

**THE TANZANIAN SEA LEVEL NETWORK:
A NATIONAL REPORT (DRAFT)**

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BACKGROUND

This report has been prepared for the Western Indian Ocean Project within the framework of the IOC-Sida-Flinders Marine Science Programme and in response to recommendations that were put forward by IOCINCWIO-IV.

1. INTRODUCTION

The Tanzanian sea level network consists of two operational stations of Zanzibar and Dar es Salaam. There are also three non-operational tide gauges at Mtwara, Tanga and Pemba. The Zanzibar Station has a Handar encoder with satellite communication. In the 1990 GLOSS plan, Zanzibar and Mtwara were proposed as GLOSS stations among 17 stations in the IOCINCWIO. An IOCINCWIO workshop held in Mombassa in 1991 further recommended the establishment of Dar es Salaam and Tanga stations, out of 15 extra GLOSS stations proposed in the region.

The new tide gauge in Zanzibar was installed in 1990, replacing the old Munro IH 109 float gauge (1983-1993). The Dar es Salaam station has a mechanical SEBA float gauge, which was installed in 1997. This tide gauge replaced a Leupold and Stevens float gauge (1986-1990) whose stilling well was damaged by a boat. The tide gauge in Mtwara was a Munro IH 109 float type, which worked from 1959 to 1962. Previously, a Munro IH 40 was in operation from 1956 to 1957. A Munro IH 40 tide gauge in Tanga worked from 1962 to 1966, while that of Pemba (Munro IH 109) was incorrectly installed in 1991 and so it never worked. Of all these stations, the Zanzibar station has been operating quite well since 1984.

At the moment, there is no single agency responsible for the management of tide gauges. The Zanzibar Station is locally administered by the Zanzibar Department of

Lands and Surveys. The old station at Pemba was also under the same department. The Dar es Salaam tide gauge station is administered by Tanzania Harbours Authority, but before installation of the new gauge in Dar es Salaam, the Station was under the Institute of Marine Sciences of the University of Dar es Salaam. Old tide gauge stations of Mtwara and Tanga were both under the Division of Surveys and Mapping of the Ministry of Lands, Housing and Urban Development.

2. STATUS OF SEA LEVEL NETWORK

2.1 INSTALLED AND OPERATIONAL STATIONS

2.1.1 Zanzibar Station

Location: The gauge is located on the main jetty of Zanzibar Harbour

Latitude: 06° 09.3'S

Longitude: 039° 11.4'S

Previous installed gauges: Float type, R.W. Munro, model IH 40, up to mid 1950's
Float type, R.W. Munro, model IH 109, (1983-1993)

Currently installed gauge: Handar encoder, 1990 to date

Organisation/individual responsible for station:

UHSLC in cooperation with
The Director
Department of Surveys and Mapping
Commission for Land and Environment
P.O. Box 811, Zanzibar, Tanzania

Organization/individual performing maintenance:

UHSLC in cooperation with
The Director
Department of Surveys and Mapping
Commission for Land and Environment
P.O. Box 811, Zanzibar, Tanzania

Tide gauge benchmarks description:

Old TGBM is about 30.0m from tide gauge (521209E, 9319992N)

Benchmark relationships:

BM1 at Malindi roundabout is 3.80m above LSD (1984, 1987)

Mean Sea Level is 2.08m above Chart Datum

Auxilliary benchmarks:

TGBM1 is 3.709m above LSD

TGBM2 is 3.750m above LSD

TGBM3 is 3.925m above LSD

Tide predictions performed by: UHSLC
Dedication to projects: GLOSS, UHSLC
Data Centres to which data is sent: UHSLC on monthly basis
Data format: Diskettes
Data Communication at Station: Satellite altimetry, airmail
Nearest Meteorological Station: Zanzibar Airport
Other data available: NIL

2.1.2 Dar es Salaam Station

Location: The gauge is located on the ferry terminal of Dar es Salaam Harbour

Latitude: 06° 49.2'S

Longitude: 039° 17.3'S

Previous installed gauges: Float type, Leupold and Stevens, model A-71, (1983-1993)

Currently installed gauge: Float type, SEBA Hydrometry GMBH, Serial No. 011997

(July 1997 to date)

Organisation/individual responsible for station:

Principal Hydrographer
Tanzania Harbours Authority
P.O. Box 9184
Dar es Salaam, Tanzania
Email: tha-do@raha.com

Organization/individual performing maintenance:

Principal Hydrographer
Tanzania Harbours Authority
P.O. Box 9184
Dar es Salaam, Tanzania
Email: tha-do@raha.com

Tide gauge benchmarks description:

TGBM is about *m from tide gauge (*E, *N)

Benchmark relationships:

BM1 at * is *m above LSD (19**)

Mean Sea Level is 1.5m above Chart Datum

Auxilliary benchmarks:

TGBM1 is *m above LSD

TGBM2 is *m above LSD

TGBM3 is *m above LSD

Tide predictions to be performed by: The UK Hydrographic Office

Admiralty way, Taunton, Sommerset

TA1 2DN, UK

Tel: +44(0) 1823 337900

Fax: +44(0) 1823 337900

Dedication to projects: NIL (Previously, UHSLC)

Data Centres to which data is sent: UK Hydrographic Office, Taunton

Data format: Analogue Charts

Data Communication at Station: Airmail

Nearest Meteorological Station: Dar es Salaam Airport

Other data available: NIL

2.2 INSTALLED BUT NOT OPERATIONAL

2.2.1 Mtwara Station

Location: Mtwara Harbour

Latitude: 10° 17'S

Longitude: 040° 11'S

Previous installed gauges: Float type, R.W. Munro, model IH 40 (1956-1957)

Float type, R.W. Munro, model IH 109, (1959-1962)

Currently installed gauge: NIL

Organisation/individual responsible for station:

UHSLC in cooperation with

The Director

Surveys and Mapping Division

Ministry of Lands, Housing and Urban Development

P.O. Box 9201, Dar es Salaam, Tanzania

Tide gauge benchmarks description:

TGBM is about *m from tide gauge (521209E, 9319992N)

Benchmark relationships:

BM1 at * is *m above LSD (1984, 1987)

Mean Sea Level is *m above Chart Datum

Auxilliary benchmarks:

TGBM1 is *m above LSD

TGBM2 is *m above LSD

TGBM3 is *m above LSD

Dedication to projects: Previously to GLOSS, UHSLC

Data Centres to which data is sent: Previously to UHSLC

Data format: Analogue Charts

Data Communication at Station: -

Nearest Meteorological Station: Mtwara Airport

Other data available: NIL

2.2.2 Tanga Station

Location: Tanga Harbour

Latitude: 05° 04'S

Longitude: 039° 06'S

Previous installed gauges: Float type, R.W. Munro, model IH 40 (1962-1966)

Currently installed gauge: NIL

Organisation/individual responsible for station:

The Director

Surveys and Mapping Division

Ministry of Lands, Housing and Urban Development

P.O. Box 9201, Dar es Salaam, Tanzania

Tide gauge benchmarks description:

TGBM is about *m from tide gauge (*E, *N)

Benchmark relationships:

BM1 at * is *m above LSD (19**)

Mean Sea Level is *m above Chart Datum

Auxilliary benchmarks:

TGBM1 is *m above LSD

TGBM2 is *m above LSD

TGBM3 is *m above LSD

Dedication to projects: -

Data Centres to which data is sent: -

Data format: Analogue Charts

Data Communication at Station: -

Nearest Meteorological Station: Tanga Airport

Other data available: NIL

2.2.3 Pemba Station

Location: Mkoani Harbour

*Latitude: *'S

*Longitude: *'S

Previous installed gauges Float type, R.W. Munro, model IH 109, (1991)

Currently installed gauge: NIL

Organisation/individual responsible for station:

The Director

Commission for Land and Environment

P.O. Box 811, Zanzibar, Tanzania

Tide gauge benchmarks description:

TGBM is about *m from tide gauge (E, *N)

Benchmark relationships:

BM1 at * is *m above LSD (19**)

Mean Sea Level is *m above Chart Datum

Auxilliary benchmarks:

TGBM1 is *m above LSD

TGBM2 is *m above LSD

TGBM3 is *m above LSD

Dedication to projects: NIL

Data Centres to which data is sent: NIL

Data format: Analogue Charts

Data Communication at Station: -

Nearest Meteorological Station: Pemba Airport

Other data available: NIL

2.3 PLANNED STATION:

No station has been planned. However, the stations of Mtwara, Tanga and Pemba should be rehabilitated so that sufficient data is generated for the national sea level network.

3. AVAILABILITY OF DATA FROM THE STATIONS

3.1 DATA FORMAT

Data at the Zanzibar station is available in digital form. At the Dar es Salaam station, data is made available in analogue charts. Previous sea level records of Mtwara, Dar es Salaam and Tanga are also available in digital form. All these data are available at international data centres such as WOCE, PSMSL and UHSLC. However, data from the new tide gauge in Dar es Salaam is in analogue charts. Processing of data from this station is scheduled to commence in 1999.

3.2 AVAILABLE DATA

- a) Zanzibar Station: Span of Data: 1 March 1984 up to date
- b) Dar es Salaam Station: Span of Data: 6 July 1986 to 30 September 1990
and July 1997 to date
Incomplete data: 1986, 1987 and 1989
- c) Mtwara Station: Span of Data: 1956 to 1957 and 1957 to 1962
Incomplete data: 1956, 1957, 1959, 1960 and 1962
- d) Tanga Station: Span of Data: 1962-1966
Incomplete data: 1962, 1966

4. CAPACITY AVAILABLE

4.1 INSTALLATION AND MAINTENANCE OF GAUGES

No capacity is available for installation of gauges. The operating stations of Zanzibar and Dar es Salaam are maintained as follows:

- a) Zanzibar Station:

Mr. Mussa Mohammed Abdalla: Attended the 8th IOC course on Mean Sea Level at PSMSL, Bidston Observatory, UK in 1990.

- b) Dar es Salaam Station:

Mr. Ignatus K. Nhnyete: BSc (Hydrography) and Postgraduate Diploma (Sea Surveying)

4.2 ANALYSIS AND INTERPRETATION OF DATA

a) Dr Julius Francis: Phd (Physical Oceanography);

Dr I. Dubi: Phd (Coastal Engineering)

Mr O. Mwaipopo: MSc (Physical Oceanography) and

Mr A. Ngusaru: MSc (Physical Oceanography), currently on a PhD programme

Institute of Marine Sciences, University of Dar es Salaam

P.O. Box 668, Zanzibar, Tanzania

Mr Mwaipopo attended the IOC training workshop on sea level data analysis in Dehra Dun, India in 1995.

Mr Ngusaru attended the IOC training course on Mean Sea Level at PSMSL, Bidston Observatory, UK in 1989.

b) Mr S.B. Mahongo: MSc (Physical Oceanography)

Tanzania Fisheries Research Institute

P.O. Box 9750, Dar es Salaam, Tanzania

Mr Mahongo attended the IOC training workshop on sea level data analysis in Cape Town, South Africa in 1998.

5. SEA LEVEL PRODUCTS

a) Tide predictions for Zanzibar are produced by the UHSLC. These are made available to the Department of Lands and Surveys in Zanzibar. The predictions are in the form of heights and times of low and high water.

b) Hydrographic Charts and navigation aids are produced by the Tanzania Harbours Authority

c) Some limited literature related to sea level is available

6. BIBLIOGRAPHY OF SEA LEVEL LITERATURE

i) Cederlof, U., Rydberg, L., Mgendi, E. and O.U. Mwaipopo, 1995: Sea levels and hydrodynamics of Chwaka bay: Zanzibar. *Ambio*

ii) Wolanski, E., 1989: Modelling and monitoring of mangrove swamps. *COMARAF Serie Documentaire* (3)

iii) Lwiza, K.M.M. and P. R. Bigendako, 1989: Kunduchi tides. *Tanzania Journal of Science*

- iv) National Environment Management Council, 198*: Erosion of the Dar es Salaam coastal area.

7. RECOMMENDATIONS

- a) Among the tide gauge stations proposed in the GLOSS plan of 1990 (Zanzibar and Mtwara) and by IOCINCWIO in 1990 (Tanga and Dar es Salaam), only the Zanzibar and Dar es Salaam stations are operational. The Dar es Salaam station however, is currently not dedicated to GLOSS. The Mtwara and Tanga stations should therefore be rehabilitated and together with the Dar es Salaam station, be linked to the GLOSS network of tide gauge stations. The stations to be rehabilitated should be equipped with data loggers so as to obtain reliable digital data which is easy to process. Priority for rehabilitation should be given to the Mtwara station basing on its geographical location, and its inclusion in the 1990 GLOSS plan.
- b) Rehabilitation of the non-operational stations should be accompanied by training of personnel for maintenance of the equipments. Training in installation might not be a priority, but such training would also be useful.
- c) A single agency should be commissioned to act as a link to the tide gauge stations so as to harmonise the activities of the stations such as levelling, analysis of data and mobilization and training of technical personnel.
- d) The tide gauge stations should also be equipped with sensors for time series measurement of sea surface temperature. This variable is important in sea level data analysis and interpretation but no records are being taken at the moment. Other meteorological factors like wind, air temperature and air pressure may be obtained from nearby meteorological stations.
- e) The available sea level records should be analysed so as to monitor the trend of sea level, to identify any anomalies and to provide scientific information that may be of practical importance for the conservation of the coastal zone. The analyses may also be of regional and global importance if they can provide relevant information on aspects such as those that relate to global warming and sea level rise.
- f) The tide gauges should regularly be levelled, at least once or twice a year so as to be able to filter out any variations that may be associated with rise or fall of ground level.

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ABBREVIATIONS:

BM Bench Mark

GLOSS Global Sea Level Observing System

IOC Intergovernmental Oceanographic Commission

IOCINCWIO IOC's Regional Committee for Cooperative Investigations in the North
and Central Western Indian Ocean

LSD Land Survey datum

TGBM Tide Gauge Bench Mark

UHSLC University of Hawaii Sea Level Centre

WOCE World Ocean Circulation Experiment

* Information that is still missing but will be available in the final report