.N.P., export earning, and employment opportunities, this aspect of animal byproducts utilization merits serious consideration.



G . 8 . 74