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INDUSTRIAL SERVICES

DP/AFG/72/003

AFGHANISTAN

Technical report:
REACTIVATION OF JALALABAD SUGAR FACTORY

Prepared for the Government of Afghanistan by the
United Nations Industrial Development Organization,
executing agency for the
United Nations Development Programme

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Based on the work of L. J. H. Brand, sugar industry technologist

United Nations Industrial Development Organization
Vienna, 1977

Explanatory notes

A full stop (.) is used to indicate decimals.

A comma (,) is used to distinguish thousands and millions.

References to "tons" are to metric tons, unless otherwise specified.

References to dollars are United States dollars, unless otherwise stated.

The monetary unit in Afghanistan is the afghani (Af). During the period covered by this report, the value of the afghani in relation to the United States dollar was $US 1 = Af 44.0.

Pol refers to polarization.

ABSTRACT

The mission covered by the present report, "Reactivation of Jalalabad Sugar Factory", forms part of a large-scale project entitled "Industrial Services" (DP/AFG/72/003), for which the Government of Afghanistan requested UNDP assistance in April 1972. The industrial services project was formally approved by UNDP in June 1975, with the United Nations Industrial Development Organization (UNIDO) designated as executing agency, and the Afghanistan Ministry of Mines and Industries as Government counterpart agency. Within its framework the mission to consider the reactivation of the Jalalabad sugar factory took place in two parts, the first from October to December 1975, the second from August 1976 to January 1977. This report covers the second part of the mission.

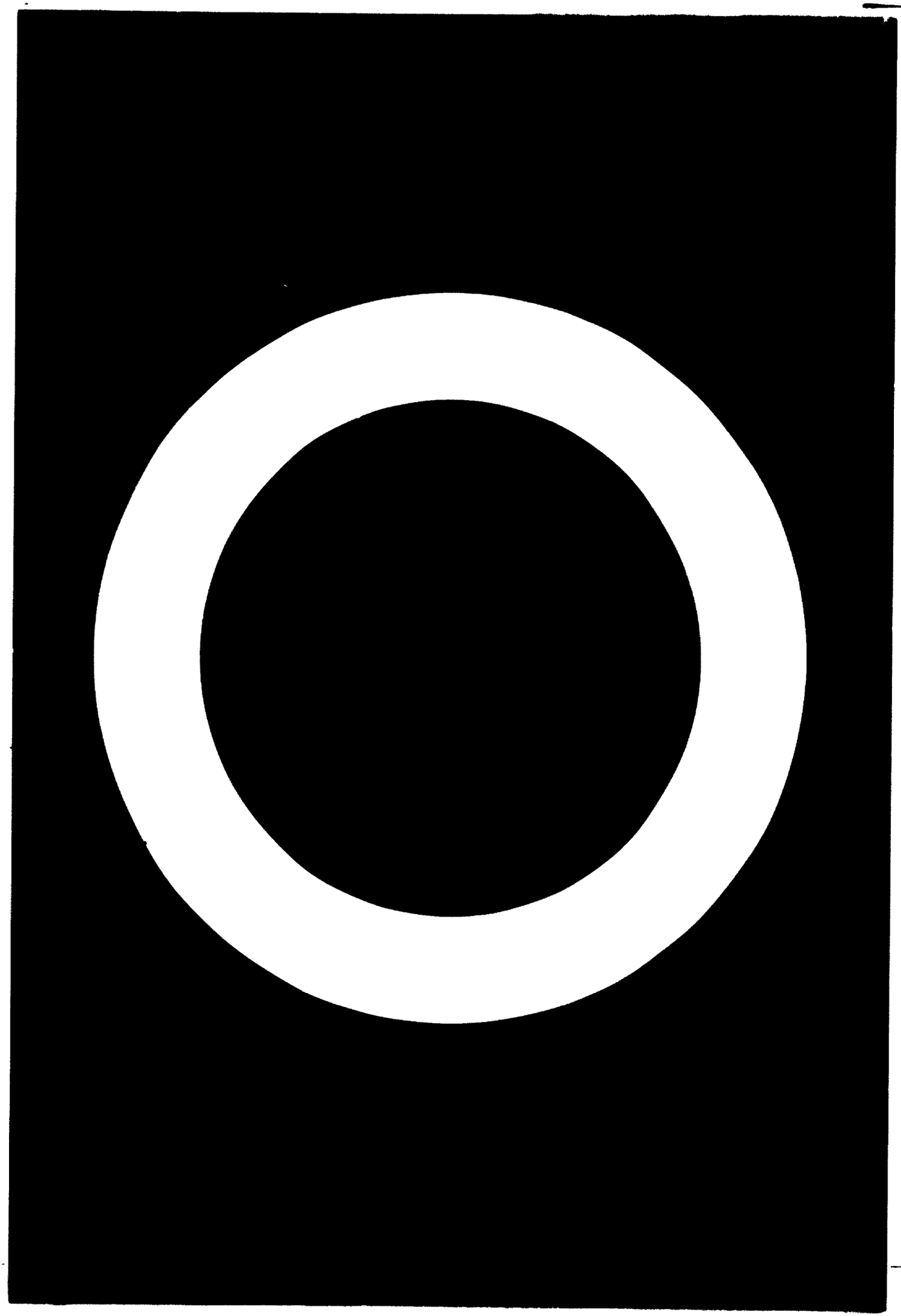
The machinery for the factory was purchased almost 50 years ago, and installed between 1952 and 1957. The factory then worked for three seasons, after which it closed down and lay idle for 16 years. The mission covered in part by this report originated in the Government's decision to reactivate the factory.

The expert's main conclusions are the following:

(a) The steps taken to reactivate the factory have had some positive results, but there is little prospect of ensuring its proper operation and maintenance unless it acquires more experienced and skilled personnel;

(b) The Government is faced with the following choices: closing down the factory; selling it to a private concern if possible; maintaining it as a pilot plant and training centre; developing it into an experimental sugar research station.

The chief recommendations of the report concern the process methods applied, the purchase and repair of machinery and utilities, and the need for better trained and more experienced personnel.



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INTRODUCTION

In April 1972 the Government of Afghanistan requested UNDP assistance in the field of industrial services and institutions in order to find solutions to current industrial problems, in particular those relating to applied industrial methods in existing enterprises and the preparation and appraisal of new investment ventures. The long-term objectives of the project were to achieve an accelerated growth of the country's industrial sector in accordance with the Government's development objectives. The immediate project objectives were to provide the Government with services such as the preparation of industrial feasibility studies, to assist in the formulation of an industrial development plan, and to ensure that the country has at its disposal the economic and technical know-how required to achieve the above-mentioned objectives. The project, entitled "Industrial Services" (DP/AFG/72/003), was formally approved by UNDP in June 1975, with an estimated government input in kind of $74,000, and an estimated UNDP contribution of $619,000. The United Nations Industrial Development Organization (UNIDO) was designated as the executing agency, and the Afghanistan Ministry of Mines and Industries as the government counterpart agency.

The mission covered by the report entitled "Reactivation of the Jalalabad Sugar Factory" forms part of this large-scale project. The machinery for the Jalalabad sugar factory was bought in 1928/29 and installed between 1952 and 1957. The factory worked for three seasons and then closed down. The Ministry of Mines and Industries now wishes to reactivate it. There is sufficient raw material available and the market for sugar is assured. The total investment in land, plant and machinery is 17 million afghani (Af), and it was considered that the factory could be made economically viable. However the machinery has rusted as a result of disuse, and some spare parts need replacement. A study of the technical and economic problems and requirements of its reactivation is therefore needed.

This report covers the second part of the mission undertaken to consider the feasibility of reactivating the Jalalabad sugar factory. The first part of the mission took place from October to December 1975, the second part from August 1976 to January 1977. The expert's report on the first part of his mission is on file at UNIDO and may be consulted upon request.

I. PROJECT ACTIVITIES

The mission was divided into the following three phases: a preparatory period of 33 days, a rehabilitation period of 42 days, and an operations period involving trial runs with the available sugar cane. A government economist, Mr. Nadem, who was appointed director of the factory, had primary responsibility for representing the host country within the framework of the mission.

A. Preparatory period

The expert arrived in Kabul on 26 August. The beginning of the mission therefore coincided with the Islamic sacred month of Ramadan, which is not, in general, a suitable time to start a project in any field.

The preparatory period was intended to focus on arrangements to be made for the factory with regard to financing, staffing, utilities, organization and cane suppliers. Although it was not possible to achieve as much as had been planned, the following steps could be taken:

(a) The Jalalabad sugar factory was transferred from the Ministry of Liquidation back to the Ministry of Mines and Industries;

(b) Administrative personnel for the factory were approved;

(c) Four panboilers, who had been sent for training in Kanpur, India, and had met with a language problem, were transferred to the Baghlan beet-sugar factory for training;

(d) Arrangements were made with the Jangalak workshop in Kabul to manufacture essential equipment for the factory;

(e) The expert and government project personnel visited the factory to become familiar with the premises, which also included an olive factory, a petrol station, the sugar monopoly office, and depots where part of the workshop machinery was stored;

(f) An account was opened at the Bank of Jalalabad and arrangements were made for cheques to be issued on the account by the designated head of the sugar factory;

(g) Assurances were obtained concerning the assistance of two skilled workers and boiler attendants from a textile factory and an engineer and an analyst from Baghlan, and the provision of a permanent engineer by a bicycle factory.

The objectives of the preparatory period were not fully achieved for various reasons, including transport difficulties; the lack of machinery design drawings, handbooks and documents; the unavailability of trained sugar engineers or chemists (in this connection, no arrangements were made to send chemists or engineers abroad to study the cane-sugar industry); and the absence of certain international and government project personnel.

On 28 September the expert and other project personnel returned to Jalalabad to begin the second phase of the mission.

B. Rehabilitation period

The main purpose of the rehabilitation period was to provide staff training and fully to overhaul and equip the factory for crushing and processing operations.

The relatively minor job of repairing this small factory was beset by numerous difficulties. Only two skilled workers and a few semi-skilled workers were available, the rest being unskilled. Funds were lacking when required, and there were no tools, materials, or workshop machinery to start with. There was also a language problem. Only the engineer from the bicycle factory spoke a little English, and one of the skilled workers from the textile factory spoke German.

Many visits had to be made to Kabul to try to find the required materials in the bazaar, and to the Jangalak workshops to obtain missing parts, a new boiler feed-water pump, oxygen for gas welding and cutting, and a carbide gas generator. Visits were made to the Sugar Monopoly in Jalalabad to recover workshop machines. No drawings or documents were made available.

The main job was to get both damaged boilers back into operation. It was necessary to replace 36 tubes in boiler No. 1 by means of a tube expander. A welding set was then obtained and used to repair boiler No. 2.

Both boilers with a working pressure of 10 kg/cm^2 have finally been hydraulically tested to 15 kg/cm^2. On 16 November all the machinery in the factory had trial runs under steam.

On 24 November ten tons of sugar cane were brought in to be used in training unskilled workers as factory operators. There was no chief chemist to provide guidance to the workers, but an evaporator and a panboiler from the Baghlan sugar factory were available. These men had had no previous experience in boiling sugar-cane juice and syrup, and differences of opinion arose owing to communication difficulties, but during the third trial run these problems were overcome.

Throughout the rehabilitation period considerable help and encouragement were received from the President of the Department of Industries.

C. Operations

Having received some technical instruction during the rehabilitation period, the permanent workers could now be trained in the actual operation of the machinery. In other words, they could be shown how to fill the cane carrier, to burn bagasse under the boilers, to convey the juice through the heaters into the liming section (no sulphur gas was used), to obtain a quick settling of the juice, and to work the filter station, the evaporator and the vacuum pan. This involved an initial trial run with only ten tons of sugar-cane. The trial run began on 24 November and lasted for three days, producing only a light syrup. The evaporator did not work properly and there was not enough syrup to boil a vacuum pan.

The next trial was planned for 5 December, but this coincided with the Id holidays and the Baghlan people were on leave. The trial run therefore had to be postponed until they returned.

The second trial run was started with 23 tons of sugar-cane on 10 December. During this trial the electricity from the power station at the dam failed a few hours and there was no water.

To keep the process as simple as possible, no sulphur gas was used during this trial. An excellent clarification could be achieved with lime and by heating to a temperature of 104°C. This effect was spoiled by leaking elbow valves, and three tanks had to be sent through the filter press. The syrup from the first trial was fermented and could not be used. As the evaporator was still not working well, the Baghlan evaporator men produced a very light syrup with only 19° Baumé.

It took 17 hours and the consumption of a good deal of fire wood to boil this syrup in the vacuum pan. As there was again not enough syrup for the pan, only a massecuite too light for the chain pump was produced. This massecuite was dropped on the floor to harden and later remelted and sent back to the panfloor for use during the third trial. Immediately after boiling juice into syrup the evaporator was opened for boiling with caustic soda. This removed a considerable amount of scale from the tubes, which could not have been achieved in 40 days by cleaning with hand brushes.

During this second trial an exhaust pressure of 5 kg/cm^2 developed because no one opened the throwaway valve or stopped using reduced-life steam instead of exhaust steam. This very dangerous situation was remedied by a locally produced safety valve of 2" diameter, which keeps the back pressure at 0.9 kg/cm^2.

The third trial run was undertaken on 18 December with sulphur gas and 20 tons of cane. However, no chemist was available and no one knew how to keep the furnace going or to use the gas. With remelt from the previous trial a small amount of sugar having a very bad grey colour was finally produced. The evaporator was once again boiled with caustic soda.

The pan boilers continue to boil cane sugar at temperatures higher than 80°C. The boiler men making the steam find it easier to burn firewood than bagasse. Nevertheless, they have to learn how to burn bagasse, despite the difficulties involved.

About this time it was necessary to visit Kabul to correct a growing misimpression that the plant was already fully operational and to make it clear that the personnel was not yet sufficiently trained for two shifts. This was followed by an order to start the factory on 28 December for ten days, with the chief technician and chemist from Baghlan assisting in the conduct of the operations.

On 23 December the Minister of Mines and Industries and the President of the Department of Industries went to the Jalalabad sugar factory, and on 26 December the technologist reported to the Resident Representative.

On 28 December the factory started operations with the evaporator working well. The President of the Department of Industries requested the technologist to draw up a list of 20 men to attend a crash course in English and then to be sent to Kampur Institute in India for further training in sugar industry work.

Many stoppages occurred due to sulphuring, pump failure, steam reduction, the presence of bagasse between the second mill trash plate, the lack of clean filter cloths, and so on. There was no cane by 3 January, and often no water.

The absence of one textile factory technician and the departure of another on 4 January for reasons beyond his control left only unskilled mechanics to continue the work. There were further electricity failures on 2 January, including an hour at night. On 5 January one of the technicians returned and went straight on duty.

As boiler pressure and the evaporating rate could not be maintained, one boiler was stopped for cleaning tubes, while boiling soda was in the evaporator. One clean boiler was started again on 6 January while the second boiler was being cleaned. The second technician reported back on duty on 8 January.

Despite the difficulty of curing the massecuite in the centrifugals, it was still possible to produce a light brown sugar. The crushing rate had to be kept low, since all treated juices must go through the filter presses with double cloth. Due to the curing problem a considerable amount of steam was used, causing the sugar to melt and blend with the molasses. Substantial losses arose from the rejection of burned high-purity molasses.

From a load of 498 tons of crushed sugar-cane 182.765 tons of bagasse were produced, which, with an estimated 6% pol in bagasse, takes 10.96 tons of sugar to be burnt. These figures were used to calculate average sugar trial results. The 316 tons of extracted juice, with 17.9% brix, 15.05% pol and an average purity of 83.9, gave about 47.460 tons of sugar, with an estimated cane fibre of 12.5%, this works out to 13.14% pol in cane, which is an encouraging enough figure for nine-months-old cane to justify considering the establishment of a large sugar factory in the area (see the annex for comparative efficiency data on sugar factories). In this connection, it has been suggested that the old Baghlan beet factory should be dismantled and rebuilt at Jalalabad, which would thus have a combined beet-sugar and cane-sugar factory.

A total of 19 tons of sugar were bagged on 11 January, and the sugar recoverable in the process was estimated at 6.4 tons. The following results were therefore recorded:

	Amount in tons
Sugar input: 47.460	
Bagged sugar	19.007
Estimated recoverable sugar	6.400
Total recoverable sugar	25.407
Estimated losses	
Spillage (overflowing, pump failure)	1.470
Filter press (frequent changes and double filter cloth)	10.813
High-purity molasses (66%) (as opposed to 33% commercial purity)	8.300
Miscellaneous (arising from overboiling evaporator and pan, vacuum fluctuations and water supply problems)	1.470
Total losses	22.053

Operations were still in progress when the expert left Jalalabad. From the beginning they have been hampered by the lack of a cane-sugar chemist and characterized by a high consumption of firewood (over 200 tons) largely due to long and frequent stoppages and to the bad burning of bagasse. This is one of the reasons why the factory cannot yet work economically. The results have been unsatisfactory, and have confirmed the need for more and better training.

When this report was drafted it was not known how many men on loan to the factory would leave following the departure of the expert. This represented a considerable handicap to the factory, and it was doubtful whether another short run could be conducted within the following two months to obtain more sugar-cane data.

II. ADMINISTRATIVE, ECONOMIC AND ORGANIZATIONAL PROBLEMS

A. Personnel

Although the administration is in accordance with the rules and regulations applied in Afghanistan, it is top-heavy and has what a foreigner would consider a strange way of management, for it minimizes the executive power of the manager, delays progress, disheartens the productive personnel, thus creating a situation which would be dangerous to any industry.

The storage system is in disorder despite the availability of controllers. Cane-buying requires a three-man delegation from Kabul to check the weights and payments. In the factory there is also a shortage of technicians and people with training in chemistry. The engineer, the only English-speaking person in the factory, has been kept busy in administrative work, and has had little time to spare for the factory. Two able technicians and three men operating the boilers have been available on loan from the textile factory, and six beet-sugar men from Baghlan have also been used on a loan basis.

The panboilers from Kanpur, although finding it somewhat difficult to work with the Baghlan people, seem to be eager to learn.

Permanent technical personnel

Semi-skilled and operating	37	
Carpenter	1	
Mason	1	
Engineer	1	
Storekeepers	2	
Total	42	
Temporary workers	33	in shifts
Casual workers	40	in shifts
Men on loan during season	13-17	

B. Operating costs

A group of farmers' sons were brought to the idle factory and in four months taught how to handle repair and maintenance work adequately and trained to be operators on a shift basis. All this training cost little, the result being that the scrap value of 1.07 million afghanis (Af) quoted four months ago has been capitalized again and has a current replacement value in the range of 50 million Af.

The laboratory is collecting as much sugar-cane data as possible from the trial runs. This will be very valuable for making decisions about a future factory.

Twenty years ago the cane was estimated to have 6.5% sugar in it. The 1975 field trials produced cane juice with a 12.16% sugar content, and the 1976 series of trial runs produced cane juice with a 15.02% sugar content. This was the result of education and research.

The recovery of sugar from cane is still unsatisfactory because of inexperienced cane-sugar panboilers who burn juice, syrup and massecuite and therefore have to throw off a rich molasses of 70% purity instead of the commercial low purity of 35% to 29%. These high losses have to be borne as a result of the training process.

It is obvious that some of the chemical workers need more training in Kampur, India, before the factory will be able to grind 100 tons of sugar-cane per 24 hours and process it with good results. Only then will it be possible to run the factory economically.

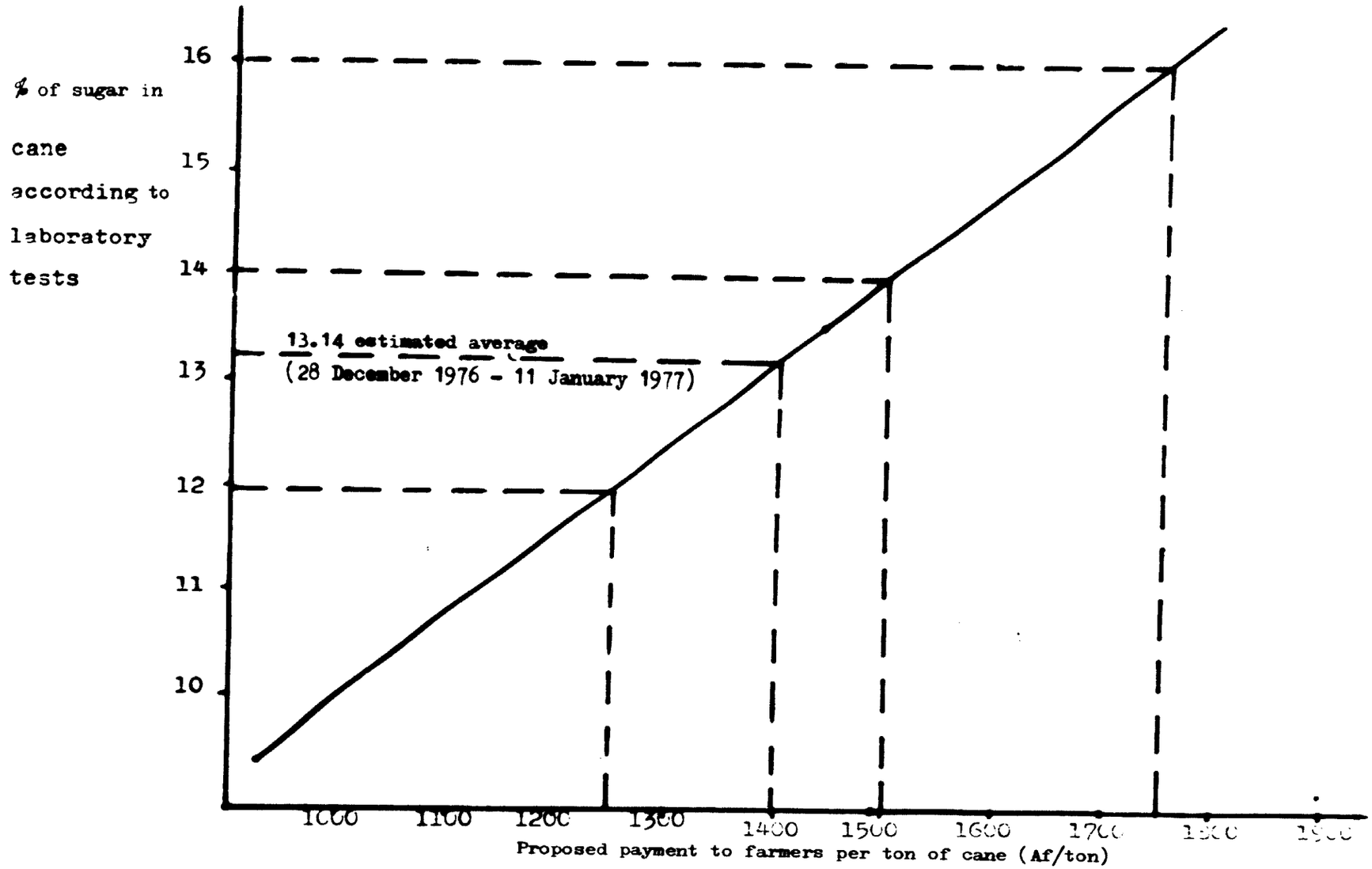
There is a very high consumption of fire wood in the boilers, while bagasse burning is irregular owing to frequent stoppages and most probably a high moisture content of the bagasse. High losses also occur in the filter presses, as all treated juice goes through them. This not only slows down the daily crushing rate but also leads to high sugar losses due to frequent changes of the filter-press cloths.

Water supply difficulties involving the olive factory caused frequent fluctuations in the vacuum of the evaporator and pan, which in turn makes the evaporator and pan boil over and sugar disappear through the vacuum pumps and into the drain. This probably accounts for the factory's high operating loss rate. Towards the end of the current campaign a sugar balance will be made up. It seems clear, however, that the factory produces a very expensive sugar.

Sugar cane

A sliding scale was prepared by the expert to provide guidelines to the Government for payment of the farmers per ton of cane produced (see figure below). This scale was accepted by the Government, which decided however on a final price of Af 1,500 per ton of cane for the starting period, since analyses of the percentage of sugar in cane could not be carried out in the laboratory with untrained analysts.

Figure. Proposed payment to farmers per ton of cane produced



No attempt was made to obtain the best sugar-cane, as no experienced cane buyers were available. The sugar-cane purchases were checked financially and the exact product weight was verified on a weighbridge by a three-man delegation from Kabul.

Stores

The stores remain in considerable disorder after stock-taking by a delegation from Kabul. The system of storekeeping in Afghanistan involves sealed locks, soldiers, the presence of a representative of the administration, the elaborate requisitions in writing for sometimes non-existent goods, with no English or charts being used and much unnecessary material still on the inventory. It is clear that something must be done to rationalize the storage system.

A normal sugar factory keeps in storage from 5% to 7% of its replacement value, which in the case under consideration amounts to Af 2.5 million. As transport is "on loan" and the factory is not a normal sugar factory but a training centre, it can make do with less money for stores. However, a list of required spare parts should be drawn up in due time.

III. CONCLUSIONS AND RECOMMENDATIONS

A. Conclusions

1. Without staff reinforcements, there is little prospect of ensuring proper maintenance of the factory and achieving good results in future runs. Language problems prevent some of the men being sent overseas for training. The alternative may be for the Government to request UNIDO to provide two men, one a cane-sugar chemist and the other a cane-sugar engineer, to prepare the factory for a better campaign next season with the assistance of an interpreter. It is clear that the factory could achieve far better results with skilled people.

2. The factory has been reactivated, but even if it could now be sold to a private buyer, it could not be properly run owing to a lack of experienced and skilled personnel.

3. The average sugar content of cane juice measured in the laboratory during the short series of trial runs was 15.02% from farmers' cane of about nine months old. This may be considered an encouraging figure for the future development of a large-scale cane-sugar factory. However, the limited overall results of the trials have shown the operations to be uneconomical from the point of view of production or quality.

4. The process of pre-liming and sulphuring after liming does not produce a clear juice and quick settling of mud. The practise of running all treated juice through the filter presses prevents the mill from crushing 100 tons of cane a day, and pan boiling has resulted in uncurable massecuites in the centrifugals.

5. The most suitable process method seems to be that applied during the first trials. It involves pre-heating the juice to 70°C, liming only to about 7.2 pH and sending the juice through the next heater at 104°C to the settling tanks. It produces a clear juice and sends only about 25% mud through the filter presses. In this way the crushing rate can be kept up. The syrup may be sulphated to a pH of 5 for bleaching effect.

6. The factory is currently operating as a training centre only and is not yet financially viable. It would therefore be a doubtful policy to remove the olive conserving factory from its premises, as this factory is both productive and a source of foreign exchange by virtue of its export trade.

7. The Afghanistan Government has to decide on the future of the plant. The following possibilities might be considered:

Closing down the factory

Selling it to a private enterprise if possible

Maintaining it as a pilot plant and training centre

Promoting it with Afghanistan's experimental sugar research station.

Whatever decision is taken will be a costly one. In particular, the four above-mentioned possibilities would entail, respectively, the following consequences:

Dead capital and unemployment

Failure to obtain replacement value

Fulfilment of it's purpose as a training school for unskilled people and a centre for collecting data which will be useful for making decisions regarding large-sized factories

Achievement of the ultimate goal of advanced training in sugar technology.

The last two cases would require the use of imported know-how.

B. Recommendations

Instrumentation

1. To save firewood a temperature meter with a range of 0°-1000°C is required in the flue-gas channel to the chimney. The temperature should read 550°-600°C for natural draught.

2. Draught meters or U-tubes filled with water should be used to provide the boiler attendant more guidance. One should be placed before the flue gases enter the boiler tubes, one after it leaves the tubes, and one after the damper.

3. A weighing scale capable of handling three tons of juice per hour is required together with an electric-driven chokeless juice pump for sending three tons of juice per hour through the juice heater to the liming station under a total head of 30 meters.

4. Measuring devices are required to determine the pol and moisture content of bagasse and the fibre content of cane. These measurements are essential for assessing mill efficiency and determining sugar losses caused by burning bagasse.

Electricity and water

5. In accordance with Electricity Department requirements, the factory should complete the installation of a new 300-meter-long cable, 60 meters of which have already been installed, from its transformer to its main switch.

6. The old wooden distribution masts in the factory premises should be replaced by iron masts made from old boiler tubes.

7. Two steam-driven hot-water pumps and one cold-water pump should be replaced by electric-driven pumps handling 3,000 litres per hour against a head of 20 meters (the type used for home water supplies).

8. A 300-ampere welding set should be purchased (the one used hitherto was borrowed from the Sugar Monopoly).

9. The electrician should be provided with a current-measuring tong of 0-500 amperes.

10. To avoid further disputes over water supplies, the sugar factory should be provided with its own system, for which a list of required materials has already been submitted to the management. A supply system from the factory well to the swimming pool and the vacuum pump intake channel should be installed. The requirements are 50 m^3/h, a 45-meter total head, and 2,900 r.p.m. A motor is available. An alternative would be to remove the olive factory from the sugar factory premises and to take over the existing water supply system.

11. The sugar hopper under the centrifugals is very sensitive to alterations in the speed of the steam engine driving it. To obtain a constant speed, this hopper should be given an independent electrical drive with a 5 hp, 1,500 r.p.m. motor with V pulleys.

12. The burned-out air-compressor motor should be repaired.

Machinery and plant

13. The cast-iron grate furnace under boiler No. 1 should be dismantled and sent to Jangalak workshops or another foundry for reproduction in sufficient amounts to complete both furnaces in cast-iron and be able to store a set of spare parts.

14. Two new tailbars for the couplings between mills and gears should be ordered in a better quality steel.

15. The installation in Jalalabad of the redundant sulphur tower from Baghlan should be considered.

16. The live steam valve to the steam reducer should be replaced by a new one, since the loose seat ring could give rise to further difficulties.

17. Consideration should be given to resetting the dismantled 15-ton weigh-bridge on its old foundations. Missing parts could be made locally.

18. An oil-fired boiler developing 5,000 kg of steam per hour at a working pressure of 10 kg/cm^2 should be considered. It would have the following advantages: using more efficient fuel than wood, thereby cutting total fuel costs; preventing "steam-down" when bagasse is used under the old boilers; leaving open the possibility of producing cattle-feed if it can be sold at a reasonable price.

19. If reinstalling the cane cutter is considered, the driver end of the cane carrier should be closer to the crusher so as to obtain a steeper fall plate for shredded cane.

Annex

COMPARATIVE EFFICIENCY DATA

Country	Fibre % of cane	Sugar % of bagasse (Pol)	Sugar % obtained by mill extraction	Sugar % in cane (Pol)	Mill juice purity (%)	Final molasses purity (%)	Sugar % obtained by boiling-house extraction	% of cane sugar recovered
Philippines	10.32-14.69	3.16-4.60	92.53	11.60-13.93	-	34.14-44.84	-	9.87-12.78
Hawaii	12-14	1.5-3.0	90.96	9.87-15.37	80.90-86.50	35.20-43.30	83.4-93.0	8.10-11.50
Louisiana	14-16	2.3-4.3	87-93	9.52-11.56	75.65-81.32	29.60-43.40	55.45 (avg.)	5.97-8.27
Puerto-Rico	11.87-18.20	-	89.31-95.03	11.20-12.37	78.86-85.35	29.06-33.88	-	9.05-11.33
India	12.35-17.13	2.59-4.61	89.80-94.15	10.49-14.03	72.33-84.68	30.84-37.10	80.02-88.06	8.71-11.75

a/ Data compiled in 1960.

The results given below were recorded at Jalalabad.

Pol in cane juice (%)	Date
10.4 - 14.8	23 October 1975
12.16 (average) and	28 November 1975
14.56 from four tests	

The following average laboratory percentages were obtained at Jalalabad during the short series of runs from 28 December 1976 to 11 January 1977, with an estimated 12.5% fibre and 13.14% Pol in cane:

Brix	17.9
Purity	83.9
Pol	15.02