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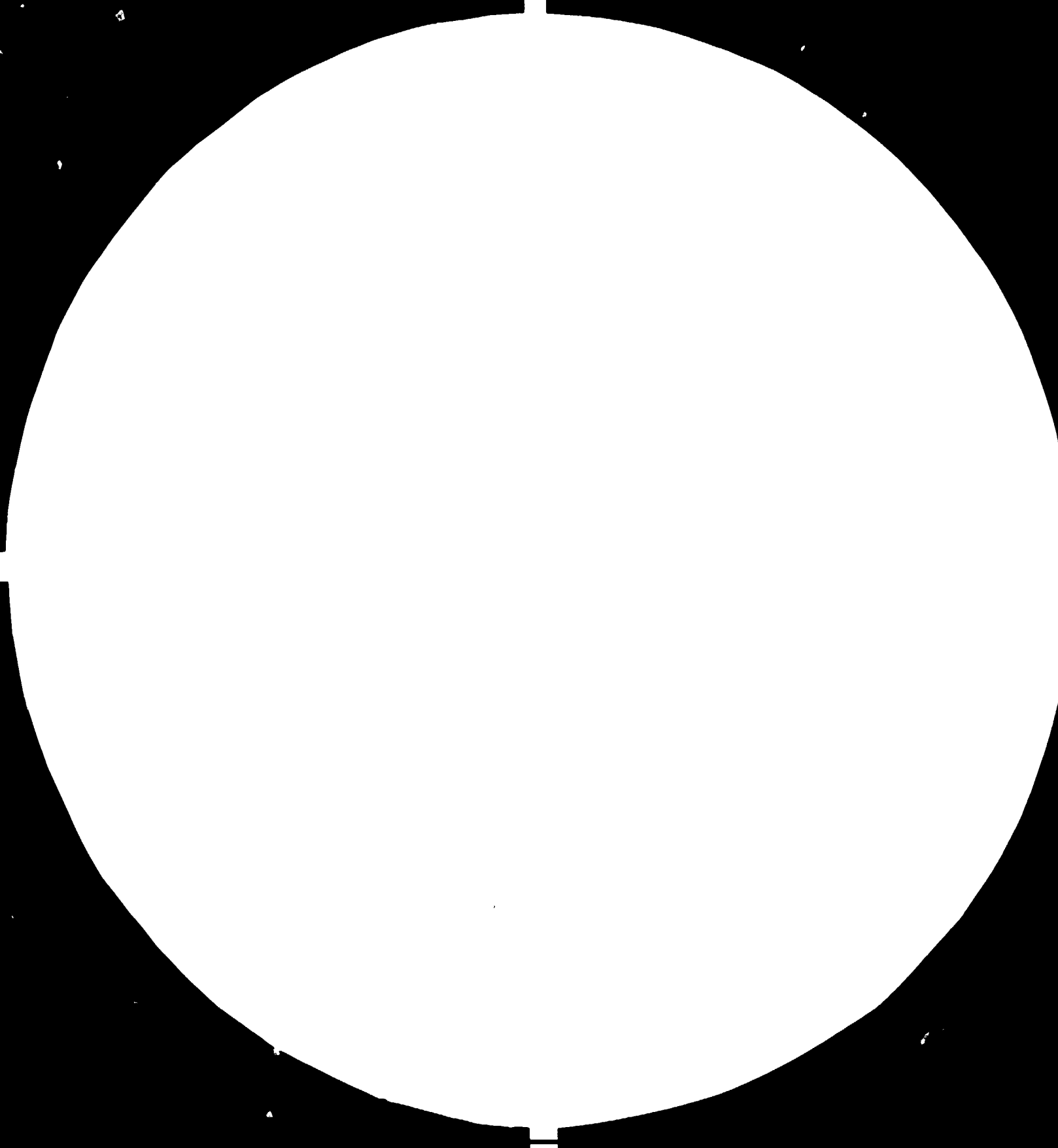

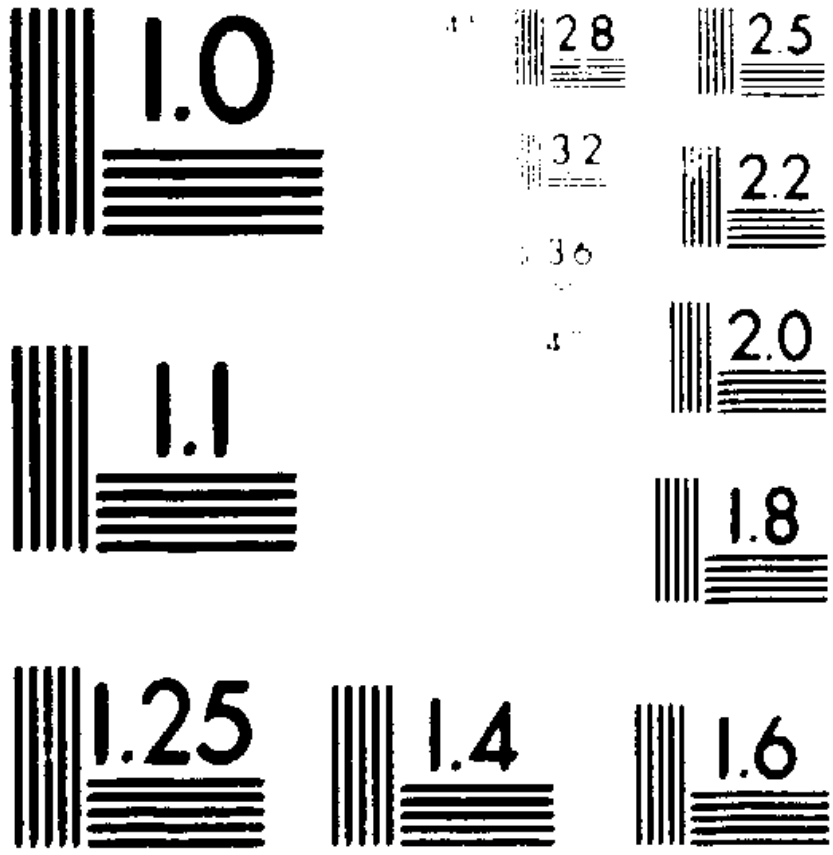

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REPORT (Computer applications, sugar industry)

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These notes are a result of a UNIDO sponsored mission to Mexico, Barbados and Cuba. The author wishes to thank the sponsoring organization for making her trip possible, the GEPLACEA officials for their assistence and encouragement, the SIDFAS', UNDP officers and the UNDP administrative staff in visited countries for their help in administrative matters and for organizing some visits. Particular thanks are due to Dr. Jose Antonio Cerro, Mr. Ramón Consuegra and Mr. John Cropper for their excellent cooperation and many fruitful, helpful discussions.

The mission has begun in Mexico City and then Barbados and Cuba were visited. The mission was concluded in Mexico City where the author was debriefed by the key GEPLACEA officers with whom the observations and activities in visited countries were discussed as well as the main points of recommendations agreed.

It is my duty to warn the readers that these notes should be taken for what they really are, namely observations from a one-month mission in three countries: Mexico, Barbados and Cuba but not as a complete state-of-the-art of the discussed subject.

A. MEXICO

Group of Latin American and Caribbean Sugar Exporting Countries - GEPLACEA

1. Visit on 7 May, meeting with Dr. Jose Antonio Cerro - adviser to the Executive Secretariat (Mr. Enrique Estremadoyoro - Executive Secretary was absent).

I informed him of the purpose of my visit and we agreed upon meetings and other details of my mission.

Dr. Cerro described the pricipal trends of the GEPLACEA activities. We have also discussed the optimization needs of the GEPLACEA region in connection with microcomputer applications in the sugar factories and in the field.

The summary of the discussion is as follows:

- GEPLACEA is a regional organization made up of 21 Latin American and Caribbean cane sugar producing countries and it represents approximately 40 per cent of the total output. Countries being the GEPLACEA members represent different level of sugar production, different level of the sugar factories automatization, varies in climate, soil conditions, sugar cane growing time as well as cultivation methods. However, one feature seems to be common for the whole GEPLACEA region. For the majority of the GEPLACEA member countries sugar represents essential source of their income and influence the countries employment level. For these countries cane sugar as well as sugar cane, derivatives

and by - products constitute important source of food and energy.

- GEPLACEA is currently implementing and co-ordinating programmes in two areas: marketing/statistic and technology. In the first area the activities have been carried out in three main fields: information, training and research. In the second area there are, among others, the following programmes. Cane Agriculture Programme, Industrial Efficiency Programme, Maintenance Program (partly sponsored by UNIDO) etc.

- Low sugar prices on world markets and increasing labor costs have a decisive influence on the efficiency of cane sugar production. In this contex the sugar industry ought to design and implement new solutions for establishing favorable conditions for further development. These solutions will result in reduction of production costs as well as provide reasonable employment.

- The sugar industry in the GEPLACEA region with but few exceptions is suffering from lack of well qualified man-power. This problem is particularly important when micro-computers systems are to be introduced to the sugar factory yard. Even if limited number of qualified specialists exists, the fact, that sugar factories are located in the remote, from cultural centers, places causes real difficulties in attracting the staff to them.

- In Dr. Cerro opinion computerization of the sugar industry in unvoidable as it is the only possibility of achieving a harmonised and optimised production.

In my opinion:

1. The GEPLACEA region has sufficient number of universities in which reasonable number of graduates in computer applications could be educated. The special education programmes (some examples could be found in Cuba) should be prepare and initiated. To do this, a policy to establish computer applications in sugar industry must be clear and credible enough to let the universities develop the process of education in belief that in 4-5 years the graduates will find suitable employments.

2. Although GEPLACEA does nct possess the adaquate data concerning utilization of microcomputers in sugar factories it seems that in this respect the Region is retarded. Promising approach, to reverse the current situation in the Region may be establishment of a regional microcomputer application policy aimed primarily at better organization and management of sugar industry.

2. Visit on 8 and 15 May, meeting with Mr. Jcselo Sanchez Dergan and Mr. Rafael Ortiz Quesada - both the GEPLACEA agricultural consultants. We discussed optimization needs of agricultural sector.

The results of discussion could be summed up as follows:

- The varieties of cane that are now cultivated in the GEPLACEA region have different life cycle, eg. Mexico 12 - 13 months, Peru 18 - 24 months, Haiti 24 - 26 months and the beginning of the growing cycles is fixed to the determined time of year. Thus, with this kind of varieties it is impossible to plan the sugar cane varieties distribution on fields (and to achieve the balanced processing load in the sugar mills, cf. Dr. Miller's opinion quoted in Mr. Fialkowski's report)

- In the frame of the Cane Agriculture Programme, co-ordinated by GEPLACEA, the search for new varieties is conducted. Those varieties are expected to have higher profitability, and/or high resistant to rust, smut and other plaques as well as a shorter life cycle.

- In spite of the fact that experiences, e.g. in Australia, show that farmers find economic benefits through computer-based management systems, the information systems for farmers do not exist in the GEPLACEA region.

- The transportation of the sugar cane from the field to the sugar mill and cane sugar from plants to warehouses or to larger centers is done almost entirely by wagons, tractors, trucks and trains - except of Haiti and the Dominican Republic, where 3-ton ox carts are used.

The freshness of the cane, determined by the

time-lapse between cutting and grinding is one of a decisive factors of sugar yields. Namely, polysaccharids with a heavy molecular weight are produced, by micro-organisms as leuconostocs. Polysaccharids increase the viscosity of the massecuite, hinder crystallisation that adversely affect the quality of cane sugar. Process of increasing leuconostocs intensifies in sugar cane after 12 hours of being cut. So the 12 hours delay (from cutting to grinding) is fully acceptable and may be even extended to 24 hours. Further delay causes the substantial leuconostocs contents increase and is hardly acceptable.

However, the time-lapse of more than 2 days between cutting and grinding appears very often in countries of the Region.

In my opinion:

1. The best solution improving the effectiveness of transportation of sugar cane is to apply microcomputer system with the linear programming software adjusted to local parameters (cf. (2) of my comments concerning Barbados case).

2. Aiming at mechanization and automation introduction in the cultivation and harvesting of sugar cane can not loose sight of the fact that the first step is to make a detailed study on the local conditions: topographical, ecological, planting, etc. The study should take into consideration fact that in many developing countries cultivation of sugar cane

is the main source employment for the local manpower. The automation will result in the necessity of transfering the manpower previously employmend in harvesting of sugar cane to other activities. This constrain must be carefuly considered before introducing advanced mechanization and automation.

3. Visit on 9 May, meeting with Dr. Ricardo Skertchly - GEPLACEA ccnsultant in Systems, Microcomputers Applications and Office Automation.

The main points of the meeting were as follows:

- GEPLACEA is not in possession of current information of modernization and automation of sugar factories in the Region with exception of Cuba and Mexico. In Mr. Skertchly opinion in the most Spanish-speaking countries of the Region computers are used only for statistical calculation and most simple applications, e.g. payroll etc.
  Weakness of the links between GEPLACEA and English-speaking member countries make difficult for the GEPLACEA headquarter to assess the situation in those countries.

- In automation of sugar factories Cuba is the leading country in the Region. The co-operation between Cuba and Mexico is being developed. Cuba is transmitting to Mexico results of its researches and experiences

computer applications to sugar industry.

- Results of microcomputers applications in Cuba and developed countries (e.g. optimization techniques) convinced GEPLACEA to aim in the nearest future at establishment of a computerization programme for the member countries. It was mentioned that UNIDO assistence would be welcome .

In my opinion:

1. GEPLACEA headquarter is aware of advantages of computer applications in sugar industry.

2. GEPLACEA should make an effort to obtain adequate data on automation of the sugar industry in all member states before preparing the policy.

3. Microcomputer applications in the sugar industry aim at increasing the efficiency of sugar production. However, to decrease the costs, the adequate data of total costs as well as the costs of particular levels of sugar production must be known. GEPLACEA should advice the member states to obtain and transmit to GEPLACEA the mentioned data.

B. BARBADOS

Caribbean Agricultural Research and Development Institute (CARDI)

1. Visit was on 17 May, meeting with John Cropper; the head of planning of the CARDI. We discussed the programme of my stay in Barbados and agreed the details.

The same day the meeting with SIDFA and with the officials of the Sugar Technology Research Unit, the Barbados Sugar Industry, the University of the West Indies, the Goverment Data Processing Department and other institutions.

During the meeting the problems of the Barbados sugar industry were discussed.

The same day the meeting with Dr. Stephen Brooks from Sugar Technology Research Unit. General discussion on trends and opportunities in the Barbados sugar industry took place. It was nctified that Barbados has weak connections with GEPLACEA.

2. Visit on 18 May. CARDI teleconference (UWIDITE center in Jamaica, Dominicana, St. Lucia, Barbados, Trinidad and Tobago) to discuss the report by Dr. St. Clair King - Professor of Electronics and Instrumentation Faculty of Engineering UWI - entitled "A micro-computer and data communication system for CARDI".

Barbados Sugar Industry Ltd (BSI)

Visit was on 21 May meeting with the officials of the Barbados Sugar Industry: Mr. Michael Gooding, Mr. Peter Farmer Dr. Malcolm Biddlestone, Mr. David H. West - the president of Dave West and Associates Inc. (Canada), on FAO contract to Barbados and Mr. John Cropper - CARDI.

The results of the meeting are summed up us follows:

- Barbados has six operating sugar mills. All of them belong to the Barbados Sugar Industry Ltd. and use bagasse (the sugar cane pith after juice has been expressed)as a fuel.

- The Portvale factory which came on steam two years ago produced the most sugar - almost 19600 tonnes.

- Barbados sugar output for 1934 has been the best for four years. Over 100,000 tonnes of cane sugar were produced from 850,000 tonnes of sugar cane. The 1984 sugar cane harvest gave production total 13 per cent higher than produced last year.

- Sugar cane from estates and small farmers (approx. 10 per cent of total crop) is mostly transported from the fields to the factories by trailers and tractors.

The factories allocateweekly quotas of sugar cane to their suppliers. The suppliers regulate daily quotas which depend on the factories grinding capacity. Generally, a daily quota varies from day to day (eq. Mon 17% of weekly quotas, Tu 20%, Wed 22%, Th 18%, Fri 13%, Sat 10%).

- Barbados Sugar Industry has not control over the decisions taken by farmers.

- Generally, estates cut more sugar cane than they can deliver. Approximately 25 per cent of sugar cane is older than two days when processed.

- Officials from BSI assert that there is a surplus of transport units. Farms have more units than they need for transportation of cane from field to factory. On the other hand the same equipment has multiple uses for other activities, eq. cultivation. Thus the farmers may not accept reduction which may follow from the transportation needs only.

- Neither electronic instruments nor microcomputers are used for monitoring of sugar process.

- BSI has an access to computer from Coopers and Lybrand but it is used only for administrative applications.

In my opinion:

(1) The Barbados Sugar Industry ought to examine its overall computer needs and assess the computer system configuration to fulfill the needs.

(2) In the present situation of Barbados transportation of cane from fields to factory seems to be a major opportunity to improve the industry perfomance.

Having the surplus of transport units the transportation of cane should be organized more effectively. It will results in avoiding an incoordinate stickpile of sugar cane.

Computer simulation models matching the transportation needs could be useful in the Barbados Sugar Industry, provided that the adequate data are used as model parameters eq. number of transport units, distance from fields to the factory, the time needed to harvest one ton (hectar of field) of cane, daily capacity (troughput) of sugar mill. The limited number of constrains (only six sugar mills, short distances between fields and factories (min. less than 1 mile, max. 7 miles), surplus of the transport units) allows to utilize a simple microcomputer configuration to solve the problem. The cost of the solution should not exceed US$ 15,000.

The Andrews Factory

Visit was on 21 May. The findings are as follows:

- Weekly (6 days) sugar cane input is approximate 11,000 tonnes.

- Bagasse is used as a fuel. Moreover, plans are under way to make its excess power available to the Barbados Light and Power Company.

- 75 per cent of sugar cane is processed within less than 24 hours after being cut and 25 per cent is 2-4 days old.

- Modernisation of equipment is desirable but no studies till now has been undertaken.

The Sugar Cane Breeding Station

Visit on 21 May. I met Mr. D.I. Walker - the director of the Station and Dr P.S. Rao - geneticist.

The program of research and needs of the Station were discussed.

The findings are following:

- The Station is owned and operated by the Sugar Association of the Caribbean.

- The search programme is the largest breeding programme in the tropics. It aims at varieties of higher sucrose profitability and/or resistant to damaging diseases as rust, smut and others. Also the programme covers exploiting the genetic diversity in the various species.

- The Station maintains ties with other major cane breeding institutes (not only from the GEPLACEA region) and exchanges varietes for breeding purpose.

- The Station has an active collection of over 1000 varieties. Seed is distributed to over 20 breeding institutes in the countries with different climate preparation of soil etc., among others to India, Nigeria, Senegal.

- Computerised storage, retrieval and analysis of breeding variety testing data in the Caribbean region, and world wide, including disease information constitutes the research programme of the Station.

- Quoting Mr. John Cropper statement 'The Cane Breeding Station perceives two major applications for its newly

acquired microcomputer (TRS80). The first has to do with data base management and a rationalised procedure for its cross breeding programme. At present only 50 crosses can be made each day from among the many potential crosses among the parents flowering on that day. A software programme now has to be written.
The second use is for the monitoring and evaluation of variety performance in the breeding stations member countries. At present all records are kept manually and are extremely voluminous. Here again their need is mainly data base management. But their main limitation at the moment is reliable and consistent data to enter, since the various cane testing stations do not respond regularly or adequately to requests for information on varieties distributed by the station.
The station would like a consultant to visit member countries to update the backlog of missing information on varieties. They are also seeking links with a breeding station having similar data handling requirements.

In my opinion:

1. The station has high quality university - educated personal aware of advantages computerisation in sugar cane breeding research. Barbados is the most proper place for a pilot breeding station computerization.

2. Computerised data base together with retrevial and optimizatien procedures, i.e. data bank on sugar cane clones substantialy increase the efficiency of its cross breeding programme. It should be assessed whether the newly acquired TRS80 microcomputer would perform all the above mentioned tasks.

C. CUBA

1. Meeting on 24 May in UNDP with Mr. Uwe Alssem. I explained the purpose of my mission and discussed the programme of my stay in Cuba.

2. Meeting on 24 May with Eng. Ramon Consuegra, the Chief of Engineering Department of the Sugar Research Institute (ICINAZ). Mr. R. Consuegra described to me the situation in the sugar industry in Cuba.

The findings are following:

- Cuba has 153 sugar mills. All are State-owned.

- Cuba has made a great effort to improve the efficiency of sugar production mainly by improved organization of sugar manufacture and large investments in the production facilities (8 new sugar factories were built in the last 25 years).

- In the GEPLACEA area Cuba is the leading country in the use of advanced sugar cane technology for cutting and chopping the sugar cane. More than 30 million tonnes of sugar cane is mechanically harvested.

- In respect to sugar factories automatization Cuba is also the leading country (not only in the GEPLACEA region). The following areas are generally complete mechanized and/or automated:

  a) feeding of sugar cane on the endless carries
  b) continuous part area (purification, alcalization, evaparation process)
  c) boiling in vacuum pans
  d) cristallisation process
  e) centrifuging.

  Besides that, in a few sugar factories, electronic instruments are introduced to monitor boiling in vacuum pans, pH and temperature.
  It is expected that new microcomputer control loops in vacuum pans will be introduced.

- Sugar industry employs high qualified engineers. The nqtional training center for the sugar industry and two university departments train specialists for sugar industry. In addition to the efforts undertaken by the sugar industry itself nearly all Cuban industry is sugar oriented.

Mr. Consuegra informed me that Cuba is deeply interested in application of microcomputers in cane sugar process and any assistence from the UNIDO side would be welcome.

Department of Analysis and Control

Visit on 24 May in the Departamento de Analisis y Control de Zafra, meeting with Mr. Julio Israel Rodriguez the head of the Department.

The results of the meeting could be summed up us follows:

- The Texas Instrument computer (64 K RAM, used as an intelligent terminal) is utilized there. The main computer is located in the Ministry of Sugar Industry.

- The Department prepars three types of reports on national sugar cane output production: daily, 10th days and monthly report.

- For the sugar industry accounting system, the country is divided into 13 provinces. In each province operates so called sugar office which owns a computer center. The sugar office co-ordinates and monitors all activities in the province oriented to sugar production and distribution. Each sugar mill informs the office of sugar production (by telex daily at around 11 a.m.) The province computer report is ready around 1 p.m. The computers of all province offices constitute a computer network where computer of the Ministry of Sugar Industry is the main nod . The daily compu-

terized country report is available for the authorities with negligable delay.

Through earlier mentioned intelligent terminal the Department is informed on the daily production actions.

With the same procedure the 10 days' and monthly reports are prepared.

All the described monitoring is utilized to nearly immediate correction actions as well in production as in adjustment of export quotas.

Automation Institute of Sugar Industry

Visit was on 25 May, meeting with Mr. Francisco Vera, the vicedirector of the Institute. The applications of micro-computers in the sugar factories as well as the computerized production process schemata for sugar mills were discussed in detailed.

The results of the discussion are summed up as follows:

- Cane sugar technology is divided into 6 technological areas:

  1. milling plant
  2. continuous part (purification, alcalization, evaporation process)
  3. cristallisation (vacuum pans, cristallisation process, centrifuging)

4. steam process
5. electrict plants
6. storage

In 153 factories, 350 technological areas are mechanized and/or automated (i.e.: if in the factory A two areas and in the factcry B three areas are mechanized and/or automated, then five technological areas are mechanized and/or automated in the factories A and B). In the case of 8 factories build in the last 25 years all 6 technological areas are totally mechanized and/or automated.

The most automated technological area in factories is cristallisation. It is expected that in two years all technological areas in all 153 factories will be at least totally mechanized.

- In the five sugar factories Cuban made computers are instaled and used for statistical calculation only.

Mr. Vera informed me that the Cuban Goverment is interested in implementing advanced technologies in sugar factories. He also told me that according to the govermental policy on-line control is to be applied in sugar factory yards. Off-line mode will be preserved for the technical and economical analysis.

Sugar Research Institute (ICINAZ)

1. Visit was on 25 May. I visited the experimental sugar mill the 'Pablo Noriega' (1000 tonnes of cane troughput a day). As the harvesting time was over the sugar mill has not operated.

The findings are as follows:

- The mill is fully mechanized.

- Monitoring of boiling in vacuum pans is performed by electronic instruments. Electronic control of this process allows to maintain temperature, steam, inflow of syrup, molasses water, which result in reduced time of boiling, higher exhaustion of mother liguor.

- Cristallisation process is monitored by microcomputer (Russian made, data non-available). As results, the reduction of peaks, energy consumption and better exhaustion of mother liguor are obtained.

2. Visit in the computer center of the ICINAZ.

The findings are as follows:

- Texas Instrument computer (64 K RAM) is utilized there.

- There are 10 qualified staff members engaged in the Center activities.

- A program written in BASIC for controling cristallisation process is being debuged.

- The Center has also prepared the programme to optimize amount of bagasse fuel for all factory processes, as well as programme for monitoring boiling in vacuum pans.

Meeting on 28 and 29 May with Mr. R. Consuegra. We discussed trends, issues and opportunities in the Cuba sugar industry.

In my opinion:

1. Awareness of the officials on advantages resulting from computer applications is high and the approach enthusiastic

2. Cuba represents high level of modernization of sugar mill equipment as well as developed technology of sugar production.

3. Cuban sugar industry should extend microcomputer applications to the following items of sugar process

a) transport scheduling

b) crushing of sugar cane

c) juice clarification

D. MEXICO

Azucar S. A. and C. V.

Meeting with Ing. Federico Hasbach - vicedirector of Production of the Azucar S. A. and C. V. and with Mr. Emilio Fernandez la Madrid - the chief of the computer center of the Azucar S. A. and C. V.

The results of my visit are summed up as follows:

- Mexico has a total of 69 sugar mills, 52 of which are State-owned. Mexicos' sugar output for 1984 was 3 million tonnes of raw sugar, approx. 100,000 tonnes higher than the last year.

- Under the agreement between Mexico and Cuba, Cuba has transfered to Mexico among others know-how in factory automation maintenance system and monitoring system for daily sugar production supervision. The monitoring system is adapted to Mexican conditions.

- Microcomputers are installed in 28 State-owned factories and used mainly for statistical calculation.

- Microelectronic instruments are used in new sugar mills to monitor pH, temperature, boiling in vacuum pans, etc.

Mr. Hasbach informed me that officials from the sugar industry are aware of advantages resulting from computer applications. However, in his opinion, a serious obstacle in automation of sugar factories is lack of qualified computer personal. Besides that sugar industry is located in countryside. Thus the sugar factories are not attractive work-places for well qualified computer specialists (cf. (1) of my opinion p.2).

GEPLACEA

1. Visit on 1 June meeting with Ing. Alberto Golcher - Assistent Executive and Dr. Jose A. Cerro.

I have informed them of my observation from the stay in Barbados and Cuba. We discussed on Cuba as a place for microcomputer application pilot project in a sugar factory. Also we discussed measures and methods to encourage the member countries to modernize the equipment (including micro-processor application of sugar mills).

2. Visit on 4 June, meeting with Mr. Enrique Estremadoyro - Executive Secretary and with Dr. Jose Cerro.

Mr. Estremadoyro told me that GEPLACEA is deeply interested in modernization of the sugar industry as it seems to be the ~~unique~~ remedy to the low efficiency of existing cane sugar production. Computer application were also discussed.

I presented my observation from the whole mission and indicated 'Pablo Noriega' sugar mill in Cuba as the location for a microcomputer applications pilot project. Mr. Estremadoyro emphasized that Cuba with its experiences in the subject as well as with the consistent govermental policy aiming at greater efficiency and reduced costs, guarantees implementation of the mentioned project.

During the discussion the GEPLACEA preparation for the regional project launching were itemized. Later other items of my recommendations were presented. Mr. Estremadoyro accepted them with some modifications which were introduced.

In addition he suggested a seminar on computer application in sugar industry. The seminar should include country paper presentation on computerization level attained in each member state as well as the case studies of computerization taken from and outside the Region. The idea was discussed with Mr. Fajnzylber, SIDFA, and gained also his support.

UNDP

Visit on 5 June, meeting with Mr. Fernando Fajnzylber - SIDFA.

I informed him of my terms of reference and presented my observation from the visits in Cuba. We discussed the main points of my recommendations. Mr. Fajnzylber agreed that the experimental sugar mill 'Pablo Noriega' in Cuba is a proper place for location of a center of microcomputer applications pilot project for a sugar factory. As mentioned before he supported Mr. Estremadoyro's idea of having a seminar on microcomputer applications in sugar industry.

GEPLACEA

Visit on 7 June, meeting with Dr. J. Cerro and Dr. R. Skertchly.

We discussed details of proposed seminar. According to the SIDFA's suggestions we decided to include in the seminar methodological aspects of microcomputer implementation in sugar industry.

It was suggested, that

- Information of the seminar ought to be disseminated during the annual GEPLACEA meeting in Argentina (. in October 1984).

- A seminar may be organized next year.

- Invitations to specialists from the advanced sugar producing countries from the outside of Region should be sent.

- A seminar is expected to be a forum for information exchange on equipment and automation needs of sugar industry.

- Computer simulation models as well as computer optimization procedures in the agricultural sector should be presented.

- GEPLACEA is deeply convinced that computerization of sugar industry render economical advantages. The outline of the relevant policy expected to be an output of the seminar.

RECOMMENDATIONS

Based on the results of my mission the following is recommended:

1. A seminar increasing awareness of microcomputers applications in cane sugar industry and presenting up-to-date knowledge in the field, is suggested and agreed with GEPLACEA who will organize that seminar.

GEPLACEA is willing to support partly the seminar (funds available no earlier than in 1985) and UNIDO will be requested to promote the idea of the seminar outside the Region and present, if possible, background papers.

It is expected that specialists from the developed countries will present the state-of-the-art of microelectronics applications in the cane sugar industry. Specialists from Louisiana and Australia are suggested.

In co-operation with GEPLACEA and also Cuban specialists the terms of reference on "Seminar on the microcomputers applications in the sugar factories" were prepared. They contained the collection of problems reflecting user's needs, the seminar should deal with (enclosed).

2. One, especially important, microcomputer application is the use of computer technology to increase the efficiency of "sugar cane breeding station". In Barbados the breeding station is dealing with more than 1000 different varieties of sugar cane clones looking for the optimum ones in respect to resistance to smut and rust disease as well as the high sucrose content. A computerized data base together with retrevial and optimization procedures, i.e. data bank on sugar cane clones, would substantially increase the efficiency of selection. It should be assessed whether the available TRS 80 computer would perform all above mentioned tasks. The special software packages are to be subject of more detailed studies with active participation of the sugar cane breeding station staff. Breeding station computerization in Barbados, where the specialists are aware of advantages of computerization and have relevant knowledge of the subject seems to be the best location for above mentioned data bank.

3. As a result of discussions with several GEPLACEA experts as well as with specialists in Cuba, Mexico and Barbados the need of strengthening international (not only regional) co-operation was articulated. Besides developed countries (Australia, Louisiana-USA) among developing countries India was mentioned as a potential source of know-how on sugar cane automation. It is recommended that UNIDO may assist in organizing and fostering the India-GEPLACEA co-operation.

4. One of the mission aspects mentioned in the terms of reference was a selection of a place for a pilot project, where several aspects of sugar cane process automation (including optimization) would be tested. Resulting from numerous discussions with the GEPLACEA experts and visits to sugar mills, 'Pablo Noriega' Experimental Facility in Cuba is recommended as the possible place to start the pilot project.

This selection has the following advantages:

- introduction of electronic equipment had already taken place in the mentioned sugar mill. It is used mostly to monitor vaporation process in vacuum pans,

- some computer applications were already introduced to the process, e.g. monitoring of cristalization,

- a programme unit was recently organized to prepare the specific software for sugar cane mill applications,

- the awareness of the sugar mill staff on advantages resulting from computer applications is high and the approach enthusiastic,

- the sugar mill belongs to the ICINAZ which is one of the priority enterprises in the country. Thus, a strong national support for the project may be expected.

- GEPLACEA experts who know the region indicated univocally Cuba as most advanced and most appropriate location for the pilot project. Especially 'Pablo Noriega' sugar mill was indicated as the above mentioned facts concerning this sugar mill were partly known to the GEPLACEA experts.

5. Computer simulation models are important tools of forecasting of cane sugar output in functions of environmental factors (e.g. amount of rain, type of soil, growing time of variety, etc.) and should be developed. However, for reliable quantitive indications the parameters must be closely related to the given place of the cane growth. The programmes like these, used in developed countries (e.g. Australia) proved effectiveness of the approach. UNIDO may assist the GEPLACEA region to develop parametric programmes of these type.

6. Computer optimization procedure including harvesting transportation-processing parameters proved to be effective tools of increasing sugar cane productivity in developed countries. However, it seems not to be the top priority subject in most of the GEPLACEA region. An attempt to apply these programmes may be undertaken in Cuba. It would be useful to utilize for these programmes experiences attained rather in developing countries than the developed ones. UNIDO should assist in collecting relevant information for these programmes, from other developing countries (India was mentioned).

APPENDIX I

TERMS OF REFERENCE FOR A SEMINAR ON MICROCOMPUTERS APPLICATIONS IN THE MONITORING AND CONTROL OF THE PRODUCTION PROCESS IN THE SUGAR CANE INDUSTRY

1. Technological flow description of the process through the use of block diagrams.

1.1 Definition of the sub-processes that could be automatized and of those already automatized.

1.2 Inventory and development plans for the automatization of each participating country.

2. Description of the instrumentation utilized in the sugar factories including:

2.1 Implemented measurement instrumentation.

2.2 Type of measurement instrumentation in accordance to its possibilities to be connected on-line to computers.

2.3 Development plans for instrumentation.

3. Computerization of the industry.

3.1 Application of computers in the direct digital control of the technological process.

3.2 Analysis of the possibilities for the implementation of a direct digital control, taking in account the following:

3.2.1 Type of instruments required

3.2.2 Training of technical personnel

3.2.3 Tasks to be performed by computers

4. Working out propositions for optimal use of micro-computers in analysed cases.

4.1 Definition of automatization levels.

4.2 Definition of the required instruments.

4.3 Definition of the technical computerization means.

4.4 Staff requirements.

4.5 Analysis on the possibilities of developed countries and South-South assistance in relation to the technical problems as well as to know-how and computer programmes protection.

4.6 Technical and economical considerations on introduction of micro-processors in the control of the sugar process.

APPENDIX II

Terms of Reference of the GEPLACEA requested mission

1. Visit selected sugar cane mills selected by GEPLACEA in three or four GEPLACEA member countries.

2. Discuss with local professionals the optimization needs in the sugar cane growing/processing cycle and propose appropriate microcomputer applications matching the needs. The developing countries environment should be taken into consideration.

3. Present to UNIDO a report comprising the inventory of optimization needs as well as recommendations concerning priority applications and suggestions concerning location of suggested pilot projects. The mathematical procedures for suggested applications should also be presented.