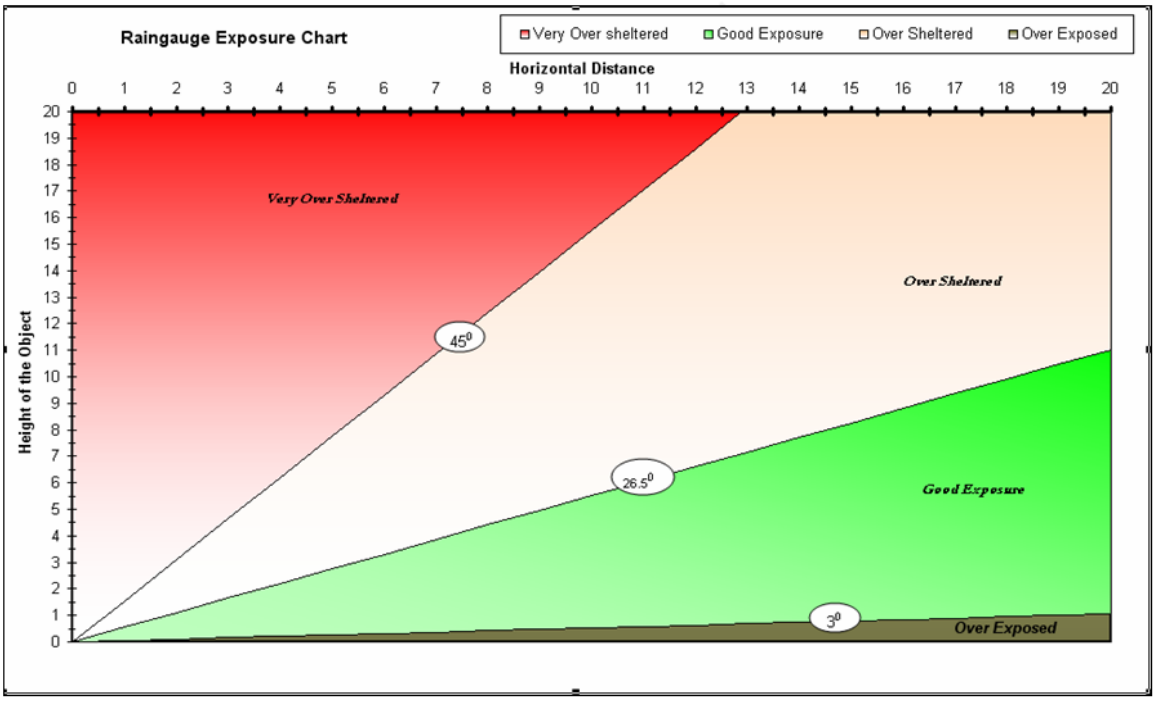
Somalia Rainfall Observers' Manual



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Muchiri P.W., Cody J. (2006), Somalia Rainfall Observers Manual, Technical Report No W-02, FAO-SWALIM, Nairobi, Kenya.

Table of Content

Section

1

Rain gauge Installation, Reading and Maintenance

1 Introduction

SWALIM is re-establishing the national manual rain-gauge network as part of its water and land information systems. The national data set formed will be used to support climate mapping, flood early warning and other hydrological studies. The data set will also be freely accessible to any interested parties. SWALIM will maintain the observations of each station in a dedicated database which will be handed over to an emerging Somali authority at the appropriate time.

Making acceptable precipitation measurement is not as straight forward as it may first appear. It is important to realise that measurements made in a rain gauge represent samples over an area. For this reason the rain gauge must be located and installed so that its catch is as representative as possible of the area being sampled. Rain gauges have been used for hundreds of years, and over this period a comprehensive set of rules and guidelines for locating, installation and reading have evolved. The principle aim of these rules is to ensure that all measurements from a particular network are consistent and comparable.

The purpose of this handbook is to explain in simple terms the working of a rain gauge and to provide guidelines for the installation, maintenance reading and recording the rainfall catch from the rain gauge It is intended for use by Observer's who are part of, or who are associated with, the Somalia Climate

1.1 Rain gauge theory

Manual storage rain gauges are carefully made vessels in which the depth of rainfall over a given area (the area of the entrance to the storage chamber) is measured. This depth is normally associated with a time period normally and is then referred to as the catch e.g. 24-hour catch, 6 hour catch etc. This catch can be converted into a volume of water by the following formula:

$$V = d \times A$$

Where V is the Volume of rainfall collected;

d is the catch in the gauge;

A is the cross-sectional area of the rain gauge.

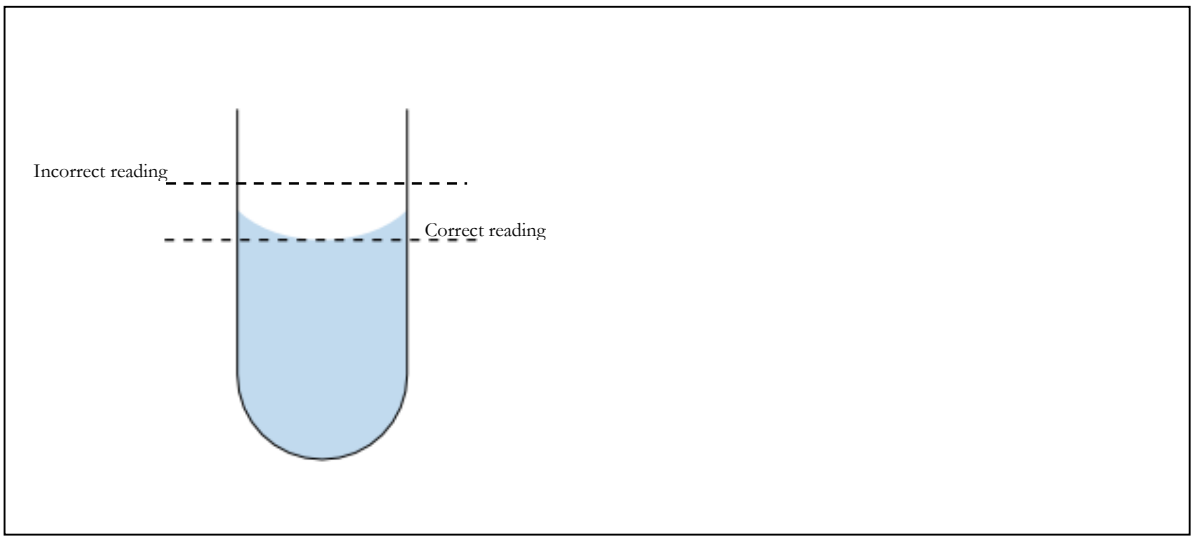
The gauge is supplied with a measuring cylinder which is calibrated to provide a direct reading of the depth per unit area of the gauge. It is critically important that this measuring cylinder be used to measure the catch from the gauge. Rearranging the above equation yields:

$$d = \frac{V}{A}$$

Thus the catch of the rain gauge is determined by the volume of rain falling and the area of the gauge. This means that using a measuring cylinder calibrated for a different gauge will lead to erroneous readings. For example, imagine that 200 mm^3 is collected in a rain gauge with a $50mm^2$ collecting funnel over a 24 hour period. Using a measuring cylinder calibrated for the gauge, the catch would be recorded as 4 mm. However, if a measuring cylinder calibrated for a rain gauge with a $100mm^2$ collecting funnel was used, the catch would be incorrectly recorded as 3 mm.

When water is poured into the measuring cylinder, a meniscus may be formed due to the attraction between the water molecules and the measuring cylinder materials. In such a case the lower level of the convex surface water surface should be read.

Figure 1: Correct reading level when meniscus is formed



A typical rain gauge is designed to ensure that:

- rain falling into the gauge cannot splash out;
- rain falling outside the gauge cannot splash in;
- collected rain cannot evaporate or leak away;
- collected rain cannot be increased by either condensation or flooding.

There are two types of rain gauge currently in use in Somalia; the Nylex 1000 rain gauge and the Standard Rain-Gauge. Descriptions of the construction of these two rain gauge types, the procedures to be used for taking readings from them are presented in the following two sections.

1.2 Description of the Nylex '1000' Rain gauge

The Nylex "1000" Professional Rain Gauge is a plastic rain gauge consisting of

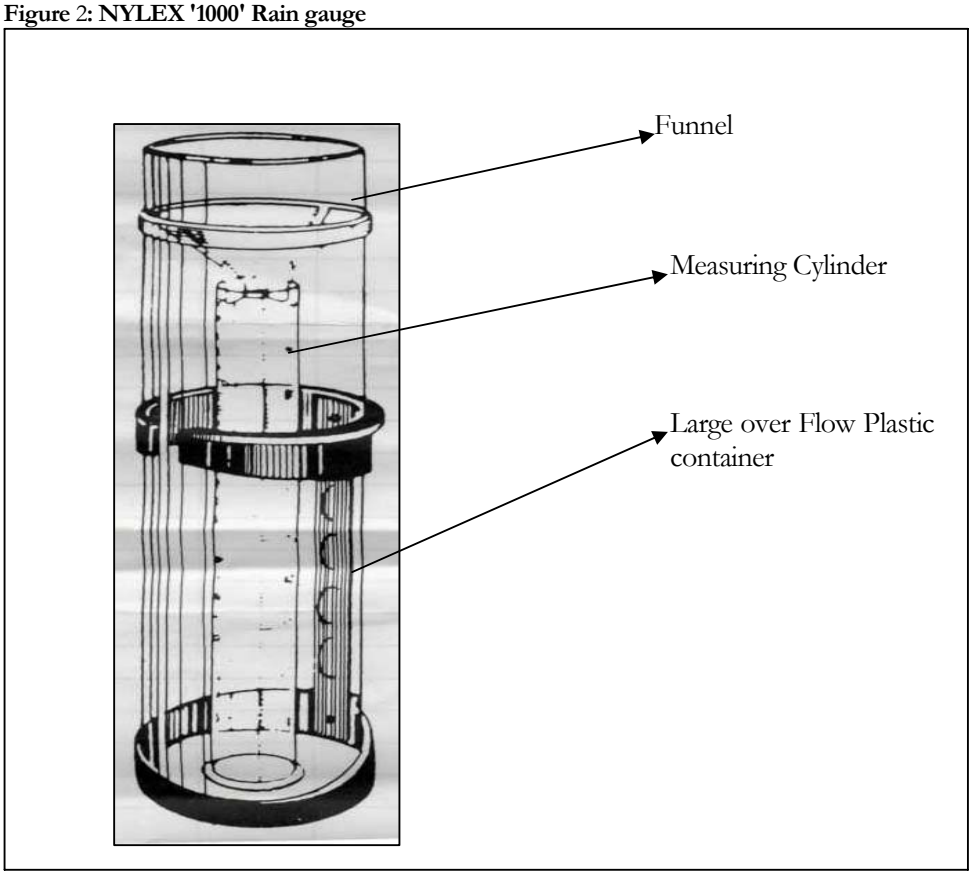
1. A black plastic funnel (diameter 101.6 mm).
2. A calibrated, transparent plastic measuring cylinder.
3. A transparent plastic overflow canister.

4. A black plastic upper mounting

5. A black plastic lower mounting.

The funnel acts as the actual rain collector. The catch is directed from the funnel directly into the measuring cylinder, which is graduated from 0 – 25 mm in 0.5 mm intervals. The plastic overflow collector serves the dual purpose of providing a means of locating the measuring cylinder relative to the funnel and collecting overflow in the event that the catch exceeds the capacity of the measuring cylinder. The upper and lower mountings hold the rain gauge in place on the mounting post (not supplied) by means of two screws.

Figure 2: NYLEX '1000' Rain gauge



1.2 Installation of the NYLEX '1000' Gauge

The rain gauge should be mounted on a sturdy post that has been buried in the ground. The rain gauge should be in a vertical position, with the funnel horizontal. The rim of the funnel should be a minimum of 400mm above ground level.

1.3 Procedure for NYLEX '1000' Rain gauge rainfall collection

The measurement is to be made once daily, as near 9.00 a.m. (East African Standard Time) as possible.

1. Check that the funnel is clear from any debris or blockages such as leaves, twigs etc. If this is the case remove debris, clean funnel and note in the remarks column on the Monthly Rainfall Report form and proceed to Step 2 (See Appendix);

2. Remove funnel and lift out the measure cylinder. If there is no water in the measuring cylinder, proceed to Step 5, recording 0 (zero) reading on the Monthly Rainfall Report next to the appropriate date. If there is water proceed to Step 3

3. Hold measuring cylinder at eye level;

4. With your eye opposite the water level to fix the nearest line on the scale to the lower water surface.

5. Note the reading on the Monthly Rainfall Report[1].

6. Empty the measuring cylinder after noting the reading. Failure to empty the measuring cylinder will give a wrong reading the following day.

7. Replace measuring cylinder and funnel, ensuring that the measuring cylinder is properly located in the overflow canister and that the funnel is properly located in the measuring cylinder.

If the catch has exceeded the 25 mm capacity of the measuring cylinder, water will have spilt into the overflow container. In this case the following procedure should be used:

1. Remove funnel and lift out the measure cylinder;

2. Carefully pour water from the measuring cylinder into the overflow canister;

3. Using the funnel, carefully fill the measuring cylinder up to the 25 mm level from the overflow canister;

4. Repeat this process as often as required, noting how many times you refill the measuring cylinder;

5. For the remainder, with your eye opposite the water level to fix the nearest line on the scale to the lower water surface

6. Calculate the total catch using the following formula:

   Total Catch = 25 x (number of times cylinder refilled) + remainder.

   To illustrate this calculation, suppose that you need to fill the measuring cylinder twice, and the remainder is read as 7.5 mm. the total catch would then be;

   Total Catch = 25 + 25 + 7.5=57.5 mm..

   Should it be necessary, the water can be emptied into a separate container so that it can be re-checked.

7. Note the reading on the Monthly Rainfall Report.

[1] As the measuring cylinder is graduated in 0.5 mm increments, this is the limit of precision to which the gauge can be read. Any readings reported to a greater degree of precision than this will automatically be rounded to the nearest 0.5 mm in the Database.

8. Replace measuring cylinder and funnel, ensuring that the measuring cylinder is properly located in the overflow canister and that the funnel is properly located in the measuring cylinder.

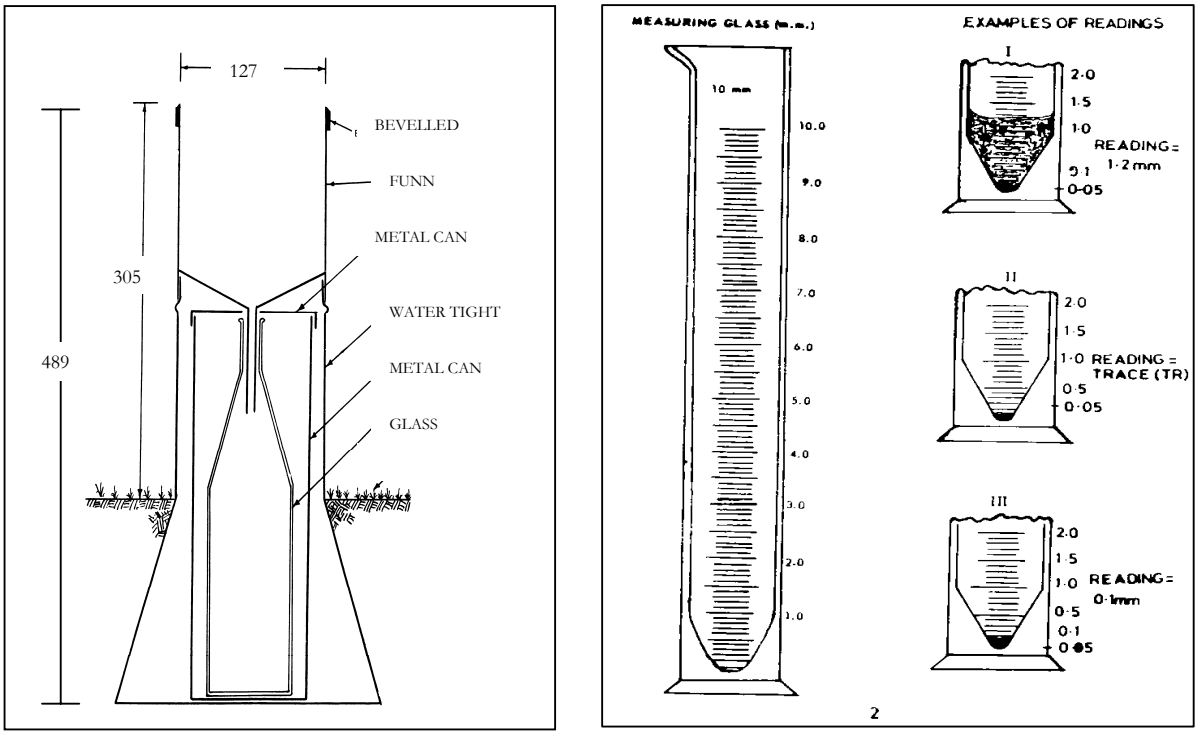
1.3 Description of the standard Rain gauge

The Standard Rain-gauge is normally made of galvanised iron and consists of the following parts:

1) An outer water tight can whose lower portion is conical in shape;
2) A funnel that has a brass rim of 127mm diameter mounted at the top which slides closely over the top section of the outer water tight can;
3) An inner cylindrical can with a metallic cover that acts as the rainfall collector;
4) A glass bottle with a narrow necked aperture to reduce evaporation (not supplied). Using a glass bottle can simplify checking the catch and carrying measurements. Normally a 500ml soda bottle is preferred

The arrangement of the various components is shown in Figure 3.

Figure 3: Standard rain gauge construction and measuring cylinder



The funnel acts as the rain collector and directs the rainfall amount into the glass bottle. To measure the catch the measuring cylinder supplied with the gauge must be used. Unlike the NYLEX 1000

gauge, the measuring cylinder is a separate component on the Standard Rain Gauge, and is not part of the operational gauges construction. The Standard Rain Gauge measuring cylinder (Figure 3) has a capacity of 10.0mm and is graduated in divisions of 0.1 mm, allowing the catch to be read to a precision of a tenth of a millimetre. Whole millimetres graduations are marked (1.0, 2.0, etc.). In addition a division of 0.05 is marked on the lowest point of the scale to improve the reading accuracy for rainfall depths below 1mm.

1.3.1 Installation of the Standard Rain gauge

The standard rain gauge should be buried to the top of the conical section of the gauge, which will leave 305 mm of the gauge above ground level. The rim of the gauge should be level.

1.3.2 Procedure for Standard Rain gauge rainfall collection

The measurement is to be made once daily, as near 09.00 a.m. Somalia Time (East African Standard Time) as possible.

1. Check that the funnel is clear from any debris or blockages such as leaves, twigs etc. If this is the case remove debris, clean funnel and note in the remarks column on the Monthly Rainfall Report form and proceed to Step 2;

2. Lift off the top can of the gauge and take out the inner cylindrical can, or bottle, in which the rainwater is collected. If there is no water in the measuring cylinder, proceed to Step 5, recording 0 (zero) reading on the Monthly Rainfall Report next to the appropriate date. If there is water proceed to Step 3

3. If the inner can/glass bottle contains water, carefully pour it into the measuring cylinder, ensuring that none is split;

4. With your eye opposite the water level, fix the nearest line on the scale to the lower water surface;

5. Note the reading on the Monthly Rainfall Report in mm and tenths of mm (Appendix 1).

If the rainfall has exceeded the 10 mm capacity of the measuring cylinder;

6. Carefully pour water into the measuring cylinder to between the 9 and 9.5 mm graduation, ensuring that none is split;

7. With your eye opposite the water level, fix the nearest line on the scale to the lower water surface and note the reading (Reading 1);

8. Pour water in the measuring cylinder into a jug or jar and repeat Steps 6 and 7 until the inner can or bottle is empty;

9. When the inner can is empty calculate the total catch the total catch

   To illustrate this calculation, suppose that you fill the measuring cylinder three times, the first time to 9.5 mm, the second time to 9.7 mm and the third time to 7.5 mm. The total catch would then be;

Total Catch = 9.5+9.7 + 7.5=26.7 mm

Should it be necessary, the water can be emptied into a separate container so that it can be re-checked;

10. Repeat the process with the water in the jug or jar to check the result;

11. Note the total catch on the Monthly Rainfall Report;

12. Return the bottle, the metal can cover and the funnel properly.

If so much rain has fallen that the inner can is filled and there is some in the outer can, the gauge must be taken out of the ground and all the water measured. This must be done with great care because heavy falls of rain are important.

1.4 General Guidance on Site Selection and Installation

Wind is has the most influence on a rain gauges catch. If the rain gauge is over sheltered by being placed to close to obstructions such as buildings, trees or fences, rain driven by strong winds will not reach the rain gauge. On the other if the rain gauge is over exposed in a very open position then considerable quantities of rain can be carried away by wind eddies. The site selected for a rain gauge should full fill the following requirements:

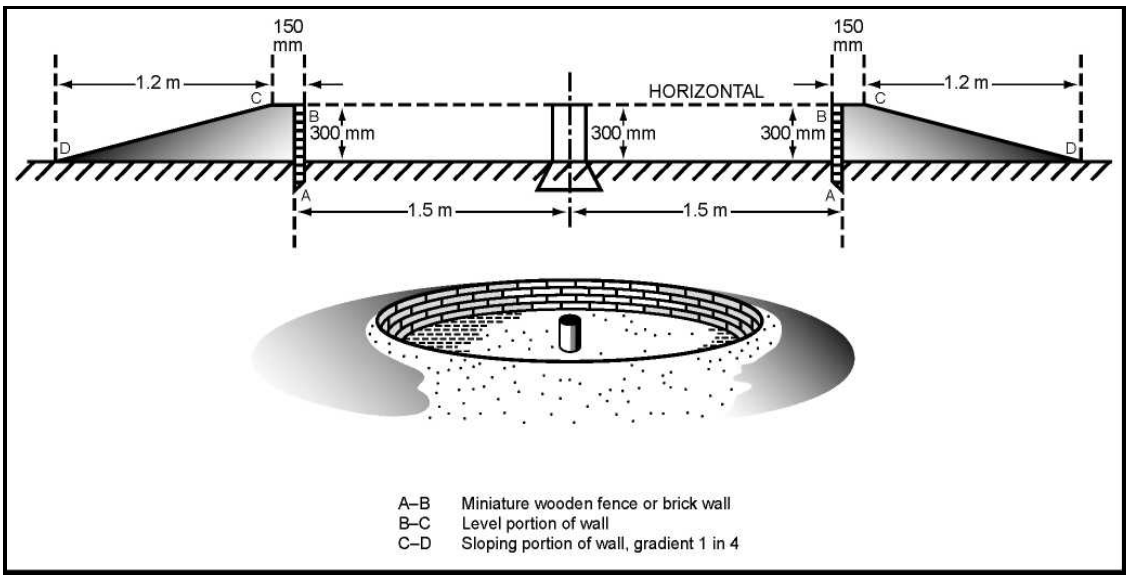
1. Be on level ground and not on a slope or terrace;

2. As a rule of thumb, the rain gauge should be placed away from an obstruction at a minimum distance of twice the height of that obstruction;

3. Ideally, the site should be grass-covered for some distance, in order to prevent heavy rain falling around the gauge from splashing into the gauge.

If the rain gauge is found to be over exposed, a 'turf wall' can be constructed. The Purpose of the turf wall is is to minimise the formation of wind eddies. A diagram of a turf wall is shown Figure 4.

Figure 4: Turf wall construction

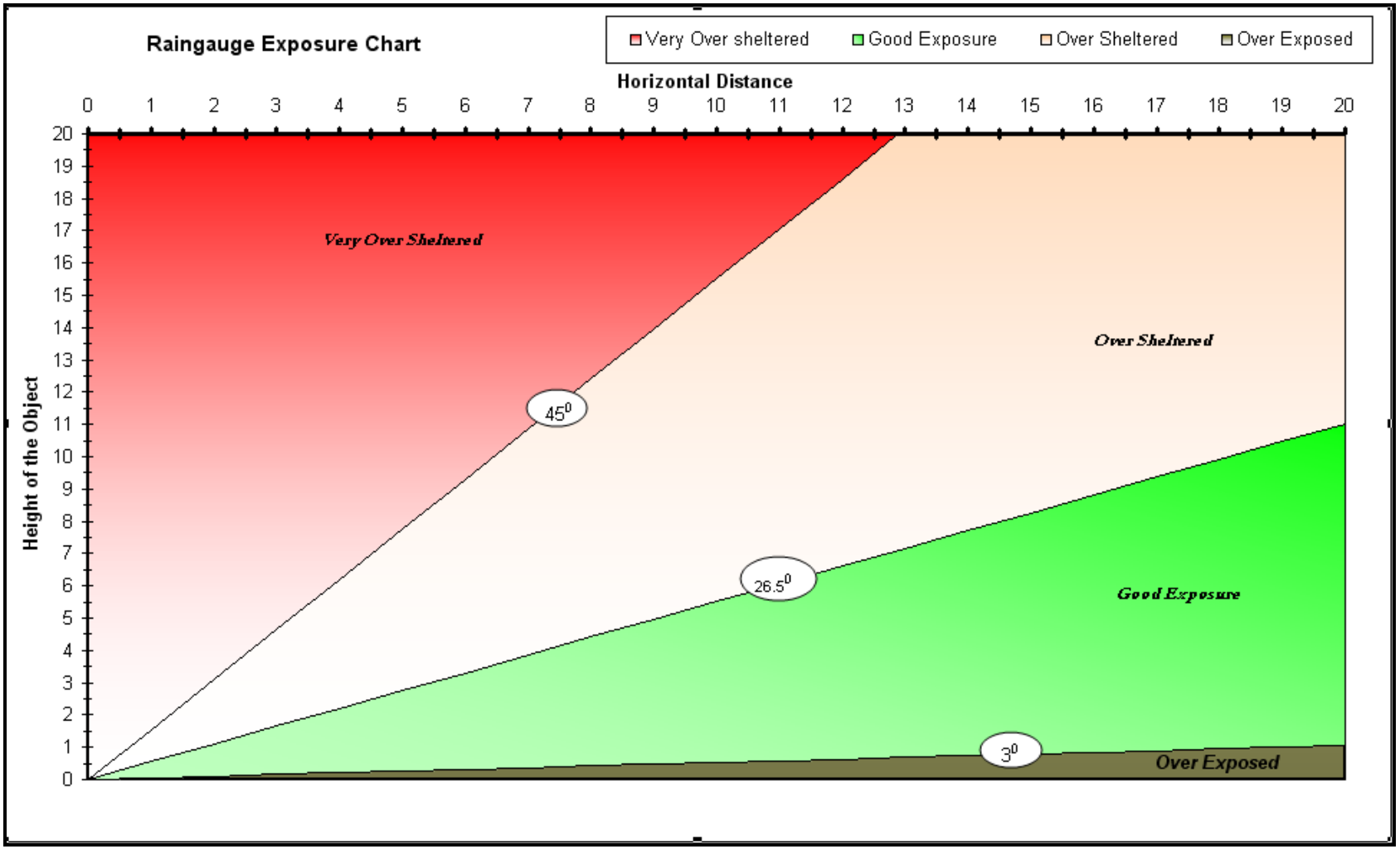


The small embankments of the turf wall prevent wind eddies from carrying the catch away from the raing gauge collecting funnel. The turf wall should have an internal diameter of 3 metres. The crest should be horizontal and in the same plane as the rim of the rain gauge. The turf wall should be 150 mm thick at the top, the inside should be vertical and the outside should slope down by one in four. It is advisable to put a pipe through the wall for drainage purposes. It is essential that the height (300 mm) of the wall should be maintained over the operational life of the gauge.

A fence may have to be built round the gauge to protect it, if so some form of stock-proof open-mesh fencing should be used. When the instrument has been placed in position it should not be moved. If the gauge must be moved details of the change and the reason for it should forwarded with the next rainfall return.

The chart in Figure 5 provides a means of assessing the exposure of a rain gauge at a given site. The vertical height of a possible obstruction is estimated and marked on the vertical axis of the chart. Then the horizontal distance between the possible obstruction and the proposed rain gauge site is estimated or measured and marked on the horizontal axis of the chart. The point of intersection on the charts where these two points meet indicates the exposure of the rain gauge.

Figure 5: Rain gauge exposure chart



1.5 Care And Maintenance of rain gauges

1.5.1 S*ite*

- Grass should be kept short and the growth of trees or flowers restricted so as not to interfere with the exposure of the gauge.
- Garden sites can quickly over shelter a rain gauge whilst still remaining very tidy and well kept. Observers should therefore check the site regularly to make sure that no plants are nearer to the gauge than twice their height.

1.5.2 Rain gauge

- The containers should be kept clean and free from leaves; rust, etc.
- The rain gauge components should be regularly inspected for leaks by filling each one with water to make sure that none escapes at any point.
- When testing the funnel block the lower end of the delivery tube with a finger and fill it with water. Alternatively, the funnel may be tested by blocking the lower end of the delivery tube, turning it upside down and pressing it downwards into a container of water. In this case the presence of a leak will be shown by the escaping bubbles of air.
- If the rain gauge is damaged or leaking it should be repaired locally. If this is not possible, SWALIM should be contacted immediately to supply a new gauge.
- If a bottle is used with the standard rain gauge it should be kept clean, as a dirty bottle inhibits the free flow of water drops and makes small catches difficult to read.

1.5.3 *Measuring Glass*

- The measuring cylinder should be kept clean and free from marks or scratches.
- The standard rain gauge must not be left in the rain gauge & should preferably be stored in a safe place indoors when not in use.
- If the measuring glass is broken the matter should be reported to SWALIM immediately so that a replacement measuring cylinder can be supplied.
- The dates and description of any equipment damage should be noted on the Monthly Rainfall Report.

1.6 Absence of observer

An assistant should, be trained to measure the rainfall in the absence of the observer. If for some reason a daily reading is missed, the gauge should be left untouched until the observer's return. The accumulated amount should then be read and entered on the return, the days concerned being indicated with a bracket.

Section

2

Data Entry and Despatch of Returns

In general, black ink should be used to complete the information sheets so as to ensure the quality and legibility of photocopies and scans. Ball point pens should be used in preference to fountain pens or felt-tip pens so as to prevent smearing and running. Ball-point ink is also more resistant to water.

The fields should be completed carefully in neat, legible block capitals as the attribute is measured. Making a fair copy from field notes is not recommended due to the possibility of error when copying to the sheets. When filling in the 'check-boxes' the ✓ symbol should be used. If a check box is ticked with the ✓ symbol by mistake, this symbol should be converted to an ✘ symbol. In this case the 4 points of the ✘ should extend outside the check box.

2 Completing the Station Registration Form

On installing the rain gauge in a favourable site the gauge must be registered using the Station Registration form. The registration form contains information on the station location, observer and equipment. Entries to the form should be legible and the sketch should be clear. The completed form should then be returned to SWALIM office as quickly as possible.

2.1 Site Location

- Date: enter the date, in mmm/yyyy format that the gauge was installed.
- Agency: Enter the name of the agency responsible for managing and monitoring the rain gauge station.
- Station Name: enter the name by which the station is to be known.
- Nearest Settlement: enter the name of the nearest permanent settlement to the rain gauge station.
- North: Enter the GPS coordinates of the site to six decimal places, if available.
- East: Enter the GPS Coordinates of the station to 6 decimal places, if available.
- Elevation: To be completed by SWALIM.
- Registration Number: To be completed by SWALIM
- Contact Name: Enter the full name of the Chief Observer for the station.
- Telephone: Enter the mobile telephone (If available) and land line telephone number (if available) of the Observer, including country and area codes.
- Email: Enter the e-mail address/addresses of the observer.
- Sketch: In the space provided draw a dimensioned sketch of the gauge placement showing the heights of any obstruction in the surrounding and the distance between the obstruction and the rain gauge; other specifications to be shown on the sketch include the height of the rim above the ground and the nature of the surrounding surface e.g. earth, grass, etc.

2.2 Equipment

- Material: Enter the material that the rain gauge is made from.
- Diameter of Rim: Enter the rim diameter in millimetres
- Condition: State whether the rain gauge is in good condition or faulty etc.
- Gauge Supplied: In this field, show supplier of the gauge by ticking ☑ in the respective box .Should you tick the wrong box by mistake then cross the tick☒ and proceed to tick in the right box
- Measuring glass supplied with gauge: Put a tick in the yes box if the measuring cylinder was supplied together with the rain gauge otherwise tick the no box.
- Dimensions: Indicate whether the measuring units are in millimetres or inches by ticking in the appropriate box.
- Glass calibrated to gauge: Indicate if the measuring cylinder is calibrated to the gauge by ticking yes and No if not calibrated.
- Calibration Ratio: Enter the ratio of the scale of the measuring cylinder to actual measurement. For example, 1mm of the measuring cylinder represents 6mm.
- Dates from which records are available: Enter the date from when the records are available from the rain gauge.
- Further Information: In this space, write down further notes that are worth noting.

3 Completing and Submitting Monthly Rainfall Reports

The monthly rainfall report form (Appendix 2) is a small card that has space for daily rainfall record for each month of the year. Twelve cards are supplied annually for each station. The re-sealable plastic bags supplied with the forms are intended to protect the sheets during use.

At the beginning of each month the Observer should carefully fill in the Station Name Field, the Month and the Year fields on the top of the form. Days of the month are numbered from 1 to 31 in the left-hand column in the body of the form. The catch should be recorded each day starting in the row Numbered 1 for the first day of the month. The following procedure is used to record the daily rainfall:

3.1 Procedure for Recording the Daily Catch

- Locate the row on the form that is numbered corresponding to the current day of the month.
- Time: Enter the time of day at which the catch was recorded in ##:## format (this should be as close to 09:00 Somali time as possible).
- Rainfall: Enter the catch for the day in #.# format:

  If the measurement is less than 1 mm, the entry should consist of '0' followed by a decimal point, followed by the observed number of tenths e.g. 0.5 mm

  If the measurement amounts to 1 mm or more a decimal point should always be inserted between the figure representing whole millimetres and the figure representing tenths of a millimetre e.g. 12.5mm;

  The reading should be taken to one decimal place only, i.e. to the graduation mark nearest to the level of the water surface.

  Days without any rain are indicated by 0

  If, for whatever reason, there are missing values, an 'm' or a dash '–'should be entered. **Never enter zero for missing values**

If there is a doubt about any figure a **'?'** should be placed beside it and an explanatory note should be included in the Remarks column.

- Remark: Indicate any unusual events in this column.

3.2 Returning the Month Rainfall Report Form

At the end of each month the Observer should complete the following sections of the form:

- Changes of equipment or its location during this month: If the equipment or the rain gauge location changed within the month, including reasons for such changes.
- Observer's Name and Address Name: Enter the full name of the Chief Observer for the station, the mobile telephone number (If available) and land line telephone number (if available) of the Observer, including country and area codes. Also, indicate the e-mail address of the chief observer.
- Monthly total: Enter the summation of daily rainfall from the first day of the month to last day of the month.

The completed form should be put in one of the addressed envelopes supplied and returned to SWALIM by the quickest available route.

4 Supply of forms

Copies of Rainfall *Observer's manual* are supplied free on application to the address given below. Forms for the return of observations to the SWALIM Office are issued annually on a routine basis. Those observers who send their returns through a third party e.g. Local Authorities or International Agencies, will normally obtain their supply of forms from the agency. Downloads of all the forms will be available from the FAO SWALIM website (www.faoswalim.org).

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Appendix 1: Completed Monthly Rainfall Report Example