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ASSISTANCE FOR THE PRODUCTION
OF PEAT-BASED FERTILIZERS

SI/BDI/78/801

BURUNDI .

Technical report: visit of the Burundi officials in Hungary
for studying the technologies of peat-based fertilizers
and the use of their products in horticulture and agriculture *
(11-28 May 1985)

Prepared for the Government of Burundi
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

Based on the work of Ferenc Gati,
expert in the production of peat-based fertilizers

United Nations Industrial Development Organization
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Summaries

During the period 14 and 23 May 1985 a delegation from Burundi, entrusted by UNIDO and composed of Mr. B.Ndorimana, Mr. L.Sinzinkayo and Mr. F.Ntiburumusi, studied peat extraction in Hungary as well as the manufacture of peat-based fertilizers, soil improving materials and soil conditioning substances and their use in horticulture and agriculture. Mr. B. Ndorimana is Director of the Ministry of Energy and Mines, Mr. L.Sinzinkayo is Technical Director of the National Peat Organization /ONATOUR/ and Mr. F.Ntiburumusi is director of the Experimental Station of the Institute of Agronomic Sciences /ISABU/. It may therefore be stated that the delegation was composed to be most competent and most qualified to establish the technical level of peat extracting and processing technologies in Hungary and to forward proposals for their introduction in Burundi.

The expert was a permanent escort to the delegation during their study tour in Hungary and provided assistance in demonstrating the different peat extracting methods and processing technologies. On the other hand, the members of the delegation made extensive consultations with local technical management people about the technologies inspected and made efforts to establish the technical conditions that are required to introduce these technologies in Burundi.

Peat extraction was inspected at Osli and Kónyi in the Hanság region and at Pötréte in county Zala. Peat is extracted at these locations by the known procedures. At Osli and Kónyi, peat is lifted from below ground water level by excavator, whereas at Pötréte first water draining is performed and then the surface layer of the peat field is scraped off to 5-10 cm down. Peat is then collected in tanker trucks and delivered for further processing. Production is conducted at high technical level at both peat extracting areas.

The delegation inspected the "Sopron-Peat Technology" at Sopron which is based on complete mechanization and auto-

mation and produces peat-based garden soils of the most varied composition. The scientific and conceptual ideas for manufacturing products with composition and effect suitable to various purposes were worked out for the technology at the Soil Science Department of the Horticultural University of Budapest. The technology in question is capable of providing a capacity of 150.000 tons/year over an operational period of 7-8 montns.

In addition, the expert presented a simpler technology as well for the production of peat-based fertilizers. This technology is used at Sükösd, in the Agricultural State Farm Complex of Hosszuhegy and yields 25.000 tons a year.

The agricultural utilization of peat-based soil improving materials was studied by the delegation at the "Haladás" Farm Production Cooperative in Nyársapát where the amendments are used to ameliorate sandy soils at 60-100 tons/ha rates. On the area improved with peat compost, cereals /wheat, rye etc./ are produced and orchards are planted.

Members of the delegation attended an all-day consultation at the Soil Science Department of the Horticultural University where Prof. L. Hargitai reviewed the peat research results of the Department and the analytical methods applied to qualify the various peats on the basis of their nitrogen forms and humus fractions. The scientific and theoretical concepts provide possibilities to manufacture peat-based fertilizers with required pH-values and nutrient content.

The expert took care to show the delegation all the Hungarian methods of peat research, peat extraction and processing that enable members of the delegation to decide about which technology or its modified form is advisable for introduction in Burundi.

The delegation and the expert have agreed that on the basis of the experiences gained in Hungary the details of the R + D work should be elaborated primarily. In view of the

current situation, first a thorough research work is required to find out to what extent the various peat sorts in Burundi are suitable for technological processing and for manufacturing peat-based organic fertilizers, soil improving and conditioning materials by means of which Burundi soils can be improved, their humus content enriched and thus crop yields can be increased.

To promote the achievement of this work, the Burundi delegation expressed its wish to receive the expert still in this year in Burundi for a three-week mission so as to enable him to take samples from the major peat areas to perform chemical and physical analyses. The expert could also participate with the Burundi officials in the planning of the new project in detail and determining the requirements for equipment and training.

In the framework of the follow-up activities in the first year could be carried out the peat characterization, preparation of trial quantities of peat-based fertilizers and related products for pot trials to determine responses of different crop/soil combinations.

In the knowledge of the results in the second year could be conducted small plot field experiments to confirm the results achieved in pot experiments. To complete these investigations and experiments it is proposed to delegate the expert for further $2 \times 12 = 24$ months long mission in Burundi.

In the third year could be accomplished the technical and economic feasibility study based on the results of pot and field experiments ; further could be selected and determined the definitive products, processes and technologies appropriate to build up the plant for producing peat-based fertilizers and organic soil amendments.

It is recommended to send samples taken from Burundi peat areas to the Soil Science Department of the Horticultural University of Budapest with a view to performing special analyses /nitrogen forms, F-curve analysis on humus quality,

K- and Q-values, humic acid fractionation, etc./ on about 100 peat samples /200 kg/ and chemical and physical analysis on soil samples /50 kg/, having a total weight of 250 kg. For this work UNIDO is requested to fund about 8000 US Dollars.

It may thus be concluded that the study tour in Hungary of the Burundi officials has been successful and that the experiences gained here can serve to speed up the introduction of the Hungarian peat processing technologies in Burundi. In general they had the opinion, that the Hungarian technologies could be transferred and adopted to suit Burundi conditions and needs.

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I. Introduction

1. Objective of the study tour of the Burundi officials in Hungary

The expert was on mission in Burundi under UNIDO invitation between 23rd September and 12th October 1983 and had the opportunity to investigate peats in Burundi. Physical and chemical analyses performed by the expert indicate the peat samples obtained by random sampling from the peat areas of Kashiru-Ijenda, Gishubi-Matana and Kuruyange-Kisozi to be of 2nd and 3rd class quality. This fact, however, does not rule out the possibility to manufacture peat-based fertilizers and soil conditioning materials from peats found in Burundi. But it is very important that the chemical character of the products made of the material of the Burundi acidic peats / pH = 3-5 / should be improved by the addition of lime, dolomite and organic manure and be supplemented with mineral phosphate, potassium containing mica and feldspar which are available locally. In addition, even the clay mineral vermiculite is to be recommended as a conditioner to improve the water retention and nutrient fixation capacity. These additives being available in the country, their export is also recommended but this requires the solution of problems involved by their extraction, mining and grinding. The prerequisite for the adequate production of peat-based fertilizers and soil improving materials is also the establishment of milling facilities to grind mineral raw materials and the enhancement of the capacity of existing grinder units for limestone, dolomite and phosphate.

Subsequent to these preliminaries, the mission of the Burundi delegation to Hungary was decided. The members of the delegation were: Mr. Benoit Ndorimana, Director of the Ministry of Energy and Mines ; Mr. Leonce Sinzinkayo, Technical Director of the National Peat Organization /ONATOUR/ and Mr. Ferdinand Ntiburumusi, Director for the Experimental

Station of the Institute of Agronomic Sciences /ISABU/.

The visit took part in the period between 14 - 23 May 1985 with the objective to make familiarity with extraction methods of the peat and to inspect Hungarian technologies which might be used or adapted to conditions in Burundi in order to locally produce peat-based fertilizers and soil improving materials.

In addition, the delegation wished to take the opportunity presented by the study tour to get acquainted with large-scale farm soil improvement carried out with peat and peat compost. In accordance with the prearranged programme, the expert was the organizer and a permanent escort to the delegation during the study tour.

2. Programme for the Burundian delegation

1985, 14 May: Visit at the Company for Soil Resources Management / formerly Soil Amelioration Enterprise/ in county Győr-Sopron, Sopron. Director: L. Bertha
Subject: study into the "Sopron-Peat Technology"

15 May: Visit to the peat extraction areas in Hanság /Osli, Kónyi/.

16 May: Visit to the peat extraction area at Pötréte /Zala county/.

17 May: Visit at the Agricultural State Farm Complex of Hosszuhegy in Sükösd. Manager: S. Faragó
Subject: study of a simple peat processing technology.

20 May: Visit at the Soil Science Department of the Horticultural University. Professor: L. Hargitai
Subject: composition and analysis of peat-based soil improving substances

21 May: Visit at the Demonstration Farm of the Horticultural University at Soroksár.

Subject: study the application of peat-based soil mixtures in green-house vegetable farming.

22 May: Visit at the "Haladás" Production Farm Cooperative in Nyársapát. Chairman: S.Tóth

Subject: use of peat composts for large-scale farm land improvement for cereal crops and orchard plantations.

23 May: Visit at TESCO /Technical and Scientific Organization/. Head of section: L.Szücs.

Subject: technical preparation for the introduction of Hungarian technologies in Burundi.

II. Results

1. The peat extraction areas inspected

The delegation from Burundi has paid visit at two major peat areas.

One of them is located in the Hanság, in Győr-Sopron county /Osli and Kónyi/ where peat is lifted from below water by excavator over a marshy, wet area. The removed peat is dried in the sun, then it is taken to a central unit in air-dry state for comminution and stacking. Peat is hauled from here to the town Sopron, to the "Sopron-Peat Technology" for use as basic material. The fine structured, fibrous part of air-dry peat is repeatedly ground and sieved, then packed in 50 kg weight polyethylene sacks for export purposes. Smaller, 0.5 - 1.0 kg unit weight packages are also formulated subsequent to homogenizing peat with water, cutting into rectangular shape and drying on stands by air indoors. These peat blocks are packed into synthetic foil sacks and paper boxes. This peat is sold as nutrient cubes for the production of valuable flowers.

The other peat extraction area was at Pötréte, in Zala county, extending over hundreds of hectares. A part of the area is already entirely extracted and fish ponds were made from the depleted mining pits. On the area currently under exploitation, first the level of ground water is reduced to 2-3 meters by water outlet trenches and then the peat over the dry surface is loosened up to 5-10 cm depth by means of high performance scraper machines. The loosened peat is next collected by the same machine into heap rows with 0,5 meters row spacing. The heap rows are sucked up by special tank trucks and delivered to the central unit of the area. Peat is sieved here and packed for export into plastic sacks of 50 kg each. The peat extracted at this location has a first class rating and is composed of fine textured fibrous

material called sphagnum peat. Its degree of carbonification is lower than that of the Burundi peats.

2. The peat processing technologies studied

The Company for Soil Resources Management in county Győr-Sopron worked out a special peat processing technology which is unique in the country / see technical report: Organic materials, soil amendments and fertilizers on peat base and the technology of their production, by F.Gati. Ref.: DP /ID/ SER.A/ 493, 2 February 1984/. The "Sopron-Peat Technology" is featured by complete mechanization and automation with a production capacity for peat-based organic materials of 150.000 tons per annum, which is mainly used in flower growing. This technology is also adequate for producing peat-based fertilizers, soil improving and conditioning materials in the most varied composition. The basic materials are: peat, peat compost ripened with cattle manure, sand and nitrogen, phosphorus and potassium fertilizers. From these materials peat, sand and fertilizers are supplied ready-made to the plant, while peat composting is performed on the site. The sieved materials are carried by conveyor belt to the TF feeder which constitutes the central part of the technology. Materials are stored here in adjacent silos from where the materials are forwarded onto a conveyor belt and into the mixing machine through a slit of variable aperture. The basic materials are then transformed into a homogeneous end-product in this machine.

It is the variable feeding aperture of the silos that makes it possible to change the composition of the end-product as required by specifications. The homogenized material is forwarded to the automatic packaging machine line where it is formulated in plastic sacks of 2, 5, 10, 25 and 50 kg unit weights. The trade name, composition and the possibility of application are printed on the plastic sacks. This plant currently produces flower soil with markings Florasca A, B, C and Vegasca. Such peat mixture is also made under mark Vinasca that can be used in the process of propagation vinestocks.

The other peat processing technology is used at the Agricultural State Farm Complex of Hosszúthegy but this is simpler than the former one. The raw materials used here are: peat, peat compost made with cattle manure and a nutrient solution containing hormonal and stimulant agents enhancing plant growth. Peat is extracted nearby and the compost is made locally. The basic materials are put on conveyor belt and then treated with nutrient solution. Through another belt and a grinding facility the material in mixture is forwarded onto two homogenizing belts. The homogenized end-product is transported onto a packaging machine line to pack it into 50 kg weight plastic sacks. The sacks are then sealed by an automatic welder. Composition is adjusted in a simple manner: the basic materials are put on the first conveyor belt in different rates and ratios whereby the desired composition can be ensured. The advantage of this technology is that it requires minimum electric current and that in case of emergency the conveyor belts and the grinders can be operated from Diesel-engines as well. Operation by Diesel-power is an alternative solution in case of the "Sopron-Peat Technology" too. The technology applied at Sükösd has the other advantage that the entire operation is mobile because the entire unit, composed of 4 conveyor belts and one grinder, can be easily transferred from one peat field to the other. The end-products are used in vegetable growing and flower gardening. If no packaging is applied, the peat mixture can be supplied in bulk for soil improvement purposes.

The delegation greatly appreciated the technologies studied. They hold the view that in case the technologies are to be adapted in Burundi, some modifications might also be involved or are conceivable in order to make a better fit to conditions in Burundi. In general they had the opinion that the Hungarian technologies could be transferred and adapted to suit Burundi conditions and needs.

3. Visit at the Soil Science Department of the Horticultural University in Budapest

The Soil Science Department of the Horticultural University in Budapest is the center of Hungarian peat research. It was here that such special peat analysis methods were devel

like the investigation of peat nitrogen forms and the optical methods that are designed to assess the quality of humus and the degree of humification of peats / K- and Q-values, F-curve analysis/. The head of department, Prof. L. Hargitai established the theoretical and scientific principles that allow different peat-based organic mixtures to be produced. His name is closely associated with the elaboration of the manufacturing process for the "Sopron-Peat Technology" and its know-how.

Members of the delegation were given a thorough insight into the peat research work of the Department and into the results and findings that were aimed at the practical implementation of the research results. The delegation expressed its intention to embark upon cooperation in scientific field with the Department in the future.

This item of programme was followed by a visit to the Demonstration Farm of the Horticultural University at Soroksár where vegetable growing /pepper, cucumber, tomato/ is undertaken in sorts of medium made of peat-based organic mixtures over an area of 500-750 m² and protected by greenhouse system. Research work here expedites the procedure to produce peat mixtures with compositions most appropriate for the different vegetable crops.

4. Large-scale farm soil improvement with peat compost on sandy soil poor in humus

Inspection of a large-scale soil improvement operation with peat and peat compost was also arranged in the framework of the study tour. Location: "Haladás" Agricultural

Production Cooperative at Nyársapát situated in a sandy soil region between the rivers Danube and Tisza where production is carried on over 2.400 hectares. The delegation was given a hearty welcome by the chairman of the Cooperative, Mr.S. Tóth. The sandy soils here are poor in humus. Improvement with peat and peat compost is followed by production of cereals /wheat, rye/ and other grain crops /maize, sorghum/. The orchard area is 600 ha, where apple, plum, pear and apricot are produced. Prior to orchard planting, similar soil improvement with peat is carried out. The common procedure of soil improvement is that peat and farmyard manure in 1:1 ratio and at 60-100 tons/ha rates, combined with NPK-fertilizers, are spread over the soil surface with fertilizing machines. The amendment is then turned into the soil to 40-60 cm depth with deep-plowing machines. 30-100 % yield increases can be attained over the areas thus improved in case of cereals. Soil improvement in orchard areas is unavoidable because otherwise no fruit trees could be planted on these humus-poor sandy soils.

The Burundi delegation was content with what they saw and for comparison it was noted that in Burundi no soil improvement with deep ploughing may be performed on the steep hill slopes due to increased danger by erosion. But in case of an appropriate soil tillage technology the experience gained on this farm can be put to good use in Burundi.

5. Visit to TESCO

TESCO /Technical and Scientific Organization, H-1054 Budapest, V. Rosenberg hp.u.21/, is in charge of organising and arranging sales of Hungarian technologies abroad. Should any of the Hungarian peat technologies be introduced in Burundi, TESCO will be entrusted with its supply, delivery and turn-key installation in Burundi. In addition, TESCO is to arrange and undertake the training of Burundi specialists in Hungary as well as to undertake the start-up operation

of the facilities to be installed in Burundi, with the training of the local manpower to operate the machineries inclusive.

Negotiations at TESCO were completed with the mutual satisfaction of the counterparts. Emphasis was given to the importance of the fact that the technological installation should be implemented and the financial coverage be ensured on the basis of a contract between TESCO and UNIDO prior to implementing the final technology and the training in Hungary and in Burundi.

III. Recommendations

1. R + D work to utilize peats in Burundi

Preliminary investigations and analyses suggest that the utilization of Burundi peats through the manufacture of peat-based fertilizers, soil improving materials and soil conditioners is feasible. However, local conditions and endowments in Burundi, like e.g. peat quality, physical and chemical properties of soils, the energy and manpower supply status of the country, etc., require a thorough research-development programme to be established and implemented before any sort of peat processing technology would be deployed in the country. The members of the Burundi delegation showed a very considerate and sober-minded approach in this respect when they suggested that prior to technological implementation decision must be taken on:

- a. to what extent are the Burundi peats suitable on the tropical, e.g. latosol soils of Burundi
- b. can such peat-based fertilizers and soil improving materials be produced whose quality conforms to the requirements set by soil improvement and humus enrichment on these soils
- c. are the Burundi peats suitable to those technological processes in the course of which amendments of adequate quality can be produced and which the delegation had the occasion to study in Hungary.

The above specified reservations are in any case justified since Burundi peats are acidic /pH 3-4,6/ and the soils on the areas to be improved are likewise acidic /pH 6-6,5/. Soil amendments of such composition should therefore be made whose pH-value can be increased and whose effect does not reduce further the pH-level of the soils. In the framework of the R + D work thus the first step is to take a sufficient number of peat samples for qualification, i.e. one has to perform

those special peat analyses that are conducted at the Soil Science Department of the Horticultural University of Budapest. In addition to the usual and common routine investigations, these special analyses extend to the establishment of the degree of humification /F-curve analysis/, of the nitrogen forms and humus quality /K- and Q-values/ and to the establishment of the humic acid content in the peats. Humic acid fractionation should also be performed. The laboratory of ISABU should also participate in these investigations and it would be desirable if they continued to cooperate with the Soil Science Department of the Horticultural University of Budapest. To start with, it is desirable therefore to arrange a mission for the expert still in this year to Burundi for three weeks in order to enable him to collect samples from the peat fields. 100 peat samples of 2 kg weight each would be sent to the Horticultural University of Budapest for special analyses and technical expertise. In addition the University should receive further 20 kg peat samples for routine testing and 30 kg soil samples for chemical and physical analyses, thus 250 kg sample material would be sent in total to Budapest. A fee of 8000 US Dollars would be due to the Soil Science Department of the Horticultural University as a charge for these analyses and testings. In accordance with agreement with the expert, the laboratory of ISABU is also to perform chemical and physical analyses on the selected peat and soil samples.

Subsequently, if the results from the assessments and analyses prove to be favourable, the expert would travel to Burundi for a period of $2 \times 12 = 24$ months in 1986 in order to prepare model sample mixtures originating from the selected peat areas and appearing to be good. He then should conduct pot and small plot field experiments in the laboratory and on the areas of Experimental Station of ISABU. These experiments will be designed to lead to a final decision about the applicability of Burundi peats for soil improvement purposes.

Preparation of the model sample materials, on the other hand,

provides information about the criteria of whether Burundi peats can be technologically processed and about the extent and form of the required technological modification. The technological modification should be designed and established by the expert and by specialists of ONATOUR and IS&BU.

Since Burundi peats are acidic and their pH-value should be increased, for this purpose mostly limestone powder, dolomite and farmyard manure will be considered for use. But this does not want to say that possibly the pH-level of the soils to be improved should also be enhanced through previous lime application. The other additive materials such as mineral phosphate, mica and feldspar are designed to improve and secure the phosphorus and potassium levels of the soil-improving materials. The available nitrogen of the peat will present a criterion to decide about the measure and extent of nitrogen fertilizer application. Vermiculite is also an important additive which, as a conditioner, favourably affects the regulation of nutrient and water regime in the mixture or in the soil.

It also constitutes a part of the R + D work to explore possibilities of mining and grinding of limestone, dolomite, mineral phosphate, mica, feldspar and vermiculite which are considered as mineral resources in Burundi. A low capacity limestone milling facility is claimed to be operational in Burundi but provisions should be made for the availability of grinding and milling facilities for the other, above specified raw materials as well. These are minerals directly exportable but it should in any way be secured that the requirements of the peat processing technology be supplied from these materials.

2. Recommendation for the processing technology of peats in Burundi

Members of the Burundi delegation held that the inspected Hungarian technologies were of a very high level and had

a positive opinion about the possibility of their adaptation to conditions in Burundi. Attention should, however, be paid to the level of economic development of the country and in agreement with the expert's opinion, they wish to submit their proposals on modifications accordingly. In its essence, however, the manufacturing process represented by the technologies is entirely acceptable for the production of peat-based fertilizers, soil improving materials and soil conditioners. But the products are intended primarily for internal use in Burundi with a view to soil improvement in general. It would, however, be desirable to turn out exportable products as well from the high carbonification degree Burundi peats but this problem should also be resolved in the framework of the R + D work.

3. Recommendation to conduct pot and small plot field experiments with peat sample mixtures made from peats available in Burundi

It is a jointly developed view that before introducing the Hungarian technology or its altered version in Burundi it is indispensable to obtain sufficient proof about the agronomical value of Burundi peats. This objective can only be reached if peat-based fertilizer mixtures of different compositions are prepared from the Burundi peats, first in laboratory conditions, and if the experiments common and prescribed in agronomy and agrochemistry are performed on them. Beyond the chemical and physical analyses of the peats and of the samples made therefrom, this programme involves pot trials with different indicator plants, e.g. Rye-grass /*Lolium perenne*/, maize, sorghum, etc. to determine responses of different crop and soil combinations. On the basis of the data thus obtained, the testing should continue in field conditions on small plots with the mixtures that proved to be the best ones. These experiments should include several crops as well. An integral part of these experiments is the analysis into the chemical composition of the plants and crops involved in the pot and field

small-plot experiments. Analyses should determine nitrogen, phosphorus, potassium, calcium, sodium, magnesium and trace element contents as well.

The test period for pot trials should last for at least 12 months and likewise 12 months for the field experiments. The final evaluation and assessment is to be given in the terminal report, after analysis of the plant sample material. The members of the delegation requested that the expert should undertake these experiments, tests and analyses. At the same time, they declared that ONATOUR and ISABU were going to give every assistance so as to enable the expert to carry out these works in the laboratory and on the Experimental Station of ISABU.