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HOW TO RAISE THE LEVEL OF EFFICIENCY IN THE PULP AND PAPER MILLS OF DEVELOPING COUNTRIES 1/

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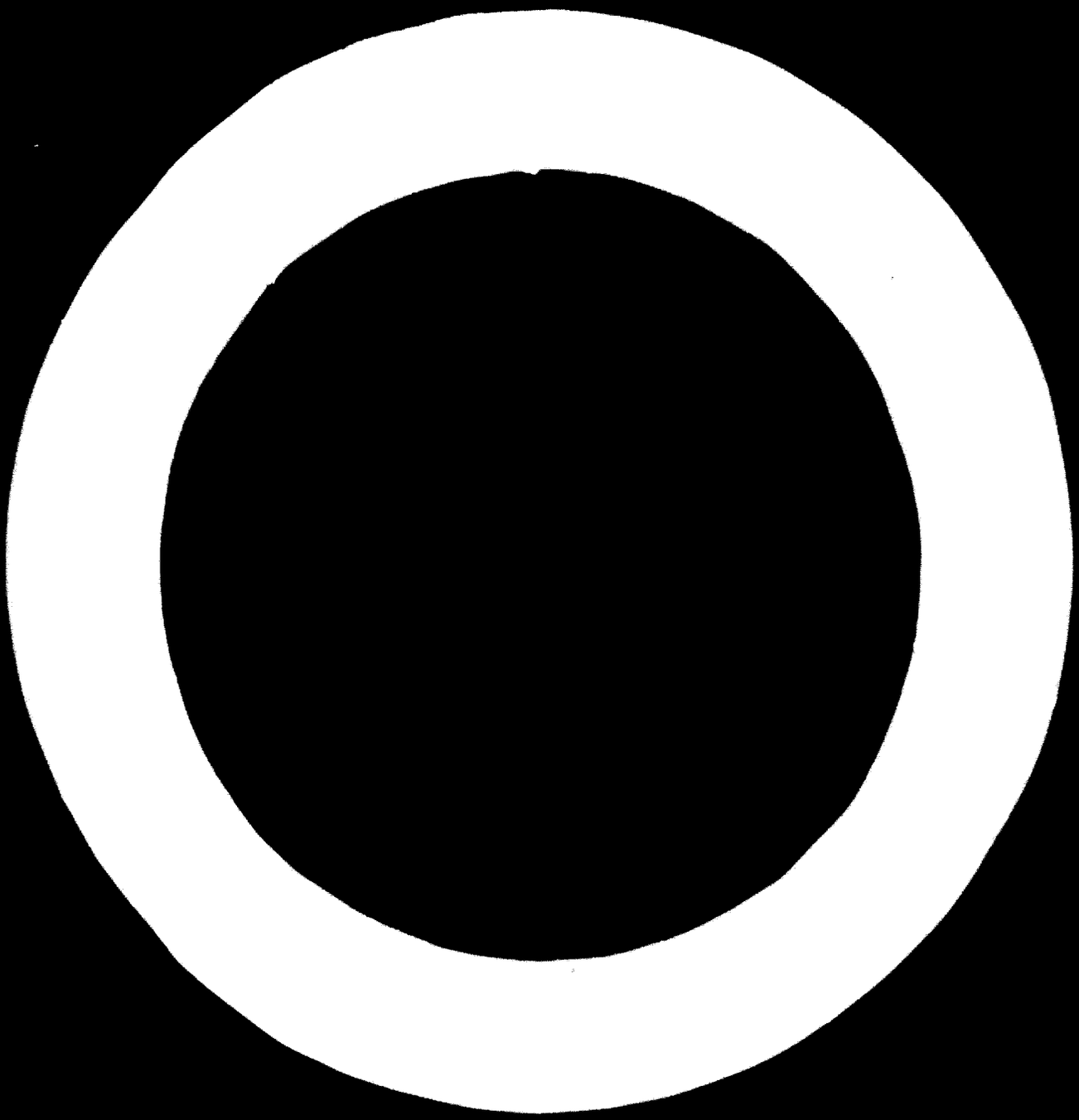


Economic development is an organized effort to reduce the relative scarcity of goods and to satisfy more of the unlimited wants of humanity. These are the aims of all economic activity. After Independence most developing countries felt that in order to increase the goods needed for a decent life and satisfy the basic wants of its population, industrial development must be stepped up.

Setting up an industry in any country needs capital investment. In an advanced country this need would probably be met by private investment, but in developing countries like Ceylon, the doubtful profitability of such investment, either foreign or domestic, poses a problem. Most private enterpreneurs find it too much of a risk, especially since the aim of most developing countries is not so much maximisation of profits as an equitable distribution of goods. In facing the problem of economic development, underdeveloped nations today generally favour the state ownership of the factors of production of the more essential goods and services. In Ceylon, therefore, most essential industries and services are run by the state; very little competition, if any, exists from the private sector.

The Paper Industry in Ceylon therefore, is faced not only with the drawbacks of low productivity that most developing countries face initially but also with all the drawbacks that a state owned industry suffers from.

The object of this paper is to state the problems that face the paper industry in developing countries and then to formulate solutions wherever these problems have been satisfactorily solved.

The Government of Ceylon under the stress of World War II, set up a semi-mechanised papcr mill based on waste paper. The products manufactured were paper board suitable for file covers and for packaging purposes. When the war was over, this mill was unable to justify its existence both on account of quality and price. This had to be therefore closed down. Subsequently, after independence, the Government, in order to develop the paper industry in Ceylon on modern lines utilizing indigenous raw materials, studied the feasibility of establishing a paper mill. The feasibility study for this project was prepared by a Paper Consultant from England.

The paper project was started in 1952 by the Government of Ceylon. Right from the outset this undertaking had been criticised and the project, on which Rs.22 million were spent, was on the verge of being closed down on more than one occasion. Gloomy predictions were made that this Government venture would never become a commercial success owing to lack of raw materials, high production costs and the lack of technical know-how.

The raw materials considered for this new project were Illuk grass (Imperata Arundanacea) and rice straw (Oriza Sativa). After laboratory investigations and experiments, the Consultant confirmed that Illuk grass and Rice Straw were suitable for pulping by the Caustic Soda process, and the paper produced was reported to be of excellent quality. Illuk grass

and Rice Straw were to be used either exclusively or in proportions varying upto 50% depending upon the characteristics of the paper required. The grades of paper to be produced were writings and printings. The planned output of the proposed project was 12.5 tons per 24 hours with provisions for increasing it to 15 tons per 24 hours at some future date. It was also intended that this project would produce 500 tons of sack paper for the manufacture of multiwall bags using imported kraft pulp, in addition to the 3,250 tons of writings and printings making a total of 3,750 tons per year.

The site selected for this project was Valaichchenai in the Eastern Province of Ceylon, 180 miles from Colombo. The Government accepted the feasibility report submitted by the Consultant and went ahead to implement the project and signed an agreement with a reputed German firm for the supply of equipment on December 15th, 1950.

While work was proceeding on this project, a mission organized by the International Bank for Reconstruction and Development visited Ceylon and criticised this project by their report dated June 10th 1952, in which they made the following observations:-

(1) The raw material selected was not suitable (i.e. Illuk grass) and they recommended the use of Citronella grass instead.

(2) The Paper Mill should be located in the city (rather than in the rice growing areas) to save on cost of -

(a) Transport

(b) Water supply installation

(c) Power supply generation

(d) Workshop facilities

(3) The consumption of paper in Ceylon is so small that the competitive success of a local paper mill is doubtful as costs will be high.

However, the Government after carefully studying the criticisms of the World Bank Mission decided that as the mission had overlooked certain local considerations justifying this project and in view of the considerable expenditure and liabilities already incurred, the project should be proceeded with to completion. Consequently, the Mill was commissioned in September 1956.

After trial runs in 1956, the quantity of paper produced was only 1,400 tons in 1957, and 1,250 tons in 1958, although the designed capacity of the plant was 3,750 tons per annum. This poor efficiency in operation was mainly due to the following factors:-

(1) Lack of proper organization for collection of indigenous raw materials.

(2) Problems connected with water supply due to imaginary fears by farmers who use the same source of water for irrigating the rice fields.

(3) Problems connected with manpower management.

(4) Lack of technical skill

(5) Absenteeism

(6) Lack of proper standardisation

(7) Problems connected with maintenance and spares

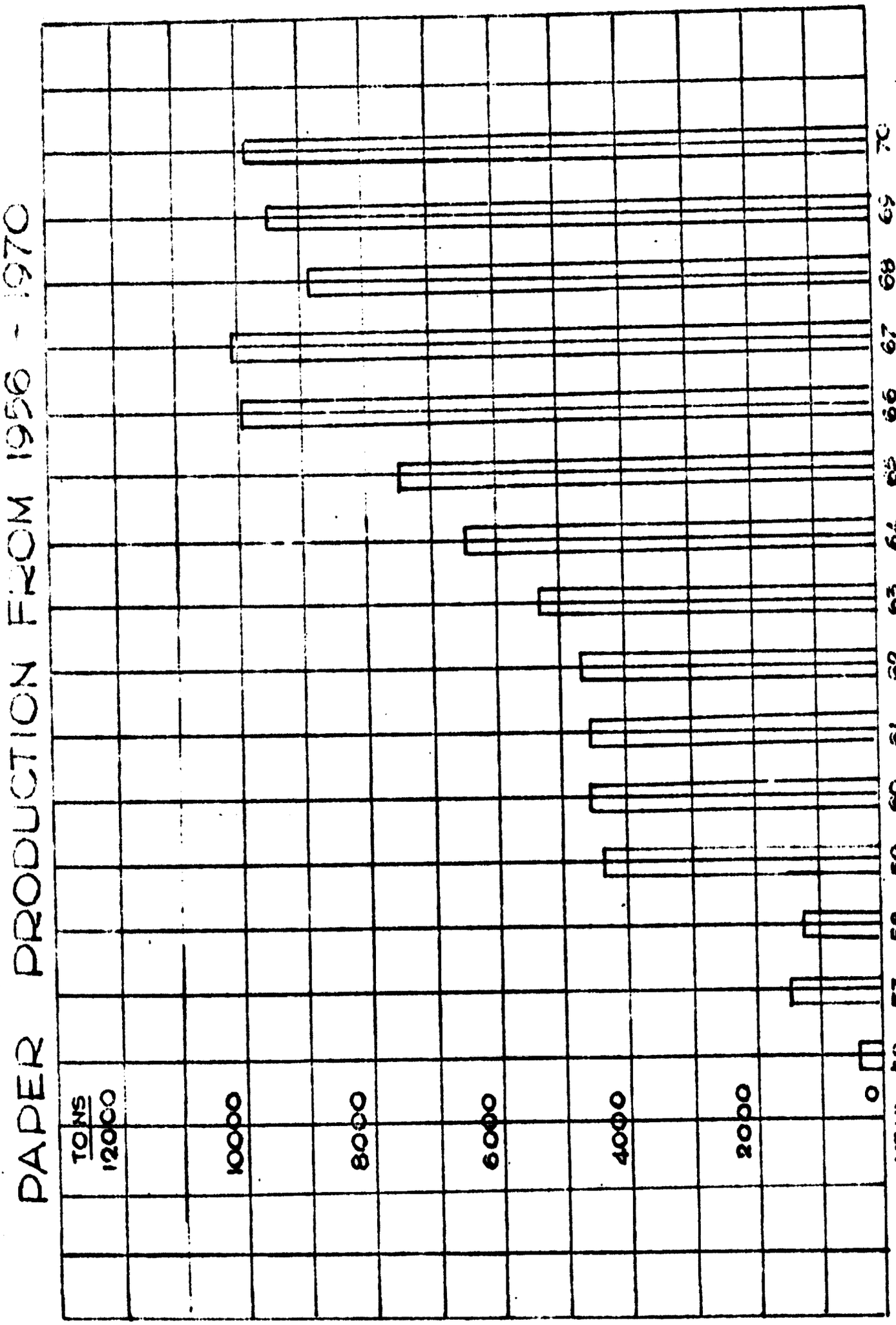
(8) Lack of management skill (e.g.low efficiency on account of state owned mills directed by Civil Servants and Administrative Officers wanting in industrial experience or Industrial aptitude.

From 1959 onwards, as these problems (listed above) were being identified, they were systematically tackled in order to raise the production efficiency of the Mill. In the following pages an attempt is made to elucidate the nature of these problems and to describe how they were handled to raise the output of the mill. The chart given on the next page indicates the increase in the output of the Mill as a result of the positive steps taken to eliminate low efficiency.

Straw Supply and Handling

Although straw was readily available in neighbouring areas within a radius of 10 to 15 miles, the operation of the Mill was adversely affected due to poor collection methods.

The Mill needed 6,000 tons of straw annually for the production of indigenous pulp. The quantity of straw collected in 1957 to 1958 was less than 1,000 tons. The main reason for this poor collection was the low price paid to the farmer i.e. Rs.15/= per ton. This price was inadequate to compensate for the labour involved in loading and transporting the straw to the mills.


PAPER PRODUCTION FROM 1956 - 1970
TONS
12000
10000
8000
6000
4000
2000
0
YEAR
56
57
58
59
60
61
62
63
64
65
66
67
68
69
70

The only means of transport available to the farmer at that time was the bullock cart. The cost of loading and transporting straw to the Mills by means of bullock cart is based on the following data:-

Quantity of straw transported by bullock cart - one trip	-	½ ton.
Time required for loading	-	2 hours
Time required for transport to the mill	-	2 hours
Time required for unloading and return to the source (i.e.farm) or to return home	-	3 hours
		7 hours

It can be therefore seen that the transport and supply of straw consumed a good part of the time of the farmer. In most cases, he used a helper to load the straw for which he had to pay about Rs.3/=. Considering the time he expended and the use of his bullocks for this purpose he was hardly getting any profit for his labour as he received only Rs.4.50 at the end of the days work. (15 x ½ = 7.50 - 3.00 = 4.50).

In order to make it profitable for the farmer to supply straw to the paper industry the price had to be raised in 1959 to Rs.25/= per ton. With this incentive the amount of straw collected increased to 2,500 tons in 1959. Even though this payment was sufficient for farmers located within a radius of 10 miles, it was no incentive to farmers living beyond this radius.

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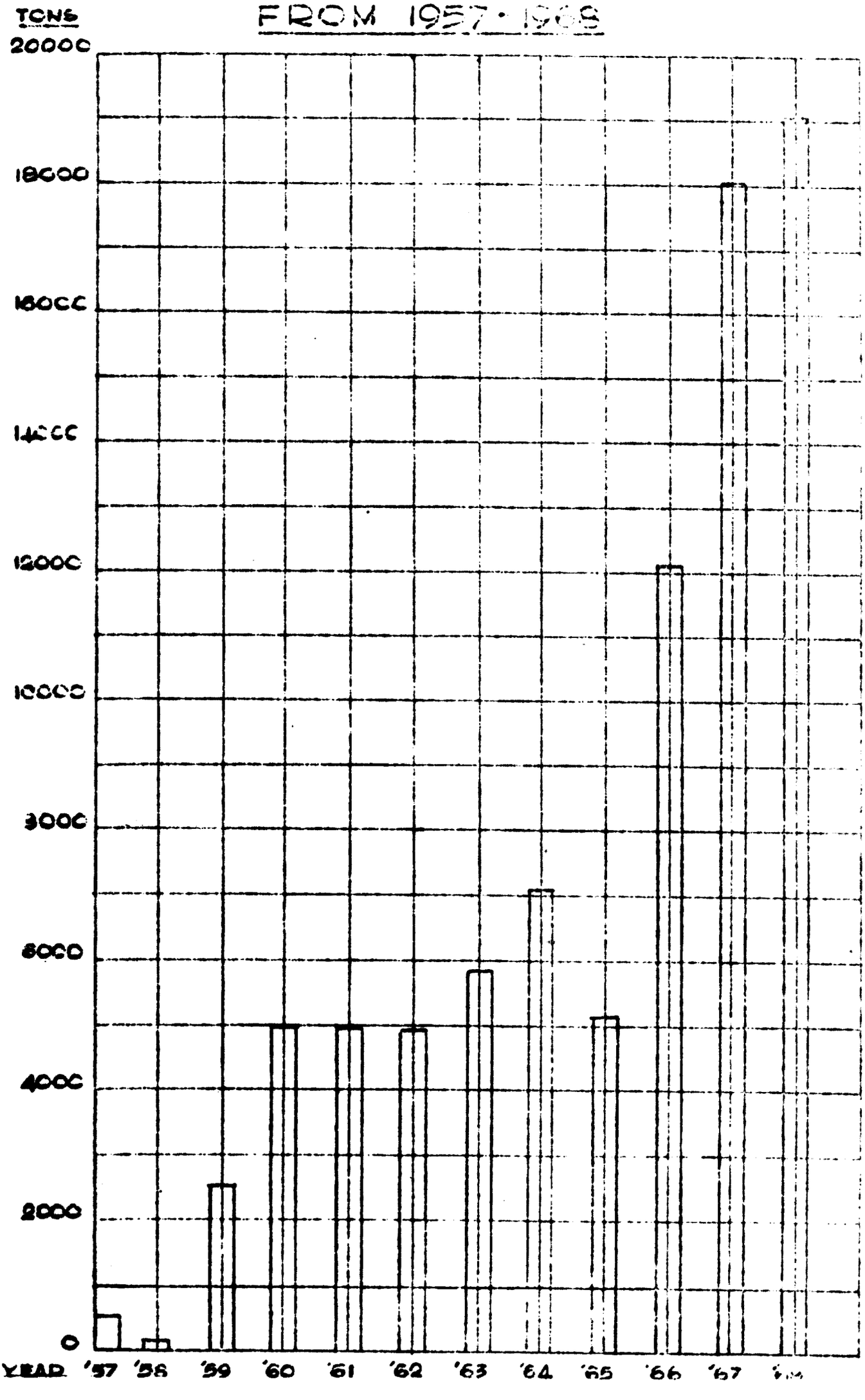
1 U.S.Dollar = Rs.5.97 cts.

It was therefore decided that the price should be further increased to Rs.50/= per ton of straw delivered at the mills, since the quantity was still insufficient to meet the requirements of the Mills. This increase in price was reasonable as the time required to transport straw to the mills worked out to 4 to 5 hours as there were no proper roads from some of these farms and the bullock carts had to traverse the distance mostly on cart tracks. The amount of straw now collected increased to 6,000 tons during the years from 1960 to 1965.

Concurrently, improvements were being effected in other areas of mill operation and a rise in production was anticipated (which was realised) during the next three years. In consequence more straw was needed for indigenous pulp production.

In a move to collect straw on a larger scale, straw centres were established at suitable locations convenient to the farmers for the delivery of straw. This reduced the distance involved in the transport of straw and the farmers were able to make more trips resulting in a higher quantity of straw being delivered. Straw balers were used to facilitate efficient transport of straw to the mills from these centres as straw is a bulky material. Balers with manual tying arrangement of bales were replaced by balers with automatic tying equipment. This reduced the baling costs and increased the efficiency not only in baling but also in the handling and transporting of straw from the centres to the mills. In view of these improvements the quantity of straw collected in 1966, 1967 and 1968 increased from a level of 7,000 tons to about 17,000 tons per year. The chart indicating the progress in the collection of straw from 1957 to 1968 is shown on Page 9.

COLLECTION OF STRAW FROM 1957-1968



On account of a further expansion programme in this mill raising the production from 10,500 tons to 22,500 tons per annum, the quantity that is estimated to be collected for this year from various straw centres around the Mill is about 30,000 tons. This is shown in Table - 1.

Table - 1

Centre	Distance from Mills	Target for 1971 Tons
Valaichchenai	(Mill site)	8,000
Koduwamadu	16	3,500
Punnanai	14	1,000
Sammanthurai	60	8,000
Ninthavur	60	4,000
Veerapura	50	2,500
Thumbankeri	50	3,000
T o t a l		30,000

In the handling of large tonnage of straw with the progressive increase in production, steps hitherto taken to improve efficiency are as follows:-

(1) The use of automatic, self-propelled, high capacity straw balers with an output of 16 to 18 tons per 8 hours replacing balers previously used which had an output of only 3 tons per 8 hours.

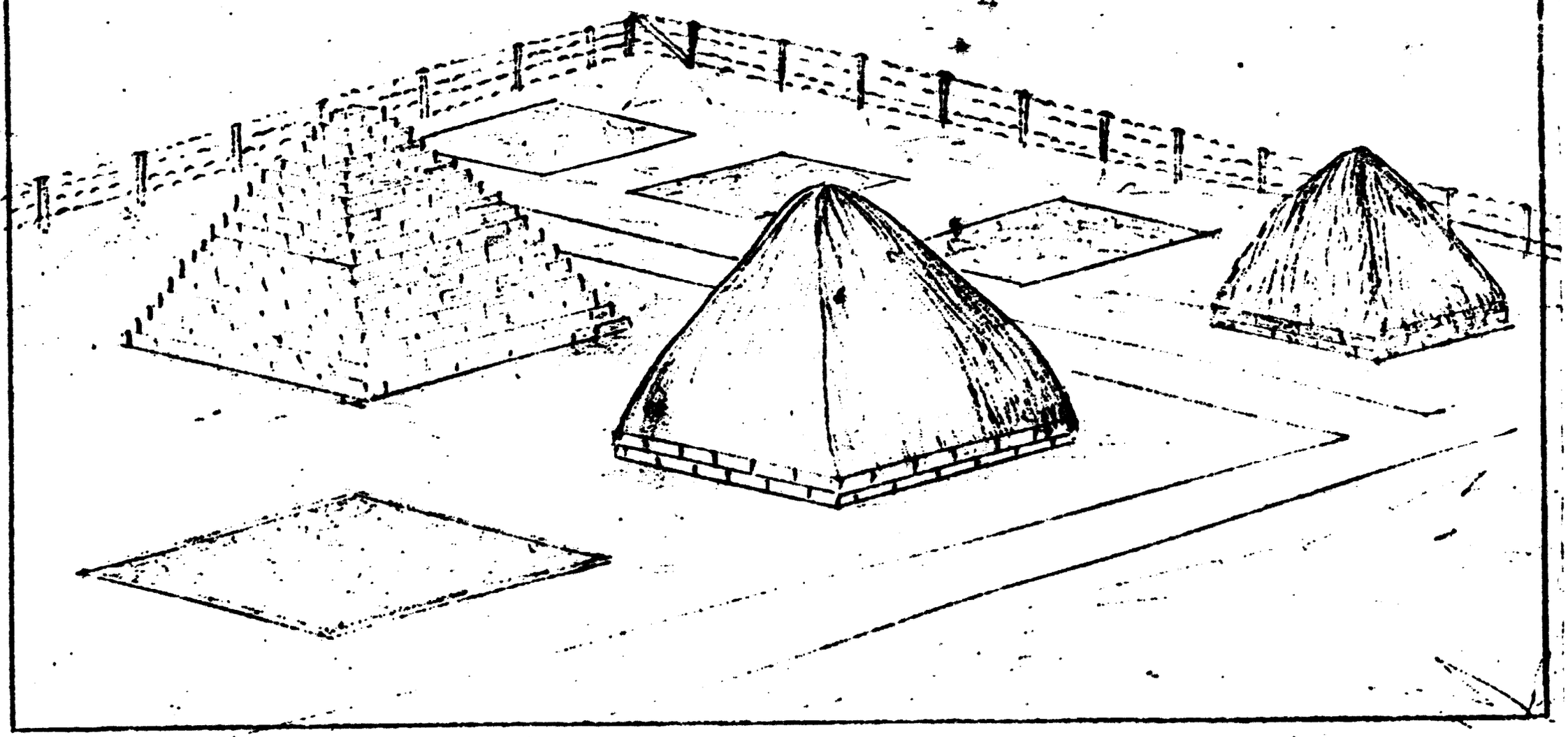
(2) The original system for the storage of straw required warehouses to protect the straw from monsoon rains as the cutters and the dusting plant could not handle moist straw and also moist straw rapidly deteriorated during storage. The storage of straw in warehouses was found to be expensive for storing large tonnages of straw for a period of 5 to 6 months a year (i.e. the monsoon period). This problem was overcome by storing straw in open yards. Here the baled straw is stacked in the form of a rectangular base ending with a pyramid at the top. The dimensions of these stacks are as follows:-

Length	- 45'
Breadth	- 40'
Vertical Height (Apex)	- 45'
Vertical Height (Base)	- 6'

The roof of the stacks are covered with loose straw to form an impervious layer thus preventing water from seeping into the stacks (Refer to diagram on Page 12)

With the improvements so far discussed, the problems that existed at the initial stages in the collection and use of straw were satisfactorily solved.

STRAW STORAGE



Problems connected with Water Supply

The developing countries which have an acute shortage of woody raw materials, depend largely on agricultural residues - i.e. rice straw or bagasse. Locating a pulp and paper mill based on rice straw needs careful planning. Though it is preferable for a paper mill using straw to be located in a rice growing region (due to the bulky nature of the raw material) yet it poses certain problems. Rice cultivation needs enormous quantities of water. The paper industry itself needs water for processing and also for disposing the effluent satisfactorily from the mill by means of irrigation channels, streams, etc. Therefore, there are bound to be problems connected either with influent or effluent. Agricultural and industrial production both seem to work at cross purposes. Most of the problems are due to farmers fears that industrial activity in a predominantly agricultural area, sharing a common source of water supply is an intruder in their midst. The paper industry in Ceylon started with this problem. The industry being newly set up in a predominantly rice growing area, the farmer started off with imaginary fears regarding the water situation which affected the smooth operation of the mill.

The Eastern Paper Mills gets its supply of water from a reservoir located about 5 miles from the Mills. This lake is not a simple reservoir but a combined river diversion and irrigation storage scheme. A weir diverts water flowing in the river into the reservoir and the actual capacity of the lake is turned over about three times in a year. The capacity of the lake is 10,450 acre feet.

When the Mills went into production there were serious interruptions in the supply of water to the Mill as the supply from the lake to the Mills was by an open channel; the total length of the channel being 6½ miles. Especially during the dry season, the operation of the Mills was seriously affected, as the farmer too operated on the same channel for the irrigation of his rice fields which were located all along the banks of the channel.

In order to maintain a steady supply of water to the mills, it was decided in 1963, a pumping main should be laid from the lake to the Mills. This step taken to assure a steady supply of water improved the mill operation.

The attitude of the farmer moreover, changed when he found that the industry directly helped him as he was able to sell the straw to the industry, thus converting this waste material (which he had hitherto burned) into money.

Manpower and Management

In starting up a new mill in a developing country, besides technical management problems there are personnel management problems as well. It is therefore, important to have a good personnel department set up to help the management of the mill.

At the initial stages, when the Mill in Ceylon was started up, there were labour disputes and discontent as there was no proper job evaluation. There were cases of employees working in certain areas where the operation was simple but where the wages paid were high as compared to jobs which demanded greater alertness, skill and responsibility. For example, a paper machine operator was paid about 60% of the wages that were paid to a truck driver. This naturally caused discontent and affected the efficiency of operation.

There was not only a poor evaluation at the skilled level, this extended to the supervisory levels as well. There were cases where foremen in charge of key operations, such as the paper machine, were being paid a lower salary compared to an office clerk. These disparities were corrected based on a complete job evaluation for the entire organization.

With a proper job evaluation of the entire mill, it was also found necessary to issue lists of duties based on the classification of jobs. This again is important for a new industry in a developing country as the duties should be well and clearly defined so as to avoid confusion in operation.

As part of personnel management, quarterly review forms were introduced to evaluate individual merit ratings such as skill, attendance, quality of work, initiative, judgement, tardiness, etc. of every employee. These reviews that are completed by the supervisory staff and heads of departments are carefully compiled to be made use of for future promotions and upgradings. The maintenance of these records has created keeness in the job and employees are encouraged to give their best.

For the supervisory staff and the foremen, it was found necessary to provide refresher courses in management. This again, from our experience, is an important factor for developing countries, because the supervisory staff with little or no experience have to be trained to perform supervisory functions effectively.

Absenteeism

The present mill at Valaichchenai is in a predominantly agricultural area, as mentioned before, Consequently the labour force drawn from this area are persons who earn their livelihood through agricultural pursuits mainly rice cultivation and fishing on a small scale.[1] Since both these occupations are of a seasonal nature, they divided their time between the two; fishing during the off-monsoon season when the seas are comparatively calm and sowing rice before the rainy season and harvesting just before the dry season.[2]

During the initial stages of commencing production the labour force employed for both unskilled and semi-skilled jobs, were mostly persons with such a background. As a result they treated working in the plant as only one of many occupations and during the fishing and harvesting seasons there was as much as 35% absenteeism.

It was therefore, decided to take definite steps to formulate a programme to reduce the percentage of absenteeism in the interest of efficient plant operation. The following are the steps that were taken over the years and absenteeism has been successfully reduced to 15% (which is still a high figure).

(1) The wages were raised. This was done with a view of making their jobs more paying, thus satisfying any need they may have for increased earnings. It was hoped they would not seek to supplement their incomes if they were paid a reasonable wage.

1/ Fishing on a small scale - the catch will amount to only 10 to 15 lbs. a day at the most. No mechanical equipment used.

2/ Dry Season - period without rainfall.

(2) Bicycle loans were given to those who lived within a radius of 10 miles and who absented themselves on account of inadequate public transportation facilities.

(3) A careful study was made of the season in which the maximum absenteeism existed. This was found to coincide with the harvesting of rice which took place just before the local festivals.[3/] It was therefore decided to plan the annual mill shut-down for maintenance work during that period making it compulsory for all employees to take their vacation at the same time except the maintenance staff. This prevented employees taking their vacation "piece meal" which formerly affected operating efficiency.

(4) A minimum standard of attendance was formulated and an attendance bonus was given.

These steps may be of interest to other developing countries where paper mills are located in predominantly agricultural areas.

Technical Skill

There is no shortage of labour in developing countries but there is a great deal of work that has to be done in training the unskilled to become industrially skilled in various grades. In starting up a new paper mill in a developing country, one of the problems that is encountered is the necessity of training both skilled workers and the supervisory staff. The problem is not so

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3/ Local festivals - the harvest time falls during the preparation for the Sinhalese and Tamil New Year in the month of April.

complicated once a mill is in operation in the country, as "On the job training" could be provided by preparing a training scheme using facilities available within the country. Our experience shows that when "on the job training" is given, the local personnel had no difficulty in acquiring the skill and professional standards needed for these jobs. The first paper mill of a developing country has a big part to play in providing training for the personnel of future mills.

On the other hand, the first mill is also greatly handicapped in attaining efficiency in operation during the first 2 to 3 years of starting up, as the personnel do not have the required experience to operate the Mill. Problems of this nature can be solved, to some extent, in the following ways:-

(1) Providing technical training abroad for key personnel.

(2) The hiring of experienced personnel from abroad to train local staff.

(3) Joint participation in a project with an established paper manufacturing company where technical know-how and administrative experience could be obtained.

Usually a developing country uses the first two methods. The reason for this is the difficulty in attracting a joint participation as generally private companies in developed countries are reluctant to invest capital for various reasons.

With respect to the first method, the training normally given to persons with the right type of academic background is for a period of about one to two years. This period itself is not quite sufficient to enable these trainees on their return to the country to operate the mill at peak efficiency. They have to be supported at some of the key operations using experienced personnel in the industry to guide the local staff in the mills operations.

The second method as well is not a panacea for all problems as the expert who has to train the local staff has to apply his knowledge to the use of new raw materials, new operating conditions and above all to new types of people, surroundings and circumstances. All this takes time and our experience shows that it would take 3 to 4 years at least for the first mill in the country to get established for efficient operation.

Local personnel sent abroad usually do not get the required type of training as the advanced countries are unable to provide a proper orientation of the problems connected with pulp and paper manufacture in developing countries. The developing countries in Asia and Africa generally use agricultural residues like straw and bagasse or new types of woody materials, such as tropical hardwoods for paper manufacture. In advanced countries, on the other hand, the type of raw materials used for paper making is quite different. Most of the mills operate on traditional raw materials such as conifers and other soft woods. The problems therefore connected with the manufacture of pulp and paper with the new raw materials such as agricultural residues, kenaf and tropical hardwoods, which are available in large quantities, are quite divergent to problems connected with standard materials like conifers. Therefore, in order to get properly

ecquainted with problems of this nature the training ahould be received in countries which have similar problems such as India, Egypt, Indonesia, Taiwan, Thailand, etc.These countries not only have problems in respect to raw materials but there are other common features auch as shortage of spares, quality problems, marketing standards, etc. Such as environmental set up for training is considered more useful for a developing country as compared to advanced countries where the industry is getting largely automated and operating conditions are quite different.

However, besides the basic training referred to above, there should be a programme of advanced training for those who are in key positions in the operation of the mill i.e. Chemists, Engineers and those who are in managerial positions. After a period of 4 to 5 years experience in the operation of a mill in a developing country, such personnel should be sent for advanced training to developed countries to broaden their field of experience and get new ideas on the latest developments in technology, Otherwise they tend to get shut out from new developments in these fields.

Standardization of Grades and Sizes

The paper industry unfortunately is plagued with the problem of different sizes and grades. This creates a serious problem for a developing country when the local industry starts producing paper for the first time to meet this market situation. Hitherto paper was imported from different parts of the world, therefore, the market had various sizes of paper of different designations such as "double elephant" "pinched post", etc. Table - 2, shows the different sizes of paper used by Printers and Converters.

Table - 2

Customary Trade Sizes of Imported Paper And Paper Board

Designation	Size (in inches)
Foolscap	13½ x 17
Foolscap - Double	17 x 27
Foolscap - Quad	27 x 34
Large Post	16½ x 21
Large Post - Double	21 x 33
Demy	17½ x 22½
Demy - Double	22½ x 35
Demy - Quad	35 x 45
Medium	18 x 23
Medium - Double	23 x 36
Medium - Quad	36 x 46
Royal	20 x 25
Royal - Double	25 x 40
Crown - Double	20 x 30
Crown - Quad	30 x 40
Secondary Sizes	
Pinched Post	14½ x 18½
Post	15¼ x 19
Post - Double	19 x 30½
Imperial	22 x 30
Poster Paper	41 x 61

In view of the multiplicity of various sizes under various designations the production efficiency on the paper machine was affected as there were deckle losses in

addition to frequent adjustment on the paper machine for different sizes. In order to improve the situation the multiplicity of sizes were reduced to a limited numbers as shown below in Table - 3.

Table - 3

Printings	-	20"	x	30"
		22½"	x	35"
Writings & Bond-		18"	x	23"
		23"	x	36"
		17"	x	27"
		26"	x	32"
Wrappings	-	29"	x	45"
Covers	-	18"	x	23"
		23"	x	36"
		26"	x	32"

The number of sheets per ream of paper imported varied i.e. 472, 480, 500, 504, and 516. In view of the multiplicity of sheets per ream standardization was found to be necessary and a single standerd of 500, sheets per ream was established.

Along with the standardization of sizes it was also found necessary to standardize the basis weight of different grades of paper. For example in the manufacture of printings, at the initial stages of production, there were basis weights such as 54, 56, 58, 60, 65, 72, 74 gsm. (grams per square metre) etc. To help in the efficiency of production the multiplicity of basis weights were also reduced to the barest minimum.

Tinted Paper

On account of market requirements for tinted paper at the commencement of production, the mill was making about 12 different shades. Colour changes involved frequent wash-ups which increased the down time on the machine. A standardization of tinted grades was necessary to improve operating efficiency. Therefore, the mill restricted manufacture to four colour shades.

"Laid" Paper and Watermarking

In addition to the standard "wove" grades, when the mill went into production, there were orders for the manufacture of "laid" grades as well. The operating efficiency on the machine was high in the manufacture of "wove" grades, as there were fewer problems connected with "wove" dandy rolls as compared to "laid" dandy rolls. A study made in respect to the end use of "laid" paper showed that printers and converters used it for no particular reason except that it was traditional. The customers were therefore encouraged to use "wove" paper instead and this not only helped to standardize on "wove" grades but also helped production efficiency as explained above.

The manufacture of water marked papers to differentiate grades or to symbolize various trade marks were also discouraged. The tonnages of such orders were so small that accepting these orders would have resulted in poor operating efficiency on the machine.

Improving Machine Performance

Operating experience has shown that there are certain areas where machine performance can be improved by making small adjustments with little or no expenditure.

These improvements have proved valuable and effective. The following are some of the areas where successful adjustments have been made by the author thereby improving the efficiency of the operation.

(1) Determining the Optimum Basis Weight for Higher Output

A Paper Mill meeting the requirements of the local market of a developing country like Ceylon, besides making a wide range of grades has to cover a wide range of basis weights as well. Even though in certain cases the designed features of the machine could permit the manufacture of a wide range of basis weights (i.e. from a low basis weight of 45 gsm to a heavy basis weight of 300 gsm) it has been found advantageous to limit the basis weight range. The optimum range for a machine was obtained by running a series of mill trials and determining the performance of the machine where maximum production, good runnability and good quality characteristics are obtained. By selecting an optimum basis weight range a high operating efficiency on the machine resulted.

(2) Reducing the Down Time on the Machine

Pulp and Paper Mill equipment are expensive involving heavy investment. It is therefore necessary to keep down time to the minimum. The most simple way to reduce down time is to

train the machine crew on efficient start-up, shut-down, grade changes, felt and wire changes etc. In a developing country such training should be introduced with the initial start-up, of the machine itself, since experience shows, it is difficult to change the methods of operation once the crew get used to operate ing in a certain way. It is therefore necessary to train the crew giving detailed operating instructions when a new machine is commissioned.

Wash-ups between grade changes and prior to shut-downs affect production hours. In order to reduce down time on wash-ups and to clean the stock and white water system effectively, it was found advantageous to use a high pressure pump. By using this equipment, interruptions to production due to machine breaks caused by slime, reduced considerably. This could be of great advantage to mills operating on straw pulp, as experience has shown that slime build up on straw pulp is considerably higher compared to wood pulp.

(3) Planning Machine Shut-downs

A careful record was maintained of all felt changes and wire changes on the paper machine. By maintaining these records and also observing the performance of the machine, it was possible to predict with reasonable accuracy when the next wire change and felt change should take place. With this information available it was

possible to plan machine shut-downs while working on a continuous roster, thus avoiding unnecessary loss of production hours. This information was also used to co-ordinate other activities, such as maintenance of the machines, holiday shut-downs, repairs to service facilities such as power, steam and water, to coincide with the planned shut-down for wire and felt changes.

Getting the Maximum Output using Existing Equipment and Facilities

Besides improving machine performance, as outlined above, our experience has shown that by careful evaluation of the facilities available in a mill, the production could be increased.

The pulp and paper industry requires complicated and expensive machinery. A developing country, on account of its numerous activities in both the agricultural and industrial sectors, is short of capital. It is therefore imperative for an industry, not only to operate at maximum efficiency, but to explore all possibilities of modifying the existing equipment to obtain a higher output as well. The writer, in this respect wishes to outline the modifications effected on the paper machine which raised the output from a designed level of 12½ tons to 30 tons per 24 hours. This increase in output works out to about 140%.

The Paper Machine was found to be basically sound for a higher output of 30 to 40 tons per 24 hours. The service facilities of the mills such as water, steam and power supply were also adequate. The capacity of the stock preparation

equipment was suitably increased to accommodate the higher output of 30 to 40 tons per 24 houre with no expenditure on capital equipment. However, the limiting factors for a higher production were:-

(1) The drying capacity of the machine

(2) The speed of the machine

To improve the drying capacity of the paper machine, four additional drying cylinders were installed. In order to obtain a better efficiency in the press section for the removal of water, a suction press was installed replacing the plain press on the No.1 position.

A study was made as to how to increase the machine speed from 120 metres to 150 metres per minute, without a major modification. The load data obtained indicated the electrical convertor system and the main DC drive motor to the line shaft were quite adequate to handle the extra load at 150 metres per minute. It was therefore decided to approach this problem in the simplest way possible with minimum production delay. This study indicated the most inexpensive and quickest method was to alter the pulley ratio between the drive pulley of the DC motor and the driven pulley of the line shaft.

By making these modifications, involving a capital expenditure of Rs.3 million or approximately U.S.$.500,000. It was found the machine could produce 140% more than the original designed capacity. This modification to raise the output from

12½ tons to 30 tons per 24 hours using Rs.3 million represents about 14% of the capital spent originally on the project. The objective in giving this example is only to illustrate how a developing country could benefit by expanding their output using similar modifications, as this could result in a high output without increasing the capital costs substantially. It is of course understood that in all cases it may not be possible to obtain an increase of 140% as experienced in this case. However, by studying each case and analysing where the bottle-necks to higher production exist, it should be possible to obtain a higher efficiency in mills operation.

Use of New Materials and Operating Efficiency

In view of technological advances in the field of plastics, synthetic fibre, etc. the conventional materials used for manufacturing wires, felts and certain machine components, are rapidly changing. A developing country on account of its isolation, both physically as well as technologically, may not be fast enough in accepting and applying new ideas and may keep the industry lagging behind. To prevent such a situation those who are in charge of technical operations and management must be alert and sensitive to these technological changes. Given below are a few typical examples to indicate that new ideas and innovations have proved beneficial in raising the operating efficiency.

(1) Transmission Belts on Machine Drive

Due to variations in temperature and humidity the down-time on the paper machine was very high and averaged about 20 to 25 hours per month. When the new type of plastic belts

became available in the market, the standard rubber belts were replaced. The new plastic belts reduced considerably the down time that previously resulted from the constant adjustment of transmission belts. An improvement of this type, on paper machine operation would be of interest to mills using mechanical drive in tropical areas where there are fluctuations in humidity and temperature.

(2) Plastic Wires

The use of plastic wires in place of the traditional phosphor bronze machine wires resulted in a saving of approximately 80 to 90 hours per year. With the use of phosphor bronze wire, the wire changes averaged about 12 to 14 per year as against plastic wires which required only one wire change. Besides a saving in down-time, plastic wires were found to be more economical as the number of plastic wires required were less.

(3) The use of Synthetic Felts

By changing over from conventional felts to synthetic felts the number of felt changes per year were reduced. Here again new types of felt designs have come into the market and by closely following new developments and adopting the most suitable felt design for the type of paper and machine, it was possible to reduce the down time resulting from felt troubles and felt changes.

(4) Use of Plastic Tape for Suction Boxes

The wooden suction box tops were replaced when the plastic type became available in the market. This not only extended the life of the machine wire but also reduced the down time as fewer replacements were needed compared to wooden tops.

Selection of Equipment

It is important for a developing country to standardize on the type and make of the equipment as far as possible. The reasons for suggesting standardization is due to the difficulty of obtaining spares as the developing countries in Asia, Africa and Latin America are located far away from equipment manufacturers and have problems connected with foreign exchange.

Our experience in standardizing items such as centrifugal pumps, circulating propellers for storage chests, valves, electric motors, etc. has helped us to maintain a low inventory of spares. Furthermore, under emergency conditions it provided the flexibility to interchange spares from a less important equipment to a vitally important equipment to keep the plant in operation.

In the selection of equipment for developing countries, consideration should be given to obtain the type of equipment that is less expensive and also simple to maintain. An example of this would be selecting a drive system for a paper machine. Although electric drive systems

are used on many machines, such a system would be more expensive and too complicated for maintenance. In a developing country, where it is not possible to get highly skilled personnel, a mechanical drive system has certain advantages:-

(1) Low cost

(2) Simplicity of maintenance.

Another important factor in the selection of equipment when adding a second or third machine to an existing unit, is the size of the machine. It has been found advantageous to have sister machines, as far as possible, of the same width and from the same manufacturer. This would avoid the necessity of duplicating spares and carrying emergency stock of machine clothing in excess, thus saving on foreign exchange expenditure for spares.

In respect to production planning, machines of the same width give the maximum flexibility to achieve a higher efficiency in operation.

Use of Maintenance Personnel

Good workmanship is an important factor in good maintenance. Often faulty fitting is responsible for the mechanical failure of an equipment. In our experience we have seen more ball and roller bearings ruined by faulty workmanship, than failure on account of genuine wear and tear. For this reason it has been found necessary to develop specialists in the handling of particular machines rather than having a common group of people for the maintenance of all types of

equipment in the mill. This system of training two or three men for a particular type of job improved plant efficiency; this not only improved the quality of the job but it was also performed speedily because the men were fully acquainted with the machinery on which they have had years of experience. In the maintenance of equipment the key factor is in being familiar with the machine, knowing exactly how to dismantle it, and the type of tools and equipment necessary for the job.

Budgeting and Cost Control

Budgeting and preparation of cost statements have helped in the efficient operation of the Mills. Cost statements are produced within 5 to 7 days after the lapse of the month. This has aided the management to carefully examine the causes for variances and to take remedial steps to correct these variances. It has been found advantageous to pass information on variances based on cost statements down the line to the operators concerned and this has evoked cost consciousness in the men who are in charge of the various physical operations in the mills. By making the man"on the job" involved in costing, it was found possible to obtain suggestions, minimise waste, improve quality, etc.

The costing system besides improving efficiency, introduces planning to a very high degree. Effective planning is an important factor for the efficient running of the mills in a developing country. By adopting this method, it was possible to avoid problems on production, material shortage and maintenance spares shortage, which are important to a mill located far from countries that manufacture equipment and supply chemicals essential to production. This has become all

the more important in view of foreign exchange problems as the official routine in obtaining foreign exchange needs careful planning. For instance, the need to obtain paper machine wires or a ball bearing for a vital equipment has to be thought of and planned nearly 12 months ahead. The process of obtaining import licences, exchange allocations and finally awaiting the shipment results in a delay of about 10 to 12 months for any imported spares or machine clothing to arrive at the mills.

By involving departmental heads and foremen in the budgeting programme, it was found possible to operate the mill efficiently, keep to production targets and achieve the desired profitability. Initially, the budgeting and cost statements were limited to production materials and production costs. But it has proved profitable to include capital jobs as well. In planning capital jobs such as modifications to the existing equipment or putting up a new building, various aspects of the job are examined to determine the cost of installing a piece of equipment. For example, installing a refiner of one type from a certain manufacturer, is compared with another type of refiner to determine the financial aspects of this capital investment and the time required to complete the job. A cost analysis on capital jobs as a part of budgeting has aided efficient management.

Quality Control

Besides improving the general output of the plant, attention has to be paid to the quality of the paper produced. In a developing country, producing paper using local raw materials, creates various quality problems as it differs from the well developed traditional raw material (i.e. conifers).

A developing country which has hitherto been depending upon imported paper, is slow to accept the local product on account of unfounded fears regarding quality. Therefore, establishing quality standards and continuously maintaining them is a challenge to a developing country. In this respect, it has been found advantageous to maintain a 24 hour quality testing programme not only at the end of the paper manufacturing process but at every vital stage of the pulp and paper processing operation.

Once the standards for the various grades of paper produced at the Mills had been established, there were other problems. The production personnel and the machine crew did not often take the quality control reports seriously. In order to avoid such problems, it was found helpful to have daily meetings on quality problems with the supervisory staff of production departments and the chemist in-charge of quality control testing. A discussion on problems based on quality control reports helped to clear doubts where clarifications were necessary. This method contributed to the efficient working of a quality control department in the mill.

Research and Development

The importance of research in the pulp and paper industry cannot be under-estimated. Continuous improvements are necessary to keep the industry in the forefront of progress. In the case of developing nations, the problems connected with the efficient running of the industry are challenging. Some of the problems peculiar to a developing country are as follows:-

(1) Developping new indigenous raw materials for the manufacture of paper.

(2) Improving the present grade of paper.

(3) Improving the existing process

(4) Reducing the cost of production.

The need to find new indigenous raw materials as substitutes for long fibred pulp is a challenge to developing countries which do not have an abundant supply of long fibred materials. A developing country like Ceylon depends entirely upon imported newsprint and imported long fibre pulp. Although certain types of hardwoods have been found suitable for the manufacture of newsprint much has to be done through research, to find substitutes for imported long fibred pulp to save valuable foreign exchange.

The use of indigenous raw materials for paper making involves quality problems. A continuous effort has to be made to produce better grades of paper to satisfy customers using paper for various printing and converting applications.

To conduct cost reduction programmes it has been found necessary to support production management with scientific knowledge. Work of this nature led to modifications of equipment improvement of operating efficiency and reduction in the use of chemicals.

Even though these problems are common to developing countries, the need for research on a large scale is limited. This is because:-

(a) The developing countries produce mainly for the home market and are unable to meet their total demand for paper. Hence competition is out of the question in the early stages. As a result the necessity for innovation, improvement and research is not sufficiently compelling.

(b) As these countries have smaller plants compared to industrialized countries, their output does not justify a heavy financial allocation for research work.

Since research to some extent is essential, as explained above, a good solution would be the pooling of research resources and the technological 'know-how' of a few developing countries either on a geographical basis or on a common raw material basis - thereby sharing expert knowledge and risks for the advancement of a larger circle of nations.

Management Skills

In order to raise the operating efficiency of a mill as outlined above, it is important to have technically competent men with industrial experience and management skills. In developing countries it is accepted as sound practise of public administration to use Civil Servants for positions of top management. This has proved .. satisfactory in most Government departments.

In the sphere of industrial ventures however, there needs to be a different approach. When these industrial undertakings are run by the state, like other state owned enterprises they are subject to all the red-tapism and bureaucratic short comings that accompany such management. Our experience has shown that when industrial concerns involving intricate technology are entirely under Civil Servants, the following drawbacks can result -

(1) Production is often held up or affected as a purely administrative manager has no clear idea of priorities.

(2) Decisions are necessarily slow because of the slow nature of the administrative machinery.

(3) Research, development and expansion programmes are effected due to a lack of experience in the industry.

Developing countries have only lately started industrializing on a large scale. As a consequence most of these plants that are installed are highly complex and modern and demand a high degree of technical know-how. At the same time these developing countries are pledged to maximum production for the benefit of all. As the industry expands it must necessarily increase the number of techniciens. Therefore, industry becomes more and more dependent on persons possessing technical knowledge and skills. At the same time the unskilled labour force diminishes as more skilled workers are being transformed into 'Junior technicians'. As these techniciens master complex processes of production, there is a need all along the line of responsibility for personnel having sound technical knowledge of the processes involved. With the great advancement in science and technology, industries in developing countries are faced not only with the problems of running very modern plants satisfactorily but also with the problem of keeping abreast with the continuous strides in technology. Consequently, management of industrial concerns play an important role in maintaining efficiency in developing countries.

As mentioned before, state owned enterprises in developing countries are not based on the profit motive (though the state often measures the success of its ventures in terms of the profits earned by these institutions). It has been demonstrated that purely administrative officials heading public

Corporations are motivated more by the 'power' motive, than profit. This often resulted in management being branded as 'power hungry' and 'bureaucratic' by trade unions. On the other hand, the objective functional aptitude and interests of technical managerial personnel are not either motivated by 'power' or'profit' . The guiding factor is mostly workmanship which calls for doing a job of production efficiently. The economic interests of such a group in terms of employment and income are promoted by the full utilization of production resources and their expansion.

Moreover, during the past few decades along with technological progress there has been a gradual change in the character of business management. There is an increasing specialization of management and consequently an increasing infilteration into management personnel of technically trained personnel. This trend is on the increase and this new type of 'technical managerial' personnel may well become the liberating force for achieving higher efficiency in plant management.

Taking all these factors into account the current trend would point to the need of a strong technical oriented chief executive responsible for all production and development work, as such a person will be capable of handling production problems and delivering the goods efficiently.

Conclusion

The paper industry in Ceylon (as mentioned before) was criticised at the initial stages. In fact it was on the verge of being closed down on account of its inability to justify itself as a commercial undertaking. This paper has dealt with the causes of low efficiency at the early stages and how these problems were overcome. The plant which was originally

designed for an output of 3,750 tons per annum will at the end of this year produce 22,500 tons per annum thereby contributing much to the national economy and conserving valuable foreign exchange.

The success of operating a pulp and paper mill at high efficiency depends much upon the managerial skills available for this operation. The paper industry being of a complex nature, involving various technical processes, will have to draw this management skill from technical men with years of experience in the industry. Initially, in a developing country as there are no experienced personnel in management, such technical experience has to be drawn from outside the country. This could only provide temporary relief and the final success would depend on building up a good management team to operate the industry at high efficiency. Therefore, when the first mill goes into production, it may take three to four years before the industry can reach maximum efficiency; but subsequent expansion and new mills will need less time to show results.

Based on the author's experience a list of guide lines has been prepared to enable the management of pulp and paper mills in developing countries to increase their efficiency and maintain it at a high level. These guide lines may also prove useful in reducing the time gap between initial production and maximum efficiency.

A List of Guidelines to Help Developing Countries to Increase the Efficiency of Pulp and Paper Mills and Maintain it at a High Level

Raw Materials

1. Ensure adequate supply of raw materials by the following:-

1.1 Estimate the quantity of raw material required for annual production, making allowances for losses during storage.

1.2 Analyse the problems connected with the supply and collection of raw materials.

1.3 Establish an efficient organisation to collect raw materials.

1.4 Programme the collection of raw materials in such a way that the entire quantity needed per year is collected in the specified period during which the raw materials are usually available (i.e straw could be collected only during the dry season.)

1.5 To circumvent high costs in the extraction or handling of raw materials, the use of modern equipment should be studied and implemented.

1.6 Determine the most economical way to store the raw materials.

Water Supply

2. Ensure a steady and constant supply of clean water throughout the year.

2.1 The problems connected with the supply of water should be carefully analysed at the outset and immediate action should be taken to prevent loss of production.

Manpower Management

3. Ensure efficient management of manpower by the following:-

3.1 Payment of wages and salaries should be based on a complete job evaluation for the entire organization.

3.2 Lists of duties should be prepared to define clearly the functions of the personnel.

3.3 Evaluation of employees performance should be based on quarterly reviews (see Annex I).

3.4 Refresher courses in management should be provided from time to time for supervisory staff at all levels.

3.5 A detailed study of the causes of high absenteeism should be made. Based on the conclusions of this study, a definite programme should be formulated to reduce absenteeism.

3.6 Ensure sound technical knowledge and skill at all levels.

3.6.1 Wherever mills already exist a comprehensive 'on the job training' scheme should be formulated specially for skilled grades.

3.6.2 Basic training in countries having similar raw materials should be provided for personnel having some experience in the paper industry or those who have suitable academic background.

3.6.3 Key personnel should be sent for advanced training to an industrialized country to study modern developments in the industry, after at least 5 years experience in a position of responsibility in their own country.

Standardization

4. Improve production efficiency by reducing multiplicity of sizes, weights, grades, colours, etc. by a system of standardization to cater for the local market.

Machine Performance

5. Improve machine performance by the following:-

5.1 Determine the optimum basis weight to increase output.

5.2 Machine crew should be trained before start-up in certain important aspects of operation such as:-

Start-up

Shut-downs

Grade changes

Wire and felt changes.

5.3 Plan machine shut downs to increase production hours.

5.4 Co-ordinate maintenance jobs, machine clothing changes and repairs to service facilities during planned shut-downs.

Utilisation of Existing Equipment

6. Utilize existing equipment and facilities as suggested below:-

6.1 Carefully evaluate facilities available at the existing plant to increase production with minimum capital costs.

6.2 Encourage technical men and operators at all levels to make suggestions towards increasing production capacities, machine performance, etc.

New Technology

7. Apply new ideas and technology, as they become available to replace the conventional methods.

Selection of Equipment

8. Generally the selection of equipment should be based on the following:-

8.1 Standardise as far as possible to facilitate common spares and to give greater flexibility to interchange spares.

8.2 Equipment chosen should be simple to suit local conditions.

8.3 Under the expansion programme, as far as possible, select machines and equipment of the same size and from the same manufacturer:-

8.3.1 This would avoid the necessity of maintaining stocks of spares and machine clothing which are difficult to procure on account of foreign exchange limitations.

8.3.2 Machines of the same width give greater flexibility in production programming. This flexibility is important for a developing country as the local production should cater for a market covering a wide variety of grades.

Maintenance

9. To obtain maximum benefits from maintenance:-

9.1 There should be a planned annual shut-down for maintenance purposes.

9.2 Two to three persons should specialise on a particular maintenance job so as to facilitate:-

9.2.1 A thorough acquaintence with the maintenance of the machine.

9.2.2 A proper dismantling and assembling of the machine.

9.2.3 The use of the right type of tools and equipment for good workmanship.

Costing

10. Introduce Budgeting and Cost Control system.

10.1 Pass information on cost performances and variances down the line to the 'Man on the Job'.

10.2 After successfully implementing production cost control introduce capital job budgeting and cost control.

Quality Control

11. To ensure that the quality of paper produced is upto standard the following steps should be taken -

11.1 Quality standards should be established for grades of paper manufactured.

11.2 A 24 hour quality testing should be maintained at every vital stage of the pulping and paper processing operations.

11.3 The quality control department must be a model of efficiency to give confidence to the operating crew.

11.4 A daily meeting should be held with the supervisory staff of the production department and the chemist in-charge of quality control.

11.5 All instruments used in the laboratory should be periodically checked and calibrated.

Research and Development

12. To handle problems related to indigenous raw materials, local operating conditions and the local market requirements, research and development work should be undertaken at least on a small scale to cover the following -

12.1 Developing new indigenous raw materials
12.2 Improvements to the grades of paper manufactured
12.3 Improvements to existing processes.
12.4 Cost reduction programmes.

ANNEX 1

EASTERN PAPER MILLS CORPORATION

EMPLOYEES REVIEW FORM

Period Covered: From _____ To _____

Name and Ticket Number: _____

Present Job : _____ Department: _____

Attendance

PAID LEAVE								UNPAID LEAVE			
Casual	Vacation	Medical	Lieu Leave	Accident Leave				No Pay Leave covered with Medical Certificate	No Pay Leave	Absent without Permission	

TIME KEEPER/LEAVE CLERK :–

N. B.

Before perfecting this form, Officers concerned are requested to ensure that they understand exactly what is required by consulting the explanatory note.

FACTOR	A 25	B 20	C 15	D 10	E 5		RATING
1. Quality of Work							
2. Quantity of Work							
3. Adaptability							
4. Job Knowledge							
5. Dependability							
6. Co-operation							
7. Initiative							
8. Absentee Record							
9. General Conduct							
10. Supervisory Ability ... ... (For Supervising Officers only)							
				TOTAL:			
				AVERAGE:			

This review was/Not discussed on _____ 19 .

General Comments:-

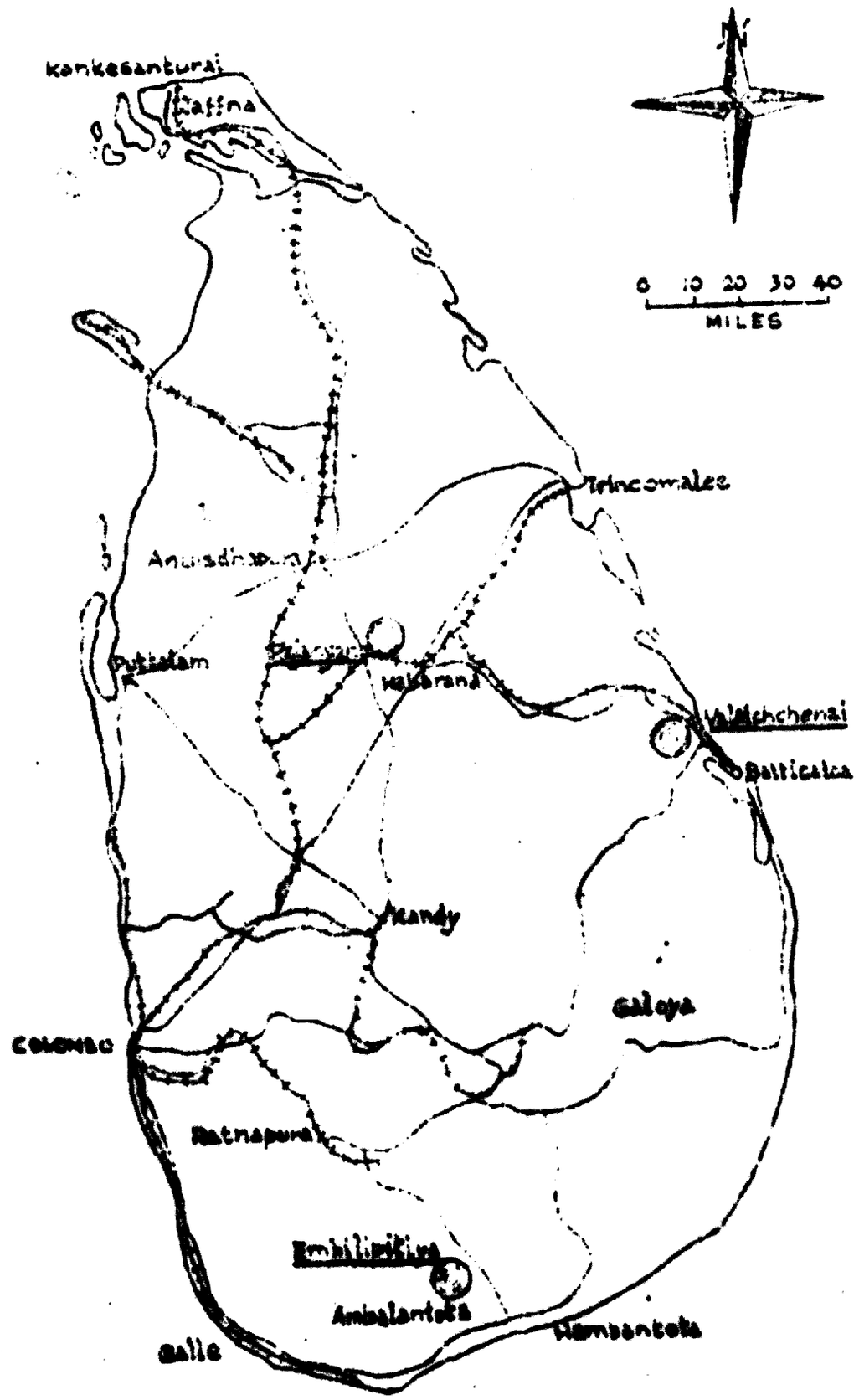
_____

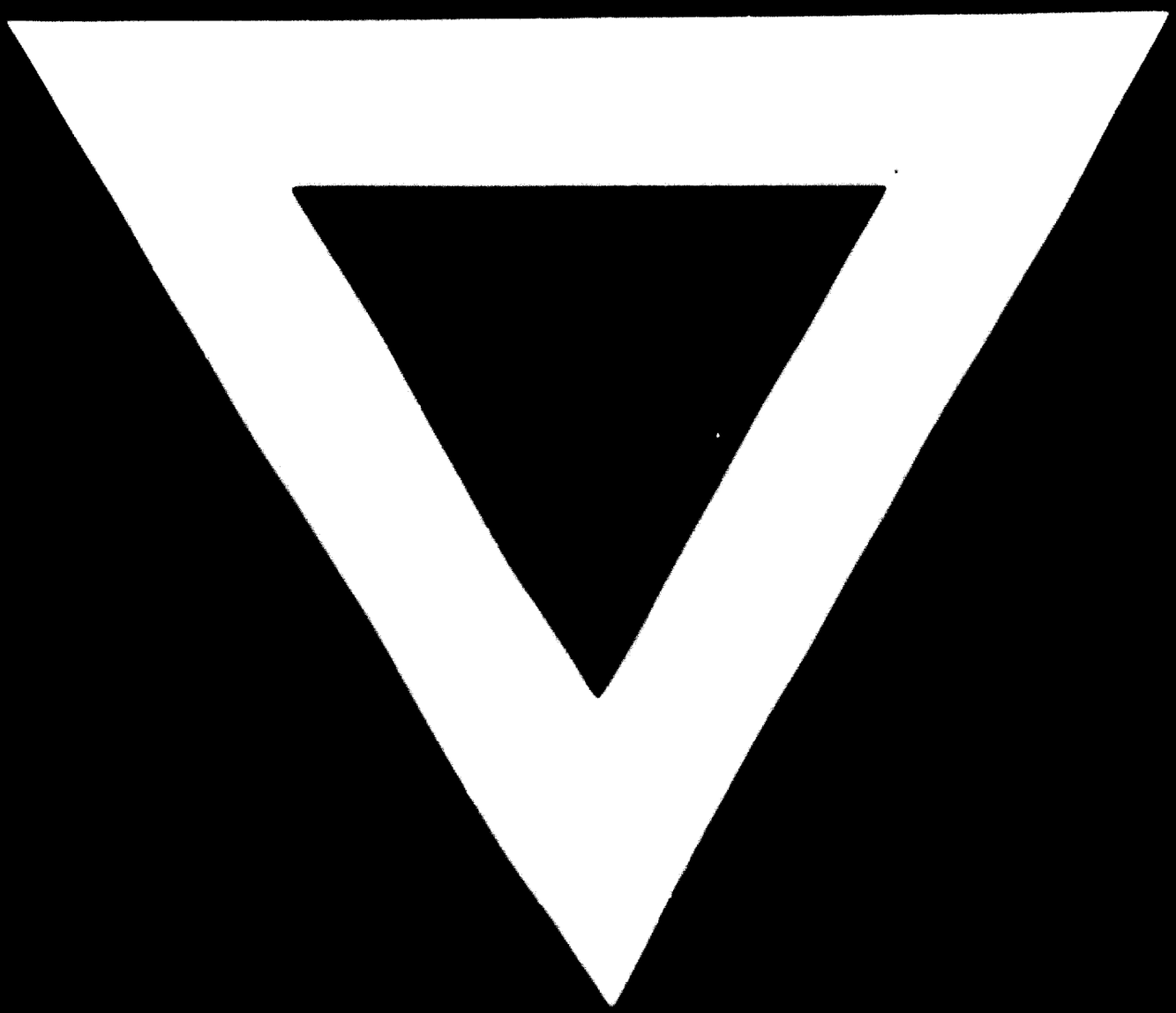
REPORTING OFFICER

Date: _____

RECOMMENDATION BY THE HEAD OF DEPARTMENT

MAP OF CEYLON
KEY MAP





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