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**LAND SETTLEMENT PROJECTS AND AGRICULTURAL DEVELOPMENT**

**An Analysis of Development Factors and Processes based  
on four Case Studies in Ghana, Libya and Saudi Arabia**

**Heinrich Speetzen, Ing. (grad.) agr. trop.**

**VOLUME II (APPENDIX)**

**October 1974**



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P A R T O N E

FAISAL SETTLEMENT PROJECT, HARADH, SAUDI ARABIA

Cropping area for the lambs to be fattened

The number of lambs to be fattened each year from 1.6 ha. will be:

$$\underline{365 \times 0.6 \text{ kg. hay}}$$

$$\underline{219.0 \times 5} \text{ (to obtain the quantity of green alfalfa)}$$

1,095.0 kg. of green alfalfa

$$+ \underline{730.0 \text{ kg. of green alfalfa (2 x 365)}}$$

1,825.0 ÷ 2 = 913.0 kg. of green alfalfa. This is the portion for the ewe.

5 kg. of green alfalfa (hay and green) x 80 = 400 kg. of green alfalfa per lamb.

40 kg. of green alfalfa consumed during growing period.

That is, 1,353 kg. of green alfalfa are necessary per lamb. Thus, 160 tons are enough to feed 118 lambs.

Demand for maize (sorghum) for a daily ration of 0.5 kg. silage:

$$\underline{365 \times 0.5}$$

$$182.5 \text{ kg.} + 2 = 91.25 \text{ kg. (ewe portion per lamb)}$$

10.00 kg. (during growing period)

$$\underline{40.00 \text{ kg. (0.5 kg. x 80 days)}}$$

141.25 kg. per lamb

$$\underline{141.25 \text{ kg.} \times 118}$$

16,667.5 kg. of silage are necessary for 118 lambs.

Assuming a wastage of 30 per cent, 16,000 kg. are available from an area of 0.6 ha.

Demand for a daily ration of 0.25 kg. of barley.

$$\underline{365 \times 0.25 \text{ kg.}}$$

$$91.25 \text{ kg.} + 2 = 45.63 \text{ kg. (ewe proportion per lamb)}$$

$$\underline{20.00 \text{ kg. (0.25 kg. x 80 fattening days)}}$$

65.63 kg. of barley per lamb

$$\underline{65.63 \text{ kg.} \times 118}$$

7,744.34 kg. of barley are necessary for 118 lambs to be fattened.





Table No. 1

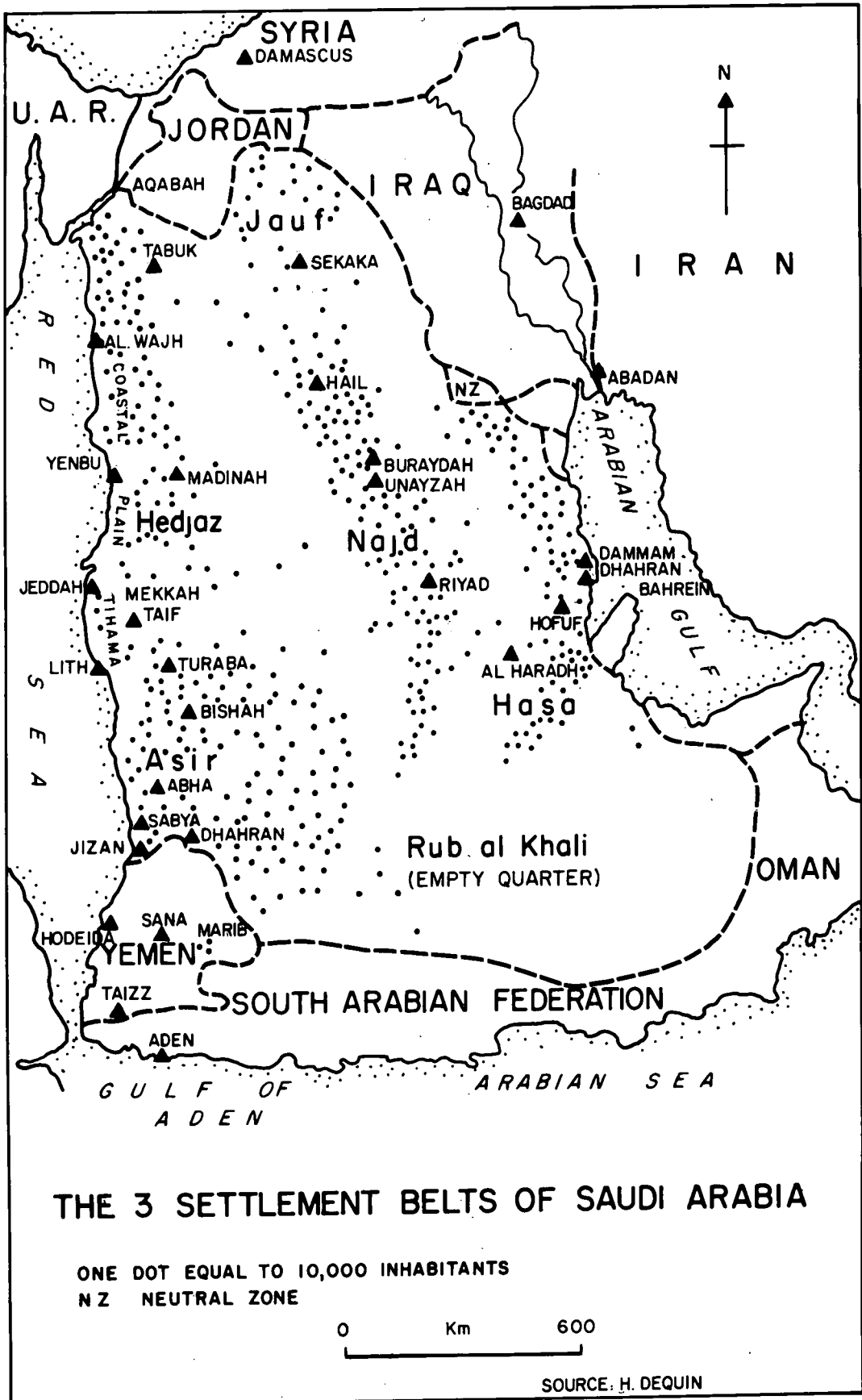
Pattern of expenditure for cash crops

| <u>Hectares</u> | <u>Crop</u>      | <u>Amount/ha.</u> | <u>SR/unit</u> | <u>SR/area</u> |
|-----------------|------------------|-------------------|----------------|----------------|
| 0.3             | <u>Barley</u>    |                   |                |                |
|                 | Seeds            | 120 kg.           | 0.70           | 25.20          |
|                 | Fertilizer       | 500 kg.           | 0.52           | 78.00          |
|                 | Plant protection | 24 SR             | -              | 7.20           |
|                 | Machine costs    | 87 SR             | -              | 26.10          |
|                 | Water            | 1,833 cu.m.       | 0.10           | 183.30         |
|                 |                  |                   |                | <hr/>          |
|                 |                  |                   |                | 319.80         |
|                 |                  |                   |                | <hr/>          |
| 0.4             | <u>Potatoes</u>  |                   |                |                |
|                 | Seeds            | 1,200 kg.         | 1.40           | 672.00         |
|                 | Fertilizer       | 600 kg.           | 0.52           | 124.80         |
|                 | Plant protection | 60 SR             | -              | 24.00          |
|                 | Machine costs    | 87 SR             |                | 34.80          |
|                 | Water            | 4,126 cu.m.       | 0.10           | 412.60         |
|                 |                  |                   |                | <hr/>          |
|                 |                  |                   |                | 1,268.20       |
|                 |                  |                   |                | <hr/>          |
| 0.6             | <u>Onions</u>    |                   |                |                |
|                 | Seeds            | 5 kg.             | 140.00         | 420.00         |
|                 | Fertilizer       | 600 kg.           | 0.52           | 187.20         |
|                 | Plant protection | 40 SR             | -              | 24.00          |
|                 | Machine costs    | 87 SR             | -              | 52.20          |
|                 | Water            | 7,308 cu.m.       | 0.10           | 730.80         |
|                 |                  |                   |                | <hr/>          |
|                 |                  |                   |                | 1,414.20       |
|                 |                  |                   |                | <hr/>          |

| <u>Hectares</u> | <u>Crop</u>                | <u>Amount/ha.</u> | <u>SR/unit</u> | <u>SR/area</u> |
|-----------------|----------------------------|-------------------|----------------|----------------|
| 0.3             | <u>Garlic</u>              |                   |                |                |
|                 | Seeds                      | 1,000 kg.         | 3.50           | 1,050.00       |
|                 | Fertilizer                 | 600 kg.           | 0.52           | 93.60          |
|                 | Plant protection           | 20 SR             | -              | 6.00           |
|                 | Machine costs              | 87 SR             | -              | 26.10          |
|                 | Water                      | 3,653 cu.m.       | 0.10           | 365.30         |
|                 |                            |                   |                | <hr/>          |
|                 |                            |                   |                | 1,541.00       |
|                 |                            |                   |                | <hr/>          |
| 0.2             | <u>Vegetables</u>          |                   |                |                |
|                 | Seeds                      | 100 SR*           | -              | 20.00          |
|                 | Fertilizer                 | 600 kg.           | 0.52           | 62.40          |
|                 | Plant protection           | 60 SR             | -              | 12.00          |
|                 | Machine costs              | 87 SR             | -              | 17.40          |
|                 | Water                      | 1,937 cu.m.       | 0.10           | 193.70         |
|                 |                            |                   |                | <hr/>          |
|                 |                            |                   |                | 305.50         |
|                 |                            |                   |                | <hr/>          |
| 0.2             | <u>Cucumber and melons</u> |                   |                |                |
|                 | Seeds                      | 3 kg.             | 28.00          | 16.80          |
|                 | Fertilizer                 | 500 kg.           | 0.52           | 52.00          |
|                 | Plant protection           | 60 SR             | -              | 12.00          |
|                 | Machine costs              | 87 SR             | -              | 17.40          |
|                 | Water                      | 2,087 cu.m.       | 0.10           | 208.70         |
|                 |                            |                   |                | <hr/>          |
|                 |                            |                   |                | 306.90         |
|                 |                            |                   |                | <hr/>          |

\* 100.00 SR is the average price

| <u>Hectares</u> | <u>Crop</u>      | <u>Amount/ha.</u> | <u>SR/unit</u> | <u>SR/area</u> |
|-----------------|------------------|-------------------|----------------|----------------|
| 0.2             | <u>Okra</u>      |                   |                |                |
|                 | Seeds            | 10 kg.            | 10.00          | 20.00          |
|                 | Fertilizer       | 600 kg.           | 0.52           | 62.40          |
|                 | Plant protection | 60 SR             | -              | 12.00          |
|                 | Machine costs    | 87 SR             | -              | 17.40          |
|                 | Water            | 1,793 cu.m.       | 0.10           | 179.30         |
|                 |                  |                   |                | <hr/>          |
|                 |                  |                   |                | 291.10         |
|                 |                  |                   |                | <hr/>          |

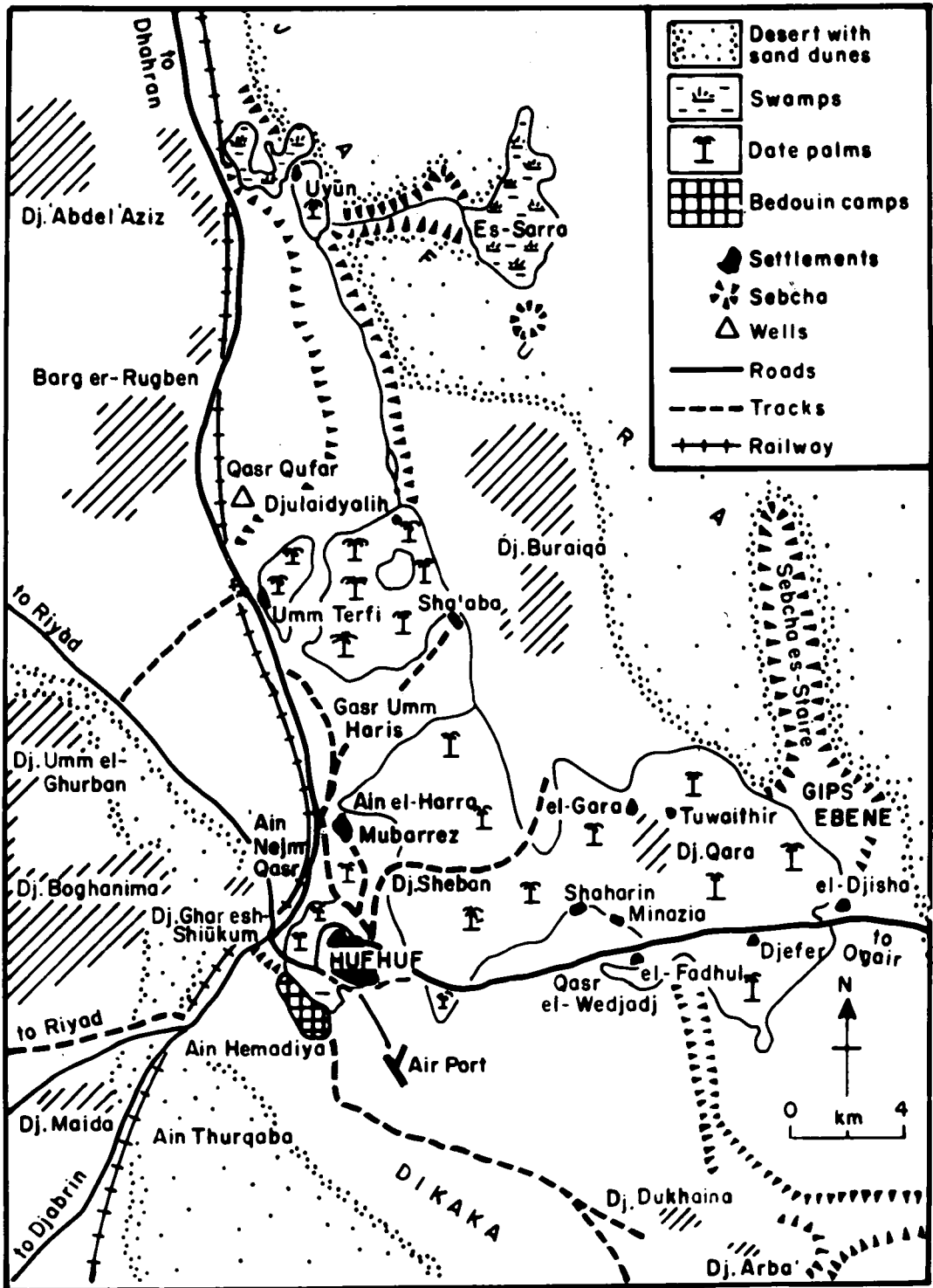


Map No. 1

P A R T   T W O

AL HASSA OASIS, SAUDI ARABIA

# AL HASSA OASIS



Source: F. S. Vidal

Map No. 1

Table No. 1

Names of the owners and sizes of the farms in Flah 1<sup>1</sup>

|     | <u>Name</u>                  | <u>Size in ha.</u> |
|-----|------------------------------|--------------------|
| 1.  | Wakf land                    | 0.222              |
| 2.  | Hukumah land                 | 0.085              |
| 3.  | Ibrahim Hassan Khalifa       | 0.369              |
| 4.  | Assayd Khalifa Ali           | 0.164              |
| 5.  | Matouk Saad al Khanfoush     | 0.134              |
| 6.  | Ibrahim Saif al Mutaweh      | 0.250              |
| 7.  | Jassem Eissa Hussein         | 0.159              |
| 8.  | Saleh Eid Jumaiah            | 0.194              |
| 9.  | Wakf land                    | 0.313              |
| 10. | Matouk Saad al Khanfoush     | 0.220              |
| 11. | Saleh al Ghanem              | 0.098              |
| 12. | Ibrahim Ali                  | 0.297              |
| 13. | Ahmed al Huwaishel           | 0.207              |
| 14. | Saleh al Ghanem              | 0.095              |
| 15. | Taher Mohammed al Shuwaiween | 0.168              |
| 16. | Ali Ahmed al Kufail          | 0.047              |
| 17. | Mohammed Hussein al Yussef   | 0.063              |
| 18. | Ahmed Marsouk                | 0.240              |
| 19. | Abdullah Asfour              | 0.433              |
| 20. | Ali Hassan Salim             | 0.043              |
| 21. | Taher Said                   | 0.110              |
| 22. | Ahmed al Ghanem              | 0.053              |
| 23. | Ahmed al Salim               | 0.140              |
| 24. | Mohammed al Dubavan          | 0.040              |
| 25. | Abdullah Asfour              | 0.271              |
| 26. | Mohammed Hussein al Kattan   | 0.263              |

|     | <u>Name</u>            | <u>Size in ha.</u> |
|-----|------------------------|--------------------|
| 27. | Abdullah Abu Auwais    | 0.035              |
| 28. | Ahmed Hassan Kathem    | 0.105              |
| 29. | Hukumah land           | 0.055              |
| 30. | Taher Said             | 0.192              |
| 31. | Ben Nathan             | 0.016              |
| 32. | Abdullah Matawah       | 0.465              |
| 33. | Hukumah land           | 0.135              |
| 34. | Ibrahim Saif           | 0.222              |
| 35. | Wakf land              | 0.055              |
| 36. | Eissa al Mudarah       | 0.227              |
| 37. | Wakf land              | 0.592              |
| 38. | Wakf land              | 0.027              |
| 39. | Wakf land              | 0.083              |
| 40. | Ali Suaiween           | 0.155              |
| 41. | Abdahrahman ben Sarrar | 0.064              |



Table No. 2

Names of the owners and sizes of the farms in F1ah3<sup>2</sup>

| <u>Name</u>                     | <u>Size in ha.</u> |
|---------------------------------|--------------------|
| 1. Wakf land                    | 0.244              |
| 2. Khalifa Ali                  | 0.865              |
| 3. Hussein Ali                  | 0.177              |
| 4. Taher Mohammed Shuaiween     | 0.024              |
| 5. Mohammed Hassan Yussef       | 0.060              |
| 6. Sons of Mohammed Eissa       | 0.253              |
| 7. Awad Hassan Ibrahim          | 0.134              |
| 8. Hamed Hassan                 | 0.071              |
| 9. Ahmed Hassan Ibrahim         | 0.103              |
| 10. Ahmed al Hussein            | 0.118              |
| 11. Hussein al Kathem           | 0.017              |
| 12. Ahmed al Kathem             | 0.024              |
| 13. Ahmed al Hassan             | 0.079              |
| 14. Sheikh Abdullah al Mubarrak | 0.944              |
| 15. Hamed al Hugaili            | 0.140              |
| 16. Hukumah land                | 1.808              |
| 17. Fahed ben Sarrar            | 0.667              |
| 18. Saleh al Mubarrak           | 0.017              |
| 19. Wakf land                   | 2 palm trees       |
| 20. Sons of Fahed al Mubarrak   | 0.766              |
| 21. Saleh al Ghanem             | 0.085              |
| 22. Saleh al Markazi            | 0.071              |
| 23. Taher Abu Khushein          | 0.124              |
| 24. Mohammed al Saheeh          | 0.050              |
| 25. Saad ben Saheeh             | 0.058              |

|     | <u>Name</u>                 | <u>Size in ha.</u> |
|-----|-----------------------------|--------------------|
| 26. | Abu Ibshait and partners    | 0.015              |
| 27. | Yussef Abdulassis al Rithe* | 0.185              |
| 28. | Mohammed al Ali*            | 1.307              |
| 29. | Hussein al Ghanem*          | 0.783              |

\* These farmers live in Al-Taraf - all the others live in Al Jafer.

Table No. 3<sup>3</sup>

Springs and their output

| <u>Name of spring</u> | <u>Output in cu.m./sec.</u> | <u>Adjacent area</u> |
|-----------------------|-----------------------------|----------------------|
| Ain al Khudud         | 3.500                       | F1                   |
| Ain al Hagl           | 2.900                       | F1                   |
| Ain Hueireb           | 0.217                       | F1                   |
| Ain Aseimi            | 0.086                       | F1                   |
| Ain Umm Freech        | 0.135                       | F1                   |
| Ain Umm Save          | 0.084                       | F1                   |
| Ain Guedab            | 0.084                       | F1                   |
| Ain al Amarah         | 0.030                       | F1                   |
| Ain Ta' Adhid         | 0.437                       | F1                   |
| Ain Rasibe            | 0.320                       | F1                   |
| Ain Buhadji           | 0.140                       | F1/P1                |
| Ain Umm al Lif        | 0.200                       | F1/P1                |
| Ain Manah             | 0.400                       | F1/P1                |
| Ain al Luwaimi        | 0.580                       | F1/P1                |
| Ain Talib             | 0.052                       | F1/P1                |
| Ain Barabir           | 0.915                       | F1/P1                |
| Ain Umm Dalli         | 0.130                       | F1                   |
| Ain Bsetina           | 0.140                       | F1                   |
| Ain al Jaburiyah      | 0.030                       | F1                   |
| Ain Mushaitiyah       | 0.042                       | F1                   |
| Ain Sable             | 0.048                       | F1                   |
| Ain Khannur           | 0.064                       | F1                   |
| Ain Jauhariyah        | 0.685                       | F2                   |
| Ain al Harrah         | 0.540                       | F3/P4                |
| Ain Mansur            | 0.620                       | F4                   |
| Ain Umm Ahabah        | 1.495                       | F5                   |

| <u>Name of spring</u> | <u>Output in cu.m./sec.</u> | <u>Adjacent area</u> |
|-----------------------|-----------------------------|----------------------|
| Ain Sumbor            | 0.400                       | F6                   |
| Ain Sedide            | 0.155                       | F6                   |
| Ain Abu Nasser        | 0.300                       | F6                   |
| Ain Hagege            | 0.095                       | F6                   |
| Ain Huweirrah         | 0.430                       | P2                   |
| Ain Bahlah            | 0.350                       | F7                   |
| Ain Nasser            | 0.230                       | F2                   |
| Ain Buhauriyah        | 0.250                       | P3                   |

Table No. 4<sup>4</sup>

| No. OF CANAL | LENGTH OF CANAL IN km. |
|--------------|------------------------|
| Z1.1         | 0.165                  |
| Z1.2         | 0.833                  |
| Z1.3         | 0.328                  |
| Z1.4         | 1.373                  |
| Z1.4.1       | 0.101                  |
| Z1.5         | 0.109                  |
| Z1.6         | -                      |
| Z1.6.1       | -                      |
| Z6.1         | 0.843                  |
| Z6.1.1       | 0.204                  |
| Z6.1.2       | 0.052                  |
| Z4           | 1.061                  |
| Total        | 5.812                  |

Table No. 5<sup>5</sup>

| No. OF CANAL | LENGTH IN km. |
|--------------|---------------|
| F1           | 19.670        |
| F1.1         | 22.889        |
| F1.1.1       | 4.040         |
| F1.1.2       | 10.466        |
| F1.2         | 8.531         |
| F1.3         | 8.038         |
| F1.4         | 4.287         |
| F1.5         | 3.503         |
| F2           | 21.386        |
| F3           | 6.441         |
| F4           | 7.281         |
| F5           | 17.184        |
| F5.1         | 3.762         |
| F6           | 6.269         |
| F6.1         | 2.252         |
| F7           | 2.880         |
| F2-F5        | 2.709         |
| Total        | 151.588       |

Table No. 6

| No. OF CANAL      | No. OF CANALS | LENGTH OF CANALS IN km. <sup>6</sup> |
|-------------------|---------------|--------------------------------------|
| F1aa-F1bc         | 28            | 28.829                               |
| F1.1aa-F1.1bf     | 31            | 26.526                               |
| F1.1.1aa-F1.1.1ae | 5             | 5.146                                |
| F1.1.2aa-F1.1.2am | 13            | 7.808                                |
| F1.2aa-F1.2am     | 13            | 22.464                               |
| F1.3aa-F1.3am     | 13            | 11.245                               |
| F1.4aa-F1.4ag     | 7             | 9.622                                |
| F1.5aa-F1.5ag     | 7             | 7.260                                |
| F2aa-F2ay         | 24            | 18.918                               |
| F3aa-F3ac         | 3             | 2.250                                |
| F4aa-F4ag         | 7             | 12.854                               |
| F5aa-F5ay         | 24            | 30.636                               |
| F5.1aa-F5.1ak     | 10            | 8.046                                |
| F6aa-F6ah         | 8             | 5.911                                |
| F6.1aa-F6.1ac     | 3             | 3.108                                |
| F7aa-F7ad         | 4             | 7.770                                |
| P1a-P1h           | 8             | 21.640                               |
| P2a-P2m           | 10            | 14.230                               |
| P3a-P3cl          | 3             | 4.613                                |
| P4a-P4m           | 12            | 23.846                               |
| Total             | 233           | 208.393                              |

Table No. 7<sup>7</sup>

| No. OF CANAL | LENGTH IN km. |
|--------------|---------------|
| D1           | 53.044        |
| D1.1         | 7.549         |
| D1.2         | 5.242         |
| D1.3         | 2.960         |
| D1.4         | 6.416         |
| D1.5         | 3.364         |
| D1.6         | 2.538         |
| D1.7         | 2.210         |
| D2           | 28.248        |
| D2.1         | 4.440         |
| D2.2         | 14.247        |
| D2.2.1       | 3.177         |
| D2.2.2       | 2.363         |
| D2.3         | 0.983         |
| D3           | 6.500         |
| Total        | 143.281       |



Table No. 8<sup>8</sup>

| No. OF CANAL      | No. OF CANALS | LENGTH IN km. |
|-------------------|---------------|---------------|
| D1aa-D1ce         | 47            | 45.477        |
| D1.1aa-D1.1ah     | 6             | 7.952         |
| D1.2aa-D1.2am     | 10            | 6.981         |
| D1.3aa-D1.3ae     | 5             | 4.621         |
| D1.4aa-D1.4ai     | 9             | 9.103         |
| D1.5aa-D1.5ae     | 5             | 5.901         |
| D1.6aa-D1.6af     | 5             | 4.416         |
| D1.7aa-D1.7ac     | 3             | 3.394         |
| D2.aa-D2bd        | 27            | 29.119        |
| D2.1aa-D2.1af     | 6             | 4.762         |
| D2.2aa-D2.2aq     | 16            | 21.841        |
| D2.2.1aa-D2.2.1ad | 4             | 4.849         |
| D2.2.2aa-D2.2.2ai | 9             | 7.643         |
| D2.3aa-D2.3ac     | 3             | 5.713         |
| D3aa-D3ak         | 10            | 12.541        |
| Total             | 165           | 174.313       |

Diagram No. 1

**MONTHLY DAILY MEAN TEMPERATURES (2.00m. ABOVE SOIL SURFACE)**  
**AGRARMETEOROLOGICAL STATION SOURCE LEICHTWEISS INSTITUTE BRAUNSCHWEIG Appendix:43**

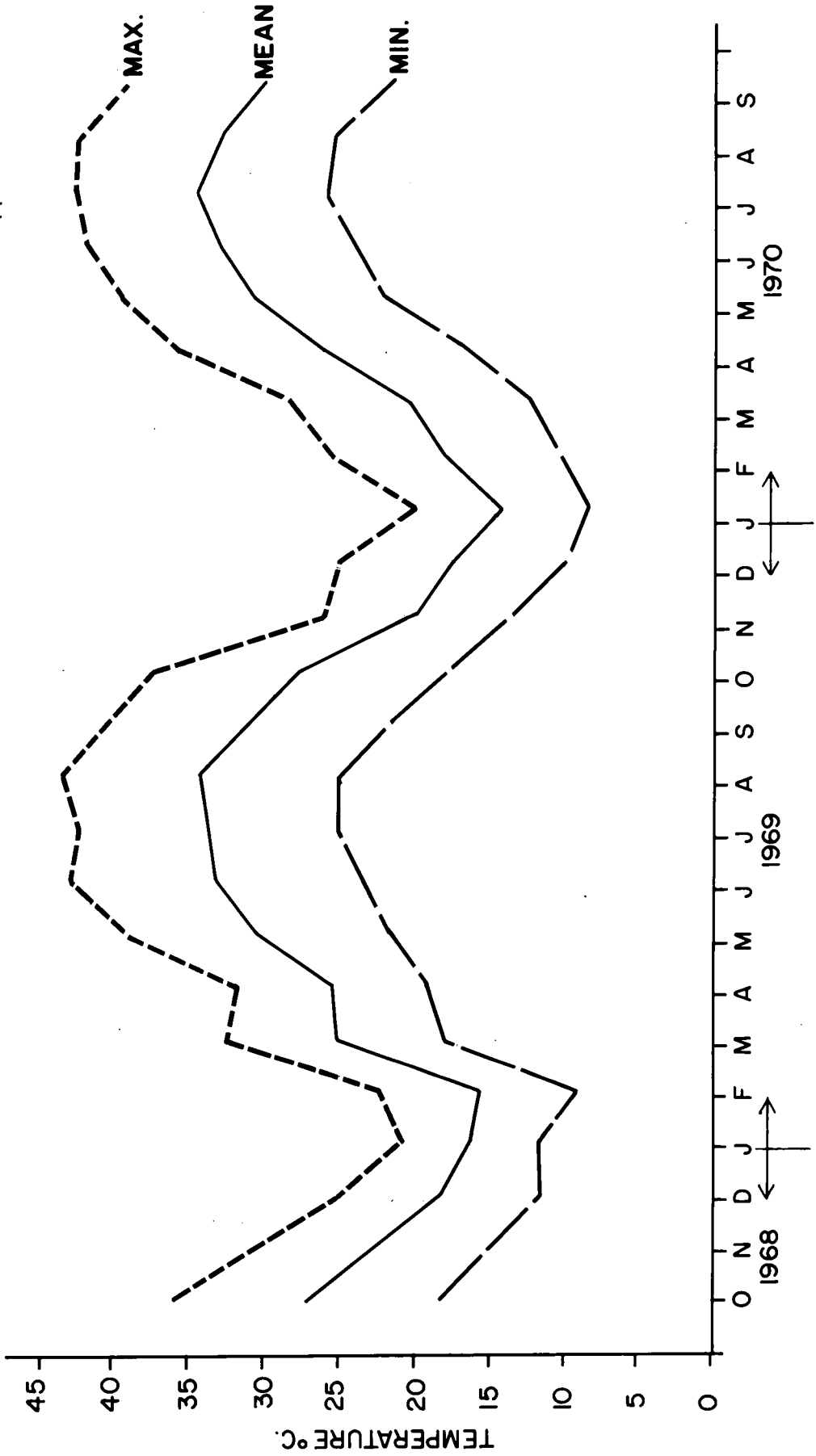
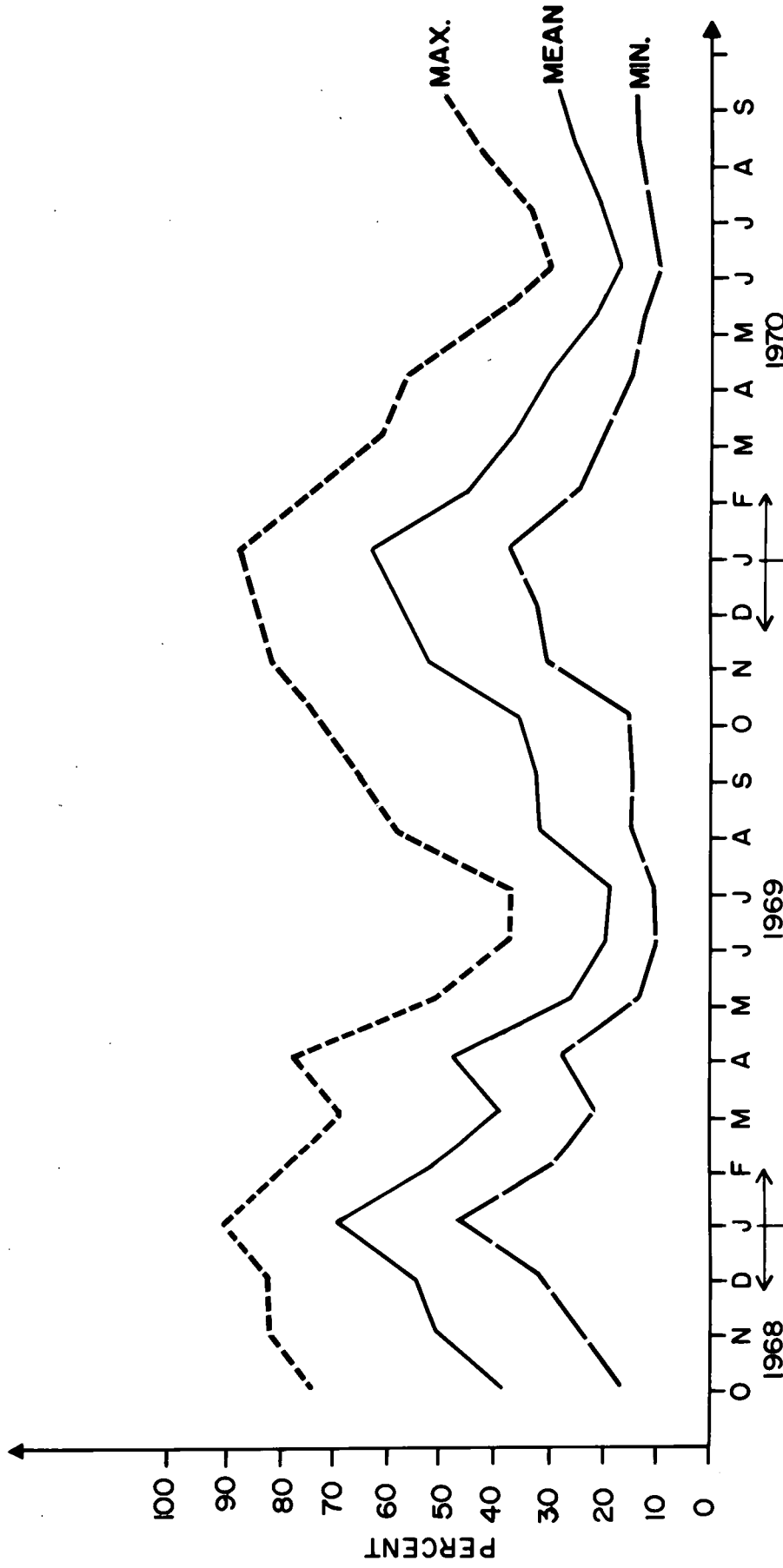


Diagram No. 2

# MONTHLY DAILY MEAN HUMIDITY OF THE AIR AGRARMETEOROLOGICAL STATION



Appendix : 4.4

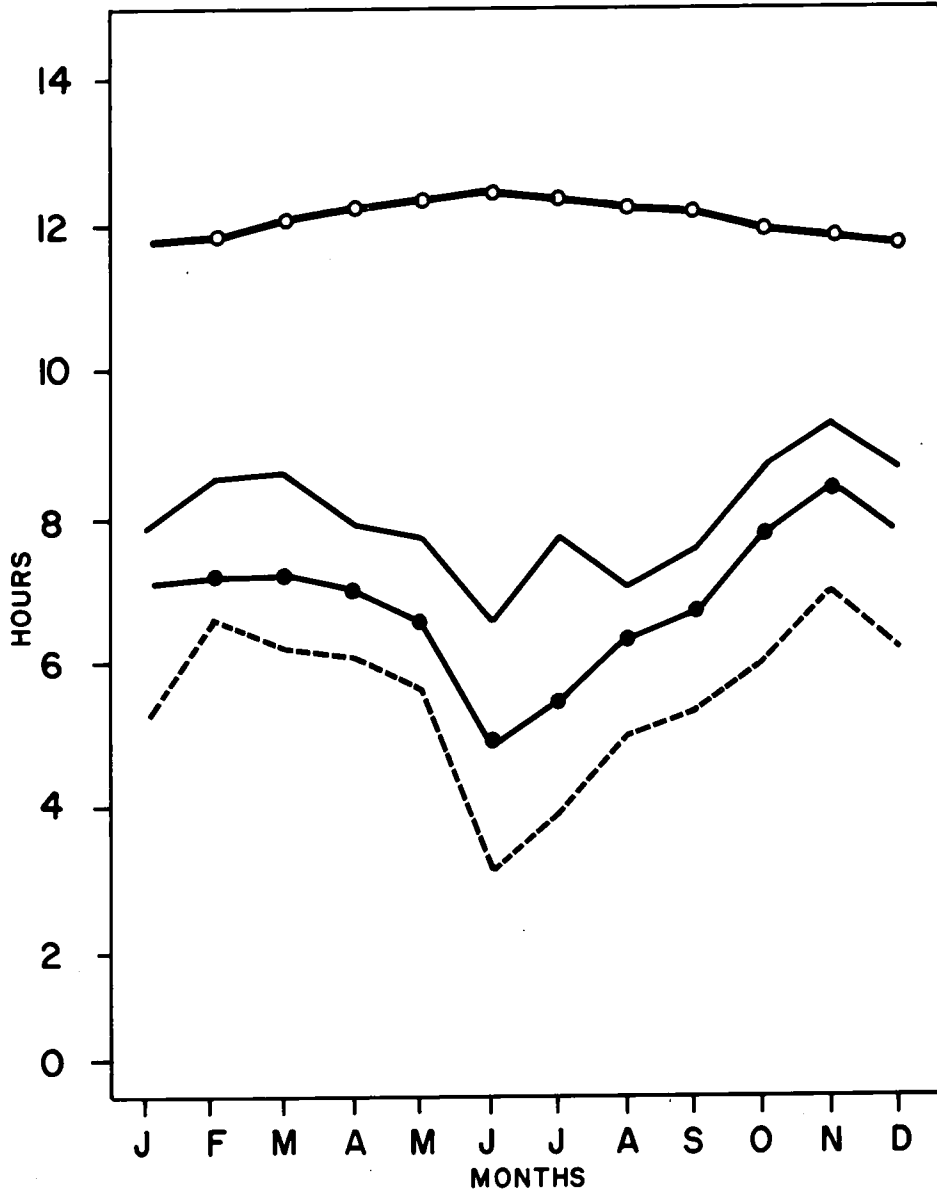
SECOND TECHNICAL REPORT ON RESEARCH WORK IN THE AL HASSA REGION  
APPENDICES LEICHTWEISS INSTITUTE BRAUNSCHWEIG 1970

PART THREE

AVU KETA, GHANA

Diagram No. 1

### MEAN MONTHLY DURATION OF SUNSHINE ADA 1956-65

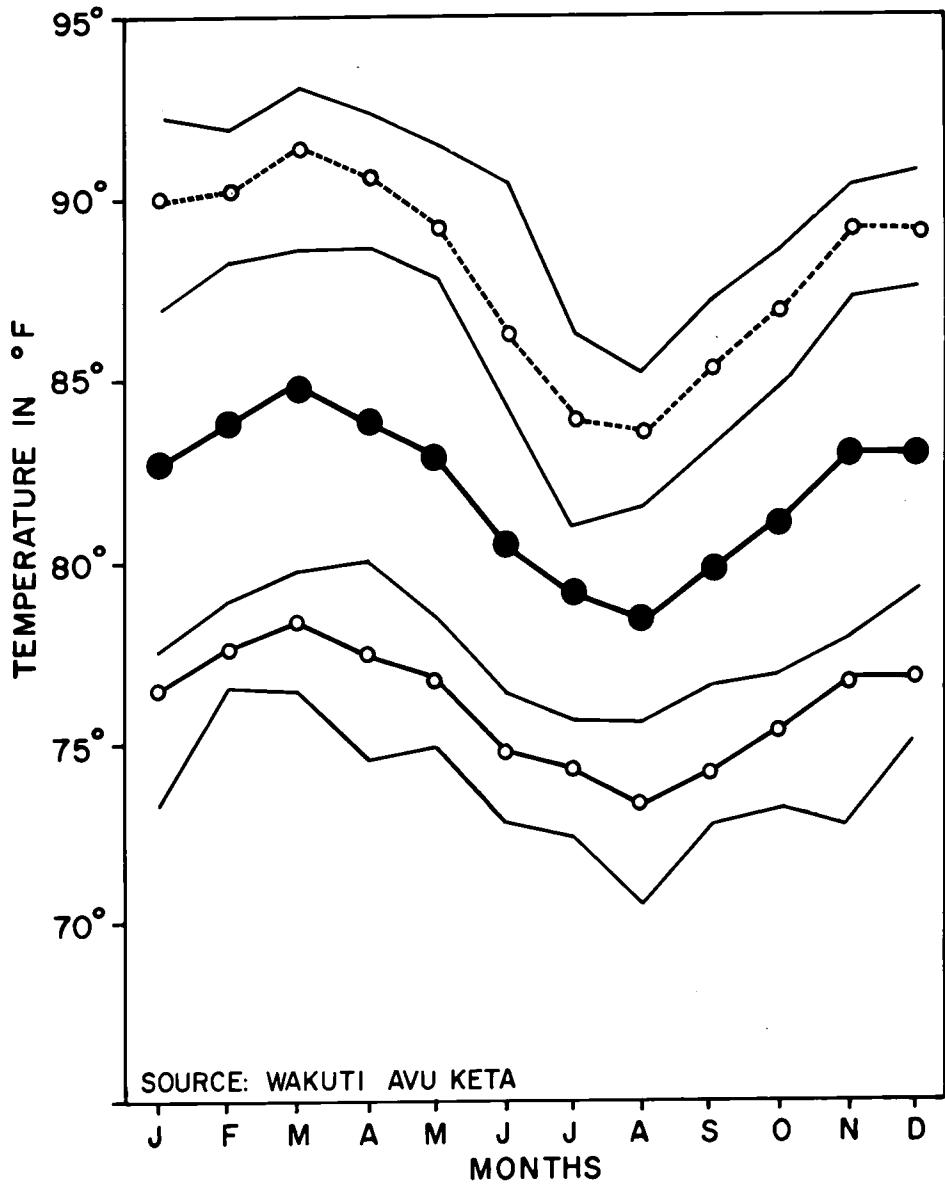


○—○ Mean monthly length of day  
●—● Mean monthly duration of sunshine

SOURCE: WAKUTI AVU KETA

Diagram No. 2

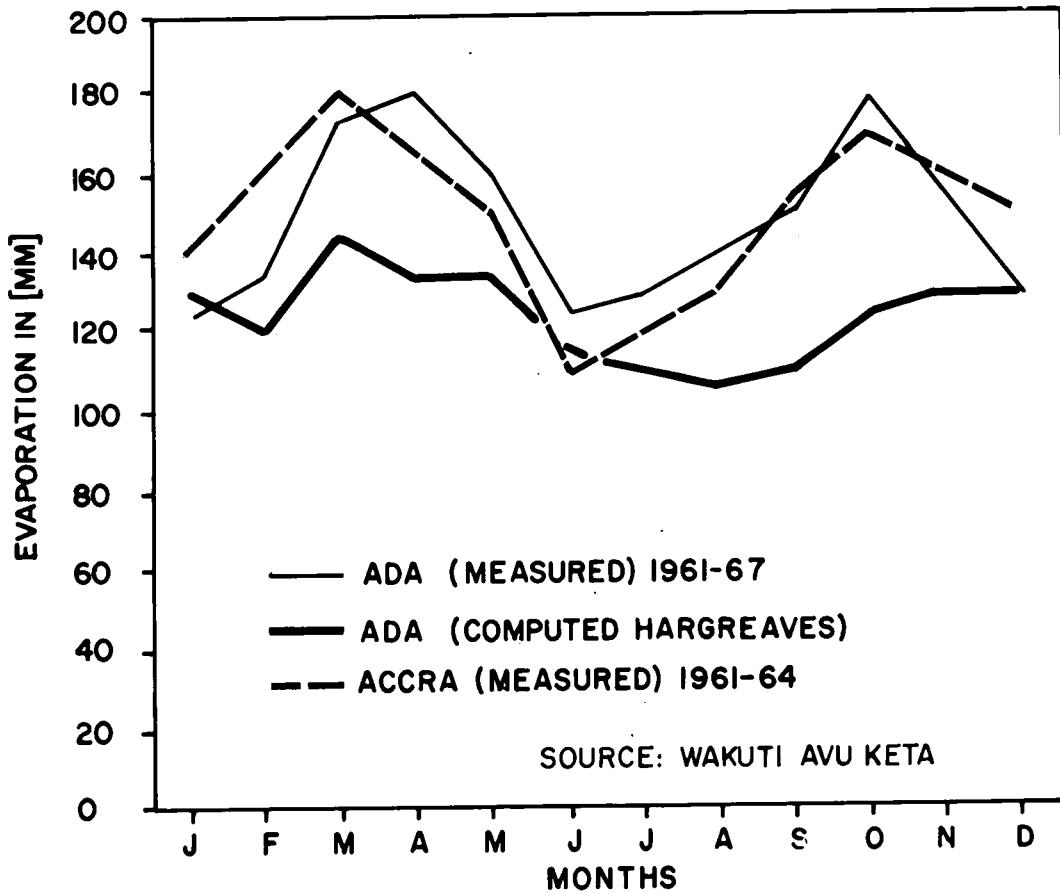
**LONG TERM MAXIMUM AND MINIMUM  
TEMPERATURE. KETA 1946 1966**

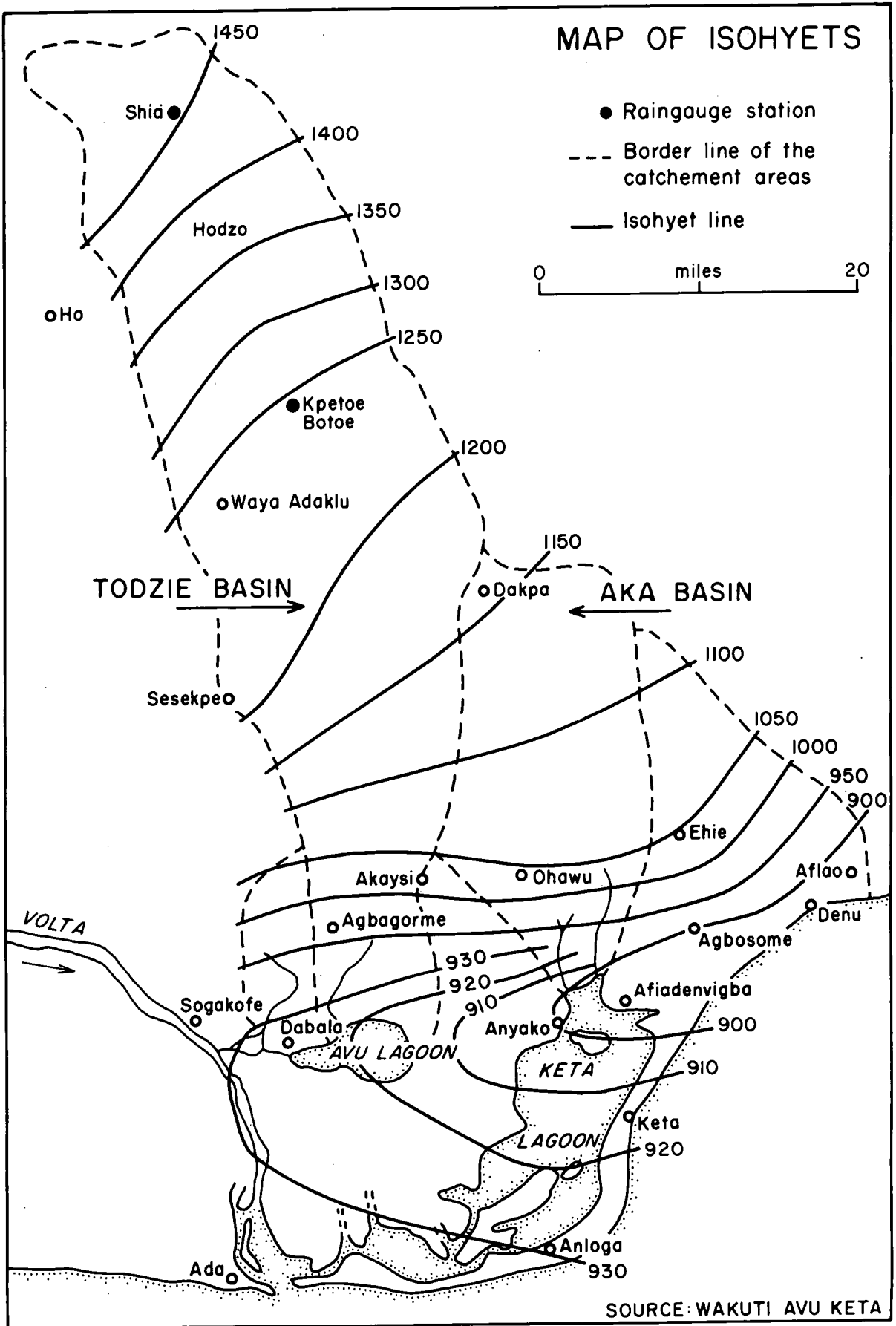


- - - - -○ Mean monthly maximum temperature
- - - - -● Mean monthly temperature
- - - - -○ Mean monthly minimum temperature

Diagram No. 3

### MEAN MONTHLY EVAPORATION





Map No. 1



PART FOUR

TAURGA OASIS, LIBYA

Map No. 1

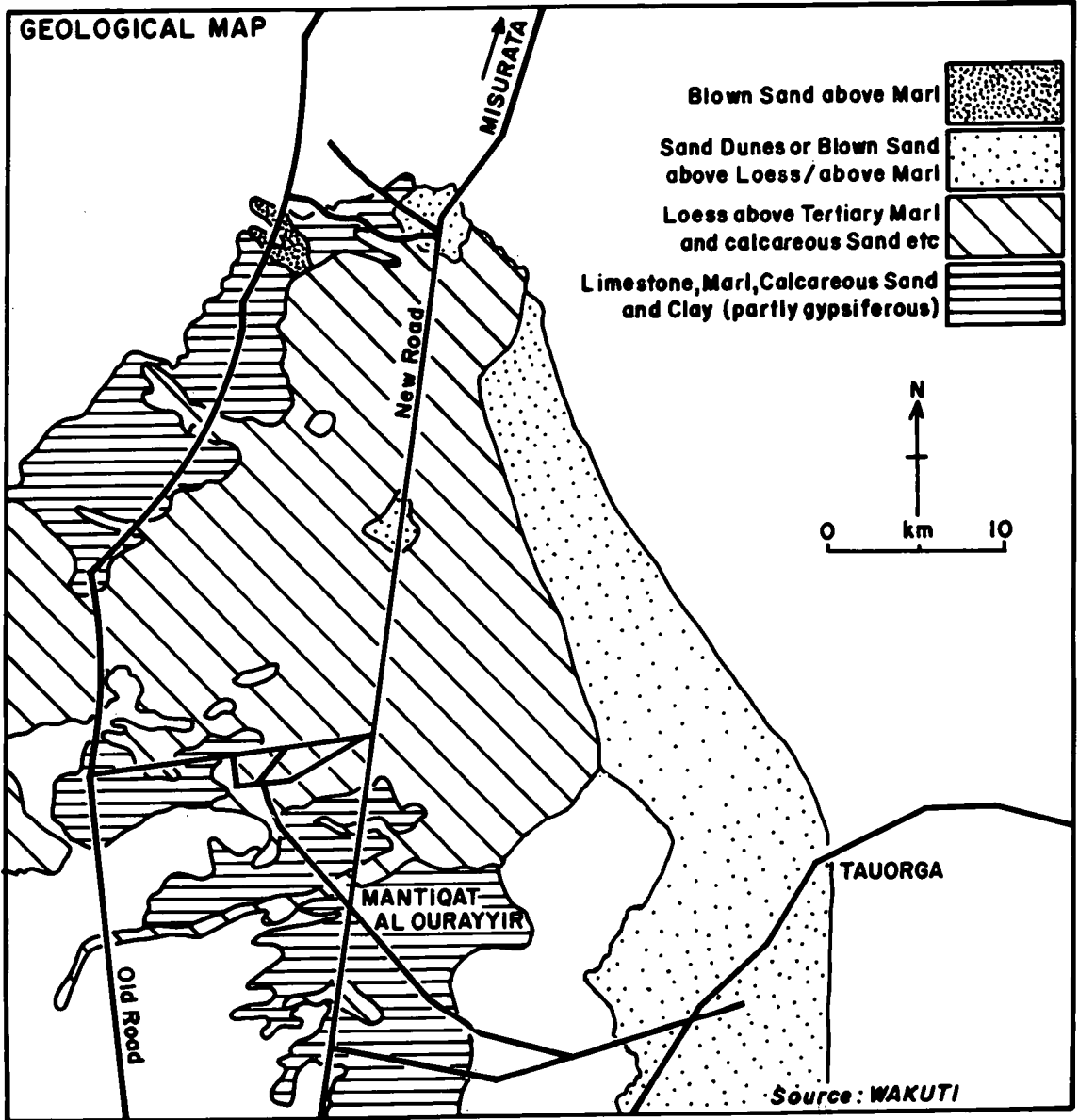
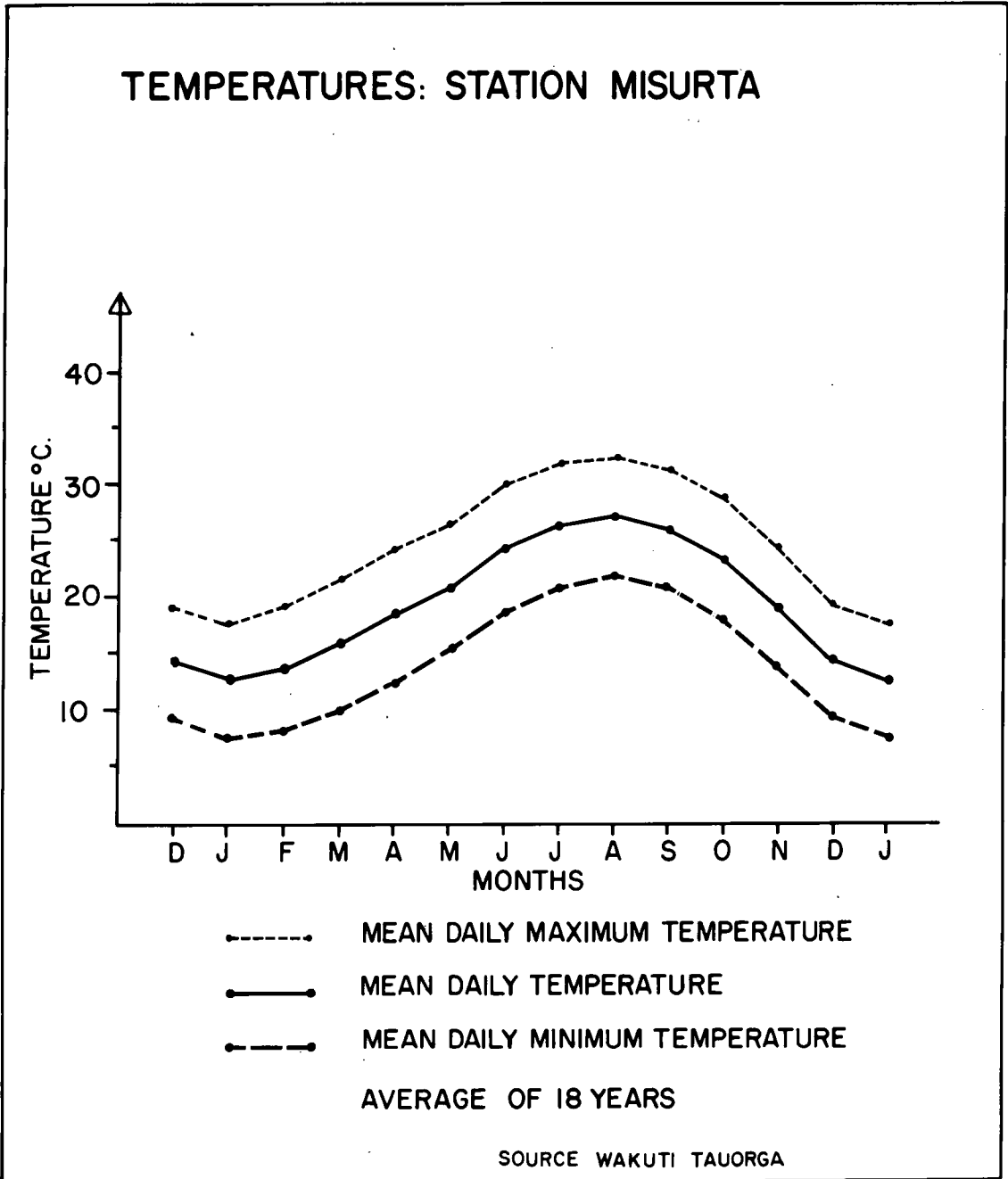
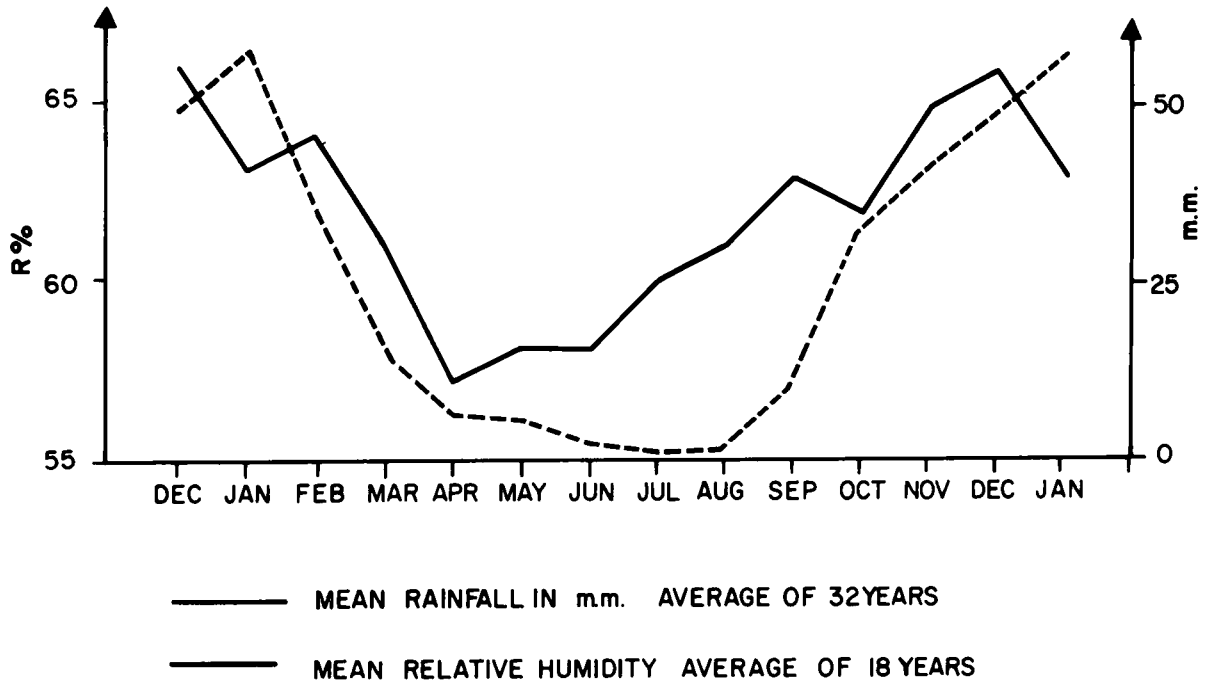


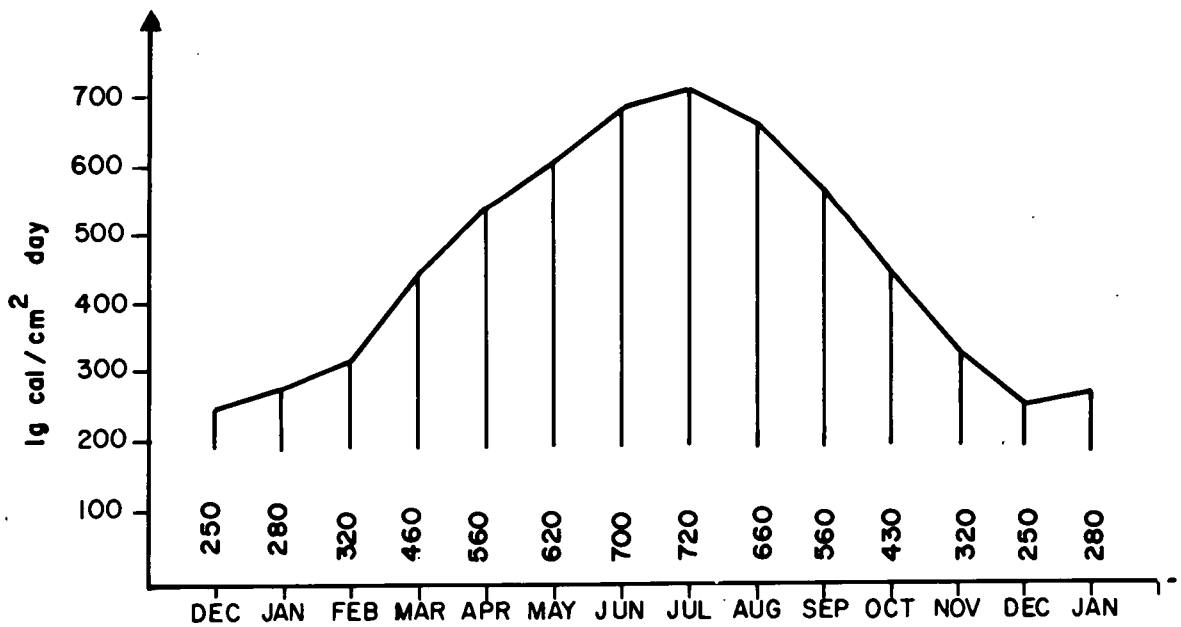
Diagram No. 1



### RAINFALL AND HUMIDITY: STATION MISURATA



### SOLAR RADIATION $I_g$ (incal/cm day on the horizontal surface of MISURATA SOURCE: WAKUTI TAUORGA



Diagrams Nos. 2 and 3

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Table No. 2

Classification of ground-water according to J. R. Jones<sup>2</sup>

| CLASS    | CHLORIDE<br>(Cl ppm) | SULPHATE<br>(SO <sub>4</sub> ppm) | TOTAL DIS.<br>SOLIDS ppm | SPEC. CONDUCTIVITY<br>MICROMHOS AT 25°C. |
|----------|----------------------|-----------------------------------|--------------------------|--|
| Good     | less than 250        | less than 250                     | less than 1,000          | less than 1,600                          |
| Fair     | 250-800              | 250-800                           | 1,000-1,500              | 1,600-2,500                              |
| Poor     | 800-1,500            | 600-1,200                         | 1,500-3,500              | 2,500-6,000                              |
| Brackish | 1,500-3,500          | 1,200-2,500                       | 3,500-6,000              | 6,000-10,000                             |
| Salty    | more than 3,500      | more than 2,500                   | more than 6,000          | more than 10,000                         |

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1. H. Speetzen, Notes on Flah, (unpublished, Hofuf, 1970)
2. Ibid.
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4. Ibid., p. 44
5. Ibid., p. 46
6. WAKUTI, Final Design for the Project of Improving Irrigation and Drainage in the Region of Al Hassa, Saudi Arabia, Explanation Report, (Siegen, 1964), pp. 43-45
7. WAKUTI, Completion Report, p. 74
8. Ibid., p. 75

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1. WAKUTI, Study on the Tauorga Irrigation Project, (Siegen, 1965), Appendix No. 2
2. Ibid., p. 47



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1. Speetzen, H. Notes on Flah, unpublished, Hofuf, May 1970
2. WAKUTI Final Completion for Supervision of the Execution of the Al Hassa Irrigation and Drainage Project, Zug, Switzerland, June 1972
3. ——— Final Design for the Project of Improving Irrigation and Drainage in the Region of Al Hassa, Saudi Arabia, (Explanation Report), Siegen, Germany, December 1964

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