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DEVELOPMENT AND COMMERCIAL PRODUCTION
OF SORREL CONCENTRATE ^{1/}

by

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SUMMARY

The commercial development of a popular food drink is described.

A small-scale processing plant was developed by the Industrial Research Institute from technology developed at the University.

Funds for the project were provided by the national Industrial Development Corporation.

The project benefited from the involvement of the University initiator throughout the entire project and highlighted some of the factors tending to inhibit the development and commercialisation of indigenous technology.

General recommendations are made on ways in which international assistance agencies can encourage the development of indigenous technology. A specific recommendation is made that Trinidad and Tobago organise a pool of competence with responsibility for the commercialisation of indigenously developed or adapted technology.

1. BACKGROUND

The tropical plant *Hibiscus Sabdariffa* var. *Sabdariffa* is known as sorrel in the Caribbean and is used to make a popular seasonal drink which is characterised by an attractive brilliant red colour and tart taste. The plant is photo generic and produces flowers and fruits during the short days from November to March. Because of this seasonality the drink has become associated with Christmas time. The drink is traditionally prepared at home from the fresh or dried calyces of the plant¹.

In March 1971, a few months after the Institute became operative, the Caribbean Industrial Research Institute (CARIRI) was approached to provide engineering services for a project which was to design a small-scale production plant to make concentrated sorrel juice. The project had grown out of work done by Dr George Sammy, Senior Lecturer in the Faculty of Engineering, Chemical Engineering Department, of the University of the West Indies (UWI). Dr Sammy had successfully developed the technology on a laboratory scale and the project, as was then proposed, was to commercialise this technology thereby making this popular local drink available all year round with the possibility of exploring its export market potential. Funds for the project were to be provided by the Industrial Development Corporation of Trinidad and Tobago (IDC).

A. The Institute

CARIRI was established in October 1970 as a Government of Trinidad and Tobago institution. Under two agreements with the Trinidad and Tobago Government, UNDP has provided assistance for the first eight years with UNIDO as the executing agency.

CARIRI's purpose as laid out in the original Plan of Operation² was to:

- a. *Provide industry with technical services which will include the following:*
 - i) *Collection and dissemination of technical information, including applicable standards specifications and quality control procedures;*
 - ii) *Chemical analytical work particularly in connection with quality control testing in food industries and other local industries;*
 - iii) *Physical (measurement) and materials testing;*
 - iv) *Engineering services, including assistance with establishing production lines, prototype designs, and maintenance and repair problems;*
 - v) *Economic and technical feasibility studies, including market surveys, with a view to identifying bankable projects.*
- b. *To engage in industrial research programmes relating to industrial operations in the region. It is expected that such programmes will be undertaken as a result of specific contracts on a fee basis from Government and interested industrial concerns.*

The institute is expected to develop its capabilities in this respect on the basis of the technical advisory work undertaken during the earlier years of the project.

- c. Provide training for the staff in the above-mentioned fields both through fellowships and on-the-job training by the international experts.*

In March 1971 CARIRI had a local staff of approximately 20 members, of which about six were research officers. At present, CARIRI has a staff of 125 of which 33 are in the professional category.

B. The University

The Faculty of Engineering of the University of the West Indies was started in 1961 with assistance from UNDP with UNESCO as the executing agency. The Faculty formed part of the University of the West Indies which had been established in 1949 as a University College of the University of London and became a University in its own right under a Royal Charter of Incorporation in April 1962.

The Faculty of Engineering consists of four departments, Chemical, Civil, Electrical, and Mechanical Engineering. The student body of the Faculty which was 90 in 1963 and 350 in 1970³ is now about 480.

C. The Industrial Development Corporation

The Industrial Development Corporation (IDC) is a Government Corporation set up in 1959 with wide ranging powers and responsibilities to promote, assist, establish, stimulate, expand and diversify the industrial development of Trinidad and Tobago, and to act as liaison between Government and the private sector in such matters.

In pursuance of its objectives the IDC administers the Government system of incentives and assists industrialists, foreign or local, in utilising the incentives offered to establish manufacturing plants, hotels or small businesses and to expand existing ones.

The funds provided by the IDC for the sorrel development project came from an Inter-American Development Bank soft loan for pre-investment studies. The loan to be capitalized if the investment proved viable.

11. THE PROJECT

The first contract on the project was actually between CARIRI and the UWI - through Dr Sammy - for the sum of TT\$8,000 to assist Dr Sammy in the erection and operation of a plant to produce sorrel concentrate and to provide space for the plant at CARIRI's premises. At that time the estimated cost of the plant was TT\$15,000.

Because of the involved process of entering into contract with the University, it was then proposed that:

- (a) The IDC enter into contract with CARIRI to develop the process and plant to the stage of commercial production.
- (b) Dr Sammy and the University would enter into agreement with the IDC whereby the IDC would exploit the idea and pay to Dr Sammy and the University royalties to be negotiated and that Dr Sammy and the University would obtain and hold the patents as inventors.
- (c) The IDC would enter into contract for the raw materials with the Government Agricultural Research Station and one of the farms of the Faculty of Agriculture of the University.
- (d) The IDC would be responsible for the marketing of the finished product and the profits if any would belong to the IDC.
- (e) Dr Sammy would be the Project Manager and Chief Consultant on the project.

This contract was entered into in October 1971 between CARIRI and the IDC for a sum of TT\$30,000 over three years.

CARIRI's responsibility was to:

- (i) Develop a pilot plant for the project and hire technical personnel for operation.
- (ii) Provide space for the plant in its building during the continuance of the project.
- (iii) Provide engineering and labour services against its normal fees.

The work was to be done in three phases.

PHASE 1

- (a) The presentation of the proposed plant and process for the approval of the Corporation and the Project Manager and Chief Consultant.
- (b) The preparation of cost estimates based on the proposed plant.

PHASE 11

- (a) Detailed design and layout
- (b) Fabrication and purchase of equipment
- (c) Supervision of erection of the plant

PHASE 111

Operation of the plant by CARIRI until all operational problems are overcome.

The plant was to be designed to have a capacity to handle sixteen hundred pounds of raw sorrel per 8-hour shift and produce approximately 600 pounds of 10.5 Brix concentrate.

NOTE: The size chosen was an attempt to strike a balance between a pilot plant and a commercially viable plant. With our scarce expertise resource it was felt that the orthodox sequence of scaling up could not be afforded. There was also the constraint that the agricultural resource had to be developed in parallel in order to avoid the traditional problem of a plant with no raw materials or farmers having to dump what they had been encouraged to grow because of the processing facility not being ready.

The work on the last phase of this contract was completed in December 1973 at an actual cost of \$48,200 as against the TT\$30,000 estimated in 1971. During this time:

- (a) The optimal operating conditions of the plant had been worked out and some attendant chemical engineering problems solved.
- (b) A product of acceptable quality was being produced.

- (c) It had been discovered that the local suppliers of stainless steel were unable to differentiate the grades of stainless steel they imported and in fact sold all grades as one material. This created problems since the highly acidic sorrel extract corrodes lower grade stainless steel.
- (d) We discovered that the reaping of the raw material was highly labour intensive and hence costly. This would have an effect on the availability of raw material for large scale production.

NOTE: A spin-off project to develop a mechanical sorrel harvester has since been proposed together with the agronomical project of growing a variety of sorrel which would be amenable to mechanical harvesting. The possibility of extending the bearing season of the shrub is also being investigated.

- (e) We discovered that farmers who were encouraged to grow the raw material for the plant, in the absence of binding contracts, preferred to sell their produce on the fresh market when the prices were high thus disrupting the plant schedule.
- (f) In final design the plant used 3,200 pounds of fresh sorrel per 8-hour period to produce 500 pounds of sorrel concentrate at 9.0 to 11 Brix.

In April 1973 the Food and Chemistry Division of CARIRI undertook a sorrel consumer acceptability survey for the IDC at a cost of \$3,300. The survey indicated an overall favourable response to a sorrel cordial prepared from sorrel concentrate on a formula developed by Dr Sammy.

Arising out of the work done on the project, several recommendations were made for modifying the plant. The chief ones being:

- (a) To change the operation from a batch to a continuous process;
- (b) To improve the concentration process
- (c) To reconstruct the plant incorporating those modifications and remove materials that were susceptible to corrosion attack by sorrel extract.

In addition, the plant was to be operated during the sorrel season of November 1973 to March 1974 to provide concentrate for market trials and to train a core group of staff for eventual commercial operations.

In June 1973 a new contract was signed with the IDC for the sum of \$30,000 to undertake this work over a period of 9 months. This contract was completed within the estimated time though the final report was not presented until December 1974. The plant however, failed to produce the planned quantity of concentrate because of interruptions in the raw material supplies.

The development work having been completed at CARIRI, the question now arose of establishing the plant as a commercial operation. It became apparent that there was no local expertise with the responsibility for undertaking this phase of the work. CARIRI was therefore contracted to produce a layout of the proposed factory including plant utilities, offices and welfare facilities, an estimate of capital investment, an outline of steam power and water requirements and an estimate of labour requirements while the IDC did an estimate of working capital and an analysis of production cost and profitability for the proposed plant. The programme also included recommendations on additional plant and laboratory equipment requirements. This contract was for \$5,000, the final actual cost was \$4,500.

In the meantime the IDC had entered into an agreement with the Government owned Orange Grove National Sugar Company to operate the sorrel plant at a factory site on one of the IDC's Industrial Estates. Under this agreement the sorrel plant was managed and operated by the Sugar Company under the supervision of an Advisory Management Committee comprising members of the IDC, the Sugar Company and Dr S. The IDC paid a fee to the Sugar Company of 15 percent of the operating expenses of the Plant, and the profit or loss on the Plant was for the account of the IDC.

In 1974 another contract to install the plant at the commercial site was undertaken by CARIRI. The estimated cost at that time was \$15,000, \$3,000 of which was to be borne by CARIRI.

NOTE: Under a policy guideline from its Board of Management CARIRI can - in order to promote the development of indigenous R & D - share the risk involved by bearing part of the cost of work done for clients.

The final cost of the contract was \$17,200 so that CARIRI absorbed \$5,200 (30%) of the cost.

A further contract to provide back-up assistance to the Orange Grove Company in commissioning and operating the plant and training plant personnel was started in December 1975 and ended in November 1976. The first complete commercial operation of the plant was the 1976/77 sorrel crop season.

In June 1976 the IDC requested information on the possibility of scaling up the plant but this proposal has not been actively followed up.

A summary of the contracts for the establishment of the sorrel plant is shown below:

TABLE 1

Contract Nos.	(1) 71-10-1	(2) 71-10-2	(3) 73-15-1	(4) 74-6-1	(5) 74-10-1	(6) 75-44-1	Total
Estimated time (months)	36	18	2	11	5	6	78
Actual time (months)	26	19	5	19	13	11	93
Estimated cost (TT\$)	30,000	30,000	3,300	3,000	15,000	14,000	95,000
Actual cost (TT\$)	48,200	31,900	3,300	4,500	17,200	14,000	118,900
Fee paid by client (IDC)	30,000	30,000	3,300	3,000	12,000	14,000	92,300
Amt. absorbed by CARIRI	18,200	1,900	-	1,500	5,200	-	26,800
% of cost borne by CARIRI	38	6	-	33	30	-	23

111. DISCUSSION

Over the period, the project had three CARIRI Project Chiefs the first two changing very quickly as the relatively new and young staff of the Institute took up training fellowships. The bulk of the project has however been carried out by one Project Chief. Changing of staff responsible for the implementation of the project was also evident at the IDC. The continuous connection of Dr Sammy with the project was therefore a major advantage.

As can be seen from Table 1 above, the time estimates were badly underestimated - except in the first contract (71-10-1) which was over estimated and the second contract (71-10-2). It can be assumed that off-estimating on the first contract and the third (73-15-1) - the acceptability survey) were due to inexperience but in the last three contracts the discrepancies in estimation were due to:

- (a) Inadequate provision for the time required to have services performed by outside parties.
- (b) CARIRI had to take on the role of project Engineers to set up the plant since we were familiar with the technology.

(a) highlights an endemic problem of developing countries whereas (b) raises the question of how far along the pipeline of commercialisation should the IRI provide for competence in its establishment.

To date CARIRI has concentrated on building competence around its laboratories and pilot plants, but on several occasions the Institute has had to perform project engineering, marketing and management services in order to ensure the success of a venture.

It is this author's opinion that an IRI should not attempt to provide competence along the entire pipeline from development to commercialisation.

Either private sector competence such as consulting engineers and management specialists (when they exist) should be encouraged to participate in the development work from an early stage or specialised institutions to provide the required expertise be set up to work closely with the IRI.

It is necessary therefore that the UN or other international assistance agencies coordinate their Country Programmes in such a way that a coherent infrastructure of institutions is built up rather than bits and pieces of multiple plans each zealously guarded by its protagonists. Undoubtedly much of this divisiveness is fostered by internal conditions in the recipient countries but it is compounded by the apparent competition between agencies and even between sections of the same Agency! The coordinating representatives of assistance agencies should take a more aggressive role by insisting on, demonstrated cooperation between, and use of, existing local institutions as a condition of approval for new ones

The sorrel project also highlighted the need to evaluate the sensitivity of certain key parameters affecting the ultimate development of an indigenous technology. In this sense the adaptation of a foreign technology to local conditions is viewed as the development of indigenous technology.

Some such parameters:

- (1) The raw material supply - particularly agricultural raw materials. What kind of impact will the new demand have on the price and availability of a seemingly abundant and cheap source of supply? Again dealing with agricultural raw materials does the traditional variety lend itself to economical harvesting in commercial quantities or to the processing technology available? How is the post harvest handling of the product going to affect the processing technology?
- (2) The adaptation of the technology available to the local raw materials. What appears to be a simple adaptation of existing technology can run into problems if not investigated sufficiently.
- (3) The acceptability of the final product. What social or institutional factors are going to affect the acceptability of the final product?

Studies of the mechanism for encouraging the transfer of and/or the development of indigenous technology should include pilot projects aimed at identifying, by field trials more or less, the factors which should be generally examined when undertaking an exercise in these areas. In other words UNIDO should not only be promoting the preparation of case studies on technology transfer but should be funding actual programmes from which case studies may be built.

Another - still present problem - highlighted in the project is the well-known one of commercialisation of the developed technology.

The arrangement with the Orange Grov. Sugar Company to provide management for the commercial plant was a compromise solution to the problems of determining how to transfer into the private sector a project developed with public funds. On the one hand the IDC and Dr Sammy wanted the farmers and small entrepreneurs to be involved but could the development costs be passed on to these small businessmen? How much of this cost should the IDC absorb? And further what criteria should be used for selecting the entrepreneurs to be involved? Under the present arrangement these questions have been avoided but not answered and at the same time the venture has a chance to develop a bit more as a commercial entity before being thrown into the private sector arena.

Some of the concentrate from the plant is blended into a cordial at the plant and distributed through sales at the factory to small commercial users and hotels. The rest of the concentrate is sold in bulk to two food chain companies who blend to their own formulae and market under their own brand names.

The export market has not been tested in any depth simply because the quantities requested by foreign customers are well above the existing capacity of the plant.

The marketing of the product is the responsibility of the Management Committee. The plant has so far succeeded in selling all its product. If however scaling up of the plant is envisaged a marketing structure will have to be organized.

Scaling up is however heavily dependent on a resolution of the raw material supply situation since the plant still suffers from disruptions in the supply of raw sorrel buds and the high cost of the available sorrel in competition with the fresh market demand.

The scaling up of the plant may have to await the development of a mechanical harvester and mechanically harvestable variety of sorrel shrub.

Another consideration in expanding the size of the operation is the relatively short operating season. The use of the facilities for processing other products is being investigated.

IV. CONCLUSIONS AND RECOMMENDATIONS

The interaction of the University, the Industrial Development Corporation and the Industrial Research Institute in this project is the classic type of example of technology development in a developing country. Each was an important element in the culmination of the venture. Yet there are so very few other examples of this kind of cooperation that the conclusion must be drawn that personalities rather than policy was the larger contributor to the project's success.

On the basis of this case and the author's experience with others it is recommended:

- (a) That UNIDO seek to promote by funding, persuasion or otherwise the interaction between complementary institutions - in order to create the linkages necessary to bring a technological idea from conception to commercialisation. These complementary institutions may be indigenous - if such exists - or may be located abroad. In the latter case the interaction can be promoted under the umbrella of bilateral or multilateral cooperation.
- (b) That UNIDO reviews and encourages other UN agencies to review programmes completed and being undertaken in recipient countries in order to ascertain that complementary local institutions are in fact cooperating rather than operating in semi-isolation with respect to technology transfer and development.
- (c) That UNIDO support actual technology transfer and development programmes so that case studies may be prepared from which models of the technology transfer/development pattern can be developed. These models will identify the parameters to be examined when embarking on such ventures.

- (d) That specific to the Trinidad and Tobago situation a pool competence be organized with responsibility for the commercialisation of indigenously developed technology. The terms of reference of this unit would allow it to work closely with the Industrial Research Institute and treat as an independent entity with the private sector for the purpose of negotiating terms and conditions of the technology transfer.

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**A HISTORICAL SKETCH OF THE DEVELOPMENT OF SORREL
(*Hibiscus sabdariffa*) CONCENTRATE**

#3

(A CASE STUDY)

by

G. M. Sanmuj, Ph. D.

#4

This case-study is concerned with the development and commercialization of sorrel concentrate.

INTRODUCTION

Sorrel or West Indian sorrel is the name given to the tropical plant *Hibiscus sabdariffa*, by the peoples of the West Indies. This term was derived from Europeans who liken the plant to *Rumex acetatus* which in English is French sorrel. It is also known by a number of other names such as red sorrel, Jamaican sorrel, rouselle or roselle and karkade.

The plant is photosensitive and produces flowers and fruits during short days, November - March. Its main use in the West Indies is the preparation of a refreshing, brilliant-red acid drink from its calyces. Because of its seasonality it is known as the Christmas drink. The plant is not of commercial importance at present, since only small quantities are grown for local consumption.

The price varies between 10 to 40¢ per pound. The highest price being paid at the beginning of the season-late November to Christmas time, thereafter it slumps. The drink is normally made from the fresh sorrel calyces, but also from dry calyces, which may be stored for future use. The drink made from dry, stored calyces are usually inferior in colour and flavour.

Traditionally the drink is made by extracting the fresh (or dry) calyces and cinnamon or crushed ginger with hot-water allowing it to effuse for at least three hours, strained sweetened and served cold, without or with rum.

DEVELOPMENT OF THE PROJECT

This project was conceived by the author in 1966/67 while at the University of Massachusetts, U.S.A. Selection of this project for development was solely on a personal basis, possibly influenced by its brilliant red colour and refreshing acid flavour.

Initially the objective was to produce an "instant sorrel" - the soluble solids of the conventional drink.

The laboratory scale research work was carried out as a series of student research projects such as extraction studies, liquid concentration, and preparation of the soluble solids.

The extraction studies indicated that:-

- a) it was not necessary to strip the calyces from the fruit before extraction as was done traditionally;

- b) the traditional extraction time of not less than three hours was far too long. A contact time of 20-25 minutes of equal weight of hot water (75-80°C) and fresh sorrel fruit removed 90-95% of the extractable material;
- c) repeated extractions resulted in a maximum concentration of 2.0-2.5° Brix at 30°C, but that the spent fruit retained 50 per cent of the extractable material;
- d) the concentrate was heat labile and attempts to increase the concentration by reboiling at atmospheric pressure resulted in decomposition of the product;
- e) a 10° Brix concentrate was obtained by flash evaporation under vacuum keeping the temperature below 75°C;
- f) in the flash evaporation volatile flavouring materials was removed in the first 5 per cent of the condensate.

PREPARATION OF A LIQUID CONCENTRATE

The hot water-extract was flash-evaporated under vacuum (28-29 inches of mercury) at 75°C. The first 5 per cent of the condensate was retained and added back to the final concentrate.

PREPARATION OF A SOLUBLE SOLUBLE SOLID

It was possible to prepare a soluble solid by spray-drying or foam-mat drying of the liquid concentrate. However, the solid obtained by either method was very hygroscopic, and caked readily even in sealed glass-jars.

Since the preparation of a soluble solid would have necessitated sophisticated equipment and special conditions, we decided to shelve the idea of preparing an "instant sorrel" and instead concentrated on production of a liquid concentrate.

ACCEPTABILITY TEST

A number of acceptability tests were conducted on a drink made from the concentrate. The results were as follows:-

1. Using tasters selected from among University personnel such as academics, students, clerical staff, technical staff and non-skilled workers.

Three sets of 50 responses each gave an overall favourable response of 87%.

2. At two agricultural fairs - St. Joseph and Point Fortin - using random selection from a cross-section of those attending the fair. At St. Joseph from 200 responses 85% were favourable while at Point Fortin from 350 responses 88% were favourable.

3. Finally a consumer acceptability survey was conducted by the Caribbean Industrial Research Institute covering a cross-section of the society. One thousand five hundred and forty-six (1,546) responses were obtained of which 87% were favourable.

The acceptability surveys confirmed that the drink prepared from the concentrate was highly acceptable by the local consumers.

SHELF-LIFE

Shelf-life studies indicated, that the concentrate showed signs of colour decomposition after three months of storage at ambient temperature (28-30°C) considerable colour change with heavy sedimentation was recorded after six months. However, in frozen storage there was no significant change after three years of storage.

Further work on colour stability was carried out by Prof. W.B. ESSELEN & G.M. SAMMY and published in Food Product Development, 9 (8) 37-40 (1975). In this study it was shown that the pigment was stable at 23.3 - 25.5°C (74-78°F) but was subject to change at 37.7°C (100°F) and was very stable at 2.6°C (37°F).

PILCT PLANT STUDIES

Having established the potential for commercialization of sorrel concentrate, the next logical step in the development of the project was the establishment of a pilot plant. At this stage the Industrial Development Corporation of Trinidad & Tobago showed an interest in the project.

In March 1971 a meeting was held with I.D.C., CARIRI and U.W.I. to determine the potential of the project for commercialization. The meeting confirmed positive potential; I.D.C. agreed to finance, CARIRI agreed to undertake the engineering aspects, and U.W.I. agreed to administer and supervise the project. Thus CARIRI was contracted to develop and establish a pilot plant of such a size as would be utilizable in semi-commercial production of the sorrel concentrate.

The project was divided into three (3) phases:-

PHASE I

- a) The preparation and presentation of a proposed pilot plant and process for the approval of the sponsors.
- b) Preparation of cost estimates based on the approved plan.

PHASE II

- a) Prepare detailed design and layout
- b) Fabricate and/or purchase equipment
- c) Erection of pilot plant

PHASE III

- a) Commission plant into operation
- b) Run for one sorrel season, in order to solve operational problems

The estimated cost for the pilot plant studies was set at \$35,000 (T&T), any increase to be absorbed by CARIRI. The duration of the pilot studies was set at three years. The pilot plant studies was completed within the stipulated period.

SEMI-COMMERCIAL OPERATION

At this stage a number of commercial firms showed interest in the plant. However the author supported the view that the enterprise should develop into a producer-processor co-operative. The reason for this was that the few food processing firms in Trinidad had failed to develop a locally produced raw material supply. After ten to fifteen years of operation they were still importing 80-90% of all raw material. The reason for this was a breakdown of confidence between the farmers and food processors, each charging the other for a breach of faith.

Thus for the commercialization of the project, three avenues were open to us:-

- a) Pass over the plant and process to a commercial enterprise.
- b) Encourage the Federation of consumer co-operatives along with Association of Agricultural co-operatives to take over the process and plant.

- c) Establish the viability of the project,
then invite the farmers to become
partners in the enterprise.

The first avenue (a) was ruled out for the reason given above. The second (b) was attempted, but proved unsuccessful, because both co-operatives at that time were having problems, some being financial. The third alternative was therefore undertaken.

At this stage the I.D.C. decided to continue support for the project on the basis that it was still experimental. The pilot plant was from CARIRI to a factory shell in Macoya in 1975 and prepared for operation for the 1975/76 season. A Board of Management was appointed, a budget provided, staff engaged and the plant had its first commercial run in 1976/76.

RAW MATERIAL SUPPLY

Since sorrel is grown on a small scale for local consumption, it became necessary for us to attempt to set up a raw material supply. In this respect, an agricultural extension officer was assigned the task of doing this, by offering a guaranteed price of 17c/lb and providing seed material.

The plant has a production capacity of 11,000 imperial gallons of 10° Brix concentrate based on a 24 hour per day, 7 days per week operation for 13 weeks - the duration of the crop. At a conversion of 55 lbs of fresh sorrel per gallon of concentrate

required 550,000 lbs of sorrel. Taking into account wastage we provided for 600,000 lbs of sorrel. However, we experienced a considerable short-fall due mainly to the following reasons:-

- a) Poor germination of seeds
- b) Flooding of fields due to abnormal rains
- c) Low yields
- d) Buoyancy of price on the open market

Thus the plant received a total of 76,995 lbs of sorrel including 6,000 lbs which were dumped because of spoilage, and produced 1,400 gallons of a 10⁰ Brix concentrate, operating far below capacity.

Although there were some operations problems, our greatest draw-back was an inadequate supply of raw material.

MARKETING

Several avenues for marketing presented itself quite early in the life of the project, both on the local market and abroad. At first it was hoped to market the product as a cordial in 500 ml and 250 ml bottles, but since the factory was not equipped for such a venture, we were persuaded to sell our concentrate to two fruit juice manufacturers. They were prepared to put it on the local market under their own trade name. Each manufacturer sought a monopoly, but we resisted this, nevertheless we allocated the greater part of our production to them, retaining a small quantity of the concentrate for our own experimentation and for the small fruit juice vendors. As far as

can be determined the local market will be able to absorb our total output from the present plant. There is also considerable interest shown in the concentrate from Great Britain, Canada and the United States of America.

ECONOMIC VIABILITY

An operation based solely on the present output of sorrel concentrate over a thirteen week period makes the project an uneconomic venture. To become economically viable one must maximize use of plant, equipment and personnel.

However, if we calculate the profitability of the operation based on the nine (9) working weeks (18th Dec. 1975 to 20th Feb. 1976) of the last season when the plant was running at 13 per cent capacity, we showed a slight profit.

In order to maximize utilization of plant, equipment and personnel the following areas of development are being considered:-

- a) Use of the spent calyces as the base for a savoury sauce and in jam making.
- b) The production of a health drink, vitamin C enrichment.
- c) The production of a jelly or sweet sauce similar to cranberry sauce.

Through development of other products.-

- a) Concentration of lime juice
- b) Utilization of lime skins in the preparation of a crystallized product
- c) Preparation of a lime cordial

FUTURE PLANS

Attempts are being made to contract farmers for the growing of sorrel.

Discussions are taking place for the merger of the Lime Factory and the Sorrel Factory.

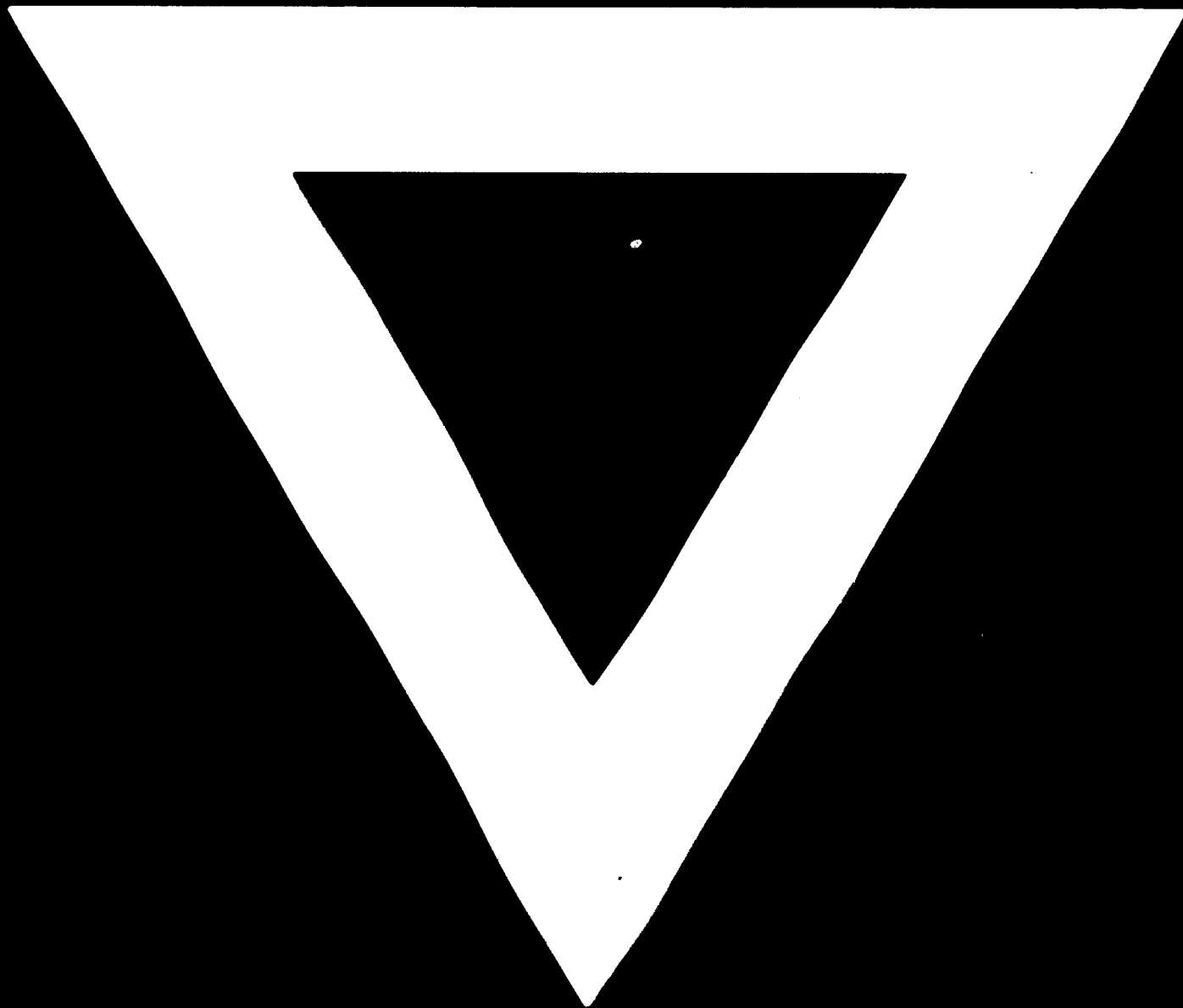
The establishment of a producer - processor co-operative is being studied.

Expansion of the present capacity of the sorrel plant is being considered.

Export potential of the concentrate and the cordial is being investigated.



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77.09.15