AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON, D. C. 20523
BIBLIOGRAPHIC INPUT SHEET

FOR AID USE ONLY
Batch 72

1. SUBJECT CLASSIFICATION

A. PRIMARY
Food production and nutrition — AF10-0000-G650

B. SECONDARY
Meteorology and climatology--Tropics

2. TITLE AND SUBTITLE
An analysis of average annual rainfall zones in the semiarid tropics of India, Africa and Brazil

3. AUTHOR(S)
Ryan,J.G.; Subrahmanyam,K.V.

4. DOCUMENT DATE	5. NUMBER OF PAGES	6. ARC NUMBER
1975	9p.	ARC

7. REFERENCE ORGANIZATION NAME AND ADDRESS
ICRISAT

8. SUPPLEMENTARY NOTES (Sponsoring Organization, Publishers, Availability)

9. ABSTRACT

10. CONTROL NUMBER
PN-AAE-780

11. PRICE OF DOCUMENT

12. DESCRIPTORS
Africa
Brazil
India
Rainfall
Semiarid land

13. PROJECT NUMBER

14. CONTRACT NUMBER
AID/ta-G-1073 GTS

15. TYPE OF DOCUMENT

AID 590-1 (4-74)

ta-G-1073 GT
PN-AAE-780

An Analysis of Average Annual Rainfall Zones in the Semi-Arid Tropics of India, Africa and Brazil

James G. Ryan and K. V. Subrahmanyam*

INTRODUCTION

This is a short note to present the results of a preliminary analysis we conducted to determine the land areas falling in the various average annual rainfall zones in the semi-arid tropical (SAT) tracts of India, Africa and Brazil. The 29 SAT countries in Africa plus SAT India and SAT Brazil together represent approximately 73 per cent of the estimated total area of SAT land in the world and 86 per cent of the estimated total SAT population[1/]. They hance represent the most significant areas of concern to ICRISAT.

The SAT zones in these areas can have an average annual rainfall of anything between 300 to 2500 millimetres or more. As a further delineation of the boundaries of the SAT which initially might be of primary concern to ICRISAT, it has been decided to define it as the SAT areas which have 500 to 1500 millimetres of average annual rainfall[2/].

---

* Economist and Research Associate respectively, at the International Crops Research Institute for the Semi-Arid Tropics, (ICRISAT), Hyderabad, India. The assistance of M. Asokan, Field Assistant, is gratefully acknowledged.

1 See Ryan [4, pp. 3-6]. The definition of the term SAT which ICRISAT is adopting is to be found in Troll [6].

2 See Kampen and Associates [1, pp. 4-6].

To assist in planning ICRISAT's research priorities and strategies we decided to analyse average rainfall data in the above three areas to determine which rainfall zones of the SAT have the largest land mass associated with them.

ANALYSES

Using rainfall isohyets from climatological maps with Troll's [6] SAT boundaries drawn on them and a planimeter, the approximate land areas falling in the various average annual rainfall categories were estimated. Table 1 shows the results of the analysis for India using rainfall data from the Ministry of Education and Youth Services [2, plate 6].

India has a land area of approximately 3,054,000 km^2, of which some 54 per cent of 1,700,000 km^2 is SAT land. Of this SAT land about 1,647,000 is on land with an average annual rainfall of less than 1400 millimetres. Almost two-thirds of this is in land with an average annual rainfall between 501 and 1000 millimetres. About 22 per cent of the SAT land is in an average annual rainfall zone of between 1000 and 1400 millimetres. Only 13 per cent has an average annual rainfall less than 500 millimetres.

These data indicate that, from the point of view of development of a relatively land-saving technology for SAT India, the priority rainfall zone would be the 500 to 1000 millimetre one, followed by 1000 to 1400, and lastly the less than 500 millimetre zone. Of course

Table 1

Area of SAT Land in Various Rainfall Classes in India[a]

Average Annual Rainfall (m.m.)	Approximate Land Area Involved (1,000 km^2)	Percentage of Total SAT Land Involved (%)
< 300	77.4	4.7
300 - 400	72.0	4.4
401 - 500	66.6	4.0
501 - 600	194.4	11.8
601 - 700	201.6	12.2
701 - 800	268.2	16.3
801 - 1000	406.8	24.7
1001 - 1400	360.0	21.8
Total	1647.0	100.0

a *Source:* Based on annual isohyets given in the Ministry of Education and Youth Services [2, plate 6].

people work and live in the low rainfall zones and we cannot ignore them in our work for this reason.

Table 2 contains the rainfall analysis for the SAT areas of Africa. The rainfall isohyets were taken from Thompson's Climate Maps of Africa [5, map 28]. Unfortunately the isohyets were not available in increments of 100 millimetres so we cannot obtain as precise a picture for Africa as we can for India. However, from Table 2 it would appear that the majority of SAT land in Africa would fall in the 400 to 1000 millimetre average annual rainfall class. In the 200 to 400 millimetre zone in SAT Africa there is a much larger proportion of SAT land than in India - 18.5 per cent in the former and approximately 9 per cent in the latter. The area of land involved in this rainfall class in Africa is twelve times that in India at 1,815,000 km^2. Maybe this suggests that if ICRISAT is to conduct research for areas with rainfall below 500 millimetres, Africa might receive relative priority. The total SAT land area in Africa is approximately 10 million km^2, which is more than five times the SAT area in India, although the population supported on this land in Africa is about 60 per cent of that in India.

Table 3 shows the rainfall analysis for Northeastern Brazil, the third major SAT area in the world. Rainfall data were derived using the annual rainfall isohyets given in Paiva *et al.* [3, p. 240]. It shows that almost 80 per cent of the SAT Northeast has an average annual rainfall of between 500 and 1000 millimetres. Hardly any SAT

Table 2

Area of SAT Land in Various Rainfall Classes in Africa[a]

Average Annual Rainfall (m.m.)	Approximate Land Area Involved ('000 km^2)	Percentage of Total SAT Land Involved (%)
< 200	nil	nil
200 - 400	1815	18.5
401 - 800	3654	37.2
801 - 1600	4356	44.3
Total	9825	100.0

a *Source* : Based on annual rainfall isohyets given in Thompson [5, map 28].

Table 3

Area of SAT Land in Various Rainfall Classes in Northeastern Brazil[a]

Average Annual Rainfall (m.m.)	Approximate Land Area Involved ('000 km^2)	Percentage of Total SAT Land Involved (%)
< 500	22.2	2.4
500 - 750	388.9	42.7
751 - 1000	333.3	36.6
1001 - 1250	111.1	12.2
1251 - 1500	55.6	6.1
Total	911.1	100.0

a *Source* : Based on annual isohyets as given in Paiva *et. al.* [3, p.240, Map IV 4].

land has less than 500 millimetres, and 18 per cent has between 1000 and 1500 millimetres.

The implication for SAT Brazil hence might be that agricultural research effort should concentrate in the 500 to 1000 millimetre zone. The area of land involved in this rainfall zone is 722,000 km^2, which is about two-thirds of the size of land in the same rainfall class in India. However in SAT India the population in the 500 to 1000 millimetre zone would be about thirteen times that in SAT Northeastern Brazil. Although we don't have precise data on this rainfall zone for SAT Africa, the land area would appear to be some five times as large as in SAT India and seven times that of SAT Northeastern Brazil. The 500 to 1000 millimetre zone in SAT Africa would have about 60 per cent of the people that India has in the zone and about eight times the people in the zone in Northeastern Brazil.

CONCLUSIONS

This analysis should not be regarded as completely accurate but to rather indicate the broad orders of magnitude of the SAT land areas in the various average annual rainfall classes. It has been compiled to assist the research staff and executive of ICRISAT in the planning of research activities in the SAT. No doubt when we have an agroclimatologist on hand more comprehensive and refined data of this kind can be assembled. In the meantime it is hoped the foregoing material will be of some use.

REFERENCES

[1] Kampen, J., and Associates, "Soil and Water Conservation and Management in Farming Systems Research for the Semi-Arid Tropics", Paper presented at the International Workshop on Farming Systems, ICRISAT, Hyderabad, India, November, 1974.

[2] Ministry of Education and Youth Services, *Irrigation Atlas of India*, Report of the Irrigation Commission, Volume IV, Government of India, 1972.

[3] Paiva, Ruy Miller, Salomao Schattan and Claus F. Trench de Freitas, *Brazil's Agricultural Sector : Economic Behaviour, Problems and Possibilities*, XV International Conference of Agricultural Economists, Sao Paulo, Brazil, 1973.

[4] Ryan, J.G., "Socio-Economic Aspects of Agricultural Development in the Semi-Arid Tropics", Occasional Paper 6, Economics Department, ICRISAT, Hyderabad, India, November, 1974.

[5] Thompson, B.W., *The Climate of Africa*, Oxford University Press, Nairobi, Kenya, 1965.

[6] Troll, C., "Seasonal Climates of the Earth. The Seasonal Course of Natural Phenomena in the Different Climatic Zones of the Earth", in Lindsberg, M.E., *et al.* (eds.) *World Maps of Climatology*, Springer-Verlag, Berlin, Heidelberg, New York, 1966, pp. 7-23.

JGR:KVS:WSR
March 17,'75.