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Expert group meeting on processing
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CASHEW NUT PROCESSING FROM VILLAGE INDUSTRY TO INDUSTRIAL COMPLEX [1]

by

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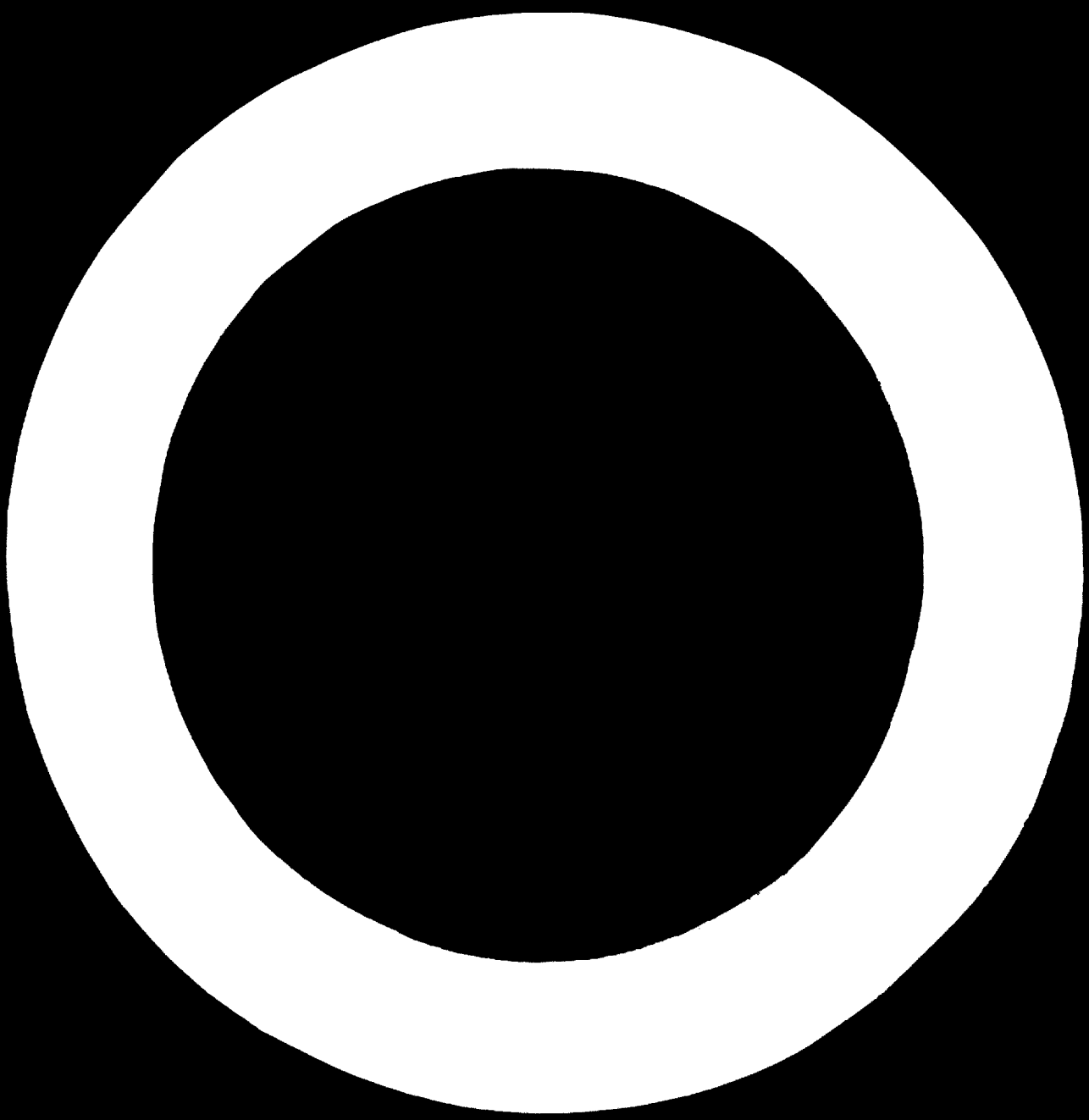

Many distinguished authors have written extensively on the remarkable growth in world cashew nut consumption in recent years and on the implications of this increasing demand for actual and potential producers in tropical countries with the very significant opportunities for foreign exchange earnings which this growing market provides. It has also been fully reported and is well known that whilst with correct climatic conditions the cashew is an easy crop to grow, it is a relatively difficult nut to process in commercial quantities. Contamination of the edible kernel either by cashew nut shell liquid or by the tannin contained in the testa would render the product practically worthless, whilst a very high premium in consumer acceptability, and consequently price, is placed on the obtaining of kernels that are whole, undamaged and free of discolouring or blemish.

Cashew nut kernels of the highest quality have been for many years produced in India by hand processors. Attempts to reproduce the Indian type of processing operation in other countries have however been largely unsuccessful due in part to the relatively high labour cost, but perhaps more importantly to the difficulty of emulating elsewhere the very high levels of manual dexterity which the Indian workers have built up over generations of tradition and experience. In general therefore the economic viability of hand process plants in other countries has been questionable.

In view of the above, the need for reliable mechanical equipment for cashew nut processing has long been recognised by producers,

by equipment suppliers and by a number of national and international bodies whose work is concerned with the promotion and development of important food crops, particularly in developing countries. A number of units have been developed but have generally been unsuccessful either because the required quality and consistency of finished product could not be achieved, or because the equipment itself was over sophisticated, prone to frequent breakdown and not suited to continuous operation in tropical conditions. Indeed there had until very recently been only one commercially available range of machinery put into use in more than one location and even this equipment has so far only been put into commercial use in large installations processing 10,000 tons of nuts per annum or more, where the size of the factory warrants the employment of the not inconsiderable numbers of skilled technical staff which the sophistication of the equipment makes necessary.

As Mr. Coward has explained in his paper the object of the research carried out by the Tropical Products Institute was to design a plant which would be economic on a low tonnage throughput which could be readily operated by relatively unskilled indigenous labour. The extent to which this objective was achieved is indicated by the excellent results achieved by the first pilot installation in Kenya, the output from which has for over two years been successfully sold on the U.S. market and by the even better results now being obtained from the first two installations in Mozambique.

Sturtevant Engineering Company Limited made arrangements with the Tropical Products Institute for the commercial manufacture of the equipment that had been developed at the beginning of 1970, and in conjunction with T.P.I. staff at once embarked on a further development programme in order to be able to market units in which full advantage would be taken of the lessons learnt during the early proving trials, and which would be completely reliable in

operation for 16 hours a day or even more. Further work had to be done both on a laboratory basis and in the field to build up the necessary experimental data relating to operating conditions for nuts from different areas, which in turn influenced certain aspects of the plant design. As shown by an example in Mr. Coward's paper[1/] processing requirements can vary very considerably for nuts grown only a few hundred miles apart. Full account had therefore to be taken in the design of the plant and in the operating specification to ensure that nuts from any area or region could be treated successfully. The result is a line of equipment in regular series production which has been fully proved under the most arduous working conditions and which can be shown to have outstanding advantages for large and small producer alike.

A study of the main cashew nut growing areas of the world shows that cashew nut processing requirements exist at two quite distinct levels. In a very few countries, probably limited to Mozambique, India and Tanzania, very large crops are available amounting to tens or even hundreds of thousands of tons per annum and processing industries are well established with a number of large individual units accounting for a significant proportion of the crop. In other areas right round the Equatorial belt crops at present available range from a few hundred to a few thousand tons and in very few other countries is the total national crop large enough to feed a single one of the large factory units in operation in Mozambique or Tanzania, even if it were economically or socially desirable for production to be concentrated in this way. In view of the increasing importance of the cashew on world markets however a number of countries that are at present only minor producers have put substantial planting programmes in hand and can expect the available harvest to multiply accordingly over the next decade. It is therefore of considerable importance that any equipment that might be installed at an early stage in their industry's development when the productive capacity is low, should be capable of logical and economical extension to keep pace with the increased throughput required. Further research was therefore

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1/ See ID/WG.88/16.

carried out to determine whether a unit that was originally designed as a village plant could be offered in a form that would make it equally suitable and economic when built up step by step to a large installation capable of dealing with 10,000 tons of nuts per annum or more. The investigations carried out have shown that this progression is indeed possible and plans are already well advanced for the progressive expansion of an existing 2,500 ton per annum facility to a level of 10,000 tons per annum and elsewhere a project has been approved for expansion over a five-year period from 600 tons to 3,000 tons.

Whilst in the future further pieces of equipment may well come on to the market offering comparable facilities it appears reasonable to claim that there is at present no other processing plant available that offers such important advantages to a producer entering the market for the first time, or to the established producer planning a steady increase in his activity. The capital cost of the equipment per ton of nuts processed is remarkably low which, quite apart from the initial investment advantage, reduces the standing charges of the operation to a very modest level and means that fluctuations in crop as may be caused by changing weather conditions from one season to another can be accepted without serious loss of economic viability.

As has been described by Mr. Coward in his paper pre-treatment of the cashew nut by soaking and humidification before roasting is of very great importance if the best combination of total kernel yield, whole kernel yield and kernel quality is to be achieved. Considerable attention in the design of the plant was therefore paid to the translation of a known technical requirement into soaking and humidifying equipment which would, with a minimum of training and supervision, lead unskilled operators through a reasonably foolproof processing sequence. The precise configuration of the humidifying and soaking equipment varies according to the physical characteristics of the nuts to be processed and the size of the plant but all units supplied are designed with the common objective

of ensuring that nuts entering the roaster are consistent in moisture content.

Considerable thought was given in the design of the plant to minimising operating costs and, to make it suitable for installation in rural as well as in urban areas, to make it so far as possible independent of outside supplies of fuel and power. All process heat requirements are met by cashew nut shell fired furnaces and if mains electricity is not available, sufficient power for a 1,200 ton per annum unit can be supplied by a small diesel generator.

In the further development and preparation of the T.P.I. plant for regular series production Sturtevant retained the principle of a relatively small decorticating unit since the advantages this gives in operating flexibility were calculated far to outweigh the possible theoretical advantages of larger units. The basic decorticator with a raw nut capacity of 600 to 700 lbs per hour was already shown to be highly efficient. Because of its limited size it allows production to be expanded in easy stages with no practical limit to the ultimate size of the total installation. Particularly on large and medium-sized multiple units, which would normally work on a two- or even three-shift basis, routine repair and maintenance work can be carried out with only a minimal reduction in the total production capacity of the plant, and production can be continued economically and profitably on occasions when supplies of raw nuts are temporarily limited. To give an example of what this might mean in practice let us take an installation with a total throughput of 6,000 tons of raw nuts per annum, working 16 hours a day, five days a week. Using the Sturtevant equipment five units would be required to give this capacity. If as a result of crop fluctuations the available nut supply should in a particular season fall to 4,000 or 5,000 tons the plant operator would have the option of reducing the number of hours worked on all plants, or of closing down one line completely and maintaining the remainder in full operation at maximum efficiency.

If on the contrary the available crop should exceed the normal level additional hours could be worked throughout the factory or on one or two lines only. By contrast a single unit designed to operate most efficiently at say 3,000 lbs of nuts per hour is likely to prove seriously uneconomic when operated at much below its rated capacity.

In all the literature on cashew nut processing great importance has quite correctly been placed on the obtaining of a high percentage of whole undamaged kernels. Fairly obviously however, though this is not always explicitly stated, the only important statistic is that relating to the percentage of whole kernels finally packed for shipment. Apparent whole kernels yields at intermediate stages of the process whilst perhaps of academic interest are of little practical importance if apparently good results are not confirmed by the final count when all operations are complete.

Results obtained from a wide variety of installations, both manual and mechanical, throughout the world indicate a wide divergence in whole kernel yields obtained, ranging from 40% or less in certain inexperienced hand process installations to 60% in the best managed units, whether manual or mechanical. The fact that even in the best plants the yield obtained falls so far short of what one might imagine to be the theoretical maximum achievement of 100% requires careful examination. It is clear that breakage occurs principally either during decortication or during peeling. If scrupulous attention is given to both these processes, therefore, yields approaching 100% should surely be obtainable. Careful laboratory examination of large quantities of nuts from various locations reveals however that this is not the case since it can be shown that significant percentages of kernels are already split inside the shell so that even with the most careful decortication the two halves must separate when shell and testa are removed. In practice whatever decortication system is used some further damage to the kernel inside the testa will from time to time occur which will become apparent as soon as the testa is taken away. Probably the

most important factor in reducing damage at decortication is pre-treatment of the raw nut which, as described by Mr. Coward, has as its main objective the humidification of the kernel in order to make it less brittle. Unfortunately however no successful means of testa removal has yet been found which does not involve drying of the kernel which again reduces it to a very brittle state and it is in this condition that the main damage occurs. Further losses are of course occasioned by varying degrees of rain and insect damage and by immature nuts contained in the original count. Unfortunately these frequently account for up to 10% of the raw nut supply and in comparing apparent yields at intermediate stages of the process it is obviously of importance to know at what stage these have been removed. The extent to which understandable confusion may arise from false comparisons is indicated by one large processing unit claiming over 90% wholes at decortication but frequently achieving less than 50% at packing, compared with another showing only 75% to 80% wholes at decortication but achieving consistently 55% to 60% at the end of the process.

It is generally accepted that decortication, that is the removal of the leathery outer shell of the cashew nut with its toxic oil content, is the most critical part of the processing operation in view of the threefold hazards that exist if it is done incorrectly: acute dermatitis for the operators, physical damage by breakage or scorching to the kernels and C.N.S.L. contamination of the kernel. The very ample evidence available both from the two years of operation of the pilot installation in Kenya and from the production units now in full commercial operation in Mozambique show that these hazards have been overcome by the Sturtevant/TPI plant.

The peeling and grading operations which are necessary before the kernels can be offered for sale present no such hazards and with normal supervision, and a modicum of good housekeeping, can be carried out either entirely by hand or with more or less mechanical assistance depending on the requirements of the processor and the availability, suitability and cost of local labour.

In certain areas social reasons make it important that any new or expanded industry should within reason provide a maximum of local employment. Under these circumstances teams of workers, either male or female, can readily be engaged and quickly trained to carry out by hand the removal of the remaining fragments of testa adhering to the kernel and the grading and sorting of the kernels by size and quality. Under these circumstances no further capital equipment of any consequence is required.

Where circumstances warrant it however further equipment can be provided that will remove automatically up to 80% of the testa, leaving only a very small amount for final hand peeling and will carry out automatically the bulk of the sorting and grading operations. The latter in particular is expensive and relatively complicated and should in our view not be contemplated until a plant has reached a sufficient size to justify the employment of the skilled technical personnel that would be required for its operation, servicing and maintenance.

The long term economic viability of the cashew nut processing industry seems well assured. The world price for cashews has with only minor fluctuations increased steadily throughout the last decade and with demand steadily rising there seems no reason to believe that present prices in real money terms will not at least be maintained. Even with raw cashew prices as high as US $170 per ton the Stortevant/TPI plant has been shown to be highly profitable, an important foreign exchange earner and a means of bringing employment and training in basic technical skills to a rural people. Its development to the stage where it is now fully proven, tried, tested and available on world markets can properly be regarded as an outstanding example of successful cooperation between Government and private industry.

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SUMMARY

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Corrigendum

Page 2, para. 3

Replace with the following:

"Yield of whole kernels at the final stage of the process is an important factor in economic production. In some factories this is as low as 40% but with the Sturtevant/TPI plant yields of 55% to 60% and even better have consistently been achieved. At intermediate processing stages, 'yield' figures are of largely academic interest, since under varying conditions, the contribution to breakage of raw nut quality, humidity and insect attack should be counted along with breakage due to process conditions."

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Salvador, Bahia, Brazil, 25 to 29 October 1971

SUMMARY

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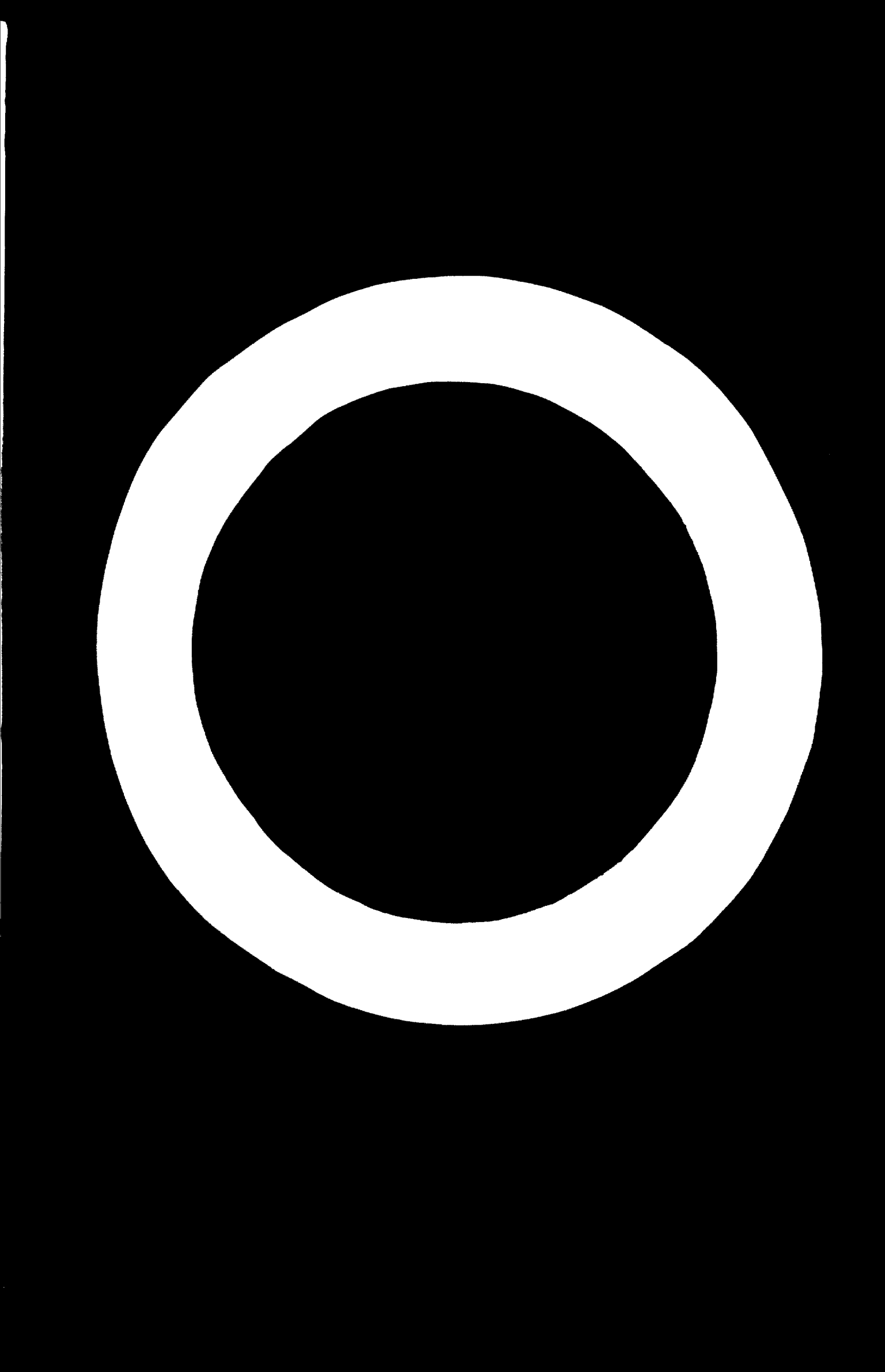
World cashew nut consumption is increasing, to the financial benefit of the tropical areas where the crop is grown. However, the market demands nuts of such high quality that processing presents considerable problems in ensuring an acceptable product in the face of possible kernel contamination and breakage.

In India, due to the availability of low cost and traditionally skillful labour, cashew nuts are processed manually on a more economic basis than is



achieved elsewhere. A mechanical system for processing has long been sought in areas where these labour conditions are not met, the requirement being for durable, reliable low cost equipment. Until recently this was not available.

The simple mechanical plant designed by the T.P.I. and manufactured by Sturtevant Engineering Co. Ltd., has now been successfully proved in both Kenya and Mozambique. Production experience, field work and laboratory testing all demonstrate the suitability of the plant for widely varying cashew crop conditions. This plant is designed both for operation as a single unit (600 tons per year) and as a modular system permitting crops of 10,000 tons per year or more to be processed in one factory. It is therefore as suited to the requirements of areas with small or growing cashew crops as to those with very large cashew potential (Mozambique or Tanzania), and its low capital cost minimises the risks caused by seasonal fluctuations in crop yields which in the case of more sophisticated equipment might seriously hazard economic viability. Design of the plant allows for foolproof operation by unskilled labour and minimal dependence on external fuel or power supply.

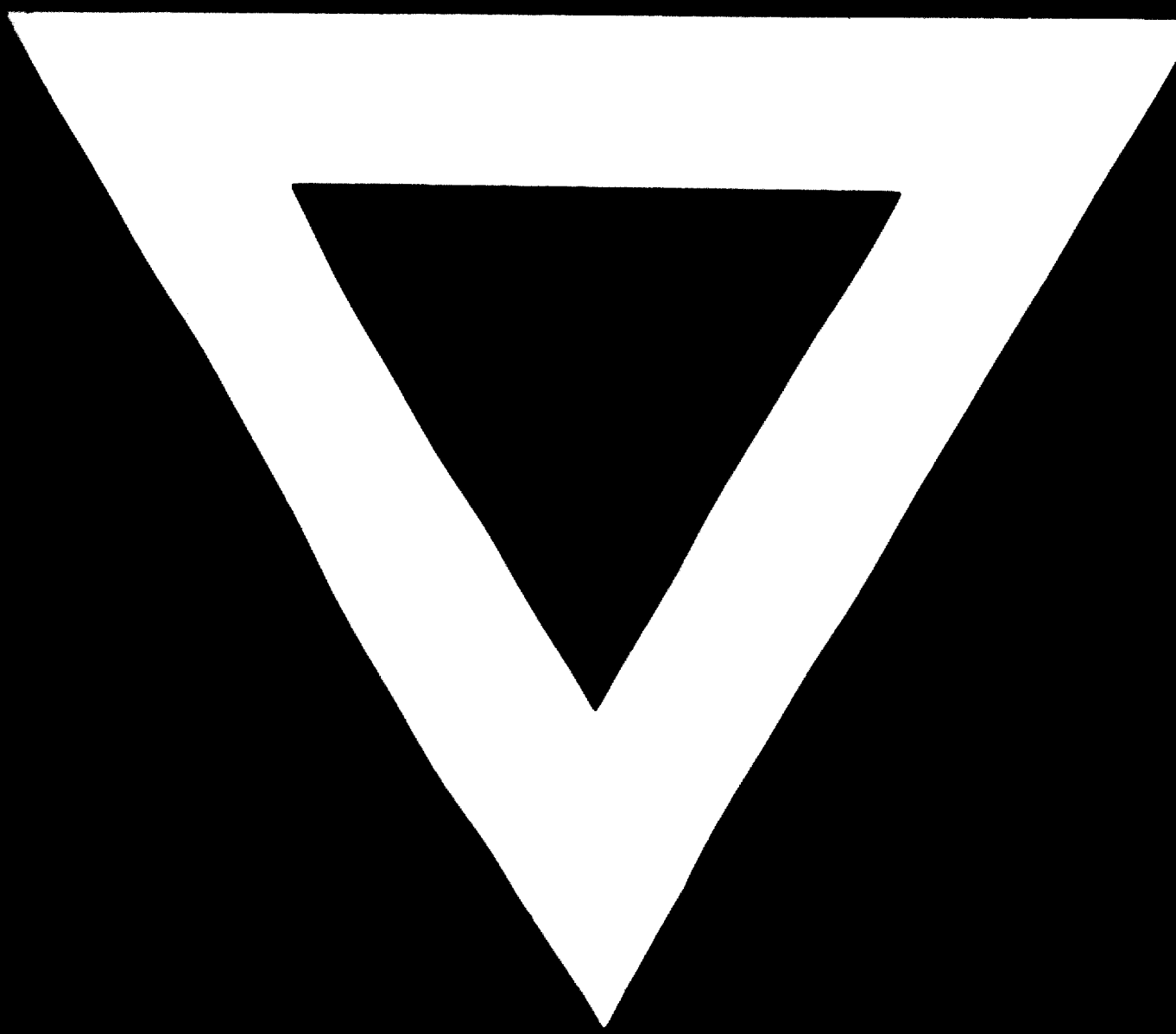
Production units with relatively small throughput, built up in multiples into installations handling several thousand tons of nuts per annum, allow down-time for adjustment or maintenance without affecting more than a fraction of total output.

Yield of whole kernels at the final stage is an important factor in economic production and range from 40% to 60%. At intermediate processing stages 'yield' figures are of largely academic interest, since under varying conditions, the contribution to breakage of raw nut quality, humidity and insect attack should be counted along with breakage due to process conditions.

The Sturtevent/TPI plant is proved to minimise the three chief problems inherent in the decortication process, e.g. the health hazard to operators represented by CNSL-caused dermatitis, kernel breakage and kernel contamination by CNSL.

Peeling and grading, either manual or mechanical, presents fewer problems. Unskilled labour can easily be utilized for this operation although it is possible to remove up to 80% of the testa by mechanical means.

Cashew nut processing appears increasingly viable. The Sturtevant/PPI plant has been shown to be highly profitable, a foreign exchange earner as well as highly educational in basic mechanical skills. Its successful development is a fine example of co-operation between government and private industry.



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