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ECONOMIC VIABILITY IN AFRICAN CONDITIONS OF THE LARGE SCALE VACUUM PAN SUGAR TECHNOLOGY[1/]

by

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INTRODUCTION

The purpose of this paper is to examine how vacuum pan sugar technology performs financially in a number of agricultural settings which relate to conditions to be found in a variety of African countries. The models considered are not designed to reveal the fortunes of existing projects but rather to illustrate how changes in certain basic parameters, technical and economic, influence the viability of selected scales of operation. Nor should the results be used to draw firm conclusions in connection with any particular proposed project, without reference to the relationship between the parameter values quoted in the paper and the corresponding values attached to the specific project.

The paper is organised into five chapters. Chapter I describes the basic methodology; chapter II provides fuller information about the calculations relating to one particular setting; chapter III summarises the major parameter differences associated with the other climatic situations; chapter IV discusses some financial implications of a change in the organisation of cane supply; and chapter V considers the main conclusions to be drawn.

I. METHODOLOGY

The economic viability of large scale vacuum pan sugar technology is examined in this paper in relation to a variety of African conditions. These conditions are divided into four types, classified by length of operating (or crushing) season and by the absence or presence of the need for irrigation of cane. The overall (gross) number of days per annum available for sugar production is taken as 270 (long season) and 150 (short season): each of these is considered in terms of rain fed and irrigated cane cultivation. Additionally two scales of production are investigated, depicted by factories of 100 and 200 tonnes of cane per hour (tch) crushing capacity. There are, therefore, 8 different models being analysed from the technical view point.

The viability of sugar production, as shown by these models, is assessed by means of a comparison of revenues and costs. The former are based on ex-factory prices for sugar and molasses. It is assumed that sugar sells ex factory at £300 per tonne (low price) and £600 per tonne (high price). The corresponding prices for molasses are £15 and £30 per tonne respectively. The low price for sugar reflects currently observed prices in certain East African countries. The high price is in fact below that to be found in, for example, West Africa. Even the low price, however, is slightly above the present world market price (FOB London) for refined sugar. It is further assumed that sugar production is carried on over 25 years.

Costs are estimated from a separate consideration of agricultural operations (ending with supply of cane at the factory) and factory operations with additional allowance for administrative overheads (financial and general management, personnel and welfare) which cover the entire operation. A detailed description of the parameters underlying the calculations relating to each of these aspects is given in turn below. The values of technical parameters have been based on what is currently in use in well managed African projects (for example the degree of mechanisation of agricultural activities). Economic data have been classified into low and high price regimes, reflecting the spread of value pertaining to different

African countries. Labour pay rates under the high price regime are taken as 100% higher than those utilised in the low price regime, whilst material and equipment prices are taken as 50% higher.

A. Agricultural Operations

Agricultural activities may be classified into land preparation, cane cultivation and harvesting, civil engineering and administrative overheads (including agricultural research). Costing these activities in the case of a particular location will depend greatly on many particular features peculiar to that location. The figures used in this paper are meant to serve as averages, being based on data relating to several recently commenced and currently planned projects. It should be noted that the cost of land - including all forms of compensation - is omitted from the cost calculations shown in this paper: this omission is common to many financial appraisals of such projects.

The starting point for the specification of agricultural costs is the determination of the required cane area. This depends on the length of growing season for cane and the yield obtained per hectare, and is described in chapter II. Costs associated with the determined cane area are divided into capital costs (land development) and operating costs. The former include purchase of agricultural equipment and use of that equipment in land clearance, road and drainage construction, and irrigation system installation if necessary. Both sets of costs are shown in Annex I in terms of £ per hectare for both long and short season situations. Calculation of costs at high prices is based on observed weightings of labour and material costs within the various activities. The latter include the cost of land preparation and planting, cultivation of plant and ratoon crops, and civil engineering (maintenance of roads etc).

Annual operating costs also include cane harvesting and administrative costs. The former are based on a 24 hour cane delivery system to the factory, with manual cutting of burnt cane at a rate of 4 tonnes per man day (long

season) and 2 tonnes per man day (short season). The system analysed assumes that cane is loaded into trailers (4.5 tonnes capacity) by grab loader, trailers being moved in and out of fields by crawler tractor and hauled to and from the factory in sets of 4 by wheel tractor. Annex II gives information on the cane harvesting equipment requirements and on annual operating unit costs.

Most of the agricultural administrative cost comprises staff salaries relating to agronomy, agricultural engineering and administration sections: this item appears to increase only slightly as the size of the operation increases, and has been taken as £500,000 for cane estates of around 5,000 hectares, rising to £700,000 for estates of around 10,000 hectares and £1,000,000 for estates of around 20,000 hectares (at low prices). In the high price models these costs are increased by 85 per cent, reflecting the assumption of 100 per cent increase in rates of pay.

B. Factory Operations

Two scales of operation, viz. 100 tch and 200 tch are analysed in this paper. The capacity of machinery required at the various workstations is estimated on the basis of material flow calculation designed to produce mill-white sugar of 99.6 pol by means of a double-sulphitation process. The characteristics assumed for cane and the various by products are shown in Table 1.

Table 1 Input - Output characteristics

	Water %	Sucrose %	Fibre %	Other Solids %	As % cane
Cane	69.6	13.0	15.0	2.4	100
Bagasse	48.0	3.0	48.33	0.67	30
Filter cake	77.5	1.5	12.0	9.0	5
Molasses	20.0	32.0	-	48.0	3.5

In addition the following assumptions have been made: (1) imbibition 200% on fibre; (2) milk of lime 1% on cane (15° Beaume); (3) wash water 116% on wet filter cake; (4) clear juice 85% of sulphited juice on average; (5) bagacillo as filter aid 2kg/tonne cane.

On the basis of these asuumptions it is estimated that sulphited juice will amount to 120% on cane and clear juice 102% on cane, with syrup at 64° Brix 20.75% on cane. An undetermined sucrose loss of 1.9% is also assumed.

The boiling system adopted for the purpose of the calculations requires C (or third) sugar to be remelted with clear juice. In the case of 200 tch, it is estimated that A massecuite of 27.3 tonnes per hour (92° Brix, 87.4% purity) will be produced from 75% of the available syrup plus the remelt, which in turn yields 15.0 tonnes A sugar (99° Brix, 99.6% purity) and 12.3 tonnes A molasses (83° Brix, 69.7% purity). B massecuite of 15.2 tonnes per hour (93.5° Brix, 74.5% purity) is produced from A molasses plus 15% of the available syrup, to yield 6.7 tonnes B sugar (98° Brix, 99.5% purity) and 8.5 tonnes B molasses (90° Brix, 53.2% purity). C massecuite of 10.8 tonnes per hour (95° Brix, 62% purity) produced from B molasses plus the remaining syrup yields 4.9 tonnes C sugar (96° Brix, 88% purity) and 5.9 tonnes C molasses (94.3° Brix, 40% purity) which is diluted to 7 tonnes final molasses at 80° Brix.

The sucrose balance, given the assumptions listed, is as follows:

Sucrose in cane		100
in bagasse	6.9	
cake	0.6	
molasses	8.7	
undetermined	1.9	18.1
Sucrose recovery		81.9

These figures are consistent with a milling efficiency of 93 per cent and a cane: sugar ratio of 9.34 (10.7 tonnes sugar at 0.05 per cent moisture per 100 tonnes cane). Estimates of factory capital cost, for both 100 tch and

200 tch, at low and high prices are shown in Annex III. In practice a sugar factory is nearly always supplied at present on a turn-key basis, so that an exact price for a hypothetical factory would depend on a detailed specification of many more parameters than those quoted. The figures given in Annex III are meant to cover the likely price range applicable to most situations.

Factory operating costs have been evaluated in terms of expenditure on staff, chemicals, bagging materials, other process materials, repairs and replacement materials, fuel and miscellaneous expenditure. Information on consumption and unit prices of various materials is given in Annex IV. Electricity consumption is calculated at 600 kw per hour (100 tch) and 900 kw per hour (200 tch) for each day the factory is not operating. The estimate of supplementary fuel requirements (the major fuel material being the bagasse, or cane residue, produced as a by-product of the factory operation) is on the low side when compared with existing needs of many factories in African countries: it may be expected, however, that plans for new projects will pay more attention to ways of increasing fuel economy.

Miscellaneous expenditure is calculated at a rate (low price regime) of £0.6 per tonne cane for the 100 tch long season and 200 tch short season factories, with corresponding amounts of £0.5 per tonne and £0.75 per tonne for the 200 tch long season and 100 tch short season factories respectively. This relationship reflects economies coming partly from the length of crushing season and partly from scale of operation.

Estimates of machinery requirements are used to build up factory manpower requirements, technical and processing, shown in Annex V. These are based on a 4 crew 3 shift system, which increases the number of jobs required but substantially eliminates overtime payments. The number of seasonal workers, included in the labour force total, is calculated separately for the long and short season situations. In the former case it is taken as semi- and unskilled workers on the processing side only, whereas in the latter case half of the unskilled workers on the technical side are also counted as seasonal.

C. Administrative overheads

This item covers the running of general management, financial and personnel departments plus the provision of transport services (cars, land rovers etc) and housing.

Capital expenditure comprises housing, vehicles and miscellaneous. The provision of housing - even the extent to which it should be regarded as a charge on the project - is variable. It is assumed here that all managerial staff including supervisory grades plus skilled workers would be accommodated. Details are given in Annex VI. An additional 10 per cent is added to the total for welfare buildings. Required expenditure on vehicles is taken as £450,000 for the 100 tch long season rain fed situation (at low prices). Calculation for other situations is based on the assumption that the requirement for irrigated situations would be 67% that of rain fed, and for short season 80% that of long season, reflecting (though not proportionately) the reduction in cane area being served. Similarly it is assumed that expenditure for the 200 tch situation would be 150% that of 100 tch. Miscellaneous capital expenditure is taken to be £250,000 irrespective of situation (at low prices). Calculation at high prices assume a 50% increase in equipment prices and 75% increase in housing costs (reflecting the assumed doubling of wage rates).

Annual operating costs largely comprise staff salaries which may be expected not to vary much on account of change in situation. A figure of £4 per tonne cane has been used for the 100 tch long season situation (at low prices): short season expenditure is taken as 90% that of long season, and 200 tch 20% higher than the corresponding 100 tch situation. High price figures are 75% higher than the low price equivalents.

D. Working capital

It is assumed that one week's production of sugar would be on hand at any one time, and that payment for sugar is received 3 months in arrears. An estimate was made of agricultural, factory and administrative stores

requirements: it was assumed that one year's consumption of factory repairs and replacement materials would be needed as stores, together with six month's consumption of all other materials. Payment for stores would be 4 months in arrears.

II. LONG SEASON RAIN FED SITUATION

This chapter provides more of the detail, for one situation only, relating to the assumptions and calculations in order to enable the reader to follow the Annex tables (VIII and IX) which summarise the cash flow results.

A. 100 tch model

Basic assumptions are as follows:

(1) crushing season 270 days gross less 10% planned stops and 10% unplanned stops to give 216 days net. Cane requirement is then 518,400 tonnes per annum.

(2) cane cycle of plant crop (22 months) followed by two ratoon crops (each 18 months) and 2 months fallow: total 60 months, with land use efficiency of 58/60 = 96.67 per cent.

(3) cane yield 5 tonnes per hectare per month on average throughout 58 months.

The land area required is thus 8640 hectares under cane, excluding seed cane which requires 1 hectare per 15 hectares planted. The total area under cane is 9058 hectares, comprising plant crop 3277 hectares, ratoon crops 5363 hectares, seed cane 115 hectares and 303 hectares fallow: the annual rotation (ARA) area is 1812 hectares.

Cane transport requirements It is assumed that cane is delivered to the factory throughout 24 hours per day, and that the average trip length from field to factory is 8.5 km.

(1) Grab loaders: 38 tch at 75% utilisation requires 3.5 and allowance for spare capacity 1.5 = 5.

(2) Crawler tractors: 2 per grab loader = 10.

(3) Wheel tractors: 4.5 tonnes cane per trailer in sets of 4 implies 18 tonnes per tractor trip.

Total number of trips per day = 134. Trip time per tractor comprises

20 minutes pickup/discharge, 34 minutes in, 26 minutes out totalling 80 minutes. At 75% utilisation this yields 13.5 trips per day giving a requirement of 10 tractors plus 2 spare = 12.

(4) Cane trailers: 12 trailers per wheel tractor = 144.

(5) Allowance is also made for cane yard tractors (3), light units (5) for night time loading, plus 3 tractors for water carriers, knife disinfectant carriers etc.

Employment requirements for drivers/operators and for field workers (excluding cane cutters paid task rate) is based on the 4 crew 3 shift system.

Expenditure distribution It is assumed that the factory commences production in year 4 at a rate of 33 per cent of normal, building up to 100 per cent by year 7. The required agricultural operating cost expenditure in the early years (expressed as a percentage of normal or equilibrium expenditure) is shown in Table 2.

Table 2 Expenditure on various activities as percentage of normal

	Year						
Activity	2	3	4	5	6	7	8
Preparation/planting	67	167	133	100	100	100	100
plant cultivation	25	100	140	125	100	100	100
ratoon cultivation			35	75	115	130	110
civil engineering		25	50	75	100	100	100
harvesting			33	75	95	100	100

Furthermore it is assumed that expenditure on agricultural overheads builds up from 20 per cent in year 1 to 100 per cent by year 4.

The distribution of fixed capital expenditure is shown in Table 3. Replacement capital expenditure - at a rate of 15 per cent per annum from year 6 for agricultural equipment and 25 per cent per annum for cane transport equipment from year 7 - is added to annual operating cost.

Table 3 Breakdown of expenditure on fixed capital (percentage)

Item	Year 1	2	3	4
Agricultural equipment	80	15	5	
Land clearance/preparation	30	40	30	
Cane transport equipment			25	75
Factory		10	50	40
Administration	10	21	23	46

Similarly replacement expenditure on administrative capital (vehicles) - taken as 20 per cent per annum from year 8 - is added to administrative operating cost, and factory replacements included under repairs and replacement materials (Annex IV).

The factory and administrative operating costs (as percentage normal) in the early years are shown in Annex VII.

Some allowance is made in the final years of the project's life for a reduced need to replace capital, though this makes little difference to the discounted cash flow calculations.

Finally it is assumed that the sugar recovery will be lower than normal in the first few years. To allow for a small amount of wastage a figure of 10.6 per cent is used as normal (equivalent to 81.5 per cent recovery). Details are given in Annex VIII for all the models.

B. 200 tch model

Technical parameters for the most part have been given the same values as in case A (100 tch). A minor difference appears in the cane transport requirement, reflecting a higher average trip length (12km) due to the greater area involved. This is however largely offset by certain economies - as in the number of grab loaders required - resulting from the presence of indivisibilities in the 100 tch case.

Annex X gives part of the layout of the cash flow calculations - for 100 tch at low prices - showing the first 8 years and a 'normal' year (in this case years 9-23). The internal rate of return (IRR) and NPV (discounted at 10 per cent per annum) are shown in Annex XI, which gives the comparable results for all the other situations.

III PARAMETER DIFFERENCES APPLICABLE TO OTHER SITUATIONS

This chapter highlights the most important parameter changes underlying the calculations for each of the other situations. The results are shown in Annex XI.

A. Long season irrigated situation

Crushing season:	216 days net.
Cane cycle:	Plant crop (20 months) plus 2 ratoons (each 16 months) plus 2 ratoons (each 15 months). plus 2 months fallow = 84 months.
Cane yield:	10 tonnes per hectare per month.
Cane area:	445 hectares (100 tch); 8,905 hectares (200 tch).

Agricultural operations in early years (as percentage normal) are shown in Annex IX.

B. Short season rain fed situation

Crushing season:	150 days gross less 10% planned stops less 10% unplanned stops = 120 days net.
Cane cycle:	Plant crop (13 months) plus 4 ratoons (each 11 months) plus 2 months fallow = 60 months.
Cane yield:	4 tonnes per hectare per month.
Cane area:	6,527 hectares (100 tch); 13,053 hectares (200 tch).

See also Annex IX.

C. Short season irrigated situation

Crushing season:	120 days net.
Cane cycle:	as case B.
Cane yield:	8 tonnes per hectare per month.
Cane area:	3,221 hectares (100 tch); 6,442 hectares (200 tch).

See also Annex IX.

IV. ALTERNATIVE FORMS OF AGRICULTURAL ORGANISATION

The purpose of this chapter is to explore some of the financial consequences that might be associated with a change in the form of agricultural organisation. The parameter values and results presented in the Annex tables relate to an integrated project where cane supply is organised by the factory. This need not require per se that the cane is grown on a single plantation, but does assume that cane is priced at cost, giving no return to the cultivators over and above the wage for labour provided. Any entrepreneurial return (to farmers if cane supply came from them) would have to come out of the return earned by the project (shown in Annex XI).

Any attempt to utilise these results in connection with a double project - cane supply on the one hand and sugar production on the other - has to be face certain questions. For instance, the area required for cane will differ if the cane yield is different. Field work observation suggests that in general outgrower yields are lower than estate yields, though the reasons for this are very varied, and this phenomenon may not be universally applicable. One reason for lower yields is simply less input per hectare thus reducing unit operating cost (per hectare) though not necessarily cost per tonne of cane. If a larger cane area is required this has implications for land development.

An outgrower system of cane supply would seem more likely to be advocated when potential cane land is already being utilised as farming land. The unit cost of land development may then be much lower than that used in this paper - though the dislocation cost may be higher. Cane transportation costs are also likely to be higher if the cane area is spread out, thus leading to higher average trip lengths.

If the cane supply is provided by outgrowers it is possible that the organisation of all aspects of supply is removed from the control of the sugar company, though it may be that many of the services are supplied by the company and paid for by means of deductions from cane payments. For example the initial capital expenditure to develop the land is usually undertaken by the company, as is the transportation - and often the cutting - of cane. The sugar project may however be considered as two integrated projects, with the agricultural capital investment removed from the sugar factory project and agricultural costs for the factory company become payments for

cane. The second (agricultural) project involves the raising of capital for land development and purchase of equipment and working capital to finance payments for material and labour until cane is harvested. In the case of the 200 tch long season rain fed project (assuming capital and operating costs are as given before) a cane payment (at low prices) of $15.4 per tonne would yield the cane suppliers a return of around 13.5 per cent (before interest charges) and yield the factory project a similar return. Similar calculation for the 100 tch long season rain fed project (at low prices) shows that a cane price of $14.7 per tonne yields 8.7 per cent to total outgrowers and factory. A higher cane price would increase the outgrowers return but lower that of the sugar factory operation.

As mentioned earlier, one situation worth further examination is that where the cost of land development is lower than that used in this paper. It is relevant in this context to calculate what increase in annual agricultural operating cost could take place without lowering the rate of return earned by outgrowers. In the 200 tch long season rain fed situation, with a cane price of $15.4 per tonne, a halving of the capital cost of agricultural development (land preparation and agricultural equipment) together with an increase of 16 per cent in agricultural operating costs would leave the return unchanged at 13.5 per cent (low price model).

Similar calculations for the 200 tch short season rain fed model (at high prices) show that a cane price of $33.75 per tonne is required for each part of the project to earn the same return (7 per cent). If the cost of agricultural development were halved, a rise of 9 per cent in agricultural operating costs would leave the outgrowers' return unchanged at the quoted cane price: alternatively halving the capital cost and leaving agricultural operating cost unchanged only raises the rate of return of the entire project (before interest charges) to 8.4 per cent.

V. CONCLUSIONS

The results given in the Annex tables are obviously dependent on the various assumptions that have been made, but in general they show that the long season situation performs better financially than the short season (the influence of fixed costs), the irrigated (or higher cane yield) situation better than the rain fed (low yield), and the large scale better than the medium scale. In the last case, this is largely due to the built-in assumption (based on observation of practical examples) of economies of scale in factory and administrative capital requirements and in their running costs. In the long season rain fed situation, about 40 per cent of the difference in NPV between the 200 tch and 100 tch models is accounted for by the assumed less than proportionate increase in capital costs and 60 per cent by the assumed less than proportionate increase in operating costs.

A doubling of output prices and labour input costs, together with a 50 per cent increase in meterial and equipment costs (i.e. an increase in the real price of sugar) considerably increases returns. In the short season situations, however, this is hardly sufficient to make investment particularly attractive even in the most favourable case.

ANNEX I

Agricultural unit costs

A. Initial capital expenditure		low price ($/ hectare)	high price
1. land clearance/preparation/ drainage		250	425
road construction		250	390
irrigation plus additional preparation/drainage		1000	1635
total:	rainfed situation	500	815
	irrigated situation	1500	2450
2. agricultural equipment			
100 tch	rainfed situation	400	600
	irrigated situation	500	750
200 tch	rainfed situation	360	540
	irrigated situation	450	675

B. Annual operating cost excluding depreciation			Area Applicable
1. land preparation/planting	240	384	ARA
2. plant crop cultivation:			area
long season	300	480	under plant
short season	480	768	crop
3. ratoon crop cultivation:			area
long season	250	400	under ratoon
short season	375	600	crop
4. civil engineering:			
rainfed situation	15	24	total under
irrigated situation	75	120	cane

ANNEX II

Cane harvesting costs

A. Capital requirements		Grab loaders	Crawler tractors	Wheel tractors	Cane trailers
1. Long season rainfed:	100 tch	5	10	23	144
(number)	200 tch	9	18	46	372
2. Long season irrigated:	100 tch	4	9	18	120
(number)	200 tch	8	19	37	300
3. Short season rainfed:	100 tch	5	10	20	108
(number)	200 tch	9	18	41	276
4. Short season irrigated:	100 tch	4	10	17	108
(number)	200 tch	8	19	29	264
5. Unit price:	low	40	27	10	3
($ thousand)	high	60	40.5	15	4.5

B. Operating costs					
1. Running costs ($/hour) excluding depreciation	low	12.4	7.3	5.0	0.5
	high	20.2	11.9	8.1	0.8

2. Rates of pay

(a) Permanent employees		Foreman	Field assistant	Headman
($/month)	low	120	80	48
	high	240	160	96

(b) Seasonal employees		Loader/ crawler operator	Tractor driver	Cane cutter	Clerk	Other Labourer
($/day)	low	2.20	1.85	1.35	1.30	1.00
	high	4.40	3.70	2.70	2.60	2.00

ANNEX III

Factory capital cost

	low prices ($ million)		high prices	
	100 tch	200 tch	100 tch	200 tch
Plant and equipment (FOB Europe)	15.00	25.00	21.00	35.00
Spares	0.60	1.00	0.84	1.40
Freight and insurance	1.56	2.60	2.18	3.64
Port charges and internal transportation	0.78	1.30	1.31	2.18
Installation	3.90	6.50	6.55	10.92
Civil works	3.90	6.50	6.55	10.92
Supervision	0.47	0.78	0.66	1.09
Total (rounded)	26.2	43.7	39.1	65.2

ANNEX IV

Factory operating costs (excluding salaries & wages)

Item	Consumption per tonne cane		Price $		
	100 tch	200 tch	Unit	Low	High
1. Fuel					
furnace oil:					
long season	0.8 litre	0.6 l	litre	0.12	0.18
short season	1.0 litre	0.8 l	litre	0.12	0.18
lubricants	0.15 litre	0.1 l	litre	0.8	1.2
electricity: (see text)					
long season	4.15 Kwh	3.10 Kwh	Kwh	0.02	0.03
short season	12.25 Kwh	9.20 Kwh	Kwh	0.02	0.03
2. Process materials					
lime +	2.0 Kg	2.0 Kg	tonne	60	90
sulphur +	0.4 Kg	0.4 Kg	tonne	300	450
sugar bags	1.1	1.1	each	0.9	1.35
other process materials	..	..	per tonne cane	0.3	0.45

3. Repairs & replacement materials:

long season	5% installed factory cost
short season	3% installed factory cost

4. Miscellaneous expenditure — See text

+ Expenditure on other factory chemicals is assumed to be 60% that on lime and sulphur.

ANNEX V

Factory employment

	Number of people		Average monthly employment cost ($)	
	100 tch	200 tch	low	high
1. Senior management	3	3	2920	5840
2. Other managerial staff	15	18	980	1960
3. Supervisory staff	39	42	250	500
4. Clerical staff	11	11	90	180
5. Skilled workers	78	105	125	250
6. Semi-skilled workers	114	130	45	90
7. Unskilled workers	204	300	28.5	57
Total	464	609		
including seasonal:				
long season	136	206		
short season	191	276		

ANNEX VI

Housing provision

Grade of Staff		Senior management	Other managerial	Supervisory staff	Skilled workers
Unit cost per house (Thousand $)		40	25	10	4
Number of houses:					
100 tch	long rain	9	38	74	231
	irrigated	9	38	68	206
	short rain	8	35	71	212
	irrigated	9	38	65	176
200 tch	long rain	9	45	91	332
	irrigated	9	45	83	312
	short rain	8	42	89	310
	irrigated	9	45	79	274

ANNEX VII

Breakdown of factory and administration expenditure
(% normal year)

	Year							
	1	2	3	4	5	6	7	8
1. Managerial staff including supervisors:								
long rain			40	80	100			
long irrigated			50	90	100			
short season		40	80	100	100			
2. Other staff:								
long rain				60	90	100		
long irrigated			20	60	90	100		
short season			60	90	100	100		
3. Repairs & replacement materials:								
long season				5	20	40	60	80
short season			5	20	40	60	80	100
4. All other materials:								
long rain				33	75	95	100	
long irrigated			10	35	70	90	100	
short season			30	65	90	100	100	
5. Fuel/miscellaneous expenditure:								
long rain				50	100	100		
long irrigated			15	50	95	100		
short season			50	90	100	100		
6. Administration operating costs:								
long rain	5	50	75	100				
long irrigated	5	50	80	100				
short season	10	60	90	100				

ANNEX VIII

Sugar recovery

	Year				
	3	4	5	6	7
1. Long season rain fed:					
cane % normal		33	75	95	100
sugar % cane		9	10	10.3	10.6
molasses % cane		3	3.3	3.4	3.5
sugar recovery %		69.2	76.9	79.2	81.5
2. Long season irrigated:					
cane % normal	10	35	70	90	100
sugar % cane	8	9	10	10.3	10.6
molasses % cane	2.7	3	3.3	3.4	3.5
sugar recovery	61.5	69.7	76.9	79.2	81.5
3. Short season:					
cane % normal	30	65	90	100	100
sugar % cane	8.5	9.5	10.2	10.6	10.6
molasses % cane	2.9	3.2	3.4	3.5	3.5
sugar recovery	65.4	73.1	78.5	81.5	81.5

ANNEX IX

Expenditure on various agricultural activities

	Year (% normal year)								
	2	3	4	5	6	7	8	9	10
A. Long season irrigated:									
preparation/ planting	150	167	150	100	100	100	100	100	100
plant cultivation	75	160	160	125	100	100	100	100	100
ratoon cultivation			30	70	100	120	140	130	110
civil engineering	20	60	80	100	100	100	100	100	100
harvesting		10	35	70	90	100	100	100	100
B. Short season:									
preparation/ planting	150	175	125	100	100	100	100		
plant cultivation	150	175	125	100	100	100	100		
ratoon cultivation		40	90	125	140	120	105		
civil engineering: rainfed		25	50	100	100	100	100		
irrigated	20	60	80	100	100	100	100		
harvesting		30	65	90	100	100	100		

ANNEX X

Summary of cash flow calculations for 100 tch long season

rainfed model (low prices) $ million

Year	Working capital	Agriculture Capital	Agriculture Operating	Factory Capital	Factory Operating	Administration Capital	Administration Operating	Revenue	Net Surplus
1	0.10	4.26	0.12			0.27	0.10		- 4.85
2	0.17	2.35	0.86	2.62		0.57	1.04		- 7.61
3	0.18	1.84	2.21	13.10	0.15	0.64	1.56		-19.68
4	1.58	0.90	3.56	10.48	1.06	1.26	2.07	4.70	-16.21
5	2.09		4.59		2.01		2.07	11.85	1.09
6	1.10		5.67		2.47		2.07	15.47	4.16
7	0.40		6.02		2.78		2.12	16.77	5.43
8	0.06		5.84		3.04		2.16	16.77	5.67
Normal			5.70		3.30		2.16	16.77	5.61

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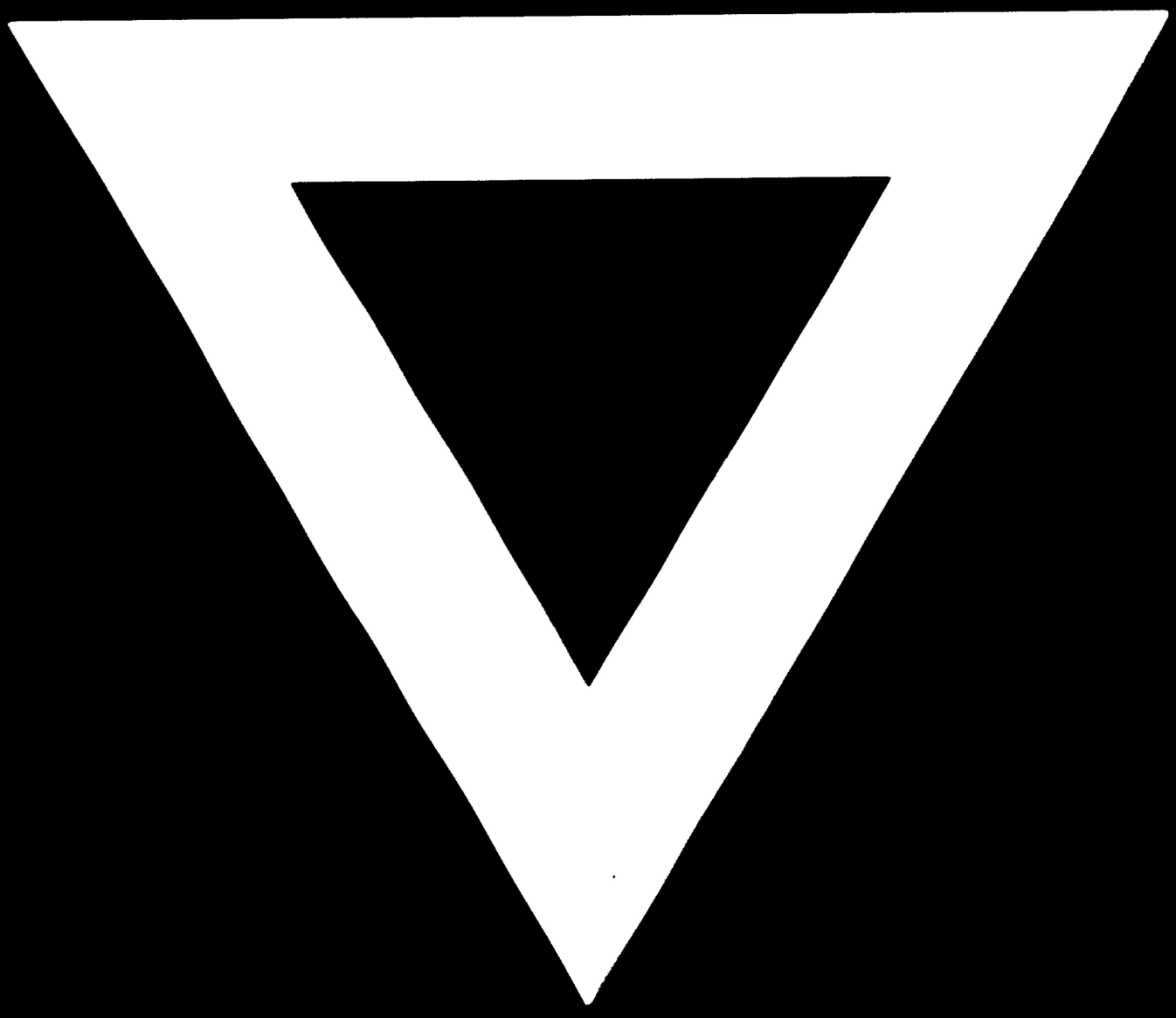

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