C7-143
PN-ACM-541
79626

February 1990

BIMODAL EOLIAN DESERT SAND SHEETS AND THEIR POTENTIAL SIGNIFICANCE FOR AGRICULTURAL DEVELOPMENT

PROGRESS REPORT

Haim Tsoar
Department of Geography
Ben Gurion University of the Negev
Beer Sheva
Israel

Kofi Anane-Fenin
Department of Physics
University of Liberia
Monrovia
Liberia

This progress report places emphasis on the first visit to Israel of Prof. Kofi Anane-Fenin, the co-investigator in Liberia. Please find his report enclosed. During Prof. Anane-Fenin's visit we discussed the envisaged first field trip to Senegal which is planned to be carried out this coming March.

As was reported before, Dr. Tsoar, the principle investigator, has been meeting with difficulties in obtaining an entry visa to Senegal. In spite of promises from Senegalese top officials, there has been no solution to this problem todate. Dr. Christian S. Diatta, the Director of the Institute for Applied Nuclear Technology (ITNA), Cheikh Anta Diop University in Dakar, who is our local collaborator, has suggested that we send someone else with a non-Israeli passport to fulfil Dr. Tsoar's capacity in the field work. Our best choise is Dr. Hendrik Bruins of the Institute for Desert Research of Ben-Gurion University of the Negev in Sde Boger. Dr. Bruins is an expert on desert environment and agriculture, mostly in Less Developed Countries. Dr.

Rec'd in SCI FEB 22 1990

Bruins has a Dutch passport and will have no problem in getting an entry visa to Senegal.

It has been agreed upon by all parties involved to materialize the field trip between March 9th and 18th. Results of the field trip will appear in our next report due in August 1990.

Prof. Kofi Anane-Fenin, Department of Physics, University of Liberia

REPORT ON A VISIT TO ISRAEL

The Purpose: Was four fold.

I. To meet, discuss and prepare with Dr. Haim Tsoar of Ben Gurion University and Dr. Hendrick Bruins of the Jacob Blaustein Institute for Desert Research Ben Gurion University, the field trip to Senegal planned for March 1990.

II. To take part in wind Tunnel Experiment work.

III. To take part in field trips to the Negev Deserts.

IV. To give some lectures.

ARRIVAL

I arrived in Israel via Zurich Switzerland on 16th November, 1989 at 19:00 hours on flight S.A. 332. Dr. Haim Tsoar and his wife were around to pick me up and drove me straight to Beersheva.

MEETING WITH DR. HENDRICK BRUINS

On 19th November, 1989 Dr. Haim Tsoar, Dr. Bruins of Meteorology Unit, Jacob Blaustein Institute Ben Gurion University of the Negev and myself met at the Department of Geography Beersheva to discuss and fix a date for our planned field trip to Senegal West Africa. It had already been suggested that since Dr. Tsoar could not make the trip owing to visa problems Dr. Bruins to go to Senegal with me.

We were able to fix a convenient date but subject to the availability of Dr. Diatta, the Director of the Institute for Applied Nuclear Technology(ITNA) Cheikh Anta Diop University of Dakar our local Collaborator.

Discussion centered around equipments and transportation to and from the field site in Northern Senegal.

VISIT TO THE LABORATORIES OF THE GEOGRAPHY, DEPARTMENT AND WORK AT THE WIND TUNNEL:

I was shown around the laboratories of Geography Department by Dan Blumberg an assistant to Dr. Tsoar. My particular interest was in how grain size analysis are done. Accordingly, I was shown the semi - automated setting tube sand analyser and how it is used. Other equipments were shown me.

WIND TUNNEL

The Wind Tunnel of Ben Gurion University is an open circuit tunnel and composed of three parts:- Entrance Cone test section and diffuser as described in our September 1989 report. Air is sucked through a bell shaped entrance by a fan located at the end of the diffuser.

..../2

Two important requirements for sand modelling are:-

I. The model should be geometrically similar and scaled to be a true prototype.

II. The vertical velocity profile and level of turbulence of boundary-layer should equal real atmospheric flow conditions.

A very important question to ask is, what wind velocity in the field, the wind tunnel velocity is competent?

The answer to this question is to match the average wind velocity in the wind tunnel with the speed of the wind measured on a high mast in the field. Demonstrational test were ran on the wind tunnel. Accordingly, preparation was made for the boundary - layer low speed winf tunnel appropriate for studying the movement of coarse sand of which sand sheets are composed.

Test were made on poorly sorted coarse created synthetically from the components selected in the Negev desert.

i. The cowdrey method for generating wind profile was used.

ii. Measurements of profiles of wind velocity were taken under several wind speeds from the threshold velocity up to the highest possible wind speed.

iii. Using sand traps, measurements of the amount of sand trapped under several different wind velocities were made leading to the calculation of threshold velocity (impact threshold).

FIELD TRIPS

There were four field trips made:-

1. Field trip to the sand dunes of Nizzana

The purpose of the trip was:-

(a) To study the morphology of dunes.

(b) To have a first hard experience of stablized dunes.

(c) To collect sand samples on parts of dunes.

(d) To have a first hard experience of the modern Agricultural Techniques on Desert Dune Sand.

- The Israeli model.

Two principal types of profile can be identified in the field:-

A. The asymmetric and rounded, having one slope with gradients of 0° up to 15° and a constant gradient usually of 33° on the other slope. The p profile characterize barchan and transverse dunes affected by one dominant wind direction (Bagnold 1941).

.../3

B. The other is the symmetrical and sharper profile which delivaetes. longitudinal (seif) dunes where the slope is steep on both side (Tsoar 1974).

The texture of sand is vital important for determining its mobility by wind the morphology of the dune, the percolation rate of water and its movement through the soil, the soils water - holding capacity and its temperature.

All these characteristics are important for plants and agriculture since the finer the texture of the soil the greater its fertility.

The morphology of sand dunes is also determined by the distribution of the grain size.

Dunes with sharp-edge shapes such as most linear (seif) dunes and transverse ones are composed of very well sorted fine sand.

On the field we took notice of erosion and deposition of sand on various parts of the dunes.

These control evaporation which in turn depend on the thickness of the upper sand layer. For this reason erosion of sand and not lack of moisture is the major limiting factor for vegelation on dunes.

Stabilization of dunes were of special interest especially biological stabilization - by perennial grass and shrubs that are adopted to sand cover or sand exposure.

The favourable section for vegetation on sand dunes are those where erosion is minimal such as the crest and slip face of transverse and barchan dunes.

Vegetation dunes in Negev and Sinai deserts contain up to 17% of salt and clay. For this reason even though annual rainfall is 100mm or less the dunes are able to stabilize naturally if the ecosystem is not interfered with by man (such as overgrazing).

We saw this clearly in Sinai between Israeli and Egyptian boarder, where the Bedouis still graze their herds on the Egyptian side.

MODERN AGRICULTURAL TECHNIQUE ON DESERT SAND DUNES - ISRAELI MODEL

Because sand deserts is an inert medium with low field capacity, agricultural cultivation is carried by geoponios in which water and fertilizers are supplied jointly to the soil.

The trickle irrigation has been used with amazing success in Israel as evident in a number of Moshav and Kibbutzim I visited during the field trips, nutrients are fed directly to the irrigation water this compensating for the lack of fertilizers in the soil.

..../4

FIELD TRIP IN THE NEGEV WITH DR. PEDRO BERLINER.

During this trip Dr. Berliner of the Desert Ran - off farm unit, Jacob Blanstein Institute, University of Ben Gurion, explained methods being used to recreate and improve the rainfall harvesting methods developed by the Israelites and continued by the Nabateaus and Byzantines 2500 - 1200 years ago.

The main sites for this research were the Avdat farm - mean annual rainfall 80 mm; located 55 km south west of Beersheva and Wadi Mashash farm - annual rainfall 115 mm located 20 km south of Beersheva.

The variety of orchard and field crops seen clearly demonstrated that water - harvesting techniques could be used for successful cultivation.

A VISIT TO THE INSTITUTE FOR DESRT RESEARCH IN SEDE BOQER WITH DR. H. BRUINS

I was taken around the Institute by Dr. Hendrick Bruins of the Meteorological unit. I met Dr. Avraham Zangvil acting head of the meterology unit and had some discussions with him. I was also introduced to Dr. Zvi Offer who works on the relationship between the meteorological parameters and air dust in desert condition (deflation, transport sedimentation; aerisols, the pollution of atmosphere).

I was particularly interested in How Dr. Offer used methods to collect dust. I visit the applied solar calculations unit and Archurlecture unit and had fruitful discussions with the scientists.

Later in the day I had lunch with the deputy head of the Institute Prof. Yair Zarmi.

LECTURES:- I was able to give two lectures on Desertification.

i. A lecture on "Desertification. A problem in West Africa" was given to the Israeli Meteorological office in Bet Dagan Tel Avviv on 23rd November, 1989.

ii. A lecture on Desertification was given to the Agro-meteorology course in Desert Oasis Holet Beersheva on 24th November, 1989.

On the whole it was a very fruitful and successful visit. I had the opportunity of speaking and interacting with Israeli scientists from many desciplines.

ACKNOWLEDGEMENT:-

My thanks goes to Dr. Haim Tsoar and his wife who made my stay in Israel a pleasant one.

REFERENCES:- BAGNOLD R. A. 1941:- The Physics of Blown sand and Desert Dunes. London 265 P.

TSOAR H. 1974:- Desert Dunes Morphology and dynamics EL-Arish (Northern Sinai Z. Geomorphl Suppl, 20,41,61.