Title

STORM TRANSPOSITION IN SRI LANKA

Author

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Abstract

Storm transposition formula K = ABC is directly giving the modified coefficient to the required location for any designs requiring intensity of rainfall with reference to a capital town in the area. One hour rainfall intensity map is prepared for Sri Lanka. This result is for the use in designinig play grounds, drains, culverts, rooves etc. The maximum one hour rainfall intensity recorded is 110 mm at Puttalam.

1.0 Introduction

Maximum rainfall intensities are collected and plotted on a map to derive isohyets for one hour precipitation. Figure one gives this map. The map also possesses elevations, locations, streams etc.

1.1 Development of intensity distribution maps for Sri Lanka

Resources

Sri Lanka has recorded the rainfall data for naval use during Dutch period. In 1830 Trincomalee has recorded 762 mm one day rainfall. In May 17, 1940 Balangoda has recoded 751 mm one day rain fall. Data is available at many institutions.

Traditional acceptance

The isohyetal map of Sri Lanka shows the wet zone dry zone demarcations with annual rainfall. Seasonal rain fall is given for yala and maha. This method of expressions are helpful for agriculture. The intensity of rainfall is useful for design of spills drains gutters rooves of urban areas. People use a type of roofing material to stand for high intensity. Cadjan asbestoes tiles are selected for roofing in wet zone. Hilly areas with less warming and rainfall can select iron sheets as roofing material.

Short term effective precipitation maps are not available and hence it is necessary to prepare a map to show the intensity of rainfall for the last 20 years.

It is also necessary to derive a suitable formula to relate an occurrence at one place for the expected storm at another place.

1.2 Storm transposition

When a known storm is recorded at one station it is transformed at another location. Any deviation more than 30 km from the wind direction is not reliable. Same way a 10 deg deviation is also not reliable. However the coastal towns are recording intensities at meteorological stations. Any provincial town has to transform data recorded at main stations.

Method of analysis

The storm pattern in Sri Lanka is studied for this project. The zones are divided as wet zone, dry zone, central mountains, arid zones, rain shadows etc.
However these zones are receiving storms with seasons, such individual patterns are important to consider reasons for high intensity.

Wet zone receives SW monsoons and coastal rains
Dry zone receive NE monsoons and coastal rains
Puttalam and Hambantota receive NE monsoon and coastal rains

These areas receive inter monsoon rains developed due to motion of the sun.

Monsoonal action brings the change of wind direction due to position of the sun which creates upwind due to heating. Surface wind generates due to filling of vacuum created by up wind. This wind is again deflects due to coriolis force depending on the location of the land from the equator.

Sri Lanka is with in 6 –10 deg Latitude. So it begins in September and March as the sun crosses vernal equinoxes. This is the doldrums where wind is low and pressure is high with low rains. High winds develop in May, June in wet zone and November, December in dry zone. A flood in August is rare but occured in 1947. Usually main wind stream enters Sri Lanka in May and pass into India in June. High wind developing results in continuous rainfall if the force is big enough to develop high as 3000 meters.
December SW upwind and NE down wind can bring heavy rainfall. June SW down wind and NE upwind can bring heavy rainfall.
Bay of Bengal is a small water surface when compared with Indian Ocean. Hence the effect of Indian Ocean brings major supply into island in both seasons to the SW zone. The central hills catch rains from both directions.

Only 8% of Ocean evaporated water reaches the land. Ocean evaporation utilizes 25% of SOLAR RADIATION. This shows that only 2% of insolation is converted to create rain fall over the land areas. This energy is converted into wind motion and with dynamic cooling releases latent heat onto the land. This is increasing the air temperature. However wind is reducing the air temperature. The land surface needs more warming to attract the wind from cooler ocean surface. Unusual warming of ocean surface reduces the potential of wind leaving the ocean.

Ocean surface and land surface have different albedo and cooling rates. This creates the coastal wind patterns. Coastal belt receives part of this wind with rainfall. These coastal rains reach a distance of 30 km. Monsoonal rain has a periodic interference with day and night winds.
Anticlones and cyclones form a series of events with a combination of pressure, temperature and wind velocity. High pressure zones are calm and quiet. Low pressure zones are creating winds and precipitation. The depression moves from point to point. Any location can receive heavy downpours due to depressions. The frontal type cold mass hot mass mixing also creates high rainfall with thunder storms.

Cloud patterns

The cumulonimbus type of clouds deliver 90 % of the rainfall where as balance 10% is delivered by stratus clouds. Ciriform clouds do not deliver rainfall. Sri Lanka receives hail falling other than water occassionally. Hail is a combination of glaze and rime. Rime is opaque while glaze is transparant.
Snow falling was recorded in Nuwara Eliya.

Probable Maximum Storm

PMS is likely to occur due to high winds passing over the land. This wind creates dynamic cooling when travels uphill and drops more rainfall. Same wind passes the summit and moves downhill with dynamic heating and gives no rainfall. Series of mountain ranges can have windward side and the summit getting heavy rains with leeward side getting no rains.

PMS has distance from the sea as a parameter. It has little sea effect beyond 30 km. Direct influence of rainfall is more on the western coast. The SW area has more rains and the effective centre lies around Kalutara. In 1940-50 period more rainfall reached Benthota.

The high intensity records are plotted on a map to identify high intensity areas. One hour period is considered for analysis. The zones are grouped into seven sectors. There are three high intensity build up namely Puttalam, Attanagalla- Kitulgala- Eheliyagoda, and Moneragala areas. Western coast has high intensity which gradually reduces landward but eastern coast has low intensity which gradually increases towards the land.

Rain shadow areas in central hills has low intensity. North has low intensity. Three recoreded storm data are annexed.

1.3 Storm Transposition Formula.

The map gives a fixed locational response to the problem. But in practice the available rain fall data is available at capital towns and transposition can be done with a formula. This formula linerarly reduces the parameters to the required location from the reference location. Hence the storm either get reduced or enlarged into the new location.
Transposited formula for the SW monsoons.

K = A.B.C
K is the modified coefficient for the new location
A is the distance coefficient for the distance in km from sea to the new location

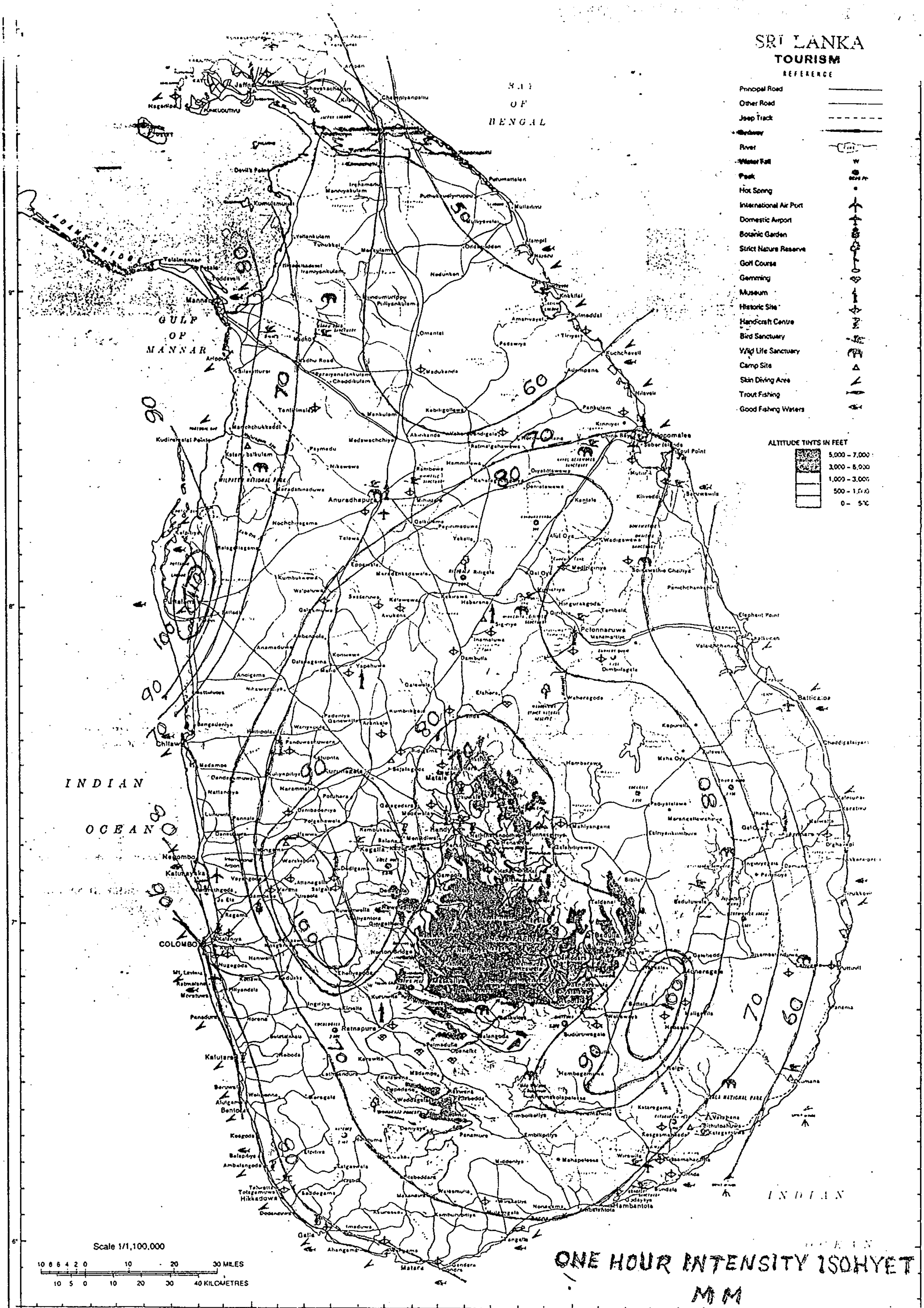
B is the distance coefficient for the distance in km from SW line drawn through the reference point. North is the positive direction
C is the locational quality factor where it is facing leeward or windward to the reference wind direction.

The following tables give the coefficients for the above formula.

Intensity are given as Puttalam 110 mm, Colombo 90 mm, Kalutara 90 mm, Galle 80 mm, Hambanthota 70 mm.

Sea distance km	0	6	12	18	24	30
Coefficient A	1	0.96	0.92	0.89	0.84	0.80

TABLE 1



Based upon the map of the Sri Lanka Survey Department with sanction of the Surveyor General

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1998

Distance (km)	30	20	10	0	-10	-20	-30
Coefficient B							
Puttalam	1.2	1.1	1.0	1	0.9	0.8	0.7
Colombo	1.0	0.95	0.9	1	1.0	0.9	0.85
Kalutara	1.15	1.1	1.05	1	0.85	0.80	0.75
Galle	1.0	1.0	1.0	1	0.9	0.8	0.7
Hambanthota	1.35	1.25	1.1	1	0.9	-	-

TABLE 2

Dry zone C = 1.0
Arid zone C = 1.0
Wet zone leeward elevated shadow C = 0.8
Wet zone windward elevated face C = 1.2

Sri Lanka map is used for evaluation.

TABLE 3

1.4 Conclusion

Sri Lanka has fairly stable pattern of rainfall. The trends are mainly due to land use patterns. Losing vegetal cover can cause low friction to wind. It can also reduce evapotranspiration. It can increase run off. Ground relief is unchanged. A heavy storm is likely after a drought. Also a drought is likely after a heavy storm. Urban planner shall use the above derivations for his designs.

1.5 References

1 Ray K. Linsley et al, Hydrology for Engineers.

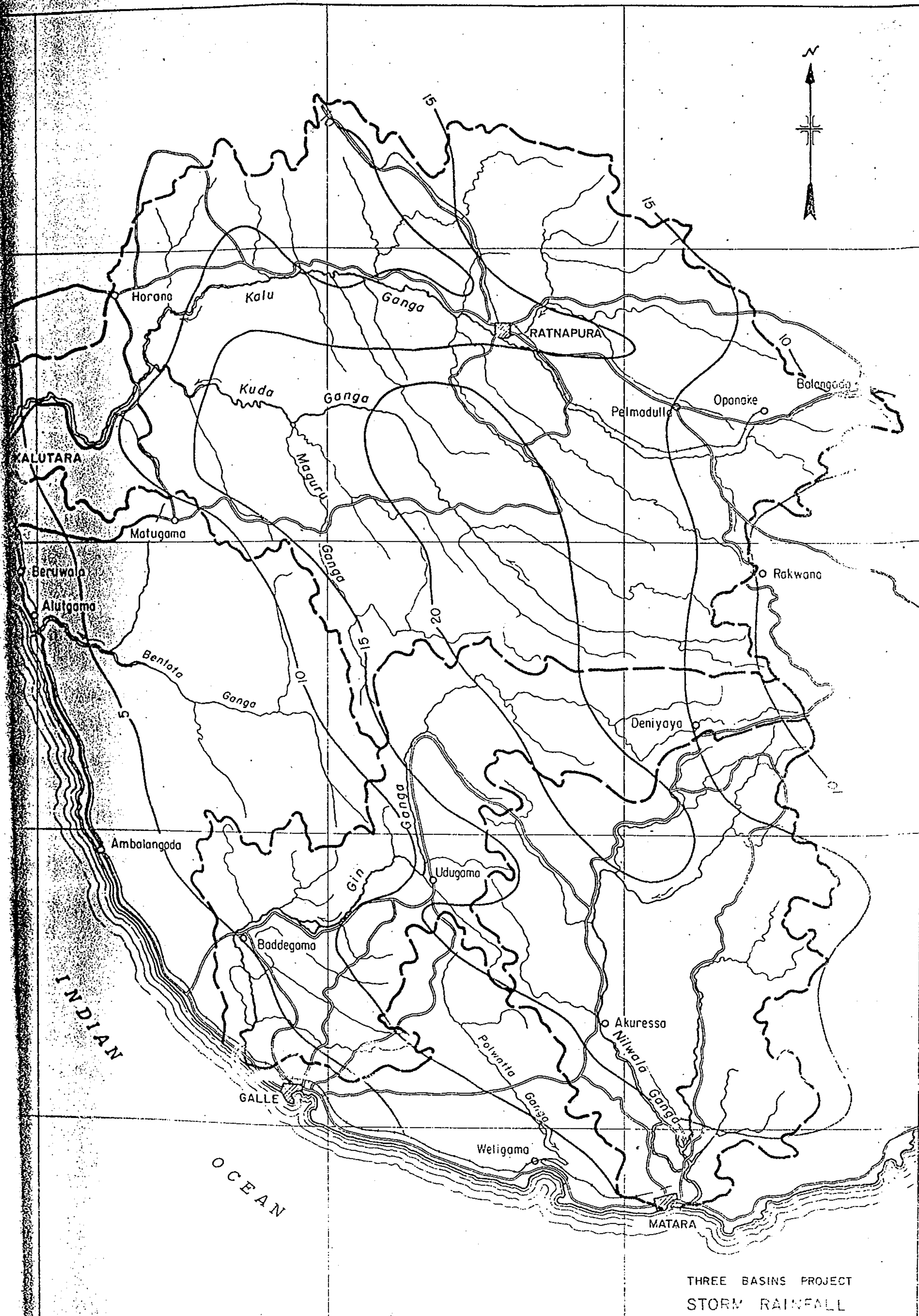
2 Hydrological Annuals, Publication of Irrigation Department.

3 Sri Lanka map of tourism published by Surveyor General 1997.

4 ECI Consultants report, Three basins project, 1975

1.6 Acknowledgements

Author wishes to thank Dr.Sohan Wijesekare and Ms M. D. M. S. Gunetileka

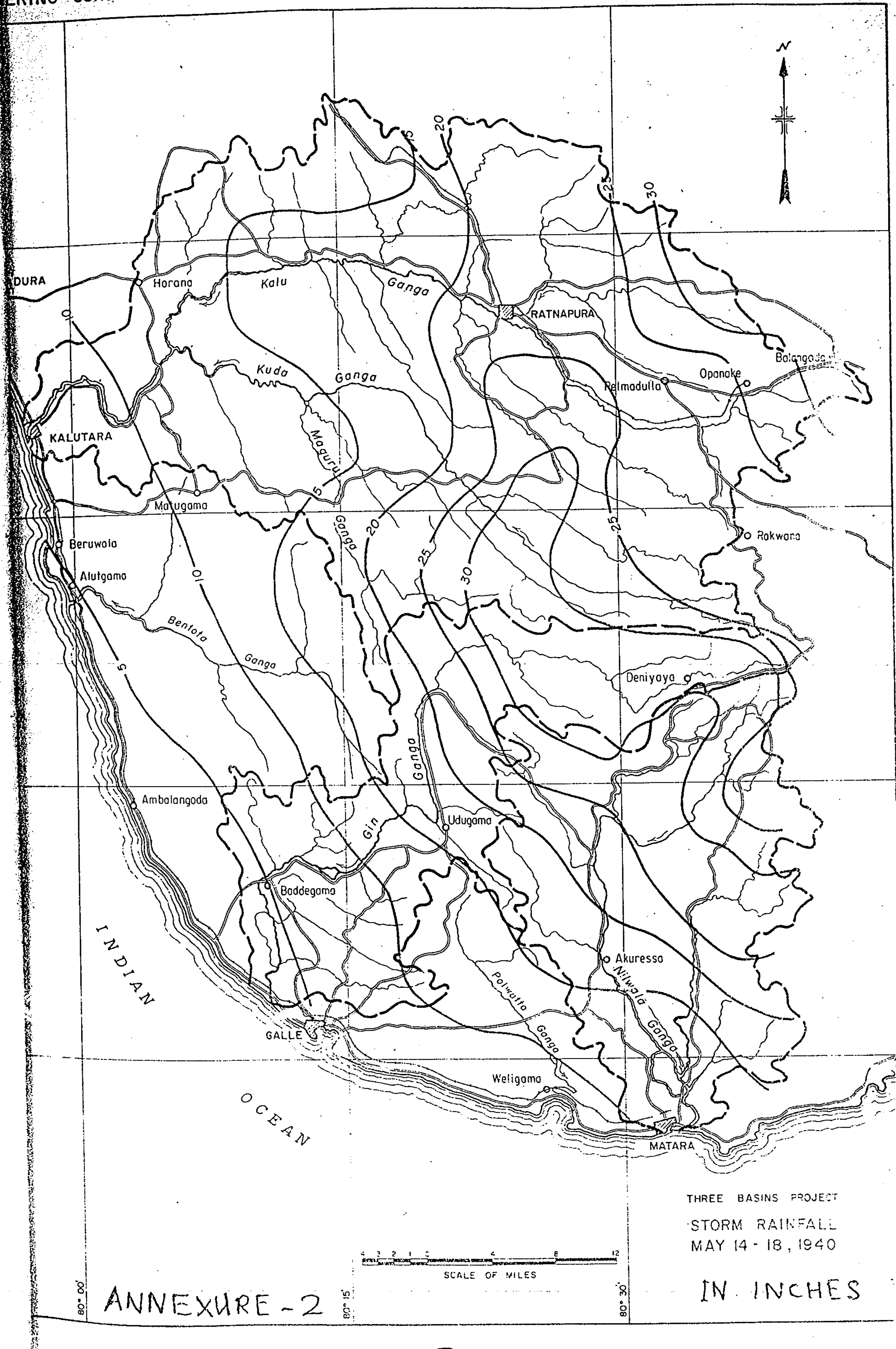


THREE BASINS PROJECT
STORM RAINFALL
MAY 14 - 20, 1944
IN INCHES

ANNEXURE - I

ERING CONSULTANTS, INC.

FIGURE IV-1



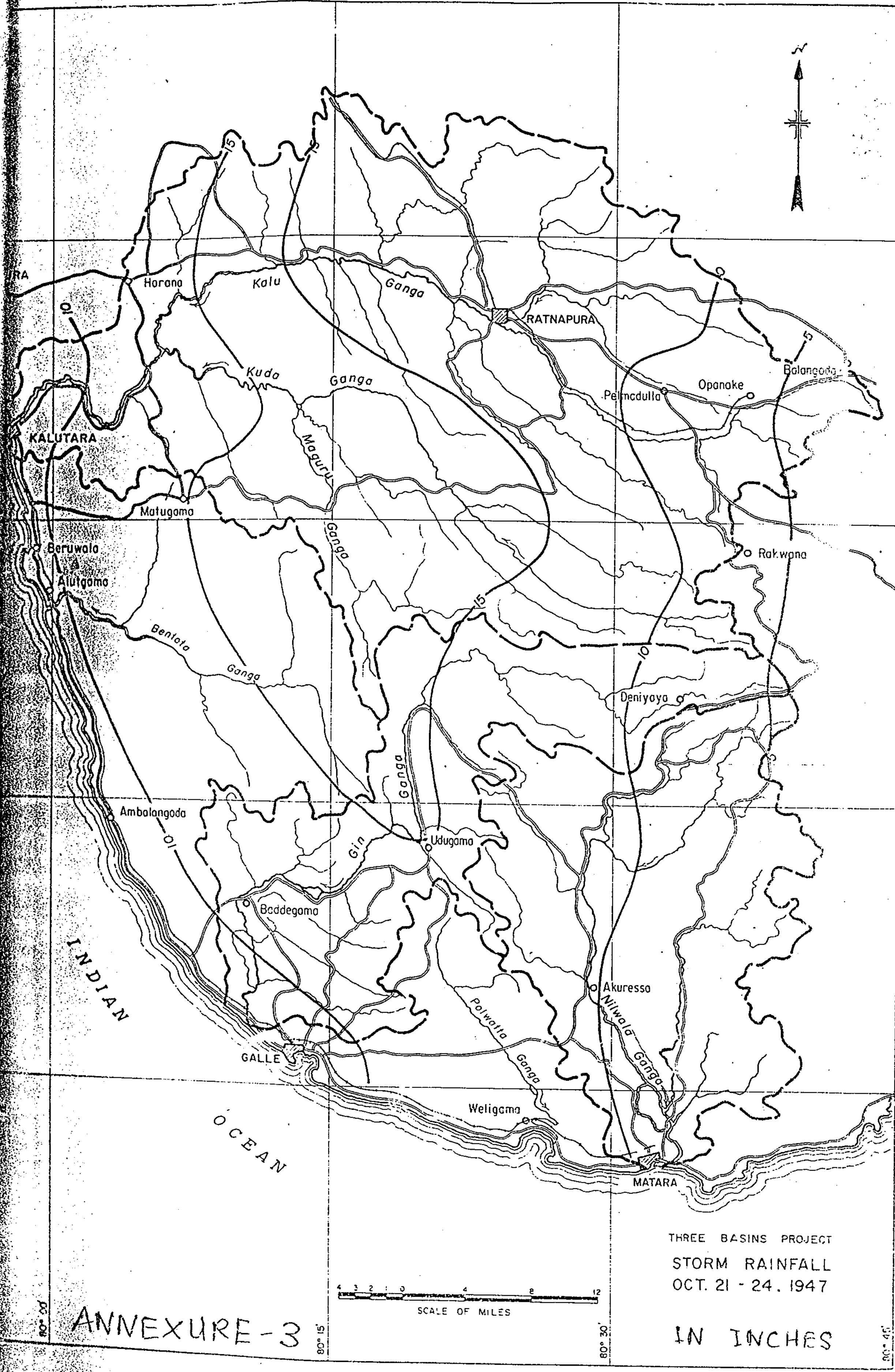
THREE BASINS PROJECT

STORM RAINFALL

MAY 14 - 18, 1940

IN INCHES

ANNEXURE - 2



THREE BASINS PROJECT

STORM RAINFALL
OCT. 21 - 24. 1947

ANNEXURE - 3

IN INCHES