(b) There should be no steeply sloping ground in the vicinity and the site should not be in a hollow. If these conditions are not complied with, the observations may show peculiarities of entirely local significance;

(c) The site should be well away from trees, buildings, walls or other obstructions. The distance of any such obstacle (including fencing) from the raingauge should not be less than twice the height of the object above the rim of the gauge, and preferably four times the height;

(d) The sunshine recorder, raingauge, and anemometer must have exposures to satisfy their requirements, preferably on the same site as the other instruments;

(e) It should be noted that the enclosure may not be the best place from which to estimate the wind speed and direction; another observation point, more exposed to the wind, may be desirable;

(f) Very open sites which are satisfactory for most instruments are unsuitable for raingauges. For such sites, the rainfall catch is reduced, some simple measures that will not interfere with other instruments should be taken to reduced heavy winds to light winds and some degree of shelter is needed so that the rain will not be blown by winds;

(g) If in the surroundings of the instrument enclosure, maybe at some distance, objects like trees or buildings obstruct the horizon significantly, then for observations of sunshine or radiation alternative viewpoints should be selected;

(h) The position used for observing cloud and visibility should be as open as possible and command the widest possible view of the sky and the surrounding country;

(i) At coastal stations, it is desirable that the station should command a view of the open sea, but it should not be too near the edge of a cliff because the wind eddies created by the cliff will affect the measurements of wind and the amount of precipitation;

(j) Night observations of cloud and visibility are best made from a site unaffected by extraneous lighting.

To minimize tampering by animals and people, it is very desirable to fence the weather station. A sample layout is shown in Figure 4. 1. This layout for northern hemisphere stations is designed to eliminate as far as possible the shadowing effect of fence posts on instruments and to ensure that direct sunlight does not enter the thermometer screen during observations. In the southern hemisphere the general orientation of instruments is different from that of the northern hemisphere, the door of the thermometer screen (Stevenson Screen), for example, is open to the south. At equatorial and tropical stations, of course, the thermometer screen have doors opening to both the north and the south. All radiation instruments and sunshine recorders should be carefully mounted in a position free from all shadows at all times. The minimum distance between instruments is also indicated in the figure 4. A larger area is recommended when other instruments and small plants for phenological observations are used.

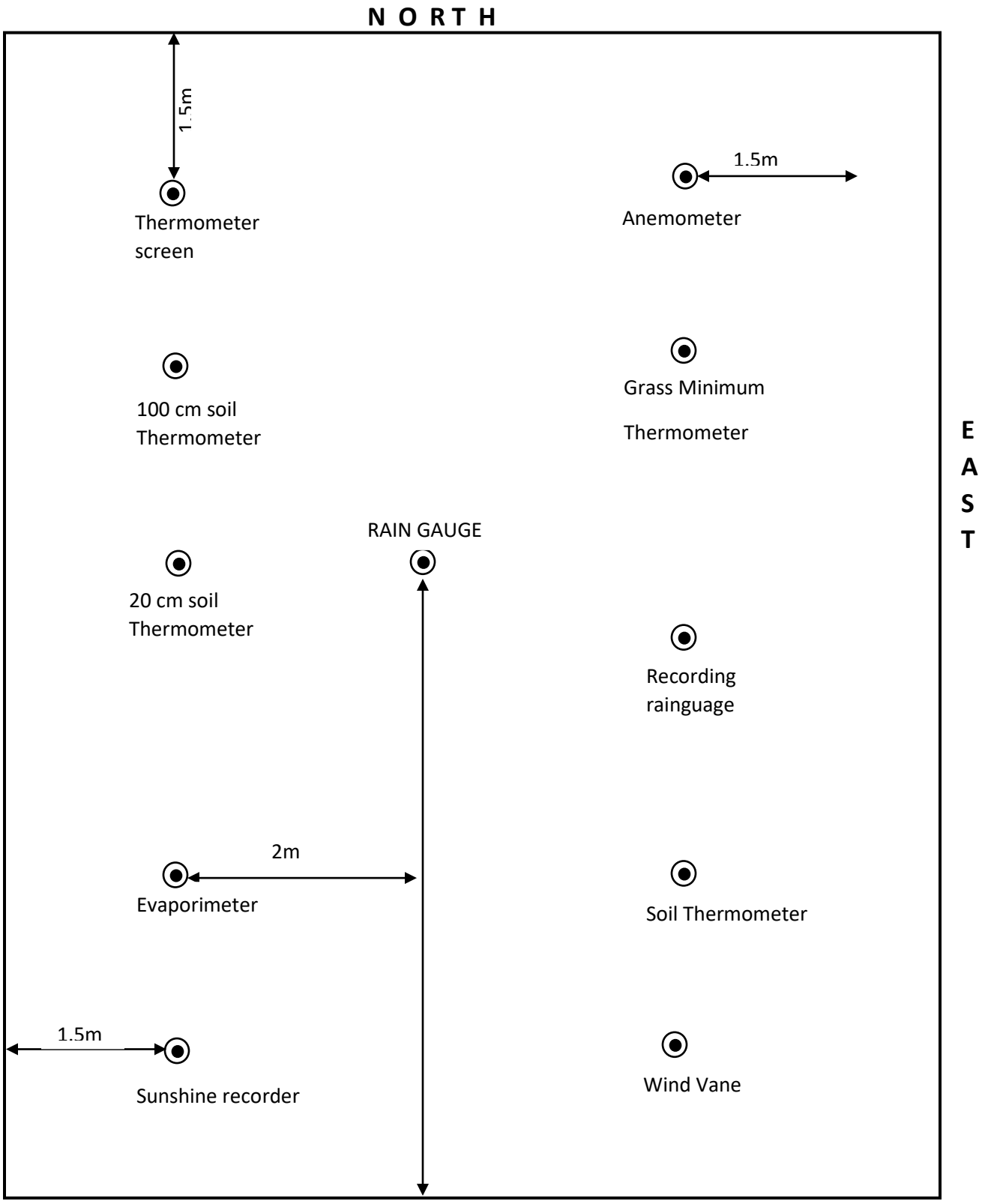

Figure 4.1 Sample layout of station :(Source: WMO-No, 8, 2008).

The establishment of Nigerian Meteorological Agency's Weather Stations must be in tandem with the WMO's Standards. The siting of instruments is important to having observations that represent any surrounding area. Many follow their own policy on selecting sites and the design of a weather station. Design and siting of Meteorological Equipment are well described in WMO Manuals and Guides. It is worthy to note that an ideal site cannot be found because of natural and artificial limitations.

As presented in Table 4.1, there is the presence of meteorological observatory in all the stations listed and this was sighted and also confirmed by all the 287 respondents drawn from Meteorologist, Forecaster and Engineers. Kano has 28% of the respondents, Kaduna has 9% respondents, Maiduguri has 7% respondents, Lagos has 18% of the respondents, Enugu has 7% of the respondents, Port Harcourt has 11 and Abuja has 20% respondents.

Table 4.1 Availability of Meteorological Enclosure

Station	**Number of Respondents**	**Yes**	**No**	**Percentage**
Kano	81	81	00	28
Kaduna	25	25	00	9
Maiduguri	19	19	00	7
Lagos	51	51	00	18
Enugu	21	21	00	7
Port Harcourt	32	32	00	11
Abuja	58	58	00	20
Total	**287**	**287**		**100**

(Source: Authors' fieldwork, 2019)

Each station making surface synoptic observations should be located at a site where the meteorological data obtained are representative of the state of the atmosphere over a large region. The station should have a plot of land specially assigned to it.

A total of 287 respondents were drawn from Kano, Kaduna, Maiduguri, Lagos, Enugu, Port Harcourt and Abuja. Kano has 81 respondents, Kaduna has 25 respondents, Maiduguri has 19 respondents, Lagos has 51 respondents, Enugu has 21 respondents, Port Harcourt has 32 and Abuja has 58 respondents.

Table 4.2 shows that the meteorological enclosure in Kano was sited according to WMO standards with regards to size, location, fencing, layout, metadata and obstruction issues this was seen and also confirmed by the Eighty One (81) respondents drawn from Meteorologist, Forecasters, Observers and Engineers.

Table 4.2 Compliance of Siting Meteorological Enclosure at Kano

Site Requirement	Number of Respondents	Yes	No
Size	81	81	00
Location	81	81	00
Fencing	81	81	00
Exposure	81	81	00
Layout	81	81	00
Metadata	81	81	00
Unobstructed	81	81	00

(**Source: Authors' fieldwork, 2019)**

Table 4.3 shows that the meteorological enclosure in Kaduna was sited according to WMO standards with regards to size, location, fencing, layout, metadata and obstruction issues this was seen and also confirmed by the Twenty Five (25) respondents drawn from Meteorologist, Forecasters, Observers and Engineers.

Table 4.3 Compliance of Siting Meteorological Enclosure at Kaduna

Site Requirement	Number of Respondents	Yes	No
Size	25	25	00
Location	25	25	00
Fencing	25	25	00
Exposure	25	25	00
Layout	25	25	00
Metadata	25	25	00
Unobstructed	25	25	00

(**Source: Authors' fieldwork, 2019)**

Table 4.4 shows that the meteorological enclosure in Maiduguri was sited according to WMO standards with regards to size, location, fencing, layout, metadata and obstruction issues this was seen and also confirmed by the Nineteen (19) respondents drawn from Meteorologist, Forecasters, Observers and Engineers.

Table 4.4 Compliance of Siting Meteorological Enclosure at Maiduguri

Site Requirement	Number of Respondents	Yes	No
Size	19	19	00
Location	19	19	00
Fencing	19	19	00
Exposure	19	19	00
Layout	19	19	00
Metadata	19	19	00
Unobstructed	19	19	00

(**Source: Authors' fieldwork, 2019)**

Table 4.5 shows that the meteorological enclosure in Lagos was sited according to WMO standards with regards to size, location, fencing, layout, metadata and obstruction issues this was seen and also confirmed by the Fifty One (51) respondents drawn from Meteorologist, Forecasters, Observers and Engineers.

Table 4.5 Compliance of Siting Meteorological Enclosure at Lagos

Site Requirement	Number of Respondents	Yes	No
Size	51	51	0.00
Location	51	51	0.00
Fencing	51	51	0.00
Exposure	51	51	0.00
Layout	51	51	0.00
Metadata	51	51	0.00
Unobstructed	51	51	0. 00

(**Source: Authors' fieldwork, 2019)**

Table 4.6 shows that the meteorological enclosure in Enugu was sited according to WMO standards with regards to size, location, fencing, layout, metadata and obstruction issues this was seen and also confirmed by the Twenty One (21) respondents drawn from Meteorologist, Forecasters, Observers and Engineers.

Table 4.6 Compliance of Siting Meteorological Enclosure at Enugu

Site Requirement	Number of Respondents	Yes	No
Size	21	21	00
Location	21	21	00
Fencing	21	21	00
Exposure	21	21	00
Layout	21	21	00
Metadata	21	21	00
Unobstructed	21	21	00

(**Source: Authors' fieldwork, 2019)**

Table 7 shows that the meteorological enclosure in Port Harcourt was sited according to WMO standards with regards to size, location, fencing, layout, metadata and obstruction issues this was seen and also confirmed by the Thirty Two (32) respondents drawn from Meteorologist, Forecasters, Observers and Engineers.

Table 4.7 Compliance of Siting Meteorological Enclosure at Port Harcourt

Site Requirement	Number of Respondents	Yes	No
Size	32	32	00
Location	32	32	00
Fencing	32	32	00
Exposure	32	32	00
Layout	32	32	00
Metadata	32	32	00
Unobstructed	32	32	00

(**Source: Authors' fieldwork, 2019)**

Table 4.8 shows that the meteorological enclosure at Abuja was sited according to WMO standards with regards to size, location, fencing, layout, metadata and obstruction issues this was seen and also confirmed by the Fifty Eight (58) respondents drawn from Meteorologist, Forecasters, Observers and Engineers.

Table 4.8 Compliance of Siting Meteorological Enclosure at Abuja

Site Requirement	Number of Respondents	Yes	No
Size	58	58	00
Location	58	58	00
Fencing	58	58	00
Exposure	58	58	00
Layout	58	58	00
Metadata	58	58	00
Unobstructed	58	58	00

(**Source: Authors' fieldwork, 2019)**

Conclusion

Meteorological observing stations are designed so that representative measurements (or observations) can be taken according to the type of station involved.

Where stations are used for several purposes, for example, aviation, synoptic and climatological purposes, the most stringent requirement will dictate the precise location of an observing site and its associated sensors.

It has been proven by the reconnaissance survey conducted and from the respondents that were interviewed that all the meteorological stations that covers the scope of this study were established based on WMO Standards using Guide to Meteorological Instruments and Methods of Observation. This is equally an indication that the meteorological parameters expected from these stations can be effectively used for flood warning system in Nigeria.

Recommendations

This study recommends that:

i. More meteorological station be established at every 150km intervals for surface stations and every 300km for upper air station.

ii. Training and retraining of staff on use and maintenance of the instruments and also to make them effectively manned the stations is recommended.

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