# CHAPTER 12. CONCLUSIONS AND RECOMMENDATIONS

## 12.1 Conclusions

This Study was commenced in March 2000 with two objectives, (1) to formulate a Master Plan of flood forecasting and warning system for the 6 sub-basins with a total area of 3,500 $km^2$ on the left bank of the Tensift River, and (2) to carry out technical transfer to Moroccan counterpart personnel.

Following basic studies of about a year, a draft Master Plan was compiled in the Interim Report 2 in April 2001. In the draft Master Plan an automatic telemetry system of 20 flood watch stations and an automatic remote-control system of 17 warning posts were proposed to cope with flash floods that the existing manual system hardly manage.

A part of the draft Master Plan, was implemented as a Pilot Project in the Ourika River Basin step-wisely between July 2001 and September 2003, in order to actually examine the effectiveness of equipment and systems proposed in the draft Master Plan. A semi-automatic system of the first phase was completed in December 2001, and immediately its experimental operation started and continued about one and half years until when the second phase was completed to realize an full automatic telemetry system in July 2003. The experimental operation of the telemetry system was also made about one and half months from the beginning of August to mid-September 2003.

During the Pilot Project period, the JICA Study Team supported and monitored the experimental operation in Morocco and even from Japan while the team was back in Japan. A variety of technical transfer programs including simulation drills were also carried out to build up capacities of personnel concerned involved in the FFWS operations.

The effectiveness of the telemetry system was obvious. During the 4 August 2003 rainstorm, the system detected the first 1 mm raindrop and immediately warned ABHT. Thanks to this system ABHT could for the first time inform the occurrence of the intensive rainfall to Al Haouz Province earlier than its local authorities. On the other hand, several problems, mostly concerning the manual operations that are the mate to the equipment system for comprising the total FFWS, also arose during the Pilot Project. Weakness of permanence system, misunderstandings or insufficient understandings of personnel concerned on the operations, etc were revealed.

Based on the evaluation of the Pilot Project, the draft Master Plan that was compiled two and half years ago were modified and updated slightly. In due consideration of the severe financial situations mainly accompanied by the transition of DRHT into ABHT, the Master Plan was proposed to be implemented alternatively in a longer implementation period of 10 years in addition to 5 years proposed in the draft plan. A semi-automatic system was introduced partially to the warning dissemination system. Necessity of provincial/prefectural coordinating committee as machinery for assuring sustainable and appropriate operation of the Master Plan was emphasized in the operation and maintenance plan of the Master Plan.

The total cost of the Master Plan is estimated at Dh 51 million excluding that of the Pilot Project. Economic Internal Rate of Return of greater than 16% is obtained if human lives are additionally included in the benefit estimation. In conclusion, the Master Plan is generally viable in terms of economical effectiveness, social and technical acceptability and environmental impacts. If sufficient assistances of national and regional levels are available, the Master Plan could be viable financially too.

## 12.2 Recommendations

The JICA Study Team proposes the Master Plan of the FFWS in the Atlas Region in this report to the Government of Morocco, and strongly recommends that the Master Plan will be implemented soon to contribute to the enhancement of the safety of inhabitants and visitors in the Atlas Region. To facilitate the implementation of the Master Plan, the following actions are earnestly desired:

(1) Establishment of Coordination Committee

Necessity of machinery for assuring the sustainable operation of the pilot FFWS is recognized among personnel concerned as stipulated in the convention signed by Al Haouz Province, ABHT and DPE Al Haouz. This committee should be realized soon and is expected to lobby for the promotion of the Master Plan too.

(2) Sustainable Operation of Pilot Project System

Prior to the implementation of the Master Plan, it is essential to continue to operate and maintain appropriately the FFWS installed in the Pilot Project. If the pilot FFWS goes out of use, the Master Plan is out of the question.

(3) Comprehensive Approach to Disasters in Atlas Region

It is impossible to totally prevent and/or mitigate rain-induced disasters in the Atlas Region such as floods from main rivers and tributaries, debris flows and slope failures with the FFWS alone. Comprehensive approach composed of combinations of a variety of structural and nonstructural measures is indispensable against the disasters.

(4) Installation of Radar by DMN

More accurate weather forecasts are indispensable for realization of a reliable FFWS. It is strongly recommended that DMN implement the installation of precipitation radar in or near the Atlas Region as it plans.

# *TABLES*

## Table 2.1.1 CLIMATE IN MARRAKECH

| Month | Temperature (℃) | | | | | Humidity (%) | Sunshine (hour) | Precipitation | |
|---|---|---|---|---|---|---|---|---|---|
| | Maximum | | Minimum | | Mean | | | (mm) | Number of Days |
| | Mean max | Extreme | Mean max | Extreme | | | | | |
| Jan | 18.4 | 23.4 | 5.3 | 1.4 | 11.8 | 58.5 | 228.8 | 32.3 | 5.8 |
| Feb | 20.1 | 27.7 | 7.7 | 3.4 | 13.9 | 57.9 | 197.8 | 33.8 | 6.4 |
| Mar | 22.6 | 30.0 | 9.6 | 5.7 | 16.1 | 52.5 | 254.6 | 52.7 | 5.6 |
| Apr | 24.5 | 32.2 | 11.3 | 7.2 | 17.9 | 51.6 | 275.7 | 15.5 | 5.3 |
| May | 27.4 | 36.0 | 13.8 | 10.2 | 20.6 | 48.4 | 297.6 | 9.5 | 3.1 |
| Jun | 32.2 | 38.8 | 16.4 | 13.3 | 24.3 | 48.0 | 324.6 | 6.0 | 0.9 |
| Jul | 37.7 | 43.9 | 20.8 | 16.3 | 29.2 | 40.9 | 318.5 | 1.8 | 1.6 |
| Aug | 37.2 | 43.9 | 21.0 | 16.7 | 29.1 | 40.9 | 308.3 | 3.8 | 1.3 |
| Sep | 33.7 | 41.5 | 19.3 | 15.2 | 26.5 | 43.1 | 253.6 | 5.6 | 1.9 |
| Oct | 27.3 | 33.4 | 14.9 | 11.1 | 21.1 | 50.9 | 250.6 | 14.0 | 3.8 |
| Nov | 22.6 | 29.7 | 11.2 | 5.6 | 16.9 | 55.5 | 229.4 | 37.3 | 6.8 |
| Dec | 19.7 | 25.7 | 7.4 | 2.5 | 13.6 | 57.0 | 223.1 | 16.9 | 4.8 |
| Total | 323.4 | 406.2 | 158.7 | 108.6 | 241.0 | 605.2 | 3,162.6 | 229.2 | 47.3 |
| Average | 27.0 | 33.9 | 13.2 | 9.1 | 20.1 | 50.4 | 263.6 | 19.1 | 3.9 |
| Maximum | 37.7 | 43.9 | 21.0 | 16.7 | 29.2 | 58.5 | 324.6 | 52.7 | 6.8 |
| Minimum | 18.4 | 23.4 | 5.3 | 1.4 | 11.8 | 40.9 | 197.8 | 1.8 | 0.9 |

Data Source: DRHT

## Table 2.1.2 TEMPERATURE AT SIDI RAHAL STATION AND LALLA TAKERKOUST STATION

Sidi Rahal

| Month | Temperature(℃) | | | Average Evaporation (mm) |
|---|---|---|---|---|
| | Average | Extreme Max | Extreme Min | |
| Jan | 12.3 | 28.2 | -0.6 | 119.3 |
| Feb | 13.3 | 29.0 | -5.6 | 115.6 |
| Mar | 14.9 | 32.6 | 1.8 | 138.1 |
| Apr | 16.1 | 36.0 | 3.0 | 138.9 |
| May | 19.1 | 40.0 | 5.0 | 197.5 |
| Jun | 23.2 | 43.4 | 8.4 | 246.2 |
| Jul | 28.2 | 45.0 | 11.4 | 365.7 |
| Aug | 27.8 | 43.6 | 12.2 | 340.7 |
| Sep | 24.9 | 41.4 | 9.4 | 263.5 |
| Oct | 20.1 | 37.4 | 5.0 | 190.0 |
| Nov | 16.3 | 31.2 | 2.0 | 150.6 |
| Dec | 13.0 | 28.0 | -0.8 | 117.6 |
| Total | - | - | - | 2,383.7 |
| Average | 19.1 | 435.8 | 51.2 | 198.6 |
| Maximum | 28.2 | 45.0 | 12.2 | 365.7 |
| Minimum | 12.3 | 28.0 | -5.6 | 115.6 |

Data Source: DRHT

Lalla Takerkoust

| Month | Temperature(℃) | | | Average Evaporation (mm) |
|---|---|---|---|---|
| | Average | Extreme Max | Extreme Min | |
| Jan | 10.9 | 28.8 | -7.4 | 90.3 |
| Feb | 12.8 | 29.4 | -4.8 | 88.8 |
| Mar | 14.8 | 32.0 | -2.6 | 120.6 |
| Apr | 15.4 | 39.4 | -4.2 | 123.1 |
| May | 18.7 | 41.2 | 1.0 | 155.6 |
| Jun | 22.2 | 42.0 | 3.8 | 175.3 |
| Jul | 27.0 | 45.8 | 6.4 | 244.1 |
| Aug | 26.4 | 46.0 | 8.6 | 239.5 |
| Sep | 23.2 | 42.2 | 3.6 | 178.4 |
| Oct | 18.6 | 36.6 | 2.2 | 134.3 |
| Nov | 14.9 | 31.8 | -2.2 | 105.0 |
| Dec | 12.2 | 28.4 | -6.4 | 96.6 |
| Total | - | - | - | 1,751.6 |
| Average | 18.1 | 443.6 | -2.0 | 146.0 |
| Maximum | 27.0 | 46.0 | 8.6 | 244.1 |
| Minimum | 10.9 | 28.4 | -7.4 | 88.8 |

Data Source: DRHT

## Table 2.1.3 ANNUAL MAXIMUM DISCHARGE

| River | N'FIS | N'FIS | RHERAYA | OURIKA | ZAT | R'DAT |
|---|---|---|---|---|---|---|
| Station | I.E.HAMMAM | N'KOURIS | TAHANAOUT | AGHBALAU | TAFERIAT | S.RAHAL |
| 1880 | | | | | 730.0 | |
| 1937/38 | | | 145.0 | | | |
| 1938/39 | | | 130.0 | | | |
| 1939/40 | | | 75.0 | | | |
| 1940/41 | | | | 155.0 | | |
| 1941/42 | | | | 135.0 | | |
| 1942/43 | | | | 130.0 | | |
| 1944/45 | | | 100.0 | | | |
| 1945/49 | | | | | 490.0 | |
| 1949 | | | | | | 380.0 |
| 1948/49 | | | | 350.0 | | |
| 1950/51 | | | | | 100.0 | |
| 1952/53 | | | | | 120.0 | |
| 1954/55 | | | | | 150.0 | |
| 1962/63 | | | 34.5 | | 145.0 | |
| 1963/64 | | | 13.0 | | 285.0 | |
| 1964/65 | | | 35.7 | | 209.0 | 70.3 |
| 1965/66 | | | 37.3 | | 600.0 | 200.0 |
| 1966/67 | 335.0 | 272.0 | 54.3 | | 225.0 | 183.0 |
| 1967/68 | 1,400.0 | 620.0 | 290.0 | 1,060.0 | 230.0 | 202.0 |
| 1968/69 | 89.6 | 74.0 | 9.3 | | 46.4 | 66.5 |
| 1969/70 | 720.0 | 584.0 | 8.7 | 96.7 | 50.2 | 149.0 |
| 1970/71 | 110.0 | 90.0 | 24.2 | 117.0 | 96.9 | 202.0 |
| 1971/72 | 38.5 | 32.0 | 15.6 | 55.2 | 108.0 | 125.0 |
| 1972/73 | 40.7 | 34.0 | 42.3 | 72.0 | 47.0 | 60.4 |
| 1973/74 | 47.6 | 40.0 | 47.6 | 77.5 | 109.0 | 103.0 |
| 1974/75 | 50.1 | 42.0 | 12.0 | 23.4 | 63.2 | 35.7 |
| 1975/76 | 36.1 | 24.0 | 16.2 | 101.0 | 48.7 | 87.2 |
| 1976/77 | 111.0 | 119.0 | 9.4 | 52.6 | 108.0 | 49.3 |
| 1977/78 | 301.0 | 263.0 | 21.6 | 95.6 | 32.0 | 160.0 |
| 1978/79 | 400.0 | 403.0 | 9.9 | 18.4 | 108.0 | 87.8 |
| 1979/80 | 132.0 | 127.0 | 39.0 | 350.0 | 138.0 | 210.0 |
| 1980/81 | 44.8 | 44.1 | 36.7 | 8.1 | 108.0 | 210.0 |
| 1981/82 | 58.5 | 25.8 | 33.7 | 91.3 | 680.0 | 685.0 |
| 1982/83 | 51.4 | 33.8 | 22.5 | 24.4 | 14.7 | 5.5 |
| 1983/84 | 482.0 | 393.0 | 30.9 | 37.4 | 106.0 | 77.0 |
| 1984/85 | 86.5 | 45.9 | 23.4 | 40.1 | 106.0 | 110.0 |
| 1985/86 | 57.0 | 20.3 | 54.0 | 50.5 | 85.0 | 49.8 |
| 1986/87 | 508.0 | 135.0 | 155.0 | 250.0 | | 351.2 |
| 1987/88 | 810.0 | 1,120.0 | 146.0 | 651.0 | 467.0 | 397.0 |
| 1988/89 | 1,220.0 | 585.0 | 58.9 | 823.0 | 73.8 | 325.0 |
| 1989/90 | 455.0 | 229.0 | 103.0 | 265.0 | 270.0 | 345.0 |
| 1990/91 | 63.9 | 92.5 | 26.2 | 207.0 | 72.6 | 146.0 |
| 1991/92 | 446.0 | 319.0 | 71.2 | 290.0 | 99.5 | 125.0 |
| 1992/93 | 9.0 | 13.7 | 27.6 | 74.5 | 26.9 | 27.6 |
| 1993/94 | 283.0 | 146.2 | 86.4 | 226.0 | 237.0 | 144.0 |
| 1994/95 | 501.0 | 42.8 | 680.0 | 1,030.0 | 400.0 | 533.0 |
| 1995/96 | 501.0 | 212.0 | 63.0 | 165.0 | 72,8 | 407.0 |
| 1996/97 | 54.4 | 124.0 | 15.6 | 65.0 | 37.0 | 212.0 |
| 1997/98 | 155.0 | 62.5 | 44.0 | 61.3 | 17.8 | 536.0 |
| 1998/1999 | 970.0 | 158.0 | 762.0 | 561.0 | 104.0 | 252.0 |
| Maximum | 1,400.0 | 1,120.0 | 762.0 | 1,060.0 | 730.0 | 685.0 |
| Minimum | 9.0 | 13.7 | 8.7 | 8.1 | 14.7 | 5.5 |
| Average | 320.2 | 197.8 | 88.1 | 223.1 | 178.6 | 203.0 |

Source : Ajustements statistic de valeurs extremes de pluies et de debits dans le bassin de Tensift-Qsob par le logiciel "EXTREM" issued by DRHT/SHL, dec 1999

**Table 2.1.4 PROBABILITY OF ANNUAL PEAK DISCHARGE AT PRINCIPAL STATION**

($m^3/s$)

| No. | Station | Catchment Area ($km^2$) | Probability | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 1/2 | 1/5 | 1/10 | 1/20 | 1/50 | 1/100 | 1/200 |
| 1 | Sidi Rahal | 532 | 150 | 300 | 420 | 550 | 740 | 900 | 1,070 |
| 2 | Taferiat | 528 | 110 | 250 | 390 | 560 | 840 | 1,110 | 1,440 |
| 3 | Aghbalau | 495 | 115 | 300 | 490 | 750 | 1,200 | 1,650 | 2,200 |
| 4 | Tahanaout | 221 | 40 | 90 | 150 | 230 | 390 | 560 | 800 |
| 5 | Iguir N'kouris | 848 | 100 | 280 | 520 | 850 | 1,500 | 2,200 | 3,090 |
| 6 | Imin El Hammam | 1,256 | 150 | 440 | 770 | 1,220 | 2,040 | 2,880 | 3,950 |
| Total | | 3,880 | | | | | | | |

Source : Ajustements statistic de valeurs extremes de pluies et de debits dans le bassin de Tensift-Qsob par le logiciel "EXTREM" issued by DRHT/SHL, dec 1999

## Table 2.2.1 DEMOGRAPHIC DATA OF AL HAOUZ PROVINCE

| Cercle | Caidat | Commune Rurale | Area (km2) | Number of Douars | Number of Households | Population |
|---|---|---|---|---|---|---|
| Ait Ourir | Abadou | Ait Aadel | 86 | 18 | 753 | 6,113 |
| | | Abadou | 101 | 27 | 1,288 | 8,834 |
| | | Ait Hkim Ait Izid | 145 | 11 | 825 | 6,898 |
| | | Tazart | 249 | 58 | 2,029 | 14,156 |
| | Touama | Zerktene | 422 | 67 | 2,432 | 18,239 |
| | | Touama | 112 | 31 | 1,797 | 11,057 |
| | | Tamaguerte | 82 | 31 | 1,684 | 10,347 |
| | Mesfioua | Tighdouine | 454 | 49 | 2,777 | 20,939 |
| | | Tidili Mesfioua | 204 | 53 | 3,347 | 22,056 |
| | Faska Sidi Daoud | Ait Sidi Daoud | 105 | 34 | 2,716 | 17,307 |
| | | Ait Faska | 99 | 33 | 2,593 | 16,210 |
| | Ghmate | Tamazouzte | 97 | 38 | 1,637 | 11,216 |
| | | Sidi Abdellah Ghiate | 113 | 63 | 2,413 | 16,298 |
| | | Iguerferouane | 96 | 34 | 1,559 | 11,485 |
| | | Ghmate | 130 | 50 | 3,069 | 20,460 |
| | Municipalite Ait Ourir | | 10 | 11 | 2,165 | 12,162 |
| | Sub-total | | 2,505 | 608 | 33,084 | 223,777 |
| Tahanaout | Tahanaout | Tahanaout | 272 | 104 | 4,030 | 25,574 |
| | | My Brahim | 124 | 34 | 1,765 | 10,503 |
| | Ourika | Ourika | 156 | 37 | 3,580 | 21,982 |
| | | Setti Fadma | 302 | 59 | 3,025 | 20,545 |
| | | Oukaimeden | 205 | 7 | 544 | 3,798 |
| | Tamesloht | Tamesloht | 256 | 58 | 2,903 | 17,138 |
| | Sub-total | | 1,315 | 299 | 15,847 | 99,540 |
| Amizmiz | Amizmiz | Amizmiz | 47 | 9 | 2,354 | 11,919 |
| | | Amghrass | 94 | 24 | 735 | 4,527 |
| | Ouazguita | Lalla Takarkoust | 84 | 14 | 939 | 5,110 |
| | | Ouazguita | 121 | 24 | 952 | 6,058 |
| | | Sidi Bedhaj | 105 | 20 | 1,074 | 6,224 |
| | | Oulad Mtaa | 127 | 17 | 983 | 5,660 |
| | Guedmioua | Tizguine | 66 | 31 | 749 | 3,896 |
| | | Anougal | 99 | 23 | 661 | 4,143 |
| | | Dar Jamaa | 74 | 28 | 1,101 | 6,202 |
| | | Azgour | 216 | 14 | 1,097 | 6,599 |
| | Sub-total | | 1,033 | 204 | 10,645 | 60,338 |
| Asni | Asni | Asni | 161 | 30 | 2,270 | 16,235 |
| | Ouirgane | Ouirgane | 150 | 18 | 1,054 | 6,435 |
| | | Imgdal | 278 | 28 | 938 | 5,594 |
| | Talat N'Yakoub | Ijoukak | 319 | 39 | 993 | 6,305 |
| | | Talat N'Yakoub | 160 | 56 | 1,266 | 7,390 |
| | | Ighil | 189 | 28 | 750 | 5,126 |
| | | Aghbar | 161 | 17 | 633 | 4,332 |
| | Sub-total | | 1,418 | 216 | 7,904 | 51,417 |
| Total | | | 6,271 | 1,327 | 67,480 | 435,072 |

Source : 1994-based demographic data "Donnees Monographiques de la Province d'Al Haouz

## Table 2.2.2 DEMOGRAPHIC DATA OF THE PREFECTURE

**OF SIDI YOUSSEF BEN ALI**

| Cercle | Caidat | Commune Rurale | Area (km2) | Number of Douars | Number of Households | Population |
|---|---|---|---|---|---|---|
| District Sidi Youssef Ben Ali | Arrondissement Nord<br>Arrondissement Centre<br>Arrondissement Sud | Sidi Youssef Ben Ali | 13 | Urbain | 20,498 | 118,770 |
| | Arrondissement Annakhil | Annakhil | 67 | Urbain | 6,918 | 38,626 |
| | Sub-total | | 80 | - | 27,416 | 157,396 |
| Bour | Bour | Harbil | 265 | 22 | 2,067 | 13,209 |
| | | M'Nabha | 351 | 29 | 1,691 | 11,685 |
| | | Ouahat Sidi Brahim | 55 | 7 | 1,306 | 7,646 |
| | Ouled Hassoune | Ouled Hassoune | 78 | 46 | 2,762 | 18,447 |
| | | Al Ouidane | 120 | 54 | 2,570 | 15,607 |
| | Ouled Dlim | Ouled Dlim | 575 | 76 | 2,191 | 15,909 |
| | Sub-total | | 1,444 | 234 | 12,587 | 82,503 |
| Total | | | 1,524 | 234 | 40,003 | 239,899 |

Source : Document of the Prefecture of Sidi Youssef Ben Ali based on 1994 national census

## Table 2.3.1 DOMINANT TREE AND FOREST AREA IN AL HAOUZ PROVINCE

| Cercle | Total Area ($km^2$) | Ratio of Forest (%) | Forest Area ($km^2$) | Forest Area by Tree Species ($km^2$) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Holm Oak (Chenevert) | Juniper (Geneviers) | Thuya | Alep pine (Pin d'Alep) | Morocian indigenous species (Arganier) | Secondary species (Essences seconaires) | Reforestation (Reboisement ) | Cypress of Atlas (Cypres de l'Atlas) | Cork oak (Cheneliege) | Defrissement | Bare lands (Vides) |
| Asni | 1,547 | 53.50% | 828 | 448 | 142 | 79 | 3 | 0 | 1 | 0 | 21 | 0 | 2 | |
| Tahanaout | 1,128 | 40.00% | 451 | 256 | 32 | 9 | 0 | 0 | 0 | 13 | 0 | 0 | 3 | |
| Amizmiz | 1,074 | 42.20% | 454 | 254 | 14 | 13 | 10 | 0 | 7 | 0 | 16 | 0 | 27 | |
| Ait Ourir | 2,482 | 39.90% | 990 | 547 | 123 | 43 | 35 | 0 | 0 | 0 | 0 | 3 | 20 | |
| Province | 6,231 | 43.70% | 2,723 | 1,506 | 311 | 144 | 47 | 0 | 7 | 13 | 37 | 0 | 51 | 603 |
| Ratio of Foret Composition | | | | | | | | | | | | | | |
| Asni | | | 100.0% | 54.2% | 17.2% | 9.5% | 0.3% | 0.0% | 0.1% | 0.0% | 2.5% | 0.0% | 0.3% | 16.0% |
| Tahanaout | | | 100.0% | 56.7% | 7.0% | 2.0% | 0.0% | 0.0% | 0.0% | 2.8% | 0.0% | 0.0% | 0.7% | 30.8% |
| Amizmiz | | | 100.0% | 56.0% | 3.2% | 2.8% | 2.2% | 0.0% | 1.5% | 0.0% | 3.6% | 0.0% | 5.0% | 24.9% |
| Ait ourir | | | 100.0% | 55.3% | 12.4% | 4.4% | 3.5% | 0.0% | 0.0% | 0.0% | 0.0% | 0.3% | 2.0% | 22.1% |
| Province | | | 100.0% | 55.3% | 11.4% | 5.3% | 1.7% | 0.0% | 0.3% | 0.5% | 1.4% | 0.1% | 1.9% | 22.2% |

Data Source: Service Forestier de Marrakech, Direction Provincial de l'Agriculture et de la Reforme Agraire

**Table 2.4.1 LIST OF TELEPHONE INSTALLATION AT AL HAOUZ PROVINCE**

| Nos. | Network (Station Name) | Kinds of Line | Numbers of Telephone Line | Numbers of demand Line | The station Within Study Area |
|---|---|---|---|---|---|
| 1 | **TAHANAOUT** | CR | 340 | 0 | Rheraya |
| 2 | DAR OURIKI | CR | 102 | 1 | Ourika |
| 3 | RHMATE | CR | 42 | 30 | Ourika |
| 4 | D.AIT KADDOUR | LC | 14 | 8 | Rheraya |
| 5 | ASNI | CR | 79 | 1 | Rheraya |
| 6 | AGHBALLOU(STI FADMA | CR | 51 | 0 | Ourika |
| 7 | TOUAMA | CR | 42 | 0 | R'Dat |
| 8 | TAMAGARTE | CR | 6 | 20 | |
| 9 | MY. BRAHIM | CR | 56 | 0 | Rheraya |
| 10 | HAD ZREKTEN | CR | 17 | 0 | R'Dat |
| 11 | A. GHIATE | LC | 49 | 0 | Ourika |
| 12 | TADDARTE | LC | 10 | 0 | R'Dat |
| 13 | TOUFLIHTE | CR | 1 | 0 | R'Dat |
| 14 | AZGOUR | CR | 9 | 0 | N'Fis |
| 15 | OUIRGANE | CR | 44 | 0 | N'Fis |
| 16 | T. N'YAAKOUB | CR | 56 | 0 | N'Fis |
| 17 | IJOUKAK | CR | 7 | 1 | N'Fis |
| 18 | AMGDAL | CR | 7 | 0 | N'Fis |
| 19 | SIDI BEDHAJ | CR | 0 | 0 | N'Fis |
| 20 | A. TIGHDOUINE | CR | 39 | 0 | Zat |
| 21 | T. MESFIOUA | CR | 12 | 2 | Zat |
| 22 | AIT AADEL | CR | 28 | 0 | |
| 23 | ABADOU | CR | 14 | 1 | R'Dat |
| 24 | DAR JAMEA | LC | 4 | 0 | N'Fis |
| 25 | TAGOUNDAFTE | LC | 3 | 0 | |
| 26 | MOLDIKHTE | LC | 9 | 0 | |
| 27 | IDNI | LC | 2 | 0 | N'Fis |
| 28 | MZOUZITE | CR | 7 | 0 | N'Fis |
| 29 | AGHBAR | CR | 5 | 0 | N'Fis |
| 30 | IGUERFEROUANE | CR | 3 | 0 | Ourika |
| 31 | OUZGUITA | CR | 9 | 0 | N'Fis |
| 32 | IGHIL | CR | 5 | 0 | Ourika |
| 33 | TAMAZOZTE | CR | 27 | 0 | |
| 34 | ANOUGAL | CR | 7 | 0 | N'Fis |
| 35 | TADMENT | LC | 1 | 0 | Ourika |
| 36 | IMLIL | LC | 34 | 0 | Rheraya |
| 37 | AIT HKIM | CR | 8 | 0 | |
| 38 | TAKERKOUSTE | CR | 119 | 0 | N'Fis |
| 39 | TAMSLOHTE | CR | 96 | 4 | N'Fis |
| 40 | **AIT OURIR** | CR | 927 | 0 | Zat |
| 41 | AIT FASKA | CR | 52 | 0 | Zat |
| 42 | AIT SIDI DAOUD | CR | 21 | 0 | Zat |
| 43 | **AMIZMIZ** | CR | 608 | 0 | N'Fis |
| 44 | AMEGHRASS | CR | 11 | 0 | N'Fis |
| 45 | IGOUDAR | CR | 100 | 21 | N'Fis |
| 46 | TIZGUINE | CR | 50 | 0 | N'Fis |
| 47 | **OUKAIMDEN** | CR | 46 | 0 | Ourika |
| | **TOTAL** | | 3179 | 89 | |

Note: CR Radio Circuit
LC Line circuit

Source: Office National de PTT, Tahanaout (As of March 2000)

**Table 2.5.1 TOURISM SURVEY METHODOLOGY**

| | | | |
|---|---|---|---|
| Survey Items | Number of tourists and vehicles (counting tourists and vehicles in each area) | | |
| | Characteristics of tourism (attribute of tourists, behavior, language capability etc.) | | |
| | Awareness on flood (fear of flood, where to evacuate, necessity of alarm or guide) | | |
| | Traffic (counting vehicles going in and out of Ourika at Aghbalou) | | |
| | Others | | |
| Survey Methodology | Questionnaire/ Interview (Setti Fadma, Iraghf, R'ha Moulay Brahim and Imlil) | | |
| | Counting tourists and vehicles | | |
| | Traffic counting (counting vehicles at fixed point) | | |
| Interviewees | Tourists (Moroccans and foreigners) | | |
| | Owners of cafe-restaurants and hotels<br>(Setti Fadma, Iragfh, R'ha Moulay Brahim, Imlil) | | |
| Date | Weekday | Wed. 2nd Aug. 2000 | Rheraya (R'ha Moulay Brahim, Imlil) |
| | | Thu. 3rd Aug. 2000 | Ourika (Setti Fadma, Iraghf, Whole Ourika, Aghbalou) |
| | Weekend | Sat. 5th Aug. 2000 | Rheraya (R'ha Moulay Brahim, Asni market) |
| | | Sun. 6th Aug. 2000 | Ourika (Setti Fadma, Iraghf, Whole Ourika, Aghbalou) |
| Sampling number of questionnaire | Ourika | Setti Fadma | 100 tourists |
| | | Iraghf (Oulmes) | 76 tourists |
| | Rheraya | Imlil (Oulmes) | N/A (very few people in the river) |
| | | R'ha Moulay Brahim | 140 tourists |
| Counting survey | Tourist counting | Setti Fadma | |
| | | Iraghf (Oulmes) | |
| | | R'ha Moulay Brahim | |
| | | Asni market (only every Saturday open) | |
| | | Whole Ourika (from Aghbalou to Setti Fadma) | |
| | Traffic counting | Setti Fadma | |
| | | Iraghf (Oulmes) | |
| | | R'ha Moulay Brahim | |
| | | Asni market (only every Saturday open) | |
| | | Whole Ourika (from Aghbalou to Setti Fadma) | |
| | | Aghbalou (fixed point traffic going in and out of Ourika) | |

## Table 2.5.2 SUMMARY RESULTS OF QUESTIONNAIRE TO TOURISTS

| | | Total | Setti Fadma | Iraghf | R'ha |
|---|---|---|---|---|---|
| Sampling number | | 316 tourists | 100 tourists | 76 tourists | 140 tourists |
| Sex | 1. Male | 76 % | 89 % | 62 % | 74 % |
| | 2. Female | 22 % | 11 % | 36 % | 24 % |
| Nationality | 1. Moroccan | 90 % | 88 % | 96 % | 89 % |
| | 2. Foreigner | 6 % | 10 % | 1 % | 6 % |
| Trip style | 1. One day trip | 50 % | 53 % | 68 % | 28 % |
| | 2. Stay | 50 % | 47 % | 32 % | 72 % |
| | ( days) | 8.3days | 7.3days | 14.8days | 6.0days |
| Composition of member | 1. Adults only | 41 % | 62 % | 29 % | 33 % |
| | 2. With children | 51 % | 38 % | 59 % | 55 % |
| Group style | 1. Family | 61 % | 45 % | 76 % | 65 % |
| | 2. With friends | 29 % | 49 % | 12 % | 24 % |
| Did you join package tour? | 1. Yes | 9 % | 14 % | 0 % | 11 % |
| | 2. No | 86 % | 82 % | 96 % | 84 % |
| How did you come here? | 1. Own car | 39 % | 36 % | 41 % | 40 % |
| | 2. Taxi | 44 % | 49 % | 49 % | 37 % |
| | 3. Rental car | 1 % | 1 % | 1 % | 0 % |
| | 4. Coach | 16 % | 12 % | 4 % | 26 % |
| | 5. Mini bus | 1 % | 0 % | 1 % | 1 % |
| | 6. Motorbike | 1 % | 1 % | 0 % | 1 % |
| | 7. bicycle | 1 % | 0 % | 1 % | 1 % |
| For what did you come here? | 1. Climbing the mountain | 38 % | 61 % | 25 % | 28 % |
| | 2. Playing in and around the river | 94 % | 88 % | 97 % | 96 % |
| | 3. Others | 3 % | 1 % | 7 % | 3 % |
| What attracts you? | 1. Weather | 77 % | 65 % | 92 % | 78 % |
| | 2. Mountain | 83 % | 80 % | 89 % | 81 % |
| | 3. Nature | 95 % | 98 % | 97 % | 91 % |
| | 4. River & water | 86 % | 79 % | 97 % | 86 % |
| | 5. Others | 7 % | 1 % | 18 % | 5 % |
| How many times do you come here? | ( times / year) | 2.3times / year | 2.7times / year | 3.2times / year | 1.6times / year |
| How many days do you spend here? | ( days / year) | 7.9days / year | 6.1days / year | 12.4days / year | 6.8days / year |
| What language can you read and write? | 1. French | 68 % | 73 % | 76 % | 60 % |
| | 2. Arabic | 88 % | 85 % | 92 % | 89 % |
| | 3. Berber | 11 % | 0 % | 13 % | 19 % |
| | 4. English | 27 % | 26 % | 32 % | 25 % |
| What language can you speak and hear? | 1. French | 71 % | 73 % | 79 % | 66 % |
| | 2. Arabic | 94 % | 89 % | 95 % | 97 % |
| | 3. Berber | 30 % | 36 % | 25 % | 29 % |
| | 4. English | 24 % | 22 % | 28 % | 24 % |
| How much do you spend? | ( Dh./ day/ person) | 106.4 Dh./ day/ person | 120.0 Dh./ day/ person | 90.5 Dh./ day/ person | 105.4 Dh./ day/ person |
| Do you know previous disasters? | 1. Yes | 92 % | 92 % | 97 % | 89 % |
| | 2. No | 6 % | 3 % | 1 % | 11 % |
| Do you fear a flood? | 1. Yes | 61 % | 64 % | 74 % | 52 % |
| | 2. No | 17 % | 33 % | 0 % | 15 % |
| Where do you evacuate if flood comes? | 1. Car | 12 % | 9 % | 13 % | 14 % |
| | 2. Restaurant or cafe | 0 % | 0 % | 0 % | 1 % |
| | 3. Climb the highest place | 81 % | 82 % | 83 % | 79 % |
| | 4. No idea | 8 % | 13 % | 4 % | 6 % |
| | 5. Others | 4 % | 0 % | 5 % | 6 % |
| Do you want alarm? | 1. Yes | 99 % | 99 % | 99 % | 99 % |
| | 2. No | 0 % | 1 % | 0 % | 0 % |
| Do you want guides? | 1. Yes | 97 % | 93 % | 97 % | 99 % |
| | 2. No | 3 % | 6 % | 1 % | 1 % |
| Do you go to Moulay Brahim also? | 1. Yes | | | | 91 % |
| | 2. No | | | | 4 % |
| Which is main destination R'ha Moulay Brahim or Moulay Brahim? | 1. Moulay Brahim | | | | 6 % |
| | 2. R'ha Moulay Brahim | | | | 4 % |
| | 3. Both | | | | 68 % |

**Table 2.6.1 CATCHMENT AREAS OF SUB-BASIN**

| No. | Basin | Catchment Area ($km^2$) | Remarks |
|---|---|---|---|
| 1 | N'fis River Basin | 1,256 | Upstream from Sta. Imin El Hammam |
| 2 | Rheraya River Basin | 221 | Upstream from Sta. Tahanaout |
| 3 | Ourika River Basin | 495 | Upstream from Sta. Aghbalau |
| 4 | Zat River Basin | 528 | Upstream from Sta. Taferiat |
| 5 | R'dat River Basin | 532 | Upstream from Sta. Sidi Rahal |
| 6 | Issyl River Basin | 421 | Upstream from Root N8 |
| Total | | 3,453 | |

**Table 2.6.2 DIMENSION OF MAJOR RIVERS**

| No. | River | Length (Km)*1 | Origin EL. (m) | End EL. (m) | | Slope |
|---|---|---|---|---|---|---|
| 1 | N'fis River | 133.1 | 3,000 | 300 | (780) | 1/50-1/200 (1/110) |
| 2 | Rheraya River | 87.2 | 3,800 | 350 | (925) | 1/5 -1/140 (1/45) |
| 3 | Ourika River | 76.1 | 3,000 | 430 | (1,011) | 1/5 -1/160 (1/32) |
| 4 | Zat River | 93.8 | 3,700 | 430 | (760) | 1/10-1/160 (1/70) |
| 5 | R'dat River | 76.6 | 2,400 | 500 | (700) | 1/10-1/155 (1/100) |
| 6 | Issyl River | 47.0 | 1,900 | 400 | - | 1/20-1/160 |

*1 : From confluence with Tensift river to Origin
( )…Value at edge of downstream of each river in the study area)

**Table 2.7.1 (1/2) FEATURE OF FLOOD AND SEDIMENT FLOW DAMAGE IN 1995 FLOOD**

| River Basin | Damage Site | Contents of Damage | | | | | | | | Scale of Damage | | Cause of Damage | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | House | People | | Household Effects | Live Stocks | Agricul-tural Area | Infra structure | Others | Wide Area | Localized | Flood | debris | |
| | | | Loss of Lives | Injured | | | | | | | | | | |
| R'dat | Sidi Rahal | | | | | | Yes | | Yes | | Yes | Yes | | Generally debris damage occurred by tributary, Flood damage occurred by main river |
| | Zerqten | Yes | Yes | | Yes | Yes | Yes | Yes | Yes | Yes | | Yes | Yes | |
| Zat | Tighedouine | Yes | Yes | | Yes | Yes | Yes | Yes | Yes | Yes | | | Yes | |
| Ourika | Aghbalau | | | | | | | Yes | | | Yes | Yes | | |
| | Iraghf | Yes | Yes | Yes | Yes | | | Yes | | Yes | | Yes | Yes | |
| | Setti Fadma | Yes | Yes | Yes | Yes | | Yes | Yes | | Yes | | Yes | Yes | |
| Issyl | — | Yes | | | | | | | | | | Yes | | |
| Rheraya | Asni | Yes | | | | | Yes | Yes | | | Yes | Yes | | |
| | Tahanaout | | | | | | | | Yes | | Yes | Yes | | |
| | my. Brahim | | Yes | Yes | | | | | Yes | | Yes | Yes | | |
| | Imlil | | | | | | | | Yes | | Yes | Yes | | |
| N'fis | Wirgane | | | | | | Yes | Yes | | | Yes | Yes | Yes | |
| | Imigdal | | | | | | Yes | Yes | | | Yes | Yes | Yes | |

**Table 2.7.1 (2/2) FEATURE OF FLOOD AND SEDIMENT FLOW DAMAGE IN 1995 FLOOD**

| River Basin | Damage Site | Contents of Damage | | | | | | | | Scale of Damage | | Cause of Damage | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | House | People | | Household Effects | Live Stocks | Agricultura l Area | Infra structure | Others | Wide Area | Localized | Flood | debris flow | |
| | | | Loss of Lives | Injured | | | | | | | | | | |
| R'dat | Sidi Rahal | | | | | | | | | | | | | Generally, debris damage occurred by tributary, Flood damage occurred by main river |
| | Zerqten | | | | | | | | | | | | | |
| Zat | Tighedouine | | | | | | | | | | | | | |
| Ourika | Aghbalau | Yes | | | | | | Yes | | | Yes | Yes | | |
| | Lgharmane～Setti Fadma | | | | | | | Yes | | Yes | | Yes | | |
| | Setti Fadma | | | | | | Yes | Yes | | | Yes | Yes | Yes | |
| Issyl | — | | | | | | | | | | | | | |
| Rheraya | Asni～Imlil | | | | | | | Yes | | Yes | | Yes | | |
| N'fis | Imigdal | | | | | | Yes | | | | Yes | Yes | | |
| | Ijoukak | | | | | | Yes | | | | Yes | Yes | | |
| | Talat N'Yacob | | | | | | Yes | | | | Yes | Yes | | |
| | Wirgane～Mzouzite | | | | | | Yes | Yes | | Yes | | Yes | Yes | |

**Table 2.10.1 PROJECTS SUBJECT TO EIA**

| 1. Establishments classified as dangerous of the first category | 2. Infrastructure projects | 3. Industrial projects | 4. Agricultural projects |
|---|---|---|---|
| | Transport routes<br><br>Urban development<br><br>Industrial zones<br><br>Sea ports<br><br>Dams and other water storage facilities<br><br>Tourist structures<br><br>Disposal sites<br><br>Wastewater treatment facilities<br><br>Dangerous or toxic materials transport | Mining (quarries, mines, cement plants, plasterworks)<br><br>Energy (gas storage, oil refineries, energy transfer, thermal plans, nuclear plants, hydroelectric plants)<br><br>Chemicals (manufacturers of pesticides, pharmaceuticals, paints, elastomers and peroxydes, asbestos works)<br><br>Food (food conservation, dairy products, brewing, fiseries, slaughterhouses, flour mills)<br><br>Textiles, leather, wood, rubber, paper and cardboard industries | Rural land exploitation<br><br>Reforestation<br><br>Projects on potential but uncultivated lands |

## Table 3.1.1 CLASSIFICATION OF LAND FORM FOR 1/50,000 MAP

| Landform classifications | Definition |
|---|---|
| Steep Slope | Mountainous and hilly steep slopes of 15 degrees or over. Landslide and creeping slopes are excluded in this classification. Possibility of slope failure is very high where slope exceeds 25 to 35 degrees.<br>Surface soil is seen in a forest, but rocks and/or residual sediments including big boulders that are seen at tree-less places could be a source of rockfalls. |
| Riverbed | Present riverbed. Sediment has moved on the riverbed recently. |
| Floodplain (valley plain) | It has such a small relative height from the present riverbed that it is subject to flooding. |
| Alluvial fan | Mildly sloped landform at the mouth of a valley through which a river runs. It is created by sedimentation. Where the relative height from the present riverbed is small, the alluvial fan may be subject to flooding. |
| Former waterway | Trace of an old waterway in a floodplain or an alluvial fan. Since former waterways are in an slightly low-lying area, they tend to be main courses of flood waters. |
| Natural levee | Slightly raised landform in a floodplain or an alluvial fan that is subject to inundation during a great flood. |
| Flood-prone terrace | Landform created on the bank of a torrential mountain stream by sedimentation. The low-level terrace with a relative height from the present riverbed of about 5 m is almost free from small to medium flooding. A rise of the riverbed may, however, result in flooding. Where the torrential mountain stream has a steep slope in particular, there is no guarantee of safety against flooding. |
| Terrace | Flat or mildly sloped surface with a large relative height form the present riverbed, free from the danger of flooding. There may, however, be inundation due to sedimentation or water inflow from a torrential mountain stream behind the terrace. |
| Shallow Valley | This is a shallow valley formed on terraces and alluvial fans where surface runoff is likely to concentrate. Flood inundation water may be confined in a shallow valley. |
| Terrace cliff | It generally has a steep slope, has a thick layer of unconsolidated sediment, and thus may be subject to failure. |
| Alluvial cone (debris flow-prone alluvial fan) | Steep small alluvial fan formed at he mouth of a steep valley by debris flows or sediment flows. There is a great danger of inundation by debris flows or sedimentation. |
| Talus | Landform created by sedimentation of soil that slid on a slope or of rockfalls, sloping at an angle of repose for sediment. It suggests past slope slides or rockfalls on the slope. There is a great danger of failure or rockfall. The steep sloped talus itself causes debris flows, failures or rockfalls. |
| Pediment | Flat and mild erosion slopes developed in a mountain-foot in dry areas. This is generally covered by a thin layer of sands and gravels, but foundation rocks are sometimes cropped out. Flood inundation takes place during a heavy rainfall, and possibility of debris flow is high in a steep place. |
| Landslide morphology (creeping slope) | Landform created by the sliding of a mountainside slope. Landslide blocks and circular scarps are outstanding. Landslide blocks come in many variations such as a talus created by fracture, fractured rock mass or rock mass that is hardly fractured. There is a danger of large-scale failure, and the front surface of the block is subject to failure.<br>Slopes with their mountainside rock mass creeping are classified under this category. The slopes that crept are regarded as landslide landforms in the initial stage. Large-scale failures are likely to occur. |
| Landslide scar | Landform created by the falling of weathered rock or surface soil. Landslide scars are frequently found where the slope is subject to failure or failure has recently occurred frequently due to heavy rains or other phenomena. |
| Mild slope at the summit | Sediment disasters seldom occur on a mild slope near the summit. |
| Moraine | Sediment carried and deposited by a glacier in the glacial age, observed in areas at a high latitude. |
| Cirque | Circular glacial valley |
| Erosion and sediment control facilities | Check dams and groundsill |

* Since the land classification map is under preparation, classifications may be either added or changed.

**Table 3.1.2 CLASSIFICATION OF LAND FORM FOR 1/5,000 MAP**

| Landform classifications | Definition |
|---|---|
| Flood area | Area inundated by recent floods (either in 1995 or in 1999) |
| Debris flow area | Area inundated by debris flows or sediment flows during recent heavy rains (either in 1995 or in 1999) |
| Houses damaged by disasters | Houses and buildings considered to have been damaged by floods, debris flows or sediment flows |
| Major road | Automobile road leading to the Ourika valley. The damaged sections (sections that were washed away) and the sections with a small relative height from the present riverbed that are likely to be inundated with water and sediment are shown in the map. |
| Artificial landforms | Landforms created artificially by cut and fill or other methods |
| River structures | Revetment works made mainly of boulders |
| Erosion and sediment control facilities | Check dams and groundsill |

Note: Landforms common to both the 1/50,000 and 1/5,000 maps are not discussed in the table.

## Table 3.2.1 RAINFALL GAUGING STATION FOR HYDROLOGICAL STUDY

| Basin | No. | Station Name | Organization | Location | | Installation | Altitude (m) | Period of Collected Data |
|---|---|---|---|---|---|---|---|---|
| | | | | Latitude | Longitude | | | |
| R'dat | 1 | Sidi Rahal | DRHT | 31° 38.34' | 7° 28.52' | 03/10/63 | 690 | 1967-1999 |
| | 2 | Azrif | WAF | 31° 32' | 7° 16' | 1/1/51 | 1760 | 1951-1997 |
| | 3 | Taddart | WAF | 31° 21' | 7° 25' | 1/1/35 | 1650 | 1936-1997 |
| | 4 | Toufliht | WAF | 31° 28' | 7° 26' | 1/12/38 | 1465 | 1970-1997 |
| Zat | 5 | Taferiat | DRHT | 31° 32.80' | 7° 35.99' | 09/02/62 | 760 | 1980-1999 |
| | 6 | Asloune | WAF | 31° 24' | 7° 32' | 1/1/38 | 1115 | 1937-1997 |
| Ourika | 7 | Aghbalau | DRHT | 31° 19.02' | 7° 44.75' | 04/04/69 | 1070 | 1969-1999 |
| | 8 | Agouns | DRHT | 31° 11.98' | 7° 48.17' | 26/06/96 | 2200 | 1996-1999 |
| | 9 | Tazzitount | DRHT | 31° 16.443 | 7° 41.30' | 21/02/99 | 1270 | 1999 |
| | 10 | Tourcht | DRHT | 31.14.08 | 7.37.91 | 04/12/97 | 1650 | 1997-1999 |
| | 11 | Amenzal | DRHT | 31° 11.28' | 7° 45.02' | 10/04/97 | 2230 | 1997-1999 |
| | 12 | Tiourdiou | DRHT | 31° 12.02' | 7° 44.78' | 20/06/96 | 1850 | 1996-1999 |
| Rheraya | 13 | Tahanaout | DRHT | 31° 17.66' | 7° 57.85' | 08/03/62 | 925 | 1962-1999 |
| | 14 | Armed | DRHT | 31° 07' | 7° 55' | 12/02/99 | 1950 | 1999 |
| | 15 | Ifghane | WAF | 31° 14' | 7° 55' | 1/9/73 | 1920 | 1977-1999 |
| | 16 | Asni | MOF | 31° 15' | 8° 00' | 1/1/37 | 1200 | 1937-1997 |
| N'fis | 17 | Imin El Hammam | DRHT | 31° 12.87' | 8° 06.72' | 01/07/66 | 770 | 1969-1999 |
| | 18 | Iguir N'kouris | DRHT | 31° 03.54' | 8° 08.38' | 20/03/74 | 1100 | 1974-1999 |
| | 19 | Arhbar | WAF | 30° 52' | 8° 24' | 1/4/37 | 1900 | 1938-1997 |
| | 20 | Idni | WAF | 30° 55' | 8° 17' | 24/04/53 | 1700 | 1953-1997 |
| | 21 | Ijoukak | WAF | 31° 01' | 8° 09' | 1/2/42 | 1440 | 1941-1997 |
| | 22 | Wirgane | WAF | 31° 09' | 8° 07' | 2/27/89 | 1045 | 1927-1998 |
| | 23 | Talat Nos | WAF | 31° 03' | 8° 08' | 1/4/37 | 1300 | 1937-1997 |
| Other | 24 | B.L.Takerkoust | DRHT | 31° 21.47' | 8° 08.38' | 1962 | 630 | 1953-1999 |
| | 25 | Agaiouar | WAF | 31° 17' | 7° 49' | 4/25/89 | 1805 | 1930-1997 |
| | 26 | Dar Ouriki | WAF | 31° 22' | 7° 47' | 1/6/37 | 800 | 1937-1997 |
| | 27 | Tizi Ghourane | WAF | 31° 13' | 8° 14' | 1/1/36 | 1150 | 1970-1997 |
| | 28 | Amizmiz | WAF | 31° 13' | 8° 14' | 6/1/23 | 1005 | 1923-1995 |
| | 29 | Marrakech | DMN | 31° 36' | 8° 01' | 1/1/84 | 460 | 1913-1999 |

## Table 3.2.2 WATER LEVEL OBSERVATION STATION

| Basin | No. | Station Name | Organization | Location | | Installation | Altitude (m) | Period of Collected Water Level Data |
|---|---|---|---|---|---|---|---|---|
| | | | | Latitude | Longitude | | | |
| R'dat | 1 | Sidi Rahal | DRHT | 31° 38.34' | 7° 28.52' | 03/10/63 | 690 | 1963-1999 |
| Zat | 2 | Taferiat | DRHT | 31° 32.80' | 7° 35.99' | 09/02/62 | 760 | 1962-1999 |
| Ourika | 3 | Aghbalau | DRHT | 31° 19.02' | 7° 44.75' | 04/04/69 | 1070 | 1969-1999 |
| | 4 | Tazzitount | DRHT | 31° 16.443 | 7° 41.30' | 21/02/99 | 1270 | 1999 |
| | 5 | Tourcht | DRHT | 31.14.08 | 7.37.91 | 04/12/97 | 1650 | 1997-1999 |
| | 6 | Amenzal | DRHT | 31° 11.28' | 7° 45.02' | 10/04/97 | 2230 | 1997-1999 |
| | 7 | Tiourdiou | DRHT | 31° 12.02' | 7° 44.78' | 20/06/96 | 1850 | 1996-1999 |
| Rheraya | 8 | Tahanaout | DRHT | 31° 17.66' | 7° 57.85' | 08/03/62 | 925 | 1962-1999 |
| | 9 | Armed | DRHT | 31° 07' | 7° 55' | 12/02/99 | 1950 | 1999 |
| N'fis | 10 | Imin El Hammam | DRHT | 31° 12.87' | 8° 06.72' | 01/07/66 | 770 | 1966-1999 |
| | 11 | Iguir N'kouris | DRHT | 31° 03.54' | 8° 08.38' | 20/03/74 | 1100 | 1974-1999 |

**Table 3.2.3 INTENSITY-DURATION-FREQUENCY RELATIONSHIP AT AGHBALAU**

| Return Period | | Duration of Rainfall | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 15 min. | 30 min. | 60 min. | 120 min. | 180 min. | 360 min. | 720 min. | 1440 min. |
| 2 years | mm | 6.0 | 10.0 | 15.6 | 22.1 | 26.2 | 33.2 | 39.9 | 46.5 |
| | mm/h | 24.0 | 20.1 | 15.6 | 11.1 | 8.7 | 5.5 | 3.3 | 1.9 |
| 5 years | mm | 8.2 | 14.5 | 23.3 | 33.6 | 39.4 | 47.5 | 53.1 | 56.3 |
| | mm/h | 32.9 | 29.0 | 23.3 | 16.8 | 13.1 | 7.9 | 4.4 | 2.3 |
| 10 years | mm | 9.6 | 16.8 | 26.7 | 37.9 | 44.0 | 52.5 | 58.2 | 61.5 |
| | mm/h | 38.6 | 33.6 | 26.7 | 18.9 | 14.7 | 8.8 | 4.8 | 2.6 |
| 30 years | mm | 13.6 | 23.3 | 36.1 | 49.7 | 56.9 | 66.6 | 72.7 | 76.2 |
| | mm/h | 54.5 | 46.5 | 36.1 | 24.9 | 19.0 | 11.1 | 6.1 | 3.2 |
| 50 years | mm | 15.2 | 25.8 | 39.7 | 54.2 | 61.8 | 71.8 | 78.2 | 81.8 |
| | mm/h | 60.7 | 51.6 | 39.7 | 27.1 | 20.6 | 12.0 | 6.5 | 3.4 |
| 100 years | mm | 17.5 | 29.4 | 44.6 | 60.1 | 68.0 | 78.2 | 84.6 | 88.2 |
| | mm/h | 69.9 | 58.8 | 44.6 | 30.0 | 22.7 | 13.0 | 7.1 | 3.7 |

## Table 3.2.4 MAXIMUM 10 FLOODS FOR EACH RIVER

| Serial | Sidi Rahal (R'dat) | | | | Taferiat (Zat) | | | | Aghbalau (Ourika) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Data Period : Nov. 1963 to Aug. 1997 | | | | Data Period : Feb. 1962 to Aug. 1997 | | | | Data Period : Aug. 1969 to Jul. 1997 | | | |
| | Flood Period | | Peak Discharge ($m^3/s$) | Time of Peak Discharge | Flood Period | | Peak Discharge ($m^3/s$) | Time of Peak Discharge | Flood Period | | Peak Discharge ($m^3/s$) | Time of Peak Discharge |
| 1 | Aug. 13, | 1982 | 685 | 21:30 Aug. 13 | Aug. 13 to 14, | 1982 | 680 | 2:00 Aug. 14 | Aug. 17, | 1995 | 1,030 | 20:15 Aug. 17 |
| 2 | Aug. 17, | 1995 | 534 | 22:30 Aug. 17 | Oct. 27, | 1965 | 600 | 21:00 Oct. 27 | Jul. 14 to 15, | 1989 | 823 | 23:00 Jul. 14 |
| 3 | Nov. 2 to 3, | 1987 | 397 | 11:00 Nov. 2 | Sep. 23, | 1965 | 530 | 15:15 Sep. 23 | Nov. 1 to 2, | 1987 | 651 | 10:00 Nov. 2 |
| 4 | Feb. 11 to 12, | 1987 | 351 | 13:30 Feb. 11 | Nov. 2, | 1987 | 467 | 10:00 Nov. 2 | Sep. 8 to 19, | 1979 | 350 | 19:00 Sep. 10 |
| 5 | Mar. 10 to 11, | 1990 | 345 | 13:00 Mar. 10 | Dec. 3 to 4, | 1988 | 305 | 0:00 Dec. 4 | Aug. 1, | 1992 | 290 | 19:00 Aug. 1 |
| 6 | Nov. 10, | 1988 | 325 | 10:00 Nov. 10 | Dec. 20, | 1963 | 285 | 5:00 Dec. 20 | Mar. 10 to 11, | 1990 | 265 | 18:00 Mar. 10 |
| 7 | Jun. 9, | 1996 | 293 | 20:15 Aug. 17 | Mar. 10 to 11, | 1990 | 270 | 17:00 Mar. 10 | Feb. 11, | 1987 | 250 | 17:30 Feb. 11 |
| 8 | Oct. 27 to 28, | 1989 | 277 | 22:30 Oct. 27 | Mar. 7, | 1994 | 237 | 3:00 Mar. 7 | Mar. 7 to 8, | 1994 | 226 | 3:00 Sep. 10 |
| 9 | Mar. 16 to 17, | 1980 | 210 | 24:00 Mar. 16 | Nov. 12 to 13, | 1967 | 230 | 12:00 Nov. 12 | Sep. 14, | 1990 | 207 | 17:15 Sep. 14 |
| 10 | Nov. 13, | 1980 | 210 | 12:30 Nov. 13 | Nov. 3, | 1966 | 225 | 9:30 Nov. 3 | Dec. 5 to 9, | 1991 | 200 | 2:00 Dec. 7 |

| Serial | Tahanaout (Rheraya) | | | | Iguir N'kouris (N'fis) | | | | Jmin Al Haman (N'fis) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Data Period : Mar. 1962 to Jul. 1997 | | | | Data Period : Aug. 1974 to Jul. 1997 | | | | Data Period : July. 1966 to Aug. 1997 | | | |
| | Flood Period | | Peak Discharge ($m^3/s$) | Time of Peak Discharge | Flood Period | | Peak Discharge ($m^3/s$) | Time of Peak Discharge | Flood Period | | Peak Discharge ($m^3/s$) | Time of Peak Discharge |
| 1 | Aug. 17, | 1995 | 680 | 19:30 Aug. 17 | Nov. 2 to 3, | 1987 | 1,120 | 13:00 Nov. 2 | Nov. 13, | 1967 | 1,400 | 16:00 Nov. 13 |
| 2 | Feb. 11, | 1987 | 155 | 14:00 Feb. 11 | Nov. 9 to 11, | 1988 | 585 | 22:00 Nov. 9 | Nov. 9 to 11, | 1988 | 1,220 | 6:00 Nov. 10 |
| 3 | Nov. 1 to 2, | 1987 | 146 | 14:00 Nov. 2 | Dec. 3 to 4, | 1987 | 536 | 9:00 Dec. 4 | Nov. 2 to 3, | 1987 | 810 | 14:00 Nov. 2 |
| 4 | Oct. 23 to 24, | 1989 | 103 | 10:00 Oct. 24 | Jan. 18 to 19, | 1979 | 403 | 12:00 Jan. 18 | Dec. 3 to 5, | 1987 | 773 | 9:00 Dec. 4 |
| 5 | Dec. 5 to 9, | 1991 | 71 | 7:00 Dec. 7 | Nov. 16, | 1983 | 393 | 7:30 Nov. 16 | Jan. 4 to 7 | 1970 | 720 | 12:00 Jan. 4 |
| 6 | Mar. 25, | 1996 | 68 | 13:00 Mar. 25 | Dec. 7 to 8, | 1991 | 319 | 13:00 Dec. 7 | Nov. 2, | 1986 | 508 | 23:00 Nov. 2 |
| 7 | Jun. 24, | 1987 | 66 | 20:00 Jun.24 | Jan. 7, | 1978 | 263 | 14:00 Jan. 7 | Aug. 17, | 1995 | 501 | 19:00 Aug. 17 |
| 8 | Jul. 28, | 1992 | 62 | 20:00 Jul. 28 | Aug. 7, | 1994 | 239 | 22:00 Aug. 7 | Nov. 16, | 1983 | 482 | 10:00 Nov. 16 |
| 9 | Oct. 25, | 1987 | 60 | 12:00 Oct. 25 | Mar. 9 to 10 | 1990 | 229 | 14:00 Mar. 9 | Oct. 24 to 25, | 1989 | 455 | 22:00 Oct. 24 |
| 10 | Jul. 16, | 1989 | 59 | 17:00 Jul. 16 | Oct. 31, | 1993 | 229 | 4:00 Oct. 31 | Dec. 7 to 9, | 1991 | 446 | 7:00 Dec. 8 |

## Table 3.2.5 DISTRIBUTION OF DISCHARGE

**Ourika**

| Required point | CA | Distribution of Discharge | | | | | | Specific Discharege | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (km2) | 1/100 | 1/50 | 1/20 | 1/10 | 1/5 | 1/2 | 1/100 | 1/50 | 1/20 | 1/10 | 1/5 | 1/2 |
| Aghbalau | 495 | 1,650 | 1,200 | 750 | 490 | 300 | 115 | 3.33 | 2.42 | 1.52 | 0.99 | 0.61 | 0.23 |
| Tazzitount | 347 | 1,365 | 995 | 620 | 405 | 250 | 95 | 3.94 | 2.86 | 1.79 | 1.16 | 0.72 | 0.28 |
| Setti Fadma | 156 | 870 | 630 | 395 | 255 | 160 | 60 | 5.58 | 4.05 | 2.54 | 1.65 | 1.01 | 0.39 |
| Tiourdiou | 134 | 795 | 580 | 360 | 235 | 145 | 55 | 5.93 | 4.31 | 2.70 | 1.75 | 1.08 | 0.42 |

**N'fis**

| Required point | CA | Distribution of Discharge | | | | | | Specific Discharege | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (km2) | 1/100 | 1/50 | 1/20 | 1/10 | 1/5 | 1/2 | 1/100 | 1/50 | 1/20 | 1/10 | 1/5 | 1/2 |
| Imin El Hammam | 1256 | 2,880 | 2,040 | 1,220 | 770 | 440 | 150 | 2.29 | 1.62 | 0.97 | 0.61 | 0.33 | 0.11 |
| N'kouris | 848 | 2,200 | 1,500 | 850 | 520 | 280 | 100 | 2.81 | 1.99 | 1.19 | 0.75 | 0.40 | 0.14 |
| Ijoukak | 547 | 1,910 | 1,360 | 815 | 510 | 275 | 95 | 3.50 | 2.48 | 1.49 | 0.94 | 0.50 | 0.17 |
| Ait Barahi | 518 | 1,860 | 1,320 | 790 | 500 | 265 | 90 | 3.59 | 2.55 | 1.53 | 0.96 | 0.52 | 0.18 |
| Mzouzit | 454 | 1,735 | 1,235 | 740 | 465 | 250 | 85 | 3.82 | 2.71 | 1.63 | 1.02 | 0.55 | 0.19 |

**Rheraya**

| Required point | CA | Distribution of Discharge | | | | | | Specific Discharege | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (km2) | 1/100 | 1/50 | 1/20 | 1/10 | 1/5 | 1/2 | 1/100 | 1/50 | 1/20 | 1/10 | 1/5 | 1/2 |
| May Brahim | 221 | 560 | 390 | 230 | 150 | 90 | 40 | 2.53 | 1.76 | 1.04 | 0.68 | 0.41 | 0.16 |
| Asni | 193 | 520 | 360 | 210 | 140 | 85 | 35 | 2.68 | 1.87 | 1.10 | 0.72 | 0.43 | 0.17 |
| Tansghalt | 183 | 500 | 350 | 205 | 135 | 80 | 30 | 2.74 | 1.91 | 1.12 | 0.74 | 0.44 | 0.17 |
| Imi Oughlad | 85 | 315 | 220 | 130 | 85 | 50 | 20 | 3.71 | 2.59 | 1.52 | 1.00 | 0.60 | 0.24 |
| Imlil | 56 | 240 | 170 | 100 | 65 | 40 | 15 | 4.30 | 2.99 | 1.76 | 1.16 | 0.69 | 0.27 |
| Aroumd | 33 | 170 | 120 | 70 | 45 | 25 | 10 | 5.11 | 3.56 | 2.10 | 1.38 | 0.82 | 0.33 |

**Zat**

| Required point | CA | Distribution of Discharge | | | | | | Specific Discharege | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (km2) | 1/100 | 1/50 | 1/20 | 1/10 | 1/5 | 1/2 | 1/100 | 1/50 | 1/20 | 1/10 | 1/5 | 1/2 |
| Taferiat | 528 | 1,100 | 840 | 560 | 390 | 250 | 110 | 2.08 | 1.59 | 1.06 | 0.74 | 0.47 | 0.21 |
| Edge of Simulatior | 439 | 1,000 | 760 | 510 | 355 | 225 | 100 | 2.28 | 1.73 | 1.16 | 0.80 | 0.51 | 0.22 |
| tassourt | 390 | 940 | 715 | 475 | 330 | 210 | 95 | 2.41 | 1.83 | 1.22 | 0.85 | 0.54 | 0.24 |
| Tighedoune | 361 | 900 | 685 | 460 | 320 | 205 | 90 | 2.50 | 1.90 | 1.27 | 0.88 | 0.56 | 0.25 |
| Ait shmane | 297 | 810 | 620 | 410 | 285 | 185 | 80 | 2.72 | 2.08 | 1.39 | 0.96 | 0.61 | 0.27 |

**R'dat**

| Required point | CA | Distribution of Discharge | | | | | | Specific Discharege | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (km2) | 1/100 | 1/50 | 1/20 | 1/10 | 1/5 | 1/2 | 1/100 | 1/50 | 1/20 | 1/10 | 1/5 | 1/2 |
| Sidi Rahal | 532 | 900 | 740 | 550 | 420 | 300 | 150 | 1.69 | 1.39 | 1.03 | 0.79 | 0.56 | 0.28 |
| Jeddint | 140 | 430 | 355 | 260 | 200 | 140 | 70 | 3.06 | 2.52 | 1.86 | 1.43 | 1.01 | 0.50 |
| Ait Mancour | 129 | 410 | 335 | 250 | 190 | 135 | 65 | 3.16 | 2.60 | 1.92 | 1.48 | 1.04 | 0.52 |
| Tilnif | 75 | 290 | 240 | 175 | 135 | 95 | 50 | 3.88 | 3.20 | 2.35 | 1.81 | 1.28 | 0.64 |
| Tadert | 52 | 230 | 190 | 140 | 105 | 75 | 40 | 4.42 | 3.64 | 2.68 | 2.07 | 1.46 | 0.73 |

**Wirgane**

| Required point | CA | Distribution of Discharge | | | | | | Specific Discharege | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (km2) | 1/100 | 1/50 | 1/20 | 1/10 | 1/5 | 1/2 | 1/100 | 1/50 | 1/20 | 1/10 | 1/5 | 1/2 |
| Wirigane | 92 | 210 | 150 | 90 | 55 | 30 | 10 | 2.29 | 1.62 | 0.97 | 0.61 | 0.33 | 0.11 |
| Tassa Wirgane | 64 | 145 | 105 | 60 | 40 | 20 | 5 | 2.29 | 1.62 | 0.97 | 0.61 | 0.33 | 0.11 |

**Table 3.3.1 NUMBER OF DOUARS DAMAGED AND MENACED BY FLOODS IN AL HAOUZ PROVINCE**

| Cercle | Caidat | Commune Rurale | Number of Douars | |
|---|---|---|---|---|
| | | | Damaged | Menaced |
| Ait Ourir | Abadou | Tazourte | 9 | 9 |
| | Touama | Zerkten | 20 | 20 |
| | Mesfioua | Tighedouine | 17 | 17 |
| | | Tidili Mesfioua | 3 | 3 |
| | Faska Sidi Daoud | Ait Faska | 1 | 1 |
| | Ghmate | Ghmate | 2 | 2 |
| | Sub-total | | 52 | 52 |
| Tahanaout | Tahanaout | My Brahim | 1 | 1 |
| | Ourika | Ourika | 5 | 7 |
| | | Setti Fadma | 9 | 32 |
| | Tamesloht | Tamesloht | 0 | 3 |
| | Sub-total | | 15 | 43 |
| Amizmiz | Amizmiz | Amizmiz | 2 | 4 |
| | Ouazguita | Lalla Takarkoust | 6 | 5 |
| | | Ouzguita | 4 | 0 |
| | | Sidi Bedhaj | 1 | 1 |
| | | Oulad Mtaa | 4 | 4 |
| | Guedmioua | Tizguine | 1 | 3 |
| | | Anougal | 5 | 2 |
| | | Dar Jamaa | 0 | 4 |
| | | Azgour | 6 | 3 |
| | Sub-total | | 29 | 26 |
| Asni | Asni | Asni | 12 | 11 |
| | Ouirgane | Ouirgane | 13 | 0 |
| | | Imgdal | 27 | 0 |
| | Talat N'Yakoub | Ijoukak | 35 | 2 |
| | | Talat N'Yakoub | 26 | 18 |
| | | Ighil | 22 | 0 |
| | | Aghbar | 19 | 0 |
| | Sub-total | | 154 | 31 |
| Total | | | 250 | 152 |

Source: Al Haouz Province in May, 2000

**Table 3.3.2 LIST OF SELECTED DOUARS FOR SOCIAL STUDY AND PUBLIC AWARENESS OF NATURAL DISASTER**

| Cercle | Caidat | Commune Rurale | Douar |
|---|---|---|---|
| Ait Ourir | Touama | Zerkten | Tazlida-Ait Moussa |
| | | | Tazlida-Tabahggate |
| | | | Ait Ben Aamr |
| | Mesfioua | Tighedouine | Ouayfirte |
| | | | Tazourte |
| | | | Anammer |
| | | | Arba Tighedouine |
| Tahanaout | Tahanaout | Mybrahim | Rha My Brahim |
| | Ourika | Ourika | Timalizen |
| | | | Asguine |
| | | | Taourirte |
| | | | Anrar |
| | | | Tiguemmi |
| | | Setti Fadma | Aghbalou |
| | | | Irghef (Oulmes) |
| | | | Tazitounte |
| | | | Imintadart |
| | | | El kri |
| | | | Asgaour |
| | | | Anfli |
| | | | Tiourdiouine |
| | | | Timichi |
| Asni | Asni | Asni | Imlil |
| | | | Tachdirte |
| | | | Tansgharte |
| | | | Centre Asni |
| | Ouirgane | Ouirgane | Tororte |
| | | | Tassaouirgane |
| | | Imgdal | Tizgui |
| | | | Targua |
| | Talat N'Yakoub | Ijoukak | Ouathkerri |
| | | Talat N'Yakoub | Dougouj |
| | | | Talat NCB Bas |
| Prefecture de Sidi Youseef Ben Ali | | Sidi Youssef Ben Ali | Urban |

## Table 3.3.3 SOCIAL ENVIRONMENT OF SELECTED DOUARS IN STUDY AREA (1/3)

| C.R / Douar | Availability of transport service | Dispensary | School | Electricity | Source of water | Communica-tion w/ Caid | Distance (m) | | Tourist business | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | River | Route | Hotel | Restaurant/ cafe | Shop |
| C.R. Zerkten | | | | | | | | | | | |
| Tazlida-Ait Moussa | no | no | yes (2 classes) | no | spring | mule/car | 100 | 7,000 | 0 | 0 | 0 |
| Tazlida-Tabahgate | yes | no | yes (1 class) | yes | spring | telephone/car | 10 | 10 | 0 | 4 | 0 |
| Ait Ben Aamr | yes | no | yes (1 class) | no | spring/ river | telephone | 20 | 80 | 0 | 0 | 0 |
| C.R. Tighedouine | | | | | | | | | | | |
| Ouayfirte | yes | no | no | no | spring/well | walk/rental car | 1,000 | 1,100 | 0 | 4 | 0 |
| Tazourte | yes | no | yes (2 classes) | no | river/well | rental car | 400 | 1,000 | 0 | 0 | 0 |
| Anammer | yes | no | no | no | well | walk/rental car | 50 | 1,500 | 0 | 0 | 0 |
| Arba Tighedouine | yes | yes | yes (5 classes) | yes | river/well | direct talk (Caid in same Douar) | 50 | 100 | 5 | 8 | 0 |
| C.R. My Brahim | | | | | | | | | | | |
| Rha My Brahim | yes | no | no | yes | ONEP | radio/telephone | 20 | 20 | 0 | 8 | 0 |
| C.R. Ourika | | | | | | | | | | | |
| Timalizen | yes | no | yes (3 classes) | yes | spring/well | car/motorbike | 50 | 150 | 0 | 0 | 1 |
| Asguine | yes | no | yes (4 classes) | yes | well/canal | car/bicycle | 500 | 0 | 0 | 4 | 10 |
| Taourirte | no | no | yes (3 classes) | no | spring/well | car | 500 | 3,000 | 0 | 0 | 0 |
| Anrar | yes | no | no | yes | canal | car/motorbike | 500 | 20 | 0 | 0 | 0 |
| Tiguemmi | yes | no | no | yes | well/river | telephone/car | 100 | 600 | 0 | 0 | 0 |

Note: Based on information gathered during the interview survey with a chief of each selected village called "*Moquadem*" or "*Cheikh*".

ONEP stands for Office National de l'Eau Potable or National Water Supply Office.

## Table 3.3.3 SOCIAL ENVIRONMENT OF SELECTED DOUARS IN STUDY AREA (2/3)

| C.R / Douar | Availability of transport service | Dispensary | School | Electricity | Source of water | Communica-tion w/ Caid | Distance (m) | | Tourist business | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | River | Route | Hotel | Restaurant/ cafe | Shop |
| C.R. Setti Fadma | | | | | | | | | | | |
| Aghbalou | yes | yes | yes (4 classes) | yes | spring/river | telephone/car | 500 | 500 | 0 | 4 | 10 |
| Irghef (Oulmes) | yes | no | yes (4 classes) | yes | well/canal | car | 10 | 10 | 5 | 14 | 0 |
| Tazitounte | yes | no | no | no | spring/ river | car | 20 | 10 | 0 | 1 | 0 |
| Imintadart | yes | no | yes (4 classes) | yes | river | public transpor-tation | 10 | 10 | 0 | 0 | 0 |
| El kri | yes | no | yes (5 classes) | yes | spring/river | car | 70 | 50 | 24 | 10 | 0 |
| Asgaour | yes | no | no | yes | river | rental car | 150 | 50 | 9 | 4 | 0 |
| Anfli | no | no | yes (3 classes) | no | river | mule & car | 2,000 | 7,000 | 0 | 0 | 0 |
| Tiourdiouine | no | no | yes (1 class) | no | river/canal | walk & car | 500 | 9,000 | 0 | 0 | 0 |
| Timichi | no | no | yes (1 class) | no | spring | walk & car | 20 | 13,000 | 2 | 0 | 0 |
| C.R. Asni | | | | | | | | | | | |
| Imlil | yes | yes | yes (5 classes) | yes | spring/river | telephone | 100 | 80 | 4 | 7 | 0 |
| Tachdirte | no | no | no | no | spring | walk & car | 500 | 17,000 | 0 | 1 | 0 |
| Tansgharte | no | no | yes (2 classes) | no | spring | walk & bike | 500 | 5,000 | 0 | 0 | 0 |
| Centre Asni | yes | yes | yes (7 classes) | yes | spring/well | direct talk (Caid in same Douar | 500 | 100 | 1 | 15 | 0 |

Note: Based on information gathered during the interview survey with a chief of each selected village called "*Moquadem*" or "*Cheikh*".

ONEP stands for Office National de l'Eau Potable or National Water Supply Office.

## Table 3.3.3 SOCIAL ENVIRONMENT OF SELECTED DOUARS IN STUDY AREA (3/3)

| C.R / Douar | Availability of transport service | Dispensary | School | Electricity | Source of water | Communica-tion w/ Caid | Distance (m) | | Tourist business | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | River | Route | Hotel | Restaurant/ cafe | Shop |
| C.R. Ouirgane | | | | | | | | | | | |
| Tororte | no | no | yes (4 classes) | no | spring/river | mule/walk | 50 | 4,000 | 0 | 0 | 0 |
| Tassaouirgane | no | no | yes (1 class) | no | spring/river | motorbike | 600 | 6,000 | 0 | 0 | 0 |
| C.R. Imgdal | | | | | | | | | | | |
| Tizgui | no | no | yes (2 classes) | no | spring/river | truck | 150 | 17,000 | 0 | 0 | 0 |
| Targua | no | no | yes (4 classes) | no | river | walk/truck | 150 | 12,000 | 0 | 0 | 0 |
| C.R. Ijoukak | | | | | | | | | | | |
| Ouathkerri | yes | no | yes (1 class) | yes | spring | walk/bicycle | 700 | 5 | 0 | 0 | 0 |
| C.R. Talat N'Yakoub | | | | | | | | | | | |
| Dougouj | yes | no | no | yes | well | car | 500 | 10 | 0 | 0 | 0 |
| Talat N'Yakoub | yes | yes | yes (9 classes) | yes | spring/well | direct talk (Caid in same Douar) | 300 | 10 | 0 | 3 | 0 |
| Pre. Sidi Youssef Ben Ali | | | | | | | | | | | |
| Municipality of Sidi Youssef Ben Ali | yes | yes | yes (300 classes) | yes | ONEP | telephone | 20 | - | 0 | 0 | 0 |

Note: Based on information gathered during the interview survey with a chief of each selected village called "*Moquadem*" or "*Cheikh*".

ONEP stands for Office National de l'Eau Potable or National Water Supply Office.

## Table 3.3.4 SUMMARY OF ANSWERS TO QUESTIONNAIRE FOR THE SOCIAL STUDY AND PUBLIC AWARENESS OF NATURAL DISASTER (PART 1)

(1/6)

| Item | C.R. Zerkten | | | | C.R. Tighedouine | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Ait Moussa | Tabahgate | Ait Ben Aamr | Average | Ouayfirte | Tazourte | Anammer | Tighedouine | Average |
| Family members | | | | | | | | | |
| 1 – 5 | 0 | 1 | 3 | 4 | 1 | 2 | 3 | 0 | 6 |
| 6 – 9 | 1 | 4 | 4 | 9 | 6 | 10 | 8 | 7 | 31 |
| 10 – 14 | 7 | 5 | 5 | 17 | 4 | 0 | 1 | 3 | 8 |
| 15 – 19 | 2 | 0 | 0 | 2 | 1 | 0 | 0 | 2 | 3 |
| >20 | 2 | 2 | 0 | 4 | 0 | 0 | 0 | 0 | 0 |
| Ave. annual income (Dh) | 26,240 | 22,430 | 11,870 | 20,180 | 25,600 | 23,600 | 18,460 | 18,150 | 20,030 |
| Agriculture (Dh) | 14,560 | 10,360 | 5,360 | 10,090 | 20,580 | 19,030 | 17,840 | 11,310 | 15,770 |
| Non-agriculture (Dh) | 11,680 | 12,070 | 6,510 | 10,090 | 5,020 | 4,570 | 620 | 6,840 | 4,260 |
| Ave. annual expenditure (Dh) | 26,880 | 22,480 | 11,870 | 20,410 | 19,900 | 23,030 | 17,660 | 17,910 | 19,630 |
| Food (Dh) | 19,390 | 15,800 | 9,550 | 14,910 | 13,920 | 15,790 | 11,980 | 13,440 | 13,790 |
| Others (Dh) | 7,490 | 6,680 | 2,320 | 5,500 | 5,980 | 7,240 | 5,680 | 4,470 | 5,840 |
| Ave. years of life in Douar | 58 | 49 | 51 | 53 | 41 | 62 | 49 | 54 | 52 |
| Average number of livestock | | | | | | | | | |
| Cattle | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 2 |
| Sheep | 14 | 10 | 2 | 9 | 1 | 3 | 2 | 4 | 3 |
| Goat | 41 | 16 | 10 | 22 | 0 | 1 | 1 | 10 | 3 |
| Mule/donkey | 1 | 1 | 0 | 1 | 1 | 1 | 2 | 1 | 1 |
| Average land area ($m^2$) | 6,820 | 11,480 | 4,100 | 7,470 | 24,720 | 34,480 | 50,870 | 18,570 | 32,160 |
| Rain-fed ($m^2$) | 1,420 | 6,280 | 118 | 2,610 | 15,100 | 19,790 | 24,920 | 10,170 | 17,500 |
| Irrigated ($m^2$) | 5,200 | 4,840 | 3,540 | 4,530 | 9,370 | 14,520 | 25,540 | 8,100 | 14,390 |
| Plantation ($m^2$) | 3,380 | 2,980 | 1,130 | 2,500 | 6,790 | 9,450 | 8,760 | 4,090 | 7,270 |

Note: Figures are expressed in the average of 12 samples collected in each Douar through questionnaire, except number of families in item “Family members”.

## Table 3.3.4 SUMMARY OF ANSWERS TO QUESTIONNAIRE FOR THE SOCIAL STUDY AND PUBLIC AWARENESS OF NATURAL DISASTER (PART 1)

(2/6)

| Item | C.R. My Brahim | | C.R. Ourika | | | | | |
|---|---|---|---|---|---|---|---|---|
| | My Brahim | Average | Timalizen | Asguine | Taourirte | Anrar | Tiguemmi | Average |
| Family members | | | | | | | | |
| 1 – 5 | 2 | 2 | 1 | 2 | 2 | 2 | 5 | 12 |
| 6 – 9 | 3 | 3 | 4 | 4 | 6 | 7 | 4 | 25 |
| 10 – 14 | 2 | 2 | 6 | 5 | 4 | 3 | 3 | 21 |
| 15 – 19 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 2 |
| >20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ave. annual income (Dh) | 23,090 | 23,090 | 45,110 | 19,820 | 24,280 | 20,210 | 14,420 | 24,770 |
| Agriculture (Dh) | 8,600 | 8,600 | 34,430 | 15,860 | 20,370 | 13,860 | 6,480 | 18,200 |
| Non-agriculture (Dh) | 14,490 | 14,490 | 10,680 | 3,960 | 3,910 | 6,350 | 7,940 | 6,570 |
| Ave. annual expenditure (Dh) | 22,440 | 22,440 | 42,370 | 19,550 | 22,400 | 20,410 | 13,240 | 23,600 |
| Food (Dh) | 16,540 | 16,540 | 30,070 | 12,990 | 16,220 | 14,880 | 9,530 | 16,740 |
| Others (Dh) | 5,900 | 5,900 | 12,300 | 6,560 | 6,180 | 5,530 | 3,710 | 6,860 |
| Ave. years of life in Douar | 39 | 39 | 55 | 61 | 54 | 55 | 48 | 55 |
| Average number of livestock | | | | | | | | |
| Cattle | 1 | 1 | 2 | 2 | 3 | 2 | 1 | 2 |
| Sheep | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| Goat | 0 | 0 | 0 | 1 | 0 | 3 | 0 | 2 |
| Mule/donkey | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 |
| Average land area ($m^2$) | 10,670 | 10,670 | 19,370 | 14,190 | 20,160 | 14,370 | 6,490 | 14,920 |
| Rain-fed ($m^2$) | 5,000 | 5,000 | 3,860 | 2,930 | 6,750 | 1,690 | 1,250 | 3,296 |
| Irrigated ($m^2$) | 5,630 | 5,630 | 15,300 | 10,950 | 13,070 | 12,390 | 5,000 | 11,342 |
| Plantation ($m^2$) | 5,630 | 5,630 | 13,700 | 10,230 | 10,480 | 7,770 | 4,170 | 9,270 |

Note: Figures are expressed in the average of 8 samples for My Brahim and 12 samples for other Douars.
In the item of family members, the total number is given in each column.

## Table 3.3.4 SUMMARY OF ANSWERS TO QUESTIONNAIRE FOR THE SOCIAL STUDY AND PUBLIC AWARENESS OF NATURAL DISASTER (PART 1)

(3/6)

| Item | C.R. Setti Fadma | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Aghbalou | Irghef | Tazitounte | Imintadart | El kri | Asgaour | Anfli | Tiourdiouine | Timichi | Average |
| Family members | | | | | | | | | | |
| 1 – 5 | 1 | 3 | 2 | 2 | 0 | 7 | 4 | 2 | 4 | 25 |
| 6 – 9 | 8 | 7 | 6 | 5 | 7 | 5 | 7 | 6 | 2 | 53 |
| 10 – 14 | 1 | 1 | 4 | 3 | 4 | 0 | 1 | 4 | 4 | 22 |
| 15 – 19 | 1 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 2 | 6 |
| >20 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 2 |
| Ave. annual income (Dh) | 22,870 | 15,820 | 18,740 | 20,500 | 23,340 | 16,480 | 12,460 | 16,010 | 16,150 | 18,040 |
| Agriculture (Dh) | 10,070 | 6,420 | 8,620 | 10,070 | 17,130 | 8,880 | 7,530 | 11,140 | 9,570 | 9,940 |
| Non-agriculture (Dh) | 12,800 | 9,400 | 10,120 | 10,430 | 6,210 | 7,600 | 4,930 | 4,870 | 6,580 | 8,100 |
| Ave. annual expenditure (Dh) | 22,870 | 15,400 | 18,710 | 20,210 | 23,330 | 16,770 | 12,410 | 16,010 | 16,150 | 17,980 |
| Food (Dh) | 16,410 | 11,680 | 13,430 | 15,280 | 16,860 | 12,230 | 9,150 | 12,560 | 12,200 | 13,310 |
| Others (Dh) | 6,460 | 3,720 | 5,280 | 4,930 | 6,470 | 4,540 | 3,260 | 3,450 | 3,950 | 4,670 |
| Ave. years of life in Douar | 45 | 45 | 48 | 52 | 51 | 50 | 46 | 49 | 52 | 49 |
| Average number of livestock | | | | | | | | | | |
| Cattle | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 1 |
| Sheep | 1 | 0 | 3 | 1 | 4 | 0 | 1 | 5 | 4 | 2 |
| Goat | 0 | 0 | 2 | 5 | 9 | 0 | 8 | 43 | 15 | 4 |
| Mule/donkey | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 |
| Average land area ($m^2$) | 7,220 | 2,810 | 4,790 | 1,880 | 5,250 | 2,870 | 3,430 | 4,980 | 6,730 | 4,440 |
| Rain-fed ($m^2$) | 260 | 900 | 1,510 | 583 | 467 | 550 | 1,120 | 0 | 0 | 600 |
| Irrigated ($m^2$) | 6,590 | 1,770 | 2,960 | 1,200 | 4,670 | 2,190 | 2,210 | 4,800 | 6,560 | 3,660 |
| Plantation ($m^2$) | 3,730 | 1,710 | 1,190 | 1,020 | 4,340 | 2,190 | 567 | 1,580 | 4,360 | 2,330 |

Note: Figures are expressed in the average of 12 samples collected in each Douar through questionnaire, except those given in the item of family members, which show the total number of families.

## Table 3.3.4 SUMMARY OF ANSWERS TO QUESTIONNAIRE FOR THE SOCIAL STUDY AND PUBLIC AWARENESS OF NATURAL DISASTER (PART 1)

(4/6)

| Item | C.R. Imgdal | | | C.R. Ijoukak | | C.R. Talat N'Yakoub | | |
|---|---|---|---|---|---|---|---|---|
| | Tizgui | Targua | Average | Ouathkerri | Average | Dougouj | Talat N'Yakoub | Average |
| Family members | | | | | | | | |
| 1 – 5 | 2 | 4 | 6 | 1 | 1 | 4 | 4 | 8 |
| 6 – 9 | 3 | 8 | 11 | 7 | 7 | 4 | 7 | 11 |
| 10 – 14 | 8 | 1 | 9 | 2 | 2 | 1 | 0 | 1 |
| 15 – 19 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 2 |
| >20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ave. annual income (Dh) | 19,720 | 21,660 | 20,690 | 18,340 | 18,340 | 14,950 | 18,990 | 16,970 |
| Agriculture (Dh) | 9,640 | 10,730 | 10,190 | 10,280 | 10,280 | 6,810 | 11,990 | 9,400 |
| Non-agriculture (Dh) | 10,080 | 10,930 | 10,500 | 8,060 | 8,060 | 8,140 | 7,000 | 7,570 |
| Ave. annual expenditure (Dh) | 19,420 | 18,160 | 18,160 | 17,700 | 17,700 | 14,950 | 18,470 | 16,710 |
| Food (Dh) | 15,790 | 13,090 | 13,090 | 13,270 | 13,270 | 12,110 | 14,330 | 13,220 |
| Others (Dh) | 3,630 | 5,070 | 5,070 | 4,430 | 4,430 | 2,840 | 4,140 | 3,490 |
| Ave. years of life in Douar | 51 | 54 | 53 | 41 | 41 | 39 | 38 | 39 |
| Average number of livestock | | | | | | | | |
| Cattle | 2 | 1 | 2 | 2 | 2 | 1 | 2 | 2 |
| Sheep | 9 | 0 | 5 | 2 | 2 | 3 | 8 | 6 |
| Goat | 17 | 4 | 11 | 7 | 7 | 0 | 26 | 13 |
| Mule/donkey | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 |
| Average land area ($m^2$) | 4,940 | 2,450 | 3,700 | 23,220 | 23,220 | 4,600 | 10,760 | 7,680 |
| Rain-fed ($m^2$) | 50 | 40 | 50 | 6,340 | 6,340 | 1,000 | 2,750 | 1,880 |
| Irrigated ($m^2$) | 4,790 | 2,220 | 3,510 | 16,730 | 16,730 | 3,480 | 7,900 | 5,690 |
| Plantation ($m^2$) | 3,160 | 1,300 | 2,230 | 14,370 | 14,370 | 1,000 | 5,780 | 3,390 |

Note: Figures are expressed in the average of 13 samples for Tizgui and Targua, 11 samples for Ouathkerri, 10 samples for Dougouj, and 12 samples for Talat N' Yakoub. In the item of family members, the total number is given in each column.

## Table 3.3.4 SUMMARY OF ANSWERS TO QUESTIONNAIRE FOR THE SOCIAL STUDY AND PUBLIC AWARENESS OF NATURAL DISASTER (PART 1)

(5/6)

| Article | C.R. Imgdal | | | C.R. Ijoukak | | C.R. Talat N'Yakoub | | |
|---|---|---|---|---|---|---|---|---|
| | Tizgui | Targua | Moyenne | Ouathkerri | Moyenne | Dougouj | Talat N'Yakoub | Moyenne |
| Membres de la famille | | | | | | | | |
| 1 – 5 | 2 | 4 | 6 | 1 | 1 | 4 | 4 | 8 |
| 6 – 9 | 3 | 8 | 11 | 7 | 7 | 4 | 7 | 11 |
| 10 – 14 | 8 | 1 | 9 | 2 | 2 | 1 | 0 | 1 |
| 15 – 19 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 2 |
| >20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Moy. de revenu annuel(DH) | 19,720 | 21,660 | 20,690 | 18,340 | 18,340 | 14,950 | 18,990 | 16,970 |
| Agriculture (DH) | 9,640 | 10,730 | 10,190 | 10,280 | 10,280 | 6,810 | 11,990 | 9,400 |
| Non-agriculture (DH) | 10,080 | 10,930 | 10,500 | 8,060 | 8,060 | 8,140 | 7,000 | 7,570 |
| Moy. des dépenses annuelles (DH) | 19,420 | 18,160 | 18,160 | 17,700 | 17,700 | 14,950 | 18,470 | 16,710 |
| Nourriture (DH) | 15,790 | 13,090 | 13,090 | 13,270 | 13,270 | 12,110 | 14,330 | 13,220 |
| Autres (DH) | 3,630 | 5,070 | 5,070 | 4,430 | 4,430 | 2,840 | 4,140 | 3,490 |
| Moy. des âges aux douars | 51 | 54 | 53 | 41 | 41 | 39 | 38 | 39 |
| Moyenne de nombre de bétail | | | | | | | | |
| Bétail | 2 | 1 | 2 | 2 | 2 | 1 | 2 | 2 |
| Mouton | 9 | 0 | 5 | 2 | 2 | 3 | 8 | 6 |
| Chèvre | 17 | 4 | 11 | 7 | 7 | 0 | 26 | 13 |
| Mule/âne | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 |
| Moyenne de surface des terres ($m^2$) | 4,940 | 2,450 | 3,700 | 23,220 | 23,220 | 4,600 | 10,760 | 7,680 |
| Bour ($m^2$) | 50 | 40 | 50 | 6,340 | 6,340 | 1,000 | 2,750 | 1,880 |
| Irriguée ($m^2$) | 4,790 | 2,220 | 3,510 | 16,730 | 16,730 | 3,480 | 7,900 | 5,690 |
| Plantation ($m^2$) | 3,160 | 1,300 | 2,230 | 14,370 | 14,370 | 1,000 | 5,780 | 3,390 |

Note: les figures sont présentées d'une moyenne de 13 échantillons pour Tizgui et Targua, 11 échantillons pour Ouathkerri, 10 échantillons pour Dougouj, et 12 échantillons pour Talat N' Yakoub. In the item of family members, le nombre total est donné dans chaque colonne.

## Table 3.3.4 SUMMARY OF ANSWERS TO QUESTIONNAIRE FOR THE SOCIAL STUDY AND PUBLIC AWARENESS OF NATURAL DISASTER (PART 1)

(6/6)

| Item | Sidi Youssef Ben Ali | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Sidi Y.B.Ali | Average | | | | | | |
| Family members | | | | | | | | |
| 1 – 5 | 3 | 3 | | | | | | |
| 6 – 9 | 5 | 5 | | | | | | |
| 10 – 14 | 4 | 4 | | | | | | |
| 15 – 19 | 0 | 0 | | | | | | |
| >20 | 0 | 0 | | | | | | |
| Ave. annual income (Dh) | 17,337 | 17,337 | | | | | | |
| Agriculture (Dh) | 0 | 0 | | | | | | |
| Non-agriculture (Dh) | 17,337 | 17,337 | | | | | | |
| Ave. annual expenditure (Dh) | 17,337 | 17,337 | | | | | | |
| Food (Dh) | 5,202 | 5,202 | | | | | | |
| Others (Dh) | 12,135 | 12,135 | | | | | | |
| Ave. years of life in Douar | 38 | 38 | | | | | | |
| Average number of livestock | | | | | | | | |
| Cattle | 0 | 0 | | | | | | |
| Sheep | 0 | 0 | | | | | | |
| Goat | 0 | 0 | | | | | | |
| Mule/donkey | 0 | 0 | | | | | | |
| Average land area ($m^2$) | 60 | 60 | | | | | | |
| Rain-fed ($m^2$) | 0 | 0 | | | | | | |
| Irrigated ($m^2$) | 0 | 0 | | | | | | |
| Plantation ($m^2$) | 0 | 0 | | | | | | |

Note: Figures are expressed in the average of 12 samples collected by questionnaire in the Municipality of Sidi Youssef Ben Ali. In the item of family members, the total number is given in each column.

**Table 3.3.5 SUMMARY OF ANSWERS TO QUESTIONNAIRE FOR THE SOCIAL STUDY AND PUBLIC AWARENESS (PART 2)**

| | Question | Answer | Year ( 1995 ) | Year ( 1999 ) |
|---|---|---|---|---|
| 1 | Did you perceive possible attack of disaster ahead of time? | 1. Yes<br>2. No<br>If no ⇒ No.6 | 1. 365<br>2. 91 | 1. 349<br>2. 64 |
| 2 | How did you perceive or get informed ? | 1. by weather forecast of TV<br>2. by weather forecast of radio<br>3. by prediction from the past experience<br>4. by the sound from upstream<br>5. by people's shout from upstream<br>6. by information given by chief of village<br>7. others (specify) | 1. 2<br>2. 4<br>3. 192<br>4. 140<br>5. 43<br>6. 6<br>7. 3 | 1. 5<br>2. 4<br>3. 297<br>4. 82<br>5. 30<br>6. 7<br>7. 0 |
| 3 | When did you perceive or get informed ? | 1. more than 1 hour before the disaster<br>2. 30min.-1 hour before the disaster<br>3. 15-30min before the disaster.<br>4. 5-15min before the disaster.<br>5. just before the disaster struck | 1. 177<br>2. 64<br>3. 45<br>4. 55<br>5. 18 | 1. 251<br>2. 36<br>3. 24<br>4. 27<br>5. 5 |
| 4 | Did you take some action to prepare for evacuation ? | 1. Yes<br>2. No<br>If no ⇒ No.6 | 1. 140<br>2. 158 | 1. 151<br>2. 186 |
| 5 | What action did you take for the preparation of evacuation? | 1. nothing<br>2. to pack household goods<br>3. to take money with you<br>4. to let livestock evacuate<br>5. to communicate with family<br>6. to inform neighbors<br>7. to inform villagers in the downstream | 1. 71<br>2. 11<br>3. 15<br>4. 39<br>5. 73<br>6. 46<br>7. 9 | 1. 46<br>2. 14<br>3. 14<br>4. 31<br>5. 57<br>6. 39<br>7. 10 |
| 6 | How high was the water level in the river as compared to the ordinary level ? | | < 3 37<br>3 - 5m 164<br>5 - 6m 61<br>>6m 119 | <3m 69<br>3 - 5m 168<br>5 - 6m 42<br>>6m 71 |
| 7 | How fast was the water flow in the river as compared to normal discharge ? | 1. same as normal flow<br>2. a little bit faster<br>3. fast<br>4. very fast | 1. 1<br>2. 4<br>3. 64<br>4. 331 | 1. 2<br>2. 4<br>3. 116<br>4. 262 |
| 8 | Was a flood occurred ? | 1. Yes<br>2. No<br>If no ⇒ No. 10 | 1. 384<br>2. 2 | 1. 399<br>2. 2 |
| 9 | Duration of flood | | <1h 103<br>1 – 3h 213<br>3 – 5h 38<br>>5h 83 | <1h 10<br>1 – 6h 134<br>6 – 12h 48<br>12–24h 76<br>>24h 144 |
| 10 | Was a debris flow occurred ? | 1. Yes<br>2. No<br>If no ⇒ No. 12 | 1. 409<br>2. 15 | 1. 357<br>2. 23 |
| 11 | Duration of debris flow | | <1h 96<br>1 – 3h 175<br>3 – 5h 51<br>>5h 62 | <1h 15<br>1 – 6h 140<br>6 – 12h 42<br>12- 24h 141 |
| 12 | Was a landslide occurred ? | 1. Yes<br>2. No | 1. 342<br>2. 96 | 1. 301<br>2. 97 |

| | Question | Answer | Year ( 1995 ) | Year ( 1999 ) |
|---|---|---|---|---|
| 13 | Did you evacuate ? | 1. Yes<br>2. No<br>If no ⇒ No. 20 | 1. 163<br>2. 285 | 1. 89<br>2. 314 |
| 14 | When did you evacuate ? | 1. immediately after noticing or getting advanced information<br>2. within 5 min. after having noticed<br>3. within 10 min. after having noticed<br>4. within 20 min. after having noticed<br>5. within 30 min. after having noticed<br>6. within 1 hour after having noticed<br>7. after the occurrence of disaster | 1. 60<br>2. 15<br>3. 9<br>4. 7<br>5. 10<br>6. 8<br>7. 54 | 1. 34<br>2. 5<br>3. 6<br>4. 2<br>5. 6<br>6. 9<br>7. 27 |
| 15 | With whom did you evacuate ? | 1. alone<br>2. with family<br>3. with neighbors<br>4. with livestock<br>5. others (tourists, etc) | 1. 31<br>2. 113<br>3. 74<br>4. 35<br>5. 7 | 1. 12<br>2. 62<br>3. 38<br>4. 23<br>5. 5 |
| 16 | Where did you evacuate ? | 1. evacuation area<br>2. on the roof<br>3. higher location nearby<br>4. on a hill<br>5. others (other village, family's house, mosque) | 1. 2<br>2. 12<br>3. 63<br>4. 29<br>5. 75 | 1. 1<br>2. 6<br>3. 43<br>4. 17<br>5. 37 |
| 17 | How did you evacuate ? | 1. walk<br>2. run<br>3. by car<br>4. by motorbike<br>5. by bicycle<br>6. by donkey<br>7. others | 1. 53<br>2. 107<br>3. 2<br>4. 1<br>5. 0<br>6. 0<br>7. 0 | 1. 34<br>2. 55<br>3. 0<br>4. 0<br>5. 0<br>6. 0<br>7. 0 |
| 18 | What did you carry with you when you evacuated ? | 1. nothing<br>2. money<br>3. livestock<br>4. electric products<br>5. others (blanket, personal effects, etc) | 1. 108<br>2. 28<br>3. 42<br>4. 7<br>5. 15 | 1. 54<br>2. 13<br>3. 24<br>4. 8<br>5. 12 |
| 19 | When did you return home from the evacuation area ? | 1. just after the disaster<br>2. within 1 hour after the disaster<br>3. 1-6 hours after the disaster<br>4. 6-12 hours after the disaster<br>5. 12-24 hours after the disaster<br>6. more than one day<br>7. no longer return | 1. 9<br>2. 14<br>3. 53<br>4. 18<br>5. 33<br>6. 16<br>7. 8 | 1. 3<br>2. 1<br>3. 23<br>4. 6<br>5. 12<br>6. 5<br>7. 3 |
| 20 | Did you give the warning or information to somebody else ? | 1. Yes<br>2. No<br>If no ⇒ No. 24 | 1. 221<br>2. 172 | 1. 152<br>2. 172 |
| 21 | When did you give the warning or information ? | 1. immediately after noticing danger<br>2. at the time of the disaster<br>3. during evacuation<br>4. after evacuation | 1. 176<br>2. 49<br>3. 9<br>4. 1 | 1. 138<br>2. 28<br>3. 4<br>4. 1 |
| 22 | To whom did you give the warning or information ? | 1. to family<br>2. to neighbors<br>3. to the chief of village<br>4. to villages located downstream<br>5. to the tourists | 1. 162<br>2. 179<br>3. 0<br>4. 24<br>5. 55 | 1. 132<br>2. 143<br>3. 0<br>4. 22<br>5. 21 |

| | Question | Answer | Year ( 1995 ) | Year ( 1999 ) |
|---|---|---|---|---|
| 23 | How did you give the warning or information ? | 1. shout loudly<br>2. visit neighbors<br>3. whistle<br>4. ring a bell<br>5. others | 1. 169<br>2. 32<br>3. 1<br>4. 0<br>5. 0 | 1. 166<br>2. 28<br>3. 1<br>4. 0<br>5. 0 |
| 24 | Did you participate in any activities about flood-fighting or rescue operation ? | 1. Yes<br>2. No<br>If no ⇒ No. 26 | 1. 142<br>2. 241 | 1. 94<br>2. 247 |
| 25 | What kinds of activities did you participate ? | 1. guide to evacuation<br>2. rescue people<br>3. others (protection of land) | 1. 73<br>2. 81<br>3. 25 | 1. 47<br>2. 48<br>3. 11 |
| 26 | Damage situation for your family | year and month | 1995/8 | 1999/10 |
| | | number of victims | 6 | 0 |
| | | number of the injured | 9 | 0 |
| | | damage of house<br>(a) all damaged<br>(b) partially damaged | (a) 15<br>(b) 51 | (a) 3<br>(b) 10 |
| | | damage of cultivated land | 342 | 266 |
| | | damage of livestock | 14 | 3 |
| | | others (shop, restaurant equipment, water mill, motorcycle, etc) | 51 | 5 |
| 27 | Did you take some measures later to mitigate damage? | 1. Yes<br>2. No<br>If no ⇒ No. 29 | 1. 144<br>2. 266 | |
| 28 | What kinds of measures did you take ? | 1. packing things to get ready for evacuation<br>2. securing route and place for evacuation<br>3. making an evacuation plan with neighbors<br>4. others | 1. 24<br>2. 149<br>3. 2<br>4. 7 | |
| 29 | Do you always prepare for evacuation ? | 1. Yes<br>2. No<br>If no ⇒ No. 31 | 1. 236<br>2. 152 | |
| 30 | What do you prepare for evacuation ? | 1. packing things for evacuation<br>2. securing route and place for evacuation<br>3. others | 1. 45<br>2. 232<br>3. 5 | |
| 31 | Do you always fear the disaster? | 1. Yes<br>2. No | 1. 409<br>2. 1 | |
| 32 | Are you always cautious about natural disaster ? | 1. Yes<br>2. No | 1. 405<br>2. 18 | |
| 33 | Did you know that your place is vulnerable to disaster prior to your immigration ? | 1. Yes<br>2. No<br>3. I have been living here since I was born | 1. 15<br>2. 26<br>3. 371 | |
| 34 | Do you wish to relocate your house to the safe place? | 1. Yes<br>2. No | 1. 135<br>2. 273 | |

| | Question | Answer | Year ( 1995 ) | Year ( 1999 ) |
|---|---|---|---|---|
| 35 | Why don't you relocate ? | 1. due to financial problem<br>2. due to land problem<br>3. due to the relationship with community<br>4. others | 1. 255<br>2. 256<br>3. 137<br>4. 12 | |
| 36 | Did you participate in restoration work ? | 1. Yes<br>2. No<br>If no ⇒ No. 38 | 1. 397<br>2. 64 | |
| 37 | What type of restoration work did you do ? | 1. restoration of my house<br>2. restoration of neighbor's house<br>3. restoration of road<br>4. restoration of public facilities (school, hospital, etc.)<br>5. others (farmland, irrigation canal, water intake, etc) | 1. 65<br>2. 101<br>3. 314<br>4. 25<br>5. 179 | |
| 38 | If evacuation drill is planned in your village, do you want to participate in it ? | 1. Yes<br>2. No | 1. 341<br>2. 69 | |
| 39 | Is flood forecast and warning system (FFWS) necessary for your village ? | 1. Yes<br>2. No<br>If no ⇒ No. 42 | 1. 465<br>2. 13 | |
| 40 | Can you contribute something to the operation and maintenance of FFWS ? | 1. Yes<br>2. No<br>If no ⇒ No. 42 | 1. 380<br>2. 47 | |
| 41 | What type of contribution can you offer ? | 1. to keep watch communication equipment<br>2. to be voluntarily engaged in radio communication during flood period<br>3. others (any possible work if required) | 1. 244<br>2. 278<br>3. 45 | |
| 42 | What do you want as a preventive measure against disaster ? | 1. accurate forecasting<br>2. warning and information in advance<br>3. evacuation drill<br>4. place of evacuation<br>5. education<br>6. others | 1. 389<br>2. 289<br>3. 164<br>4. 128<br>5. 75<br>6. 3 | |
| 43 | Please indicate which one you need the most for your family and village | 1. safety<br>2. water<br>3. school<br>4. hospital<br>5. public transportation service<br>6. relocation land<br>7. farmland<br>8. livestock<br>9. electricity<br>10. others (mosque, bridge, road improvement, bridge, telephone, etc) | 1. 208<br>2. 162<br>3. 59<br>4. 248<br>5. 90<br>6. 100<br>7. 78<br>8. 93<br>9. 178<br>10. 116 | |

## Table 3.3.6 LIST OF DAMAGE IN SELECTED DOUARS BY THE 1995 DISASTER (1/2)

| C.R / Douar | Human | | House | | Livestock | | | | Agricultural land (ha) | | Tourist facility | | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Dead | Injured | > 50% | < 50% | Cattle | Sheep | Goat | Mule | Cultivated | Plantation | Hotel | Restaurant/ café | |
| C.R. Zerkten | | | | | | | | | | | | | |
| Tazlida-Ait Moussa | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 1.8 | 0.2 | 0 | 0 | 1 water mill, 3 water intakes |
| Tazlida-Tabahgate | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 2.0 | 0.0 | 0 | 4 | - |
| Ait Ben Aamr | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2.0 | 0.0 | 0 | 0 | 1 bridge |
| C.R. Tighedouine | | | | | | | | | | | | | |
| Ouayfirte | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.9 | 0.1 | 0 | 0 | - |
| Tazourte | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3.0 | 1.0 | 0 | 0 | - |
| Anammer | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 120.0 | 30.0 | 0 | 0 | irrigation canal |
| Arba Tighedouine | 0 | 0 | 0 | 0 | 0 | 10 | 12 | 0 | 0.5 | 1.5 | 0 | 0 | irrigation canal |
| C.R. My Brahim | | | | | | | | | | | | | |
| Rha My Brahim | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.0 | 1.5 | 0 | 0 | 200 chairs of coffee shop |
| C.R. Ourika | | | | | | | | | | | | | |
| Timalizen | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 3.0 | 0.5 | 0 | 0 | - |
| Asguine | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4.0 | 4.0 | 0 | 0 | 1 water mill |
| Taourirte | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6.0 | 2.0 | 0 | 0 | - |
| Anrar | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 0.5 | 0 | 0 | - |
| Tiguemmi | 0 | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 2.5 | 0.5 | 0 | 0 | 1 water mill, 1 water intake |
| C.R. Setti Fadma | | | | | | | | | | | | | |
| Aghbalou | 13 | 0 | 21 | 15 | 0 | 0 | 0 | 0 | 14.0 | 6.0 | 0 | 1 | 1 water mill, 10 cars |
| Irghef (Oulmes) | 100 | 0 | 10 | 4 | 2 | 0 | 0 | 0 | 14.0 | 6.0 | 0 | 1 | about 50 cars |
| Tazitounte | 10 | 0 | 6 | 5 | 4 | 5 | 0 | 0 | 0.5 | 0.5 | 0 | 2 | 3 mills, 3 cars |
| Imintadart | 0 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 2.0 | 1.0 | 0 | 0 | - |
| El kri | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 2.5 | 0 | 1 | 1 car |
| Asgaour | 7 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0.0 | 1.0 | 0 | 0 | about 100 tourist cars |
| Anfli | 0 | 25 | 0 | 1 | 0 | 0 | 50 | 0 | 1.0 | 1.0 | 0 | 0 | 4 water mills |
| Tiourdiouine | 0 | 0 | 8 | 0 | 0 | 20 | 70 | 0 | 13.0 | 2.0 | 0 | 0 | - |
| Timichi | 0 | 0 | 3 | 1 | 0 | 0 | 0 | 0 | 6.0 | 1.0 | 0 | 0 | - |

## Table 3.3.6 LIST OF DAMAGE IN SELECTED DOUARS BY THE 1995 DISASTER (2/2)

| C.R / Douar | Human | | House | | Livestock | | | | Agricultural land (ha) | | Tourist facility | | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Dead | Injured | > 50% | < 50% | Cattle | Sheep | Goat | Mule | Cultivated | Plantation | Hotel | Restaurant/ café | |
| C.R. Asni | | | | | | | | | | | | | |
| Imlil | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0.0 | 3.0 | 1 | 1 | 3 water mills, 30 cars |
| Tachdirte | 0 | 0 | 0 | 8 | 0 | 4 | 0 | 0 | 5.0 | 1.0 | 0 | 0 | irrigation canal, access road |
| Tansgharte | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 5.0 | 0 | 0 | - |
| Centre Asni | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 20.0 | 20.0 | 0 | 1 | 2 ovens |
| C.R. Ouirgane | | | | | | | | | | | | | |
| Tororte | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9.0 | 6.0 | 0 | 0 | - |
| Tassaouirgane | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5.0 | 10.0 | 0 | 0 | - |
| C.R. Imgdal | | | | | | | | | | | | | |
| Tizgui | 6 | 2 | 1 | 1 | 2 | 100 | 200 | 1 | 9.0 | 2.0 | 0 | 0 | - |
| Targua | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.4 | 0.1 | 0 | 0 | - |
| C.R. Ijoukak | | | | | | | | | | | | | |
| Ouathkerri | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2.0 | 1.0 | 0 | 0 | - |
| C.R. Talat N'Yakoub | | | | | | | | | | | | | |
| Dougouj | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.0 | 0.0 | 0 | 0 | - |
| Talat N'Yakoub | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4.0 | 1.0 | 0 | 0 | 15 water intake facilities |
| Total | 147 | 28 | 53 | 58 | 8 | 139 | 332 | 1 | 254.6 | 111.9 | 1 | 11 | |
| Pre. Sidi Youssef Ben Ali | | | | | | | | | | | | | |
| Municipality of Sidi Youssef Ben Ali | 0 | 15 | 6 | 19 | 0 | 30 | 0 | 0 | 0 | 0 | 0 | 0 | 15 bicycles |

Note: According to information provided by the chief of each village through the interview
Sidi Youssef Ben Ali was not struck by the 1995 disaster, therefore damage information given above is based on the 1982 disaster.

## Table 3.3.7 LIST OF DAMAGE IN SELECTED DOUARS BY THE 1999 DISASTER (1/2)

| C.R / Douar | Human | | House | | Livestock | | | | Agricultural land (ha) | | Tourist facility | | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Dead | Injured | > 50% | < 50% | Cattle | Sheep | Goat | Mule | Cultivated | Plantation | Hotel | Restaurant/ café | |
| C.R. Zerkten | | | | | | | | | | | | | |
| Tazlida-Ait Moussa | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.5 | 0.5 | 0 | 0 | - |
| Tazlida-Tabahgate | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | - |
| Ait Ben Aamr | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2.0 | 0.0 | 0 | 0 | 1 bridge |
| C.R. Tighedouine | | | | | | | | | | | | | |
| Ouayfirte | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2.5 | 0.5 | 0 | 0 | irrigation canal |
| Tazourte | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4.5 | 1.0 | 0 | 0 | - |
| Anammer | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 120.0 | 30.0 | 0 | 0 | irrigation canal |
| Arba Tighedouine | 0 | 0 | 0 | 0 | 0 | 10 | 12 | 0 | 0.5 | 1.5 | 0 | 0 | 1 bridge |
| C.R. My Brahim | | | | | | | | | | | | | |
| Rha My Brahim | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.0 | 2.0 | 0 | 0 | - |
| C.R. Ourika | | | | | | | | | | | | | |
| Timalizen | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 2.0 | 0.5 | 0 | 0 | - |
| Asguine | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6.0 | 4.0 | 0 | 0 | 1 water mill, 1 well |
| Taourirte | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.0 | 1.0 | 0 | 0 | - |
| Anrar | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0.5 | 0.5 | 0 | 0 | 1 water mill |
| Tiguemmi | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | - |
| C.R. Setti Fadma | | | | | | | | | | | | | |
| Aghbalou | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14.0 | 6.0 | 0 | 0 | - |
| Irghef (Oulmes) | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 20.0 | 6.0 | 0 | 1 | 2 water mills |
| Tazitounte | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 0.5 | 0 | 0 | - |
| Imintadart | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.0 | 1.0 | 0 | 0 | - |
| El kri | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 3.0 | 0 | 1 | - |
| Asgaour | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 1.0 | 0 | 0 | - |
| Anfli | 0 | 15 | 0 | 4 | 0 | 0 | 0 | 0 | 3.0 | 3.0 | 0 | 0 | 1 water mill |
| Tiourdiouine | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 13.0 | 2.0 | 0 | 0 | 2 water mills |
| Timichi | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12.0 | 2.0 | 0 | 0 | - |

## Table 3.3.7 LIST OF DAMAGE IN SELECTED DOUARS BY THE 1999 DISASTER (2/2)

| C.R / Douar | Human | | House | | Livestock | | | | Agricultural land (ha) | | Tourist facility | | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Dead | Injured | > 50% | < 50% | Cattle | Sheep | Goat | Mule | Cultivated | Plantation | Hotel | Restaurant/ café | |
| C.R. Asni | | | | | | | | | | | | | |
| Imlil | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 3.0 | 0 | 0 | - |
| Tachdirte | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | irrigation canal, access road |
| Tansgharte | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 5.0 | 0 | 0 | - |
| Centre Asni | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | - |
| C.R. Ouirgane | | | | | | | | | | | | | |
| Tororte | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | - |
| Tassaouirgane | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.0 | 3.0 | 0 | 0 | - |
| C.R. Imgdal | | | | | | | | | | | | | |
| Tizgui | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 5.0 | 1.0 | 0 | 0 | - |
| Targua | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 0.1 | 0 | 0 | - |
| C.R. Ijoukak | | | | | | | | | | | | | |
| Ouathkerri | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7.0 | 3.0 | 0 | 0 | 2 water mills |
| C.R. Talat N'Yakoub | | | | | | | | | | | | | |
| Dougouj | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.0 | 0.0 | 0 | 0 | 1 well |
| Talat N'Yakoub | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3.0 | 1.0 | 0 | 0 | - |
| Total | 0 | 15 | 6 | 5 | 0 | 10 | 12 | 0 | 222.5 | 82.1 | 0 | 2 | |
| Pre. Sidi Youssef Ben Ali | | | | | | | | | | | | | |
| Municipality of Sidi Youssef Ben Ali | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - |

Note: According to information provided by the chief of each village through the interview
Sidi Youssef Ben Ali was not struck by the 1999 disaster, and even by the 1994 flood there was no outstanding damage.

## Table 4.3.1 LIST OF FLOOD WATCH STATIONS IN STUDY AREA

| Serial | Station | Category | River Basin | Location | | | Catchment Area (km2) | Start of Operation | Sensor | | Telecommunication Equipment |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Latitude | Longitude | Altitude (m) | | | Rainfall | WaterLevel | |
| 1 | Aghbalau | Principle Station | Ourika | 31° 19.02' | 7° 44.75' | 1,070 | 495 | Apr., 1969 | ST/TP | S/FL | VHF, HF, Telephone |
| 2 | Tazitount | Simple Station | Ourika | 31° 16.44' | 7° 41.30' | 1,270 | 347 | Feb., 1999 | ST | S | VHF |
| 3 | Tourcht | Simple Station | Ourika | | | 1,650 | 19 | Dec., 1997 | ST | S | VHF |
| 4 | Amenzal | Simple Station | Ourika | 31° 11.28' | 7° 45.02' | 2,230 | 49 | Apr., 1997 | ST | S | VHF, HF |
| 5 | Tiourdiou | Simple Station | Ourika | 31° 12.02' | 7° 44.78' | 1,850 | 134 | Jun., 1996 | ST | S | VHF, HF |
| 6 | Agouns | Simple Station | Ourika | 31° 11.98' | 7° 48.17' | 2,200 | - | Aug., 1996 | ST | none | VHF |
| 7 | Aremd | Simple Station | Rheraya | 31° 07.89' | 7° 55.62' | 1,950 | 35 | Feb., 1999 | ST | S | VHF |
| 8 | Iguir N'kouris | Principle Station | N'fiss | 31° 03.54' | 8° 08.38' | 1,100 | 848 | Mar., 1974 | ST | S | HF |
| 9 | Marrakech | Central Station (DRHT) | - | - | - | 460 | - | 1970 | ST/TP | none | VHF/ HF/Telephone |
| 10 | Oukaimeden | Relay Station | - | 31° 11.04' | 7° 51.48' | 3,262 | - | 1996 | - | - | - |

Type of Rainfall Gauge; ST: Storage type (manual), TP: Tipping bucket type (automatic recorder)

Type of Water Level Gauge; S: Staff gauge (manual), FL: Float type (automatic recorder)

## Table 4.3.2 LIST OF EQUIPMENT AT FLOOD WATCH STATIONS

| Serial | Station | River Basin | Rainfall Gauge | | | Water Level Gauge | | | Radio Equipment | | | | Availability of Telephone | Availability of Commercial Power Supply | Number of Solar Panels | Number of Batteries | Availability of Generator |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Manual gauge | Automatic Gauge | | Manual gauge | Automatic Gauge | | HF/SSB | | VHF/FM | | | | | | |
| | | | Installation | Brand | Installation | Installation | Brand | Installation | Brand | Installation | Brand | Installation | | | | | |
| 1 | Aghbalau | Ourika | Apr., 1969 | FLOTTEUR AOTT | Dec., '72 | Apr., 1969 | TEL. RAUBER | Apr., 1969 | Thomson-CSF (100W) | 1995 | Motorrola (25W) | Jun., 1997 | Yes | Yes | 0 | 1 | No |
| 2 | Tazitount | Ourika | Feb., 1999 | none | | Feb., 1999 | none | | None | | Motorrola (25W) | Apr., 1999 | No | No | 2 | 2 | No |
| 3 | Tourcht | Ourika | Dec., 1997 | none | | Dec., 1997 | none | | None | | Motorrola (25W) | Jun., 1997 | No | No | 2 | 2 | No |
| 4 | Amenzal | Ourika | Apr., 1997 | none | | Apr., 1997 | none | | Codan | Aug., 2000 | Motorrola (25W) | Jun., 1997 | No | No | 2 | 2 | Yes |
| 5 | Tiourdiou | Ourika | Jun., 1996 | none | | Jun., 1996 | none | | Codan | 1996 | Motorrola (25W) | Jun., 1997 | No | No | 5 | 3 | Yes |
| 6 | Agouns | Ourika | Aug., 1996 | none | | Aug., 1996 | none | | None | | Motorrola (25W) | Aug., 1997 | No | No | 5 | 2 | Yes |
| 7 | Aremd | Rheraya | Feb., 1999 | none | | Feb., 1999 | none | | None | | Motorrola (25W) | Apr., 1999 | No | Yes | 2 | 2 | No |
| 8 | Iguir N'kouris | N'fis | Mar., 1974 | none | | Mar., 1974 | none | | Thomson-CSF (100W) | 1974 | None | | No | No | 2 | 2 | Yes |
| 9 | Marrakech (Central Station) | | 1970 | none | | | none | | Thomson-CSF (100W) | | Motorrola (25W) | Jun., 1997 | Yes | Yes | 1 | 1 | (Charger) |
| 10 | Oukaimeden (Relay Station) | | 1997 | none | | | none | | none | | (Relay) | Sep., 1997 | No | No | 0 | 0 | No |

**Table 4.3.3 ACTIONS TO BE TAKEN BY DPE/DRE**

| Alert Stuation | Necessary Actions |
|---|---|
| Reinforced Follow-up Situation (2 to 3 days forecast mainly for frontal rain) | • Verification of operation of telecommunication tools,<br>• Preparation of equipment and materials,<br>• Mobilization of officials, technicians, engines conductors, gauging team, etc., and<br>• Contacts with local authorities, civil protections |
| Pre-alert Situation | • Regular Contact with DMN,<br>• Information collection from DRH on hydrological situation and flood forecast,<br>• Continuous follow-up of hydrological situation,<br>• Patrol and reconnaissance,<br>• Diffusion of Information/messages to Ministry, DGH, DRCR, DMN, DRH, and local authorities, and<br>• Installation of PC |
| Alert Situation | In case the hydro-rainfall situation is forecasted to become worsening:<br>• Installation of PC if not yet,<br>• Diffusion of alert to DGH, DRCR, DMN, DRH and SLM,<br>• Call of brigades to vulnerable sites<br>• Mobilization of materials and equipment to damaged sites,<br>• Patrol and inspection, and<br>• Coordination with neighboring DPE/DRE |

Date Source : "GESTION DES PHENOMENES CATASTROPHIQUES NATURELS LIES AUX PLUIES ET AUX CRUES, GUIDE PRATIQUE"

# Table 4.3.4 DMN ALERT MESSAGES AND ACTUAL RAINFALL

(1) October 1 to 10, 1999 — Rainfall (mm)

| Date | 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | 7h | 18h | 7h | 18h | 7h | 18h | 7h | 18h | 7h | 18h | 7h | 18h | 7h | 18h | 7h | 18h | 7h | 18h | 7h | 18h |
| Sidi Rahal | | | | | | | | | | | | | | | | | | | | 2.0 |
| Taferiat | | | | | | | 0.4 | | | | | | | | | | | | | 1.8 |
| Aghbalau | | | | | | | 2.1 | | | | | | | | | | | | | 1.5 |
| Tazzitount | | | | | | | 1.8 | | | | | | | | | | | 1.1 | 0.5 | 8.3 |
| Tourcht | | | | | | | | | | | | | | | | | | | | 5.8 |
| Amenzal | | | | | | | | | | | | | | | | | | 2.6 | | 15.6 |
| Tiourdiou | | | | | | | | | | | | | | | | | | | 1.7 | |
| Agouns | | | | | | | | | | | | | | | | | | | 6.0 | 7.4 |
| Tahanaout | | | | | | | | | | | | | | | | | | | | 2.3 |
| Aremd | | | | | | | 4.6 | | | | | | | | | | | 1.1 | 0.4 | 12.4 |
| Imin El Hammam | | | | | | | | | | | | | | | | | | | | 0.8 |
| Iguir N'kouris | | | | | | | | | | | | | | | | | | | | 5.0 |

(2) October 11 to 20, 1999 — Rainfall (mm)

| Date | 11 | | 12 | | 13 | | 14 | | 15 | | 16 | | 17 | | 18 | | 19 | | 20 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | 7h | 18h | 7h | 18h | 7h | 18h | 7h | 18h | 7h | 18h | 7h | 18h | 7h | 18h | 7h | 18h | 7h | 18h | 7h | 18h |
| Sidi Rahal | 15.0 | 9.0 | | | | 11.0 | | | | 1.5 | | | | | | | | | | |
| Taferiat | 19.5 | 3.2 | | | | 13.8 | | | 1.5 | 0.5 | | | | | | | | | | |
| Aghbalau | 15.1 | 10.3 | | | 0.7 | 28.5 | 2.6 | | 1.4 | 0.2 | | | | | | | | | | |
| Tazzitount | 15.0 | 9.7 | | | 2.0 | 10.9 | 4.2 | | | | 1.5 | | | | | | | | | |
| Tourcht | 46.5 | 15.9 | | | 5.9 | 16.4 | 2.5 | | | | | | | | | | | | | |
| Amenzal | 32.1 | 0.5 | | | 3.7 | 16.4 | 6.6 | | | | | | | | | | | | | |
| Tiourdiou | | 12.8 | | | 5.7 | 12.3 | | | | 1.2 | | | | | | | | | | |
| Agouns | 7.7 | 9.4 | | | | 10.4 | | | | | | | | | | | | | | |
| Tahanaout | 14.4 | 10.5 | | | | 27.5 | 3.0 | | 3.3 | 0.6 | | | | | | | | | | |
| Aremd | 31.3 | 10.5 | | | 5.8 | 19.7 | 4.7 | | 0.2 | 1.4 | | | | | | | | | | |
| Imin El Hammam | 16.4 | 26.2 | | | | 24.6 | 1.2 | | | | | | | | | | | | | |
| Iguir N'kouris | 16.3 | 19.1 | | | 0.8 | 26.5 | 1.5 | | 1.0 | | | | | | | | | | | |

(3) October 21 to 31, 1999 — Rainfall (mm)

| Date | 21 | | 22 | | 23 | | 24 | | 25 | | 26 | | 27 | | 28 | | 29 | | 30 | | 31 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | 7h | 18h | 7h | 18h | 7h | 18h | 7h | 18h | 7h | 18h | 7h | 18h | 7h | 18h | 7h | 18h | 7h | 18h | 7h | 18h | 7h | 18h |
| Sidi Rahal | | 1.0 | | | | | | 10.0 | 1.0 | | 2.5 | 3.0 | | | 11.0 | 1.0 | | | | | | |
| Taferiat | | 1.6 | | | | | | | | | 1.1 | 5.0 | 0.2 | | 13.2 | | | | | | | |
| Aghbalau | | 3.0 | | | | | | 7.3 | | | 3.4 | 9.1 | 5.6 | 8.6 | 32.0 | 0.3 | | | | | | |
| Tazzitount | | | | | | | | 1.8 | | | 3.5 | 14.2 | 6.8 | 4.4 | 46.2 | 1.2 | | | | | | |
| Tourcht | | | | | | | | 2.2 | | | 3.7 | 37.8 | 3.9 | 1.4 | 104.9 | 3.4 | | | | | | |
| Amenzal | | | | | | | | | | | | 38.1 | | 8.2 | 100.1 | 3.7 | | | | | | |
| Tiourdiou | | | | | | | | | | | | | 3.1 | 12.6 | 49.0 | | | | | | | |
| Agouns | | | | | | | | | | | | | 7.3 | 6.6 | 10.0 | 10.0 | | | | | | |
| Tahanaout | | | | | | | | 5.2 | | | 1.7 | 5.4 | 3.0 | 6.1 | 18.1 | | | | | | | |
| Aremd | | | | | | | | | | 0.4 | 7.8 | 35.4 | 3.0 | 22.9 | 111.8 | 0.2 | | | | | | |
| Imin El Hammam | | 6.2 | | | | | | 8.4 | | | 1.6 | 13.8 | | 21.6 | 21.2 | | | | | | | |
| Iguir N'kouris | | | | | | | | | | 2.5 | | 13.8 | | 38.0 | 53.2 | | | | | | | |

Valid Period of Pre-Alert Message

Valid Period of Alert Message

**Table 5.2.1 SUMMARY OF DISASTER CHARACTERISTICS**

| River Basin | | R'dat | Zat | Ourika | Rheraya | N'fis | Issyl |
|---|---|---|---|---|---|---|---|
| Area ($km^2$) | | 532 | 528 | 495 | 221 | 1,256 | 421 |
| Population | | 32,000 | 35,000 | 25,000 | 17,000 | 36,000 | 226,000 |
| Location | | High Atlas | High Atlas | High Atlas | High Atlas | High Atlas | Haouz Plain |
| Number of Causalities in 1995 flood and Others | By River Flood | No Casualties | No Casualties | • 13 in Aghblau<br>• 180 in Iraghf<br>• 10 in Tazzitount<br>• 9 in Setti Fadma | • 5 in R.M.Brahim<br>• 2 in Imlil | No Casualties | Some casualities in past floods |
| | By Debris Flow | • 3 in Tazlida Tributary | • 11 in Tiferent | | No Casualties | • 6 in Tizgui<br>• 1 in Targua | No Casualties |
| Potential Disaster Area | By Flood | • 2 small spot on the road N9<br>• A few houses in 4 spots | • A few houses in 4 spots | • A total 6km of the road P2017 including Iraghf and Setti Fadma. | • A total 6km of the road P2015 including R.M. Brahim and Asni Market | • A part of T.N. Yakoub<br>• A few houses in 2 spots<br>• The road R203 at 2 spots. | • Municipality of Sidi Youssef Ben Ali<br>• Guannoune |
| | By Debris Flow | Under study | Under study | Under study | Under study | Under study | Minimal |
| Number of Tourists | | Minimal | Minimal | • 3,000 in Iraghf<br>• 2,500 in Setti Fadma<br>• 1,000 in other places | • 1,500 in R.M. Brahim<br>• 4,000 in Asni Market<br>• Many foreigners in Imlil | Minimal | Minimal |
| Major Structures | | • Road N9 | None | • Tnine Bridge | None | • Lalla Takerkoust Dam<br>• Road R203 | • Urban Area (Sidi Youssef Ben Ali) |

**Table 5.3.1 PROPOSED NETWORK OF FLOOD WATCH STATIONS IN STUDY AREA**

| Serial | Station | Observation Item | New or Exsiting | River Basin | Altitude (m) | Catchment Area (km2) | Residence House |
|---|---|---|---|---|---|---|---|
| 1 | Adrar Guedrouz | Rainfall | New | R'dat/ Zat | 2,160 | - | New |
| 2 | Aghbalau | Rainfall & Water Level | Existing | Ourika | 1,070 | 495 | Existing |
| 3 | Tazitount | Rainfall & Water Level | Existing | Ourika | 1,270 | 347 | Existing |
| 4 | Tourcht | Rainfall & Water Level | Existing | Ourika | 1,650 | 19 | New |
| 5 | Amenzal | Rainfall & Water Level | Existing | Ourika | 2,230 | 49 | New |
| 6 | Tiourdiou | Rainfall & Water Level | Existing | Ourika | 1,850 | 134 | New |
| 7 | Agouns | Rainfall | Existing | Ourika | 2,200 | - | New |
| 8 | El Azib-n-Tinzar | Rainfall | New | Ourika | 1,950 | - | No Need |
| 9 | Amddouz | Rainfall | New | Ourika | 2,200 | - | New |
| 10 | Ihdjamene | Rainfall | New | Ourika | 1,750 | - | New |
| 11 | El Jam' ane | Rainfall & Water Level | New | Ourika | 1,400 | 54 | New |
| 12 | Oukaimeden | Rainfall (Relay Station) | New | Ourika/Rheraya | 3,270 | - | No Need |
| 13 | Aremd | Rainfall & Water Level | Existing | Rheraya | 1,950 | 35 | Existing |
| 14 | Arg | Rainfall & Water Level | New | Rheraya | 1,600 | 48 | New |
| 15 | Iguir N'kouris | Rainfall & Water Level | Existing | N'fis | 1,100 | 848 | Existing |
| 16 | Taous | Rainfall & Water Level | New | N'fis | 1,340 | 290 | New |
| 17 | Iguer | Rainfall & Water Level | New | N'fis | 1,580 | 100 | New |
| 18 | Tizgui | Rainfall | New | N'fis | 1,800 | 210 | New |
| 19 | Ait bou Zguia | Rainfall & Water Level | New | Issyl | 640 | - | New |
| 20 | Ouaguejdit | Rainfall | New | Issyl | 1,000 | - | New |

**Table 5.3.2 LOCATIONS OF PROPOSED WARNING POSTS**

| Serial | Location | Province /Prefecture | River Basin | Disaster Risk | Remarks |
|---|---|---|---|---|---|
| 1 | Tazlida | Al Haouz | R'dat | Debris Flow | |
| 2 | Tiffent | Al Haouz | Zat | Debris Flow | |
| 3 | Tiguemmi-n-Oumzil et Tnine | Al Haouz | Ourika | River Flood | |
| 4 | Aghbalau | Al Haouz | Ourika | River Flood & Debris Flow | |
| 5 | Iraghf | Al Haouz | Ourika | River Flood & Debris Flow | Tourist spot |
| 6 | Tazzitount | Al Haouz | Ourika | River Flood & Debris Flow | |
| 7 | El Kri | Al Haouz | Ourika | River Flood & Debris Flow | |
| 8 | Setti Fadma | Al Haouz | Ourika | River Flood & Debris Flow | Tourist spot |
| 9 | R'ha Mouley Brahim | Al Haouz | Rheraya | River Flood | Tourist spot |
| 10 | Asni Market | Al Haouz | Rheraya | River Flood | Market |
| 11 | Imlil | Al Haouz | Rheraya | Debris Flow | Tourist spot |
| 12 | Targa | Al Haouz | N'fis | Debris Flow | |
| 13 | Tisgui | Al Haouz | N'fis | Debris Flow | |
| 14 | Tleta-n-Yakoub | Al Haouz | N'fis | River Flood | |
| 15 | Youssef Ben Ali | S. Y. Ben Ali | Issyl | River Flood | Urban Area |
| 16 | Youssef Ben Ali | S. Y. Ben Ali | Issyl | River Flood | Urban Area |
| 17 | Guannoune | S. Y. Ben Ali | Issyl | River Flood | |

**Table 5.4.1 COMPARISON OF WATER LEVEL GAUGE**

| Study Item | Float and Weight Type | Pressure Type | Ultrasonic Type | Radio Wave Type |
|---|---|---|---|---|
| 1. Measuring Principal | Water level is measured by rotary degree of pulley which is directly connected to a float balanced with a counter weight in response to up and down motion of water level | Water level is measured by detecting water pressure corresponded to water level with sensor such as crystal type | Water level is measured by detecting time from transmission of ultrasonic wave to reception of the wave reflected by water surface. Compensation of temperature is necessary. | Water level is measured by detecting time from transmission of microwave to reception of the reflected wave by water surface. Compensation of temperature is not necessary. |
| 2. Measuring Range | 0m～40m | 1m～60m | 0m～13.5m | 0～20m |
| 3. Measuring Accuracy | ±10mm (20m) | ±0.1% | ±10mm | ±10mm |
| 4. Operation temperature Range | -20～＋50 ° C | -20～＋60 ° C | -30～＋50 ° C | -20～＋70 ° C |
| 5. Application | Natural river, Dam, Canal, Tide | Natural river, canal and tide | Natural river, Dam, Canal, Tide | Dam, Canal and Storage Tank |
| 6. Field Experience | Widely use for every field. Richly installation records are observed. | Field records are observed in moderate river and canal from many variety | Widely use for natural river, dam and canal. Richly installation records are observed. | Industrial use is main purpose such as monitoring of storage tank and canal. No field record is available at natural river. |
| 7. Power Supply | No power required for sensor | Necessary. Combination of solar panel and battery is suitable. | Necessary. Combination of solar panel and battery is suitable. | Necessary. Combination of solar panel and battery is suitable. |
| 8. Power Consumption | — | More less 40VA | More less 20AV | More less 1AV |
| 9. Installation | Measuring well is needed. Rather difficult installation at natural river. | Sensor is installed on riverbed. Protection of sensor and signal cable shall be necessary and it will be very hard installation | Over hanging structure made by steel is necessary on riverbank. Design of the structure shall be fit site condition. | Over hanging structure made by steel is necessary on riverbank. Design of the structure shall be fit site condition. |
| 10. Equipment Cost | Apporx. 120,000Dhs | Apporx. 300,000Dhs | Apporx. 270,000Dhs | Apporx. 170,000Dhs |
| 11. Installation Fee | Construction cost for well and approach bridge is expensive. | Protection of sensor and cable requires high installation cost. | Low installation cost is required. | Low installation cost is required. |
| 12. Judgment | Difficult to select appropriate installation place. | Not recommendable. Damages on sensor and cable by debris and rocks easily occur. | It is depend on observation point. However, this is most suitable sensor for the project. | Cost and power consumption is attractive. But no field record on the natural river feels uneasy. |

## Table 5.4.2 COMPARISON FOR COMMUNICATION METHOD (SUMMARY)

| | System / Compliance | VHF Radio Link | HS/SSB | Telephone Line | INMARSAT-C | V-SAT | Mobile Telephone |
|---|---|---|---|---|---|---|---|
| | | DGH owned radio network | DGH owned radio network | MAROC TELECOM | MAROC TELECOM | | MAROC TELECOM |
| 1 | Feature | This is standard procedure to collect data from remote site. If maintenance work will be done satisfactory, this is most economical and reliable system. | Major feature of HF/SSB is long distance communication. Automatic Line Establish Technology make reliable communication possible. | The public dial telephone line will use for data collection instead of own radio network. However, telephone network is not cover all of target area of this project. Telephone lines will use partially. | This is latest data collection system in the world. The system aims to establish wide area telemetry within reasonable installation cost. However, due to packet communication, response time of the system will be 5 to 15 minutes. | Communication satellite has number of transponder for wide band, high speed transmission services. Usually, the transponder will be leased for business network client such as Radio and TV broadcasting and banking. | Diffusion of mobile telephone service is rapidly increased recently. Near further, service will cover in the mountain area of study area. |
| 2 | Construction cost | Total cost of this system is high compare than other's. The equipment cost are almost same as other's. However, many relay station are required in mountain area that increase the cost. | Total cost of this system is low compare than other's because of no relay station. The equipment cost are almost same as other's. | No construction cost is added within service area. Outside of service area, Telephone cable laying cost and tel-pole cost will be added on the construction cost. | The equipment cost is the lowest and antenna tower is not necessary. Antenna will install at top of the roof. Therefore, this system is most economical for construction. | There are two kinds of installation method, one is rental equipment from operator. In this case, equipment cost is not counted. In case DRHT procure the equipment themselves, total cost will be highest among them. | Cost of hand held terminal unit become low. Highest cost of hand held terminal with subscription will be 3,096Dhs. |
| 3 | Running Cost | There is no running cost except Frequency usage fee. | There is no running cost except Frequency usage fee. | Average leased line charge for one station will be 1,000 Dhs/month. The public dial telephone fee is small. | Total communication charge will be 1,700,000 Dhs / year. | Communication charges are very high. | Average of the charge utilizing the project (1minutes/24 time/day bases) will be 180Dhs /month/set |
| 4 | Maintenance | Total maintenance work is required. DRHT shall organize maintenance team not only for hydrologist but also radio technicians. | Same as left | Maintenance work will be done by MAROC TELECOM. However, if telephone line has trouble, it will take long time for its restore. | The situation is almost same as telephone line. | No maintenance work is required. | No maintenance work is required. |
| 5 | Reliability | 99.50% | 85 - 90% | 99.99% | 99.99% | 99.99% | 99.90% |
| 6 | Difficulty | The system need at least 3 VHF frequencies for telemetry and another 4 frequencies for warning system. 80MHz band is available according to concerned authority. | Selection of new frequencies include frequency allocation from ANRT is difficult work and | Telephone network is not cover all of target area of this project. So, some remote station will not be included if this system is applied . | ANRT considers that such an authorization is exceptional and should not be renewed for other projects. | High performance and cost of the equipment is big problems. | Lacking of service coverage is big problems applying mobile telephone to the project. Stations, within service coverage are usable for the project. |
| 7 | Application for the Project | This system will apply for telemetry sub system and warning sub system which will connect with remote station. | This system will apply for telemetry sub system only. | It can uses only selected route like a provincial office and DGH head office. | This is most suitable for the data collection. But ime delay of response and high communication fee are disadvantageous. | This system will apply to data transmission sub system between DGH head office and DRHT office as trunk line. | Selected places where mobile telephone service cover area is usable for the project. |
| 8 | Judgement | Good and applicable | Good but not applicable | Good but not applicable | Good but need further study | Good but not applicable | Partially good |

**Table 5.4.3 THREE ALTERNATIVES FOR MASTER PLAN**

| System | | | Option A | Option B | Option C |
|---|---|---|---|---|---|
| Sub-system | Component | Item | | | |
| Meteo-hydrological Observation and Data Collection | Neteo-hydrological Observation | Observation Equipment | Manual Observation | Automatic Observation | Automatic Observation |
| | Data Collection | Data Transmission Equipment | Radio Communication by voice | Radio Communication by voice | Radio Telemetry System |
| Data Analysis and Forecasting of Flood and Debris Flow | Data Processing | Data Management Equipment | Manual data processing | Computer Data Processing | Computer Data Procesing and Home Page service |
| | Data Distribution | Data Monitoring Equipement | Data distribution by telephone and Facsimile | Equipt with PC for data monitoring at agencies concerned | Equipt with PC for data monitoring at agencies concerned with Internet Service |
| | Data Transmission | Transmission Method | Telephone Line | Telephone Line | Own Radio network and Telephone Line as Back-up |
| Dissemination of Warning | Warning Command | Warning Control Equipment | Warning Control Equipment is not installed at Caidat. | Simple Warning Control Equipment is installed at each Caidat | Issuance Warning message at Provincial Office directly through Warning Control Equipment |
| | Warning Dissemination | Warning Post | Off-line Voice amplifier at each Warning Post | Off-line Voice amplifier at each Warning Post | On-line Voice amplifier at each Warning Post |
| | Message Transmission | VHF Radiotelephone or Telephone Line | No transmission line is provided. Caidat goes to the Warning Post and broadcasts warning message | Between Caidat and Warning Post connects by Public Subscriber Telephone and VHF radiotelephone | Own VHF Radio Network |

## Table 5.4.4 EQUIPMENT COSTS FOR THREE OPTIONS

| Item | Sub-system | Station | Nos. | Equipemnt | Unit Cost (Dhs) | Option A | | Option B | | Option C | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Q'ty | Amount (Dhs) | Q'ty | Amount (Dhs) | Q'ty | Amount (Dhs) |
| 1 | Data Processing Sub-system | DRHT | 1 | Data Processing System | 3,286,300 | 0 | 0 | 1 | 3,286,300 | 1 | 3,286,300 |
| | | | 2 | Telemetry Supervisory and Control Equipment | 1,164,200 | 0 | 0 | 0 | 0 | 1 | 1,164,200 |
| | | Monitoring Stations | 3 | Client PC with MODEM | 34,500 | 0 | 0 | 8 | 276,000 | 8 | 276,000 |
| | | **Total for Item 1** | | | | | **0** | | **3,562,300** | | **4,726,500** |
| 2 | Data Collection Sub-system | Rain Gauging Station | 1 | Rainfall Guaging Equipment | 10,000 | 0 | 0 | 8 | 80,000 | 8 | 80,000 |
| | | | 2 | Remote Terminal Equipment | 188,000 | 0 | 0 | 8 | 1,504,000 | 8 | 1,504,000 |
| | | | 3 | Telemetry Radio Equipment | 190,000 | 0 | 0 | 0 | 0 | 8 | 1,520,000 |
| | | Rain & Water Level Gauging Station (Separate Type) | 4 | Rainfall Guaging & Water Level Equipment | 416,000 | 0 | 0 | 12 | 4,992,000 | 12 | 11,076,000 |
| | | | 5 | Remote Terminal Equipment | 188,000 | 0 | 0 | 12 | 2,256,000 | 12 | 2,256,000 |
| | | | 6 | Telemetry Radio Equipment | 190,000 | 0 | 0 | 0 | 0 | 12 | 2,280,000 |
| | | VHF Radio Repeater Station | 7 | VHF Radio relay equipment | 160,000 | 0 | 0 | 3 | 480,000 | 0 | 0 |
| | | Telemetry Repeater Station | 8 | Repeater Equipment | 687,000 | 0 | 0 | 0 | 0 | 5 | 3,435,000 |
| | | Exspansion of Existing Gauges and Radiotelephone | 9 | Storage Type Rain Gauge | 5,000 | 11 | 55,000 | 0 | 0 | 0 | 0 |
| | | | 10 | Radiotelephone | 30,000 | 12 | 360,000 | 12 | 360,000 | 0 | 0 |
| | | | 11 | Staff Gauge Type Water Level Gauge | 5,000 | 5 | 25,000 | 0 | 0 | 0 | 0 |
| | | **Total for Item 2** | | | | | **440,000** | | **9,672,000** | | **22,151,000** |
| 3 | Warning Dissemination Sub-system | Warning Supervisory & Control Station (Provincial Office) | 1 | Warning Supervisory &Control Equipment | 1,217,000 | 0 | 0 | 0 | 0 | 2 | 2,434,000 |
| | | Warning Supervisory & Control Station (Caidat) | 2 | Simple Warning Control Equipment | 600,000 | 0 | 0 | 8 | 4,800,000 | 0 | 0 |
| | | Remore Controled Warning Post | 3 | Warning Equipment | 280,000 | 0 | 0 | 17 | 4,760,000 | 17 | 4,760,000 |
| | | | 4 | Radio and antenna equipment | 350,000 | 0 | 0 | 17 | 5,950,000 | 17 | 5,950,000 |
| | | Manual Warning Post | 5 | Warning Equipment | 140,000 | 17 | 2,380,000 | 0 | 0 | 0 | 0 |
| | | | 6 | Warning VHF Radio Equipment | 110,000 | 17 | 1,870,000 | 0 | 0 | 0 | 0 |
| | | Warning Repeater Station | 7 | Repeater Equipment | 687,000 | 0 | 0 | 3 | 2,061,000 | 3 | 2,061,000 |
| | | VHF Radio Relay Station | 8 | Radio and antenna equipment | 238,000 | 0 | 0 | 2 | 476,000 | 2 | 476,000 |
| | | VHF Radio equipment | 9 | Radio and antenna equipment | 55,000 | 0 | 0 | 17 | 935,000 | 17 | 935,000 |
| | | **Total for Item 3** | | | | | **4,250,000** | | **18,047,000** | | **15,681,000** |
| 4 | All Sub-system | Test Instruments | 1 | Telemetry and Warning system | 400,000 | 0 | 0 | 0 | 0 | 1 | 400,000 |
| | | | 2 | Data Processing System | 100,000 | 0 | 0 | 1 | 100,000 | 1 | 100,000 |
| | | | | **Sub-total** | | | **0** | | **100,000** | | **500,000** |
| | | Spare Parts | 3 | Telemetry system | L.S. | 0 | 0 | 0 | 0 | 1 | 1,000,000 |
| | | | 4 | Warning system | L.S. | 1 | 290,000 | 1 | 1,420,000 | 1 | 1,500,000 |
| | | | 5 | Data Processing system | L.S. | 0 | 0 | 1 | 50,000 | 1 | 50,000 |
| | | | 6 | Radio equipment | L.S. | 1 | 283,200 | 1 | 283,200 | 1 | 283,200 |
| | | | | **Sub-total** | | | **573,200** | | **1,753,200** | | **2,833,200** |
| | | Installation Materials | 7 | For Data Processing Sub-system | L.S. | 0 | 0 | 1 | 115,000 | 1 | 115,000 |
| | | | 8 | For Data Collection Sub-system | L.S. | 1 | 200,000 | 1 | 800,000 | 1 | 1,420,000 |
| | | | 9 | For Warning Dissemination Sub-system | L.S. | 1 | 200,000 | 1 | 285,000 | 1 | 320,000 |
| | | | | **Sub-total** | | | **400,000** | | **1,200,000** | | **1,855,000** |
| | | **Total for Item 4** | | | | | **973,200** | | **3,053,200** | | **5,188,200** |
| | | **TOTAL FOR EQUIPMENT AND MATERIALS** | | | | | **5,663,200** | | **34,334,500** | | **47,746,700** |

**Table 5.4.5 ESTIMATION OF NECESSARY TIME FOR FFWS OPERATION**

| Subsystem | | Alternative-1 | Alternative-2 | Alternative-3 |
|---|---|---|---|---|
| Hydrological Observation and Data Collection | Hydrological Observation | 5 to 30 min. | 0 | 0 |
| | Data Collection | 10 min. | 5 min. | 0 |
| Data Analysis, Forecasting and Data Distribution | Data Analysis | 25 min. | 15 min. | 5 min. |
| | Forecasting | 10 min. | | |
| | Distribution of Flood Notice | 10 min. | 5 min. | 5 min. |
| Issuance of Warning | | 5 mim. | 5 mim. | 5 mim. |
| Warning Dissemination | | 15 min. to 5 hrs. | 10 min. | 5 mim. |
| Evacuation | | 10 min. | 10 min. | 10 min. |
| Total Necessary Time | | 90 min. to 6 hrs. | 50 min. | 30 min. |

**Table 5.7.1 IMPLEMENTATION SCHEDULE OF ATLAS REGION FFWS PLAN**

| | Major Work Item | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
|---|---|---|---|---|---|---|---|---|
| Remaining Parts after Completion of Pilot Project | Administrative Arrangement for Tendering of F/S and D/D | | | | | | | |
| | Feasibility Study | | | | | | | |
| | Administrative Arrangement for Acquisition of Radio Frequencies | | | | | | | |
| | Detailed Design | | | | | | | |
| | Financial Arrangement | | | | | | | |
| | Administrative Arrangement for Tendering for Procurement of Equipment | | | | | | | |
| | Manufacturing and Shipment of Equipment | | | | | | | |
| | Civil Construction Work | | | | | | | |
| | Installation of Equipment | | | | | | | |
| | Training and Experimental Operation | | | | | | | |

## Table 5.8.1 ECONOMIC COST SUMMARY (DRAFT MASTER PLAN)

(Dh '000 for costs)

| Item | Financial Cost | Conversion Factor Applied | Economic Cost |
|---|---|---|---|
| A. Construction Cost | 52,492 | — | 33,582 |
| (1) Equipment | 41,905 | 0.63 | 3,260 |
| (2) Installation & Commissioning of Equipment | 5,175 | 0.83 | 2,816 |
| (3) Facility Construction | 3,657 | 0.77 | 2,816 |
| (4) Software Development | 878 | 0.83 | 553 |
| (5) Technical Training | 878 | 0.83 | 553 |
| B. Engineering Service | 13,165 | 0.83 | 10,927 |
| C. Total Construction Cost (A+B) | 65,657 | — | 44,509 |
| D. Physical Contingency (10% of C) | 6,566 | — | 4,451 |
| E. Total Construction Cost (C+D) | 72,223 | — | 48,960 |
| F. Land Acquisition Cost | — | — | — |
| G. Compensation Cost | — | — | — |
| H. Project Cost | **72,223** | — | **48,960** |

Note: Cost of the Pilot Project is excluded.

Source: JICA Study Team

## Table 5.8.2 SUMMARY OF REPORTED DAMAGE

| | 1995 Flood | 1999 Flood | Sources |
|---|---|---|---|
| Agriculture (lost land) | Fruit tree: 13 ha<br>Cereal: 197 ha | Fruit tree: 65 ha<br>Cereal: 60.5 ha | Regional Police Office and Ministry of Agriculture |
| Livestock (lost) | Cattle: 1,725<br>Goat: 1,447 | Sheep: 10<br>Goat: 12 | Ministry of Agriculture |
| Automobiles | 83 | Not reported | Regional Police Office |
| Houses | 194 | 15 (4 vacant) | Regional Police Office, public awareness survey |
| Fatalities | 289 | Not reported | Public awareness survey |
| Roads | Reported | Dh 600,000 | Ministry of Equipment |
| Damage to other public facility | Irrigation channel: 35 km<br>Reservoir: 20<br>Intake: 19, etc | Irrigation channel: 65 place<br>Reservoir: 8, etc | Ministry of Equipment |
| Return period | 30 years | 20 years | JICA Study Team |

Note: 1) Fruit trees are counted as olive trees;
2) Cereals and other crops are counted as hard wheat;
3) Large animals are counted as cattle;
4) Buildings are counted as houses.

## Table 5.8.3 ESTIMATED LOSSES ON ASSETS

(Dh million)

| | 1995 Flood | 1999 Flood |
|---|---|---|
| Agriculture | 2.26 | 1.78 |
| Livestock | 12.57 | 0.01 |
| Automobiles | 6.23 | 0.00 |
| Houses | 11.64 | 0.90 |
| Household effects | 1.16 | 0.07 |
| Roads | Details unknown | 0.60 |
| Damage to other public facility | Details unknown | Details unknown |
| Total damage Value | 70.00* | 3.36 |
| Damage on movable assets | **19.96** | **0.08** |

Note: 1) Economic value of olive trees: 17,850 Dh/ha; as it takes 7 years to grow olive trees to get harvest, net present value of future losses for seven years are included;
2) Hard wheat: 10,314 Dh/ha;
3) Please refer to **2.3 Benefit Side** for economic values of other items.
* Reported by DGH

## Table 5.8.4 ANNUAL AVERAGE DAMAGE

| Return period (year) | Damage (Dh million) | Average (Dh million) | Probability of occurrence | Probability in interval | Annual average (Dh million) |
|---|---|---|---|---|---|
| 1.1 | 0.00 | | 0.99 | | |
| | | 0.27 | | 0.49 | 0.13 |
| 2 | 0.53 | | 0.5 | | |
| | | 0.69 | | 0.3 | 0.21 |
| 5 | 0.84 | | 0.2 | | |
| | | 1.28 | | 0.1 | 0.13 |
| 10 | 1.72 | | 0.1 | | |
| | | 2.15 | | 0.05 | 0.11 |
| 20 | 2.57 | | 0.05 | | |
| | | 2.99 | | 0.017 | 0.05 |
| 30 | 3.41 | | 0.033 | | |
| | | 3.80 | | 0.013 | 0.05 |
| 50 | 4.19 | | 0.02 | | |
| | | 4.71 | | 0.01 | 0.05 |
| 100 | 5.24 | | 0.01 | | |
| | | | Total | 0.98 | **0.72** |

## Table 5.8.5 CASH FLOW (DRAFT MASTER PLAN)

(Dh million)

| Year | Benefit | Cost | | | | Net Benefit | Description |
|---|---|---|---|---|---|---|---|
| | | Initial | O&M | Replace | Total | | |
| 2005 | | 6.01 | | | 6.01 | -6.01 | Engineering service |
| 2006 | | 6.01 | | | 6.01 | -6.01 | Engineering service |
| 2007 | | 29.04 | | | 29.04 | -29.04 | Procurement of equipment |
| 2008 | | 7.29 | | | 7.29 | -7.29 | Installation of equipment |
| 2009 | 0.55 | 0.61 | 1.45 | | 2.06 | -1.51 | Training |
| 2010 | 0.55 | | 1.45 | | 1.45 | -0.90 | |
| 2011 | 0.55 | | 1.45 | | 1.45 | -0.90 | |
| 2012 | 0.55 | | 1.45 | | 1.45 | -0.90 | |
| 2013 | 0.55 | | 1.45 | | 1.45 | -0.90 | |
| 2014 | 0.55 | | 1.45 | | 1.45 | -0.90 | |
| 2015 | 0.55 | | 1.45 | | 1.45 | -0.90 | |
| 2016 | 0.55 | | 1.45 | | 1.45 | -0.90 | |
| 2017 | 0.55 | | 1.45 | | 1.45 | -0.90 | |
| 2018 | 0.55 | | 1.45 | 29.04 | 30.49 | -29.94 | |
| 2019 | 0.55 | | 1.45 | | 1.45 | -0.90 | |
| 2020 | 0.55 | | 1.45 | | 1.45 | -0.90 | |
| 2021 | 0.55 | | 1.45 | | 1.45 | -0.90 | |
| 2022 | 0.55 | | 1.45 | | 1.45 | -0.90 | |
| 2023 | 0.55 | | 1.45 | | 1.45 | -0.90 | |
| 2024 | 0.55 | | 1.45 | | 1.45 | -0.90 | |
| 2025 | 0.55 | | 1.45 | | 1.45 | -0.90 | |
| 2026 | 0.55 | | 1.45 | | 1.45 | -0.90 | |
| 2027 | 0.55 | | 1.45 | | 1.45 | -0.90 | |
| 2028 | 0.55 | | 1.45 | 29.04 | 30.49 | -29.94 | |
| 2029 | 0.55 | | 1.45 | | 1.45 | -0.90 | |
| 2030 | 0.55 | | 1.45 | | 1.45 | -0.90 | |
| 2031 | 0.55 | | 1.45 | | 1.45 | -0.90 | |
| 2032 | 0.55 | | 1.45 | | 1.45 | -0.90 | |
| 2033 | 0.55 | | 1.45 | | 1.45 | -0.90 | |
| 2034 | 0.55 | | 1.45 | -11.62 | -10.16 | 10.72 | |

**Table 5.8.6 ANNUAL AVERAGE DAMAGE (INCLUDING HUMAN LIVES)**

| Return period (year) | Damage (Dh million) | Average (Dh million) | Probability of occurrence | Probability in interval | Annual average (Dh million) |
|---|---|---|---|---|---|
| 1.1 | 0.00 | | 0.99 | | |
| | | 5.44 | | 0.49 | 2.67 |
| 2 | 10.89 | | 0.5 | | |
| | | 13.96 | | 0.30 | 4.19 |
| 5 | 17.04 | | 0.2 | | |
| | | 26.05 | | 0.10 | 2.61 |
| 10 | 35.06 | | 0.1 | | |
| | | 43.67 | | 0.05 | 2.18 |
| 20 | 52.28 | | 0.05 | | |
| | | 60.88 | | 0.017 | 1.03 |
| 30 | 69.48 | | 0.033 | | |
| | | 77.39 | | 0.013 | 1.01 |
| 50 | 85.31 | | 0.02 | | |
| | | 95.97 | | 0.01 | 0.96 |
| 100 | 106.63 | | 0.01 | | |
| | | | Total | 0.98 | **14.65** |

**Table 5.8.7 CASH FLOW**
**(INCLUDING VALUE OF HUMAN LIVES DRAFT MASTER PLAN)**

(Dh million)

| Year | Benefit | Cost | | | | Net Benefit | Description |
|---|---|---|---|---|---|---|---|
| | | Initial | O&M | Replace | Total | | |
| 2005 | | 6.01 | | | 6.01 | -6.01 | Engineering service |
| 2006 | | 6.01 | | | 6.01 | -6.01 | Engineering service |
| 2007 | | 29.04 | | | 29.04 | -29.04 | Procurement of equipment |
| 2008 | | 7.29 | | | 7.29 | -7.29 | Installation of equipment |
| 2009 | 11.27 | 0.61 | 1.45 | | 2.06 | 9.21 | Training |
| 2010 | 11.27 | | 1.45 | | 1.45 | 9.82 | |
| 2011 | 11.27 | | 1.45 | | 1.45 | 9.82 | |
| 2012 | 11.27 | | 1.45 | | 1.45 | 9.82 | |
| 2013 | 11.27 | | 1.45 | | 1.45 | 9.82 | |
| 2014 | 11.27 | | 1.45 | | 1.45 | 9.82 | |
| 2015 | 11.27 | | 1.45 | | 1.45 | 9.82 | |
| 2016 | 11.27 | | 1.45 | | 1.45 | 9.82 | |
| 2017 | 11.27 | | 1.45 | | 1.45 | 9.82 | |
| 2018 | 11.27 | | 1.45 | 29.04 | 30.49 | -19.22 | |
| 2019 | 11.27 | | 1.45 | | 1.45 | 9.82 | |
| 2020 | 11.27 | | 1.45 | | 1.45 | 9.82 | |
| 2021 | 11.27 | | 1.45 | | 1.45 | 9.82 | |
| 2022 | 11.27 | | 1.45 | | 1.45 | 9.82 | |
| 2023 | 11.27 | | 1.45 | | 1.45 | 9.82 | |
| 2024 | 11.27 | | 1.45 | | 1.45 | 9.82 | |
| 2025 | 11.27 | | 1.45 | | 1.45 | 9.82 | |
| 2026 | 11.27 | | 1.45 | | 1.45 | 9.82 | |
| 2027 | 11.27 | | 1.45 | | 1.45 | 9.82 | |
| 2028 | 11.27 | | 1.45 | 29.04 | 30.49 | -19.22 | |
| 2029 | 11.27 | | 1.45 | | 1.45 | 9.82 | |
| 2030 | 11.27 | | 1.45 | | 1.45 | 9.82 | |
| 2031 | 11.27 | | 1.45 | | 1.45 | 9.82 | |
| 2032 | 11.27 | | 1.45 | | 1.45 | 9.82 | |
| 2033 | 11.27 | | 1.45 | | 1.45 | 9.82 | |
| 2034 | 11.27 | | 1.45 | -11.62 | -10.16 | 21.43 | |

### Table 5.8.8 HYDROLOGY-RELATED BUDGET OF DGH IN 2000/01 OF DGH

(Dh)

| Budgetary Item | Total | Allocation to DRHT |
|---|---|---|
| Maintenance of hydrological stations (Buildings and equipment are included; electronic devices such as radios and personnel costs are excluded.) | 2,200,000 | 300,000 |
| Purchase of hydrological gauges | 2,500,000 | Not decided* |
| Purchase of miscellaneous goods (working wears/boots, etc) | 1,000,000 | 140,000 |
| Maintenance of electronic devises | 500,000 | Not decided* |
| Using radio frequencies payable to National Office for Posts & Telecommunications | 1,000,000 | Not decided* |

Note: * DGH decides based on requests from DRHs.

Source: DGH.

### Table 5.8.9 HYDROLOGY-RELATED BUDGET OF DRHT

(Dh)

| | 1995/96 | 1996/97 | 1997/98 | 1998/99 | 1999/00 |
|---|---|---|---|---|---|
| Maintenance of hydrologic stations | 150,000 | 190,000 | 330,000 | 285,000 | 299,070 |
| Construction of hydrologic stations (land acquisition cost is excluded) | 140,600 | 500,000 | 270,000 | - | 300,000 |
| Purchase of miscellaneous goods | 20,000 | 50,000 | 100,000 | 120,000 | 138,890 |
| Total | 310,600 | 740,000 | 700,000 | 405,000 | 737,960 |

Note: Hydrologic fiscal year: September - August

Source: DRHT.

### Table 5.8.10 O&M RESPONSIBILITY AND COST BURDEN ON LOCAL AUTHORITIES

(Dh'000)

| | O&M responsibility | Equipment cost | O&M cost |
|---|---|---|---|
| DRHT | - The data processing sub-system except 5 monitoring stations<br>- The data collection sub-system | 30,039 | 1,502 |
| Al Haouz Province | - A part of the data processing sub-system (5 monitoring stations)<br>- Warning dissemination sub-system except 3 warning posts | 14,447 | 722 |
| SYBA Prefecture | - A part of the warning dissemination sub-system (3 warning posts) | 3,262 | 163 |

## Table 5.8.11 SCREENING OF MASTER PLAN PROJECTS

| No. | Environmental item | Description | Evaluation | Remark |
|---|---|---|---|---|
| Social Environment | | | | |
| 1. | Resettlement | Transfer of residence/land ownership | Yes | Stations may be built where agricultural activity exists along the river |
| 2. | Economic activities | Loss of bases of economic activities and change in economic structure | Yes | Agriculture and tourism activities in the Study area may be affected |
| 3. | Traffic and public facilities | Impacts on schools, hospitals and present traffic conditions, such as the increase of traffic congestion | No | New stations are not expected to attract additional traffic |
| 4. | Split of communities | Community split due to the interruption of area traffic | No | New stations are not of the scale to hinder movement between communities or within the one community |
| 5. | Cultural property | Damage to loss of value of religious endowments, archeological remains or other cultural assets | No | Cultural assets in the study area are few in number and far from the new station sites |
| 6. | Water rights and rights of common | Obstruction of fishing rights, water rights, rights of common | No | Water rights are granted by the government based on the public benefit principle |
| 7. | Public health condition | Deterioration of public health and sanitary conditions due to generation of waste and the increase of vermin | Yes | There is a fear of the effect the electromagnetic field produced by the data transmission may have on the public health |
| 8. | Waste | Generation of construction waste, debris and ash | Yes | Generation of construction waste and daily wastes |
| 9. | Hazards (Risk) | Increase in danger of landslides, cave-ins, etc. | Yes | Frequent mountainside land slides and land collapse |
| Natural Environment | | | | |
| 10. | Topography and Geology | Changes of valuable topography and geology due to excavation of filling work | No | No large scale earthworks required |
| 11. | Soil erosion | Topsoil erosion by rainfall after reclamation and deforestation | Yes | Fear of tree clearing when constructing new stations |
| 12. | Groundwater | Pollution of groundwater | Yes | Small amount of wastewater will be generated at the stations |
| 13. | Hydrological situation | Changes of river discharge and riverbed condition due to landfill and drainage inflow | No | No large scale landfill expected |
| 14. | Coastal zone | Coastal erosion by rainfall after reclamation and deforestation | No | The projects sites are far from the coastal zone |
| 15. | Fauna and Flora | Obstruction of breeding, extinction of habitat conditions and encroachment into protected areas | Yes | Study area contains a protected zone (Toubkal National Park) |
| 16. | Meteorology | Changes of temperature, precipitation, wind, etc. due to large-scale land reclamation and building construction | No | Large-scale land reclamation and construction not included in the project |
| 17. | Landscape | Change of topography and vegetation due to reclamation, deterioration of aesthetic harmony by structures | Yes | The beautiful landscape of the Atlas area is sensitive to any new construction sites |
| Pollution | | | | |
| 18. | Air Pollution | Pollution caused by exhaust gas or toxic gas from vehicles and factories | No | |
| 19. | Water Pollution | Pollution caused by inflow of silt, sand and drainage into rivers and groundwater | Yes | Small amount of municipal wastewater will be generated at the stations |
| 20. | Soil Contamination | Contamination of soil by leakage and diffusion | No | Nature and operation of the new stations are not expected to induce soil contamination |
| 21. | Noise and Vibration | Noise and vibration generated from project | No | No noise and vibration are anticipated other than the siren noise in case of flood warning (which under the circumstances would be welcome news) |
| 22. | Land Subsidence | Deformation of land and land subsidence due to lowering of groundwater table | No | No disturbance to the groundwater is anticipated from the project |
| 23. | Offensive Odor | Generation of exhaust gas and offensive odor from project facilities | No | No generation of offensive odor is anticipated from the project |
| Format: JICA Environmental Guidelines | | | | |

## Table 5.8.12 CHECKLIST FOR SCOOPING

| No. | Environmental Item | Evaluation | Reason |
|---|---|---|---|
| Social Environment | | | |
| 1. | Resettlement | C | Existing agriculture activity on the riverbed or within the section marked for public domain is not legal and when the land use plans are formulated for each river basin (as stipulated in Law 10/1995) resettlement will be necessary regardless of the master plan. |
| 2. | Economic activities | D | Same as above for agricultural activities. Concerning tourism, the benefit in warning the tourists in order to save their lives far outweighs any loss in tourism because of fear of floods. The experience of the 1995 and 1999 floods when most of the victims were tourists is proof that tourists need to be forewarned. |
| 3. | Traffic and public facilities | D | No effect is expected on traffic and public facilities. Warning posts may be installed in public facilities under the project but these will aid in evacuating such places immediately in case of flooding. |
| 4. | Split of communities | D | No effect is expected from the master plan |
| 5. | Cultural property | D | The Toubkal National Park is a protected area and any master plan facilities constructed there must be designed bearing this in mind. The agreement of the ministry of culture before construction of the stations in the study area is also legally required (see appendix). However the ministry's regional office in Marrakech expressed no major concerns related to this areas. |
| 6. | Water rights and rights of common | D | No effect is expected from the master plan |
| 7. | Public health condition | C | There are still many varying opinions on the effects EMF has on the human health but all research so far has found no hard evidence either to eliminate this threat or publicize it. Further examination while recommended is not expected to produce any judgment. Therefore the project should go ahead because of its importance in saving lives. |
| 8. | Waste | C | Provision for removal of construction wastes from difficult access areas must be made. Also removal and burial of the waste generated from the stations occupants must be considered. |
| 9. | Hazards (Risk) | C | Consideration for the safety of people working at stations from landslides and land collapse must be made. Site selection is very important. |
| Natural Environment | | | |
| 10. | Topography and Geology | D | No effect is expected from the master plan |
| 11. | Soil erosion | D | No effect is expected from the master plan. There are no plans to cut trees for implementing master plan projects. The water and forests department must approve the projects before hand and they are very strict in the matter of tree cutting. |
| 12. | Groundwater | C | It is preferable to provide a septic tank at the stations for treatment of wastewater and prevention of pollution of rivers or groundwater. |
| 13. | Hydrological situation | D | No effect is expected from the master plan. There are no plans to construct any facility within the river. |
| 14. | Coastal zone | D | No effect is expected from the master plan |
| 15. | Fauna and Flora | C | Again the permission of the related authorities must be obtained before any construction in preserved area is approved. However no trees shall be cut and the scale of the master plan projects as not that which may pose a threat to the living species in the study area. |
| 16. | Meteorology | D | No effect is expected from the master plan |
| 17. | Landscape | C | The stations will stand out in the existing landscape and this cannot be avoided. However the master plan policy is to construct the stations close to existing villages and therefore the effect will be somewhat diminished. |
| Pollution | | | |
| 18. | Air Pollution | D | No effect is expected from the master plan. |
| 19. | Water Pollution | C | It is better to provide a septic tank at the stations for wastewater and system for collection of waste. Discharge of any wastes in the river will lead to surface water pollution. |
| 20. | Soil Contamination | D | No effect is expected from the master plan. |
| 21. | Noise and Vibration | D | No effect is expected from the master plan. |
| 22. | Land Subsidence | D | No effect is expected from the master plan. |
| 23. | Offensive Odor | D | No effect is expected from the master plan. |

Note: JICA Environmental Guidelines
Evaluation criteria:
"A": Serious impact is expected
"B": Some impact is expected
"C": Extent of impact is unknown. Further examination is recommended
"D": No impact is expected

**Table 5.8.13 POTENTIAL ENVIRONMENTAL IMPACTS**

| No. | Environmental item | Potential impact |
|---|---|---|
| **Social Environment** | | |
| 1. | Resettlement | New stations need to be constructed in close proximity to the river, and in some places agriculture activity may be affected and people working/living there may need to resettle. However based on the water law no. 10/1995 these people have only provisional right to occupy such lands, which are located within the land reserved for hydraulic public domain. This law should serve as a very useful tool to regulate land use in the flood plain. |
| 2. | Economic activities | Main activities in Study area include agriculture and tourism. Agriculture may be affected as described above. Emphasizing flood-warning systems through installation of sirens, warning signboards and evacuation drills may scare away tourists in areas as Setti Fatma, Iraghf, and Imlil and have a negative impact on the local economy. |
| 3. | Waste | Some stations may be constructed in areas with difficult access, such as Iguer, Tizgui abd El Azib-n-Tinzar. It is necessary to provide for removal of construction wastes after construction as well as waste generated from the stations use. The M/P requires that stations be constructed near to villages and therefore the waste may be transported to the villages. |
| 4. | Hazards (risk) | In many places in the Study area mountains surrounding the river path have steep slopes and potential for land collapse and landslide from the mountainside is observed. Station sites should be selected in safe areas in order to decrease the risk to the operators and equipment in these stations. Site selection and engineering designs should also consider this problem carefully. |
| **Natural Environment** | | |
| 5. | Groundwater | Stations should be installed with septic tanks and waste management system should be in place to minimize effect on groundwater. However this should be studied in the design phase taking into consideration situation in the surrounding villages. |
| 6. | Fauna and Flora | So far no endangered species have been identified in the Study area. However cutting of trees for installation of siren posts or antennas should be avoided because of the scarcity of trees in the Study area. The competent authorities must issue permits for building and they are in the best position to protect against endangering living environment and also protected areas. |
| 7. | Landscape | Many of the existing stations do not blend well with the surrounding landscape. In tourism areas more care may be taken in the selection of construction materials and finishing works to improve that condition. |
| **Pollution** | | |
| 8. | Water pollution | Stations should be installed with septic tanks and waste management system should be in place to minimize effect on both surface and groundwater. These measures shall be considered during the design stage. |

**Table 6.1.1 GAP BETWEEN CONDITIONS BEFORE PILOT PROJECT AND MASTER PLAN**

| System | | | Development Level to be Achieved | | | | |
|---|---|---|---|---|---|---|---|
| Sub-system | Component | Item | No Provision | Primitive Level | Between Primitive Level and Master Plan Level | | Master Plan Level |
| Meteo-hydrological Observation and Data Collection | Meteo-hydrological Observation | Density of Observation Stations | | | | 6 Stations | 11 Stations |
| | | Observation Measurement | | | Manual | | Automatic |
| | Data Collection | Data Transmission | | | | Voice Comunication via Radiotelephone | Automatic |
| Data Analyses, Forecasting, Anoucement of Flood Notices and Distribution of Flood Information/Notices | Data Processing and Analysis | | | | | | Computerized with online Data |
| | Flood Forecasting | | | | | | Development and Updating of Simulation Program |
| | Distribution of Flood Notices and Information | | | | Telephone/Fax | | Telephone/Fax and Computer Network (Internet) |
| Issuance of Flood Warning | Arangement of Guideline | | | | | | Preparation and Updating of Guideline |
| Dissemination of Flood Warning | Dissemination Measures | | | | Telephone, Fax, Verbal Dissemination | | Remote Control of 6 Warning Posts from Province |
| Execution of Evacuation | Arangement of Guideline | | | | | | Preparation and Updating of Guideline |

Legend: ➡ : Development Level Achieved before Pilot Project

**Table 6.1.2 SUBSYSTEMS OF FOUR ALTERNATIVES**

| Sub-System | Component | Item | Existing Condition (Before Pilot Project) | Alternative | | | |
|---|---|---|---|---|---|---|---|
| | | | | 1-1 | 1-2 | 1-3 | 2 |
| Hydrological Observation and Data Collection | Hydrological Observation | Density of Observation Station | 6 stations | 6 | 6 (5) | 6 (5) | 11 (11) |
| | | Observation Measurement | Manual | Manual | Automatic | Automatic | Automatic |
| | Data Collection | Data Transmission- | Voice Communication via Radiotelephone | Voice Communication via Radiotelephone | Voice Communication via Radiotelephone | Automatic Data Transmission | Automatic Data Transmission |
| Data Analysis, Forecasting, Annoncement and Distribution of Flood Notice and Information | Digital Data Analysis | | None | Computerized with manual key-in | Computerized with manual key-in | Computerized with on-line data | Computerized with on-line data |
| | Flood Forecasting | | None | Development of Simulation Program | Development of Simulation Program | Development of Simulation Program | Development/Updating of Simulation Program |
| | Distribution of Information | | Fax and Telephone | Fax and Telephone | Fax and Telephone, Computer Network (Dial-up) | Fax and Telephone, Computer Network (Dial-up) | Fax and Telephone, Computer Network (Internet) |
| Issuance of Warning | Arrangement of Guideline for Issuance of Warning | | None | Preparation of Guideline | Preparation of Guideline | Preparation of Guideline | Preparation and updating of Guideline |
| Dissemination of Warning | Dissemination Measures | | Telephone/Fax, Verbal dissemination | Telephone/Fax, Verbal dissemination | Establishment of a Warning Post with Radiotelephone | Establishment of a Warning Post with Radiotelephone | Remote Control of 6 Warning Post from Province/Prefecture |
| Execution of Evacuation | Arrangement of Guideline | | None | Preparation of Guideline | Preparation of Guideline | Preparation of Guideline | Preparation and updating of Guideline |

Number in parentheses is number of stations automated in the alternative.

**Table 6.1.3 DEVELOPMENT LEVEL OF ALTERNATIVE 1-1**

| System | | | Development Level to be Achieved | | | | |
|---|---|---|---|---|---|---|---|
| Sub-system | Component | Item | No Provision | Primitive Level | Between Primitive Level and Master Plan Level | | Master Plan Level |
| Meteo-hydrological Observation and Data Collection | Meteo-hydrological Observation | Density of Observation Stations | | | | 6 Stations | 11 Stations |
| | | Observation Measurement | | | Manual | | Automatic |
| | Data Collection | Data Transmission | | | | Voice Comunication via Radiotelephone | Automatic |
| Data Analyses, Forecasting, Anoucement of Flood Notices and Distribution of Flood Information/Notices | Data Processing and Analysis | | | | | Computerized with Manual Key-in | Computerized with online Data |
| | Flood Forecasting | | | | | Development of Siulation Model | Development and Updating of Simulation Program |
| | Distribution of Flood Notices and Information | | | | | Telephone/Fax and Computer Network (Dial-up) | Telephone/Fax and Computer Network (Internet) |
| Issuance of Flood Warning | Arangement of Guideline | | | | | Preparation of Guideline | Preparation and Updating of Guideline |
| Dissemination of Flood Warning | Dissemination Measures | | | | Telephone, Fax, Verbal Dissemination | | Remote Control of 6 Warning Posts from Province |
| Execution of Evacuation | Arangement of Guideline | | | | | Preparation of Guideline | Preparation and Updating of Guideline |

Legend: ➡ : Development Level Achieved before Pilot Project  •••▶ : Additional Development Level Achieved in Alternative 1-1

**Table 6.1.4 DEVELOPMENT LEVEL OF ALTERNATIVE 1-2**

| System | | | Development Level to be Achieved | | | | |
|---|---|---|---|---|---|---|---|
| Sub-system | Component | Item | No Provision | Primitive Level | Between Primitive Level and Master Plan Level | | Master Plan Level |
| Meteo-hydrological Observation and Data Collection | Meteo-hydrological Observation | Density of Observation Stations | | | | 6 Stations | 11 Stations |
| | | Observation Measurement | | | | | Automatic |
| | Data Collection | Data Transmission | | | | Voice Comunication via Radiotelephone | Automatic |
| Data Analyses, Forecasting, Anoucement of Flood Notices and Distribution of Flood Information/Notices | Data Processing and Analysis | | | | | Computerized with Manual Key-in | Computerized with online Data |
| | Flood Forecasting | | | | | Development of Siulation Model | Development and Updating of Simulation Program |
| | Distribution of Flood Notices and Information | | | | | Telephone/Fax and Computer Network (Dial-up) | Telephone/Fax and Computer Network (Internet) |
| Issuance of Flood Warning | Arangement of Guideline | | | | | Preparation of Guideline | Preparation and Updating of Guideline |
| Dissemination of Flood Warning | Dissemination Measures | | | | | Establishment of a Warning Post with radiotelephone | Remote Control of 6 Warning Posts from Province |
| Execution of Evacuation | Arangement of Guideline | | | | | Preparation of Guideline | Preparation and Updating of Guideline |

Legend: ➡ : Development Level Achieved before Pilot Project ▪▪▪➡ : Additional Development Level Achieved in Alternative 1-2

**Table 6.1.5 DEVELOPMENT LEVEL OF ALTERNATIVE 1-3**

| System | | | Development Level to be Achieved | | | | | |
|---|---|---|---|---|---|---|---|---|
| Sub-system | Component | Item | No Provision | Primitive Level | Between Primitive Level and Master Plan Level | | Master Plan Level | |
| Meteo-hydrological Observation and Data Collection | Meteo-hydrological Observation | Density of Observation Stations | | | | 6 Stations | | 11 Stations |
| | | Observation Measurement | | | | | | Automatic |
| | Data Collection | Data Transmission | | | | | | Automatic |
| Data Analyses, Forecasting, Anoucement of Flood Notices and Distribution of Flood Information/Notices | Data Processing and Analysis | | | | | Computerized with Manual Key-in | | Computerized with online Data |
| | Flood Forecasting | | | | | Development of Siulation Program | | Development and Updating of Simulation Program |
| | Distribution of Flood Notices and Information | | | | | Telephone/Fax and Computer Network (Dial-up) | | Telephone/Fax and Computer Network (Internet) |
| Issuance of Flood Warning | Arangement of Guideline | | | | | Preparation of Guideline | | Preparation and Updating of Guideline |
| Dissemination of Flood Warning | Dissemination Measures | | | | | Establishment of a Warning Post with radiotelephone | | Remote Control of 6 Warning Posts from Province |
| Execution of Evacuation | Arangement of Guideline | | | | | Preparation of Guideline | | Preparation and Updating of Guideline |

Legend: : Development Level Achieved before Pilot Project : Additional Development Level Achieved in Alternative 1-3

**Table 6.1.6 DEVELOPMENT LEVEL OF ALTERNATIVE 2**

| System | | | Development Level to be Achieved | | | | |
|---|---|---|---|---|---|---|---|
| Sub-system | Component | Item | No Provision | Primitive Level | Between Primitive Level and Master Plan Level | Master Plan Level | |
| Meteo-hydrological Observation and Data Collection | Meteo-hydrological Observation | Density of Observation Stations | | | | | 11 Stations |
| | | Observation Measurement | | | | | Automatic |
| | Data Collection | Data Transmission | | | | | Automatic |
| Data Analyses, Forecasting, Anoucement of Flood Notices and Distribution of Flood Information/Notices | Data Processing and Analysis | | | | | | Computerized with online Data |
| | Flood Forecasting | | | | | | Development and Updating of Simulation Program |
| | Distribution of Flood Notices and Information | | | | | | Telephone/Fax and Computer Network (Internet) |
| Issuance of Flood Warning | Arangement of Guideline | | | | | | Preparation and Updating of Guideline |
| Dissemination of Flood Warning | Dissemination Measures | | | | | | Remote Control of 6 Warning Posts from Province |
| Execution of Evacuation | Arangement of Guideline | | | | | | Preparation and Updating of Guideline |

Legend: : Development Level Achieved before Pilot Project : Additional Development Level Achieved in Alternative 2

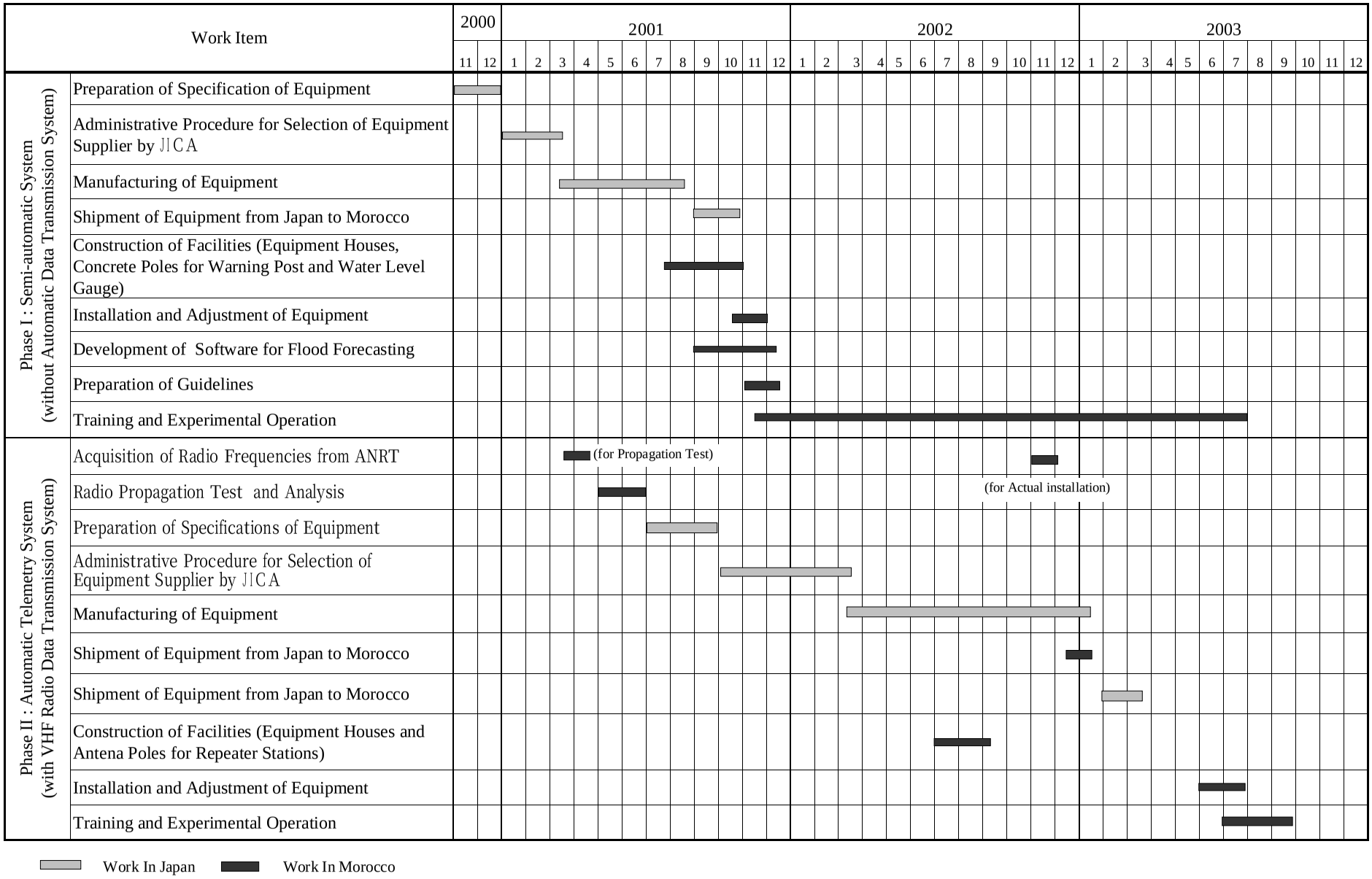
## Table 6.1.7 ESTIMATED IMPLEMENTATION SCHEDULE OF PILOT PROJECT

| Alternative | | Descriptions | Months (1–27) |
|---|---|---|---|
| Alternative 1-1 | 1 | Procurement Administration | |
| | 2 | Manufacturing of Data Procerssing System Equipment | |
| | 3 | Shipment of Equipment | |
| | 4 | Installation of Equipment | |
| | 5 | Development of Flood Forecasting Program | |
| | 6 | Preparation of Guidelines | |
| Alternative 1-2 | 1 | Procurement Administration | |
| | 2 | Manufacturing of Data Procerssing System Equipment | |
| | 3 | Manufacturing of Observation Equipment | |
| | 4 | Manufacturing of Warning System | |
| | 5 | Shipment of Equipment | |
| | 6 | Construction of Station Houses | |
| | 7 | Installation of Equipment | |
| | 8 | Development of Flood Forecasting Program | |
| | 9 | Preparation of Guidelines | |
| Alternative 1-3 | 1 | Procurement Administration | |
| | 2 | Manufacturing of Data Procerssing System | |
| | 3 | Manufacturing of Observation Equipment | |
| | 4 | Manufacturing of Warning System | |
| | 5 | Shipment of Equipment | |
| | 6 | Construction of Station Houses | |
| | 7 | Installation of Equipment | |
| | 8 | Development of Flood Forecasting Program | |
| | 9 | Preparation of Guidelines | |
| | 10 | Radio path Propagation test | |
| | 11 | Procurement Administration | |
| | 12 | Manufacturing of Automatic Data Transmission Systeml Equipment | |
| | 13 | Shipment of Automatic Data Transmission Systeml Equipment | |
| | 14 | Type Approval for Radio Unit | |
| | 15 | Construction of Repeater Station houses | |
| | 16 | Installation of Automatic Data Transmission Systeml Equipment | |
| Alternative 2 | 1 | Procurement Administration | |
| | 2 | Manufacturing of Data Procerssing System Equipment | |
| | 3 | Manufacturing of Observation Equipment | |
| | 4 | Manufacturing of Warning System Equipment | |
| | 5 | Shipment of Equipment | |
| | 6 | Construction of Station Houses | |
| | 7 | Installation of Equipment | |
| | 8 | Development of Flood Forecasting Program | |
| | 9 | Preparation of Guidelines | |
| | 10 | Radio path Propagation test | |
| | 11 | Procurement Administration | |
| | 12 | Manufacturing of Automatic Data Transmission Systeml Equipment | |
| | 13 | Shipment of Automatic Data Transmission Systeml Equipment | |
| | 14 | Type Approval for Radio Unit | |
| | 15 | Construction of Repeater Station houses | |
| | 16 | Installation of Automatic Data Transmission Systeml Equipment | |
| | 17 | Updating of Flood Forecasting Program | |
| | 18 | Updating of Guidelines | |

## Table 6.1.8 APPROXIMATE EQUIPMENT COSTS FOR FOUR ALTERNATIVES

| Item | Sub-system | Station | Nos. | Equipment | Unit Cost | Alternative 1-1 | | Alternative 1-2 | | Alternative 1-3 | | Alternative 2 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Firtst Priority | | Second Priority | | Second Priority with Radio Telemetry | | Second Priority with Radio Telemetry | |
| | | | | | | Q'ty | Amount | Q'ty | Amount | Q'ty | Amount | Q'ty | Amount |
| 1 | Data Processing Sub-system | FFWC, DRHT | 1 | Data Processing Server | 986,000 | 1 | 1 | 1 | 1 | 1 | 986,000 | 1 | 1 |
| | | | 2 | Client PC | 27,000 | 3 | 6 | 3 | 6 | 3 | 6 | 3 | 81,000 |
| | | | 3 | Network Equipment | 41,100 | 1 | 3 | 1 | 3 | 1 | 41,100 | 1 | 3 |
| | | | 4 | Telemetry Supervisory and Control Equipment | 1,164,200 | 0 | 0 | 0 | 0 | 1 | 1,164,200 | 1 | 0 |
| | | | 5 | Application Software | 1,818,000 | 1 | 5 | 1 | 5 | 1 | 1,818,000 | 1 | 5 |
| | | | 6 | Supply | 45,500 | 1 | 6 | 1 | 6 | 1 | 45,500 | 1 | 6 |
| | | | | **Sub-total** | | | **21** | | **21** | | **4,054,806** | | **81,015** |
| | | Monitoring Station | 7 | Client PC with MODEM | 33,600 | 4 | 28 | 4 | 28 | 4 | 134,400 | 4 | 112 |
| | | | | **Sub-total** | | | **28** | | **28** | | **134,400** | | **112** |
| 2 | Data Collection Sub-system | Rain Gauging Station | 1 | Remote Terminal Unit | 180,000 | 0 | 0 | 2 | 2 | 2 | 2 | 5 | 900,000 |
| | | | 2 | Tipping Bucket Rain Gauge | 10,000 | 0 | 0 | 2 | 4 | 2 | 4 | 5 | 50,000 |
| | | | 3 | GPS Receiver | 13,500 | 0 | 0 | 2 | 6 | 0 | 0 | 0 | 0 |
| | | | 4 | Thermal Printer | 13,500 | 0 | 0 | 2 | 8 | 0 | 0 | 0 | 0 |
| | | | 5 | Power Supply Equipment | 60,000 | 0 | 0 | 2 | 10 | 2 | 10 | 4 | 240,000 |
| | | | 6 | Telemetry Radio Equipment | 267,000 | 0 | 0 | 0 | 0 | 2 | 12 | 4 | 1,068,000 |
| | | | | **Sub-total** | | | **0** | | **30** | | **28** | | **2,258,000** |
| | | Rain & Water Level Gauging Station (Separate Type) | 7 | Ultrasonic Water Level Gauge | 280,000 | 0 | 0 | 2 | 14 | 2 | 14 | 6 | 1,680,000 |
| | | | 8 | Short Distance Transmitter & Receiver | 100,000 | 0 | 0 | 2 | 16 | 2 | 16 | 6 | 600,000 |
| | | | 9 | Power Supply Equipment | 170,000 | 0 | 0 | 2 | 18 | 2 | 18 | 6 | 1,020,000 |
| | | | 10 | Remote Terminal Unit | 180,000 | 0 | 0 | 2 | 20 | 2 | 20 | 6 | 1,080,000 |
| | | | 11 | Tipping Bucket Rain Gauge | 10,000 | 0 | 0 | 2 | 22 | 2 | 22 | 6 | 60,000 |
| | | | 12 | GPS Receiver | 13,500 | 0 | 0 | 2 | 24 | 2 | 24 | 6 | 81,000 |
| | | | 13 | Thermal Printer | 13,500 | 0 | 0 | 2 | 26 | 2 | 26 | 6 | 81,000 |
| | | | 14 | Power Supply Equipment | 60,000 | 0 | 0 | 2 | 28 | 2 | 28 | 6 | 360,000 |
| | | | 15 | Telemetry Radio Equipment | 267,000 | 0 | 0 | 0 | 0 | 2 | 30 | 6 | 1,602,000 |
| | | | | **Sub-total** | | | **0** | | **168** | | **198** | | **6,564,000** |
| | | Rain & Water Level Gauging Station (Non-Separate Type) | 16 | Ultrasonic Water Level Gauge | 280,000 | 0 | 0 | 1 | 16 | 1 | 16 | 1 | 280,000 |
| | | | 17 | Remote Terminal Unit | 180,000 | 0 | 0 | 1 | 17 | 1 | 17 | 1 | 180,000 |
| | | | 18 | Tipping Bucket Rain Gauge | 10,000 | 0 | 0 | 1 | 18 | 1 | 18 | 1 | 10,000 |
| | | | 19 | GPS Receiver | 13,500 | 0 | 0 | 1 | 19 | 1 | 19 | 1 | 13,500 |
| | | | 20 | Thermal Printer | 13,500 | 0 | 0 | 1 | 20 | 1 | 20 | 1 | 13,500 |
| | | | 21 | Power Supply Equipment | 128,000 | 0 | 0 | 1 | 21 | 1 | 21 | 1 | 128,000 |
| | | | 22 | Telemetry Radio Equipment | 267,000 | 0 | 0 | 0 | 0 | 1 | 22 | 1 | 267,000 |
| | | | | **Sub-total** | | | **0** | | **111** | | **133** | | **892,000** |
| | | Relay Station | 23 | Repeater Equipment | 340,000 | 0 | 0 | 0 | 0 | 1 | 23 | 1 | 340,000 |
| | | | 24 | Radio Equipment | 350,000 | 0 | 0 | 0 | 0 | 1 | 24 | 1 | 350,000 |
| | | | 25 | Power Supply Equipment | 200,000 | 0 | 0 | 0 | 0 | 1 | 25 | 1 | 200,000 |
| | | | | **Sub-total** | | | **0** | | **0** | | **72** | | **890,000** |
| | | Radiotelephone | 26 | HF/SSB Radiotelephone w/antenna | 283,200 | 0 | 0 | 3 | 78 | 3 | 78 | 6 | 1,699,200 |
| | | | | **Sub-total** | | | **0** | | **78** | | **78** | | **1,699,200** |
| 3 | Warning Dissemination Sub-system | Warning Supervisory & Control Station (Provincial Office) | 1 | Warning Supervisory & Control Equipment | 450,000 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 450,000 |
| | | | 2 | Control Console | 100,000 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 100,000 |
| | | | 3 | Radio Equipment | 267,000 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 267,000 |
| | | | 4 | Power Supply Equipment | 100,000 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 100,000 |
| | | | | **Sub-total** | | | **0** | | **0** | | **0** | | **917,000** |
| | | Simple Warning Control Station (Caidat) | 5 | Warning Control Equipment | 450,000 | 0 | 0 | 1 | 5 | 1 | 5 | 0 | 0 |
| | | | 6 | Power Supply Equipment | 100,000 | 0 | 0 | 1 | 6 | 1 | 6 | 0 | 0 |
| | | | | **Sub-total** | | | **0** | | **11** | | **11** | | **0** |
| | | Warning Post | 7 | Warning Equipment | 400,000 | 0 | 0 | 1 | 7 | 1 | 7 | 5 | 2,000,000 |
| | | | 8 | Radio Equipment | 276,000 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 |
| | | | 9 | Power Amplifier with Loud-Speaker | 23,000 | 0 | 0 | 1 | 9 | 1 | 23,000 | 5 | 0 |
| | | | 10 | Radio Equipment with Selcall | 267,000 | 0 | | 0 | 0 | 0 | 0 | 5 | 1,335,000 |
| | | | 11 | Power Supply Equipment | 70,000 | 0 | 0 | 1 | 11 | 1 | 70,000 | 5 | 0 |
| | | | | **Sub-total** | | | **0** | | **27** | | **93,007** | | **3,335,000** |
| | | Relay Station | 12 | Repeater Equipment | 60,000 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 120,000 |
| | | | 13 | Radio Equipment | 267,000 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 534,000 |
| | | | 14 | Power Supply Equipment | 200,000 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 400,000 |
| | | | | **Sub-total** | | | **0** | | **0** | | **0** | | **1,054,000** |
| 4 | All Sub-system | Station Housing | 1 | Water Level Station | 40,000 | 3 | 3 | 3 | 3 | 3 | 120,000 | 6 | 18 |
| | | | 2 | Observation Station | 160,000 | 3 | 6 | 2 | 4 | 2 | 320,000 | 6 | 36 |
| | | | 3 | Relay Station | 150,000 | 0 | 0 | 0 | 0 | 1 | 3 | 3 | 450,000 |
| | | | | **Sub-total** | | | **9** | | **7** | | **440,003** | | **450,054** |
| 5 | All Sub-system | Installation | 1 | **Sub-total installation + materials** | | **1** | **71,400** | **1** | **1,250,000** | **1** | **2,210,000** | **1** | **2,210,000** |
| | | | | **GRAND TOTAL** | | | **71,458** | | **1,250,481** | | **6,932,736** | | **20,350,381** |

## Table 6.2.1 IMPLEMENTATION SCHEDULE OF PILOT PROJECT



## Table 6.4.1 COMPARISON OF COMMUNICATION MEDIA FOR TELEMETRY SYSTEM

| System / Compliance | VHF Radio Link | HS/SSB | Telephone Line | INMARSAT-C | V-SAT | Mobile Telephone |
|---|---|---|---|---|---|---|
| | DGH's own radio network | DGH owned radio network | MAROC TELECOM | MAROC TELECOM | | MAROC TELECOM |
| Features | This is a standard medium to collect data from remote site. If maintenance work will be done satisfactory, this is most economical and reliable system. | HF/SSB is generally used for a long distance verbal communication. It can reach long distance but is more likely to be interferred. | The public dial telephone line will be used for the data transmission. However, the existing telephone network does not cover all of the Pilot Project area. . | This is the latest data collection system in the world. The system can establish a wide area telemetry with reasonable installation cost. Because of its packet communication method, however, the response of the system is comparatively as slow as 5 to 15 minutes. | This communication satellite has number of transponder for wide band, high speed transmission services. Usually, these transponders are leased for business network clients such as Radio and TV broadcasting and banking. | Diffusion of mobile telephone service is progressing rapidly recently, but the remote areas of the Pilot Project are still out of the services. Reliability of the mobile telephone network especially during disasters is unknown. |
| Construction cost | The total cost of this system is generally higher than the others. The equipment cost are almost as same as the others. However, many relay stations are required in the mountain area, resulting in an cost increase. | Total cost of this system is lower than the others because of no relay station. The equipment cost are almost as same as the others. | No construction cost is added within the service area. Outside of the service area, Telephone cable laying cost and tel-pole cost will be added on the construction cost. | The equipment cost is the lowest and an antenna tower is not necessary. Antenna will install at top of the roof. Therefore, this system is the most economical for construction. | There are two kinds of installation method available in Morocco. One is to rent equipment from the operator. In this case, equipment cost is not counted. In the other case DGH procure the equipment themselves, the total cost will be | The Cost of a hand held terminal unit is becoming lower. |
| Running Cost | There is no running cost needed except Frequency usage fee. | There is no running cost needed except Frequency usage fee. | Average leased line charge for one station will be 1,000 Dhs/month. The public dial telephone fee is small. | Communication charges are very high unless a special consideration like that for the Ouergha Project is not made. | Communication charges are very high. | The average charge is 180 Dhs/month/set if 1minute communication is made 24 times a day. |
| Maintenance | Total maintenance work is required. | the same as the left | Maintenance work will be done by MAROC TELECOM. However, if the telephone line has a trouble, it may take a long time for its restoration. | The situation is almost the same as telephone line. | No maintenance work is required. | No maintenance work is required. |
| Reliability | 99.50% | 85 - 90% | 99.99% | 99.99% | 99.99% | 99.90% |
| Difficulty | The system needs at least 2 VHF frequencies for the telemetry system of the Pilot Project. | Interferences is more significant for HS/SSB. | The public dial telephone line can be used for the data transmission. However, the existing telephone network does not cover all of the Pilot Project area. . | The slow response and the high communication charge are blocks for applying this medium. | High equipment cost and communication charges are problems. | Lacking of the service coverage and unknown liaiability during disaster times are problems of this medium. |
| Judgement | **Applicable** | Not applicable | Not applicable | Not applicable | Not applicable | Not applicable |

**Table 6.4.2 LIST OF EQUIPMENT FOR RADIO PROPAGATION TEST**

| No. | Item | Model | Serial Number | Manufacturer | Team who used equipment |
|---|---|---|---|---|---|
| 1 | Interference/field Strength Meter | ML518A | M22265 | Anritsu Corp., Japan | Team-A |
| | | ML518A | M21562 | | Team-B |
| 2 | Standard Signal Generator | FS-1015A-II | 2856K | Fujisoku Corp., Japan | Team-A |
| | | FS-1015A-II | 2857K | | Team-B |
| 3 | Level Meter | LM-312 | OY250283 | Oi Electric Co., Ltd. Japan | Team-A |
| | | LM-312 | 79210179 | | Team-B |
| 4 | Wattmeter | 43 | 234992 | Bird Electric Corp. USA | Team-A |
| | | 43 | 234989 | | Team-B |
| 5 | Mobile VHF Radiotelephone | JHM-12 | CE74422 | Japan Radio Co., Ltd. Japan | Team-A |
| | | JHM-12 | CE74421 | | Team-B |
| 6 | Non-directional Antenna | C-SH-060 | | Antenna Giken, Japan | Team-A |
| | | C-SH-060 | | | Team-B |
| 7 | 3 element Yagi Antenna | C-3BD-0602 | | Antenna Giken, Japan | Team-A |
| | | C-3BD-0602 | | | Team-B |
| 8 | Digital Circuit Tester | | | Japan | Team-A |
| | | | | | Team-B |
| 9 | Pen Recorder | ERR-3511 | | Toa Electric. | Team-A |
| | | ERR-3511 | | | Team-B |
| 10 | GPS | GPS2000 | | Japan | Team-A |
| | | GPS2000 | | | Team-B |
| 11 | Antenna Pole (10m high) | AL-10A | | Antenna Giken, Japan | Team-A |
| | | AL-10A | | | Team-B |
| 12 | Telescopic Antenna Pole (9.5m high) | CS-P-10 | | Antenna Giken, Japan | Common use |
| 13 | Battery 12v, 30AH | | 4 pcs. | Local made | Team-A, B |

## Table 6.4.3 RESULTS OF RADIO PROPAGATION TESTS

| No. | Station code | Transmission Station | Antenna Type | Antenna Gain (dB) | Output Power (W) | Station code | Recdeiving Station | Antenna Type | Antenna Gain (dB) | Distance (km) | Calculated Receiving level (dB/uv) | Actual Receivimg Level (dB/uv) | Ideal S/N (dB) | Actuial S/N (dB) | Evaluation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | MS=A | Marrakech | Sleeve | 2 | 10.50 | RP=A | Oukaimeden | Sleeve | 2 | 51.30 | 48.70 | 53.00 | 45.60 | 41.90 | Good |
| 2 | MS=A | Marrakech | Sleeve | 2 | 11.50 | RP=G | Adrar Tazaina | Sleeve | 2 | 56.00 | - | 34.00 | - | 42.10 | Good |
| 3 | MS=A | Marrakech | Sleeve | 2 | 11.00 | RP=E-2 *1 | Aoulouss-2 | Sleeve | 2 | 56.00 | - | 17.00 *3 | - | 40.00 | Fair *3 |
| 4 | MS=A | Marrakech | Sleeve | 2 | 10.00 | RP=E-1 *2 | Aoulouss-1 | Sleeve | 2 | 55.50 | - | 32.00 | - | 42.00 | Good *4 |
| 5 | RP=A | Oukaimeden | Sleeve | 2 | 10.00 | RP=G | Adrar Tazaina | Sleeve | 2 | 12.00 | 33.70 | 40.00 | 36.70 | 39.70 | Good |
| 6 | RP=A | Oukaimeden | Sleeve | 2 | 10.00 | RP=E-2 | Aoulouss | Sleeve | 2 | 23.00 | 28.50 | 26.00 | 42.80 | 41.10 | Good |
| 7 | TM=07 | Agouns | 3el.Yagi | 8 | 10.00 | RP=A | Oukaimeden | Sleeve | 2 | 6.50 | 28.50 | 18.00 *5 | 36.10 | 40.80 | Fair *5 |
| | TM=07 | Agouns | 3el.Yagi | 8 | 10.00 | RP=A | Adrar Tazaina | Sleeve | 2 | 6.20 | - | - | - | - | Good *6 |
| 8 | TM=06 | Tiourdiou | 3el.Yagi | 8 | 10.00 | RP=G | Adrar Tazaina | Sleeve | 2 | 3.10 | 18.60 | 31.00 | 35.80 | 42.10 | Good |
| 9 | TM=05 | Amenzal | 3el.Yagi | 8 | 10.00 | RP=G | Adrar Tazaina | Sleeve | 2 | 1.00 | 74.30 | 71.00 | 35.70 | 42.80 | Good |
| 10 | TM=03 | Tazzitount | 3el.Yagi | 8 | 10.00 | RP=E-2 | Aoulouss-2 | Sleeve | 2 | 4.80 | 63.60 | 28.00 | 36.00 | 41.50 | Good |
| 11 | TM=03 | Tazzitount | 3el.Yagi | 8 | 10.00 | RP=E-1 | Aoulouss-1 | Sleeve | 2 | 4.30 | 63.60 | 56.00 | 36.00 | 43.00 | Good |
| 12 | TM=03 | Tazzitount | Sleeve | 2 | 10.00 | RP=E-1 | Aoulouss-1 | Sleeve | 2 | 4.30 | 63.60 | 56.00 | 36.00 | 43.70 | Good *7 |
| 13 | TM=04 | Tourchit | 3el.Yagi | 8 | 10.00 | RP=E-2 | Aoulouss-2 | Sleeve | 2 | 1.90 | 73.30 | 43.00 | 35.70 | 42.70 | Good |
| 14 | TM=04 | Tourchit | 3el.Yagi | 8 | 10.00 | RP=E-1 | Aoulouss-1 | Sleeve | 2 | 2.10 | 73.30 | 50.00 | 35.70 | 42.80 | Good |
| 15 | TM=04 | Tourchit | Sleeve | 2 | 10.00 | RP=E-1 | Aoulouss-1 | Sleeve | 2 | 2.10 | 73.30 | 58.00 | 35.70 | 42.70 | Good *8 |

Note:

*1 Aoulouss repeater station has 2 candidate sites. RP=E-2 site locates at mid point between tourchit and mountain top (RP=E-1).
*2 RP=E-1 site locates at top of Mt. Aoulouss.
*3 Field strength value between Marrakech and Aoulouss RP=E-2 is below than target value. Therefore this circuit is not established.
*4 To solve weak signal, repeater point at Aoulouss moved to RP=E-1 site and got good result.
*5 Field strength value between Oukaimeden and Agouns is below than target value.
*6 Therefore, this circuit is changed between Adrar Tazaina and Agouns that is almost the line of sight.
*7 The circuit between Tazzitount and Aoulouss RP=E-1with sleeve antenna will be adopted.
*8 The circuit between Tourchit and Aoulouss RP=E-1with sleeve antenna will be adopted.
*9 The Sleeve antenna is non-directional type.
*10 The 3 element Yagi antenna is directional type.

## Table 7.1.1 (1/3) INVENTORY OF EQUIPMENT INSTALLED IN 2001

| Station/Post | Item Description | Model | Quantity | Unit |
|---|---|---|---|---|
| Amenzal Flood Watch Station | Ultrasonic Water Level Gauge with Accessories | W-825-00-50 | 1 | set |
| | Temperature Sensor with Accessories | E-734-00 | 1 | set |
| | SIO/BCD Module with Accessories | M-832-01-00 | 1 | set |
| | Short Distance Data Transmitter | GWD-2760-DI | 1 | set |
| | Solar Panel | WDHT136X2-02 | 4 | sets |
| | Power Distribution Board | NCB-812-32 | 1 | set |
| | Lead Acid Battery with Accessories | UXL550-2 | 6 | sets |
| | Battery Stand | UXL550-2 x 6 | 1 | set |
| | Support for Water Level Gauge | | 1 | set |
| | Rain Gauge | NKC-500A | 1 | set |
| | Remote Terminal Unit with Accessories | GWD-3015 | 1 | set |
| | Short Distance Data Receiver | GWD-2760-DO | 1 | set |
| | Power Distribution Board | NCB-814A | 1 | set |
| | Lead Acid Battery with Accessories | UXL165-2 | 6 | sets |
| | Battery Stand | UXL165-2 x 6 | 1 | set |
| Tiourdiou Flood Watch Station | Ultrasonic Water Level Gauge with Accessories | W-825-00-50 | 1 | set |
| | Temperature Sensor with Accessories | E-734-00 | 1 | set |
| | SIO/BCD Module with Accessories | M-832-01-00 | 1 | set |
| | Short Distance Data Transmitter | GWD-2760-DI | 1 | set |
| | Solar Panel | WDHT136X2-02 | 4 | sets |
| | Power Distribution Board | NCB-812-32 | 1 | set |
| | Lead Acid Battery with Accessories | UXL550-2 | 6 | sets |
| | Battery Stand | UXL550-2 x 6 | 1 | set |
| | Support for Water Level Gauge | | 1 | set |
| | Rain Gauge | NKC-500A | 1 | set |
| | Remote Terminal Unit with Accessories | GWD-3015 | 1 | set |
| | Short Distance Data Receiver | GWD-2760-DO | 1 | set |
| | Power Distribution Board | NCB-814A | 1 | set |
| | Lead Acid Battery with Accessories | UXL165-2 | 6 | sets |
| | Battery Stand | UXL165-2 x 6 | 1 | set |
| Tazzitount Flood Watch Station | Ultrasonic Water Level Gauge with Accessories | W-825-00-50 | 1 | set |
| | Temperature Sensor with Accessories | E-734-00 | 1 | set |
| | SIO/BCD Module with Accessories | M-832-01-00 | 1 | set |
| | Solar Panel | WDHT136X2-02 | 3 | sets |
| | Power Distribution Board | NCB-812-32 | 1 | set |
| | Lead Acid Battery with Accessories | UXL330-2 | 12 | sets |
| | Battery Stand | UXL330-2 x 12 | 1 | set |
| | Support for Water Level Gauge | | 1 | set |
| | Rain Gauge | NKC-500A | 1 | set |
| | Remote Terminal Unit with Accessories | GWD-3015 | 1 | set |
| | Metal pole | PANZERMAST R26 | 3 | set |
| Agouns Flood Watch Station | Rain Gauge | NKC-500A | 1 | set |
| | Remote Terminal Unit with Accessories | GWD-3015 | 1 | set |
| | Solar Panel | WDHT172-02 | 1 | set |
| | Power Distribution Board | NCB-814A | 1 | set |
| | Lead Acid Battery with Accessories | UXL-165-2 | 6 | sets |
| | Battery Stand | UXL-165-2 x 6 | 1 | set |
| Tourcht Flood Watch Station | Rain Gauge | NKC-500A | 1 | set |
| | Remote Terminal Unit with Accessories | GWD-3015 | 1 | set |
| | Solar Panel | WDHT172-02 | 1 | set |
| | Power Distribution Board | NCB-814A | 1 | set |
| | Lead Acid Battery with Accessories | UXL-165-2 | 6 | sets |
| | Battery Stand | UXL-165-2 x 6 | 1 | set |

## Table 7.1.1 (2/3) INVENTORY OF EQUIPMENT INSTALLED IN 2001

| Station/Post | Item Description | Model | Quantity | Unit |
|---|---|---|---|---|
| Iraghf Warning Post | Power Amplifier Unit with Rack Case | RIA-3241 | 1 | set |
| | Mixer Unit | RUX-2101 | 1 | set |
| | Auto-Reverse Cassette Player | FU-200CA | 1 | pc |
| | Monitor Unit | RIM-2601 | 1 | set |
| | Transformer Unit | PTF-2201 | 1 | set |
| | Microphone | MD-32 | 1 | pc |
| | Double Auto-Reverse Cassette Deck | W-860R | 1 | pc |
| | DC UPS | H-7ESSG00001 | 1 | set |
| | Protecter | H7ZASG00001 | 1 | set |
| | VHF Radio Unit with Accessories | IC-F310 | 1 | set |
| | Surge Absorbing Transformer Unit | TI-220-220-2 | 1 | set |
| | Loudspeaker | H-510A/P-500T/UCS-51A | 4 | pcs |
| | Metal pole | PANZERMAST R26 | 11 | sets |
| DRHT (Master Information Centor) | PC Server with Accessories | ProLiant DL 380 | 1 | set |
| | CD-R Drive | PX-W1210TS/BS | 1 | set |
| | Remote Access Server with Accessories | LRA508A-ET-R5 | 1 | set |
| | V90 Modem | MT5600ZDXe | 4 | sets |
| | NTP Server | JAZ-10MPS | 1 | set |
| | Rack Case | Rack 9136(36U) | 1 | set |
| | GPS Receiver with Antenna and Accessories | JAR-1 | 1 | set |
| | Electric Power Concentrator | NBJ508/509 | 1 | set |
| | Uninterrupted Power Supply Unit (UPS) | UPS R1500h | 1 | set |
| | Inkjet Printer | DeskJet 990 cxi | 1 | set |
| | Laser Printer | LaserJet 5000N | 1 | set |
| | Personal Computer with Accessories | DeskPro EN | 1 | set |
| | Uninterrupted Power Supply Unit (UPS) | UPS T700h | 1 | set |
| | Switching Hub | Center COM 8224XL | 1 | set |
| | Noise Cutoff Transformer | NCT-K 20KVA | 1 | set |
| | Power Distribution Board | 10A, 15 circuits | 1 | set |
| | Main Software for Data Processing | | 1 | set |
| | Data Server Software | | 1 | set |
| | Data Display Software | | 1 | set |
| | Data Import & Export Software | | 1 | set |
| | Instruction Manuals for Telemetry system | | 3 | sets |
| | Instruction Manuals for Data Processing System | | 3 | sets |
| | Instruction Manuals for Public Address System (Warning Post) | | 3 | sets |
| | Inspection Data | | 3 | sets |
| DGH Monitoring Station | Personal Computer with Accessories | DeskPro EX | 1 | set |
| | Ink-jet Printer | DeskJet 990 cxi | 1 | set |
| | Uninterrupted Power Supply Unit (UPS) | UPS T700h | 1 | set |
| | V90 Modem | MT5600ZDXe | 1 | set |
| | Spare Inkjet Cartridge (Black) | 51645A | 3 | pcs |
| | Spare Inkjet Cartridge (Tri-colour) | C6578A | 5 | pcs |
| DPE Al Haouz Monitoring Station | Personal Computer with Accessories | DeskPro EX | 1 | set |
| | Ink-jet Printer | DeskJet 990 cxi | 1 | set |
| | Uninterrupted Power Supply Unit (UPS) | UPS T700h | 1 | set |
| | V90 Modem | MT5600ZDXe | 1 | set |
| | Spare Inkjet Cartridge (Black) | 51645A | 3 | pcs |
| | Spare Inkjet Cartridge (Tri-colour) | C6578A | 5 | pcs |
| Al Haouz Province Monitoring Station | Personal Computer with Accessories | DeskPro EX | 1 | set |
| | Ink-jet Printer | DeskJet 990 cxi | 1 | set |
| | Uninterrupted Power Supply Unit (UPS) | UPS T700h | 1 | set |
| | V90 Modem | MT5600ZDXe | 1 | set |
| | Spare Inkjet Cartridge (Black) | 51645A | 3 | pcs |
| | Spare Inkjet Cartridge (Tri-colour) | C6578A | 5 | pcs |

## Table 7.1.1 (3/3) INVENTORY OF EQUIPMENT INSTALLED IN 2001

| Station/Post | Item Description | Model | Quantity | Unit |
|---|---|---|---|---|
| Ourika Caidat Monitoring Station | Personal Computer with Accessories | DeskPro EX | 1 | set |
| | Ink-jet Printer | DeskJet 990 cxi | 1 | set |
| | Uninterrupted Power Supply Unit (UPS) | UPS T700h | 1 | set |
| | V90 Modem | MT5600ZDXe | 1 | set |
| | Spare Inkjet Cartridge (Black) | 51645A | 3 | pcs |
| | Spare Inkjet Cartridge (Tri-colour) | C6578A | 5 | pcs |
| Spare Parts (DRHT) | Inkjet Cartridge (Black) | 51645A | 18 | pcs |
| | Inkjet Cartridge (Tri-colour) | C6578A | 25 | pcs |
| | Toner Cartridge | C4129X | 2 | pcs |
| | CD-R Media | CDQ-74CNC | 10 | pcs |
| | Rain Gauge | NKC-500A | 1 | set |
| | Ultrasonic Water Level Gauge with Accessories | W-825-00-50 | 1 | set |
| | SIO/BCD Module with Accessories | M-832-01-00 | 1 | set |
| | Remote Terminal Unit with Accessories | GWD-3015 | 1 | set |
| | Loudspeaker | H-510A/P-500T/UCS-51A | 2 | pcs |
| | Microphone | MD-32 | 1 | pc |
| | VHF Radio Unit with Accessories | IC-F310 | 1 | set |
| | Metal Pole | PANZERMAST R26 | 6 | sets |
| Maintenance Tools (DRHT) | Notebook Computer with Accessories | PP348Z-4PU82-A | 1 | set |
| | Portable Engine Generator | EM650 | 1 | set |
| | DC Power Supply Unit | PR18-5A | 1 | set |
| | Multi-Tester | CD751 | 1 | pc |
| | Clamp Type Current Meter | CL-22AD | 1 | pc |
| | Tool Set | S-10 | 1 | set |
| | Flash Memory Card Adopter | SDCF-31 | 1 | pc |
| | Gender Changer | D9S-MM | 1 | set |
| | RS-232C Cable | KRS-403XF-5K | 1 | set |

## Table 7.2.1(1/5) NECESSARY ACTIONS TO BE TAKEN IN EACH FLOOD PHASE

(1) DRHT (ABHT)

| Flood Phase | Station/Post | Necessary Actions |
|---|---|---|
| Normal Phase | Flood Watch Station | • Stand by permanently in or around the station,<br>• Report to ABHT (MIC) weather conditions and hydrological data four times a day through a VHF or HF radiotelephone,<br>• Call the ABHT radio operator immediately once something unusual including lightening, commencement of rainfall or sudden rise of water level are detected,<br>• Start frequent observation and reporting, if directed by ABHT.<br>• Inspect and maintain the FFWS equipment in good condition under the guidance of ABHT, and<br>• Conduct an internal operation drill with ABHT once a year at least. |
| | DRHT Master Information Center (MIC) | • Prepare and distribute to related organizations lists of personnel (assignment in FFWS operation, address, telephone and fax numbers) and reference maps.<br>• Keep permanent duty,<br>• Telephone a engineer of hydrology service immediately once unusual things are reported from the flood watch stations,<br>• Mobilize a FFWS operation team composed of a engineer and two technicians at least if necessary,<br>• Confirm the hydrological situation by watching maps and graphs of flood information given on the Client PC and contacting the flood watch stations once the alarm sound of commencement of rainfall is rung,<br>• Announce a Pre-River Flood Notice and distribute it to the organizations concerned including DPE, DGH and the Province by fax, once the flood situation has developed beyond the Pre-Alert Level and is expected to further develop,<br>• Inform the flood watch stations by radiotelephone of the commencement of the Flood Watch Phase, following the announcement of the Pre River Flood Notice,<br>• Receive weather and hydrological reports from the flood watch stations four times a day through a VHF or HF radiotelephone,<br>• Supervise the flood watch stations,<br>• Inspect and maintain the FFWS equipment in good condition,<br>• Have a meeting with the Province, DPE, Royal Mounted Police and Civil Protection on updating of the FFWS operation guidelines and the joint drill in May or June,<br>• Conduct a joint communication drill in June with the Province, DPE, DGH, Royal Mounted Police and Civil Protection,<br>• Conduct an internal operation drill with the flood watch stations once a year at least, and<br>• Prepare an overall evaluation report on the FFWS operation after every flood that reached the Flood Watch Phase or further and every drill with the Province, DPE, Royal Mounted Police and Civil Protection. |
| Preparatory Phase | Flood Watch Station | • Start frequent observation and reporting |
| | Master Information Center | • Mobilize the FFWS operation team if not yet,<br>• Inform the flood watch stations by radiotelephone, and remind DPE and the Province by telephone of the commencement of the Preparatory Phase,<br>• Supervise the flood watch stations,<br>• Keep in contact with the flood watch stations, DMN Marrakech Station, DPE, the Province, to collect and exchange information on weather and flood conditions,<br>• Confirm the hydrological situation by watching maps and graphs of flood information given on the Client PC and contacting the flood watch stations once the alarm sound of commencement of rainfall is rung,<br>• Announce a River Flood Notice and distribute it to the organizations concerned including DPE, DGH and the Province by fax, if the flood situation has developed beyond the Pre-Alert Level and is expected to further develop,<br>• Inform the flood watch stations by radiotelephone of the commencement of the Flood Watch Phase, following the announcement of the Pre River Flood Notice, and<br>• Inform the flood watch stations of termination of the Preparatory Phase and resume of the Normal Phase, following the expiry of the DMN message. |

**Table 7.2.1 (2/5) NECESSARY ACTIONS TO BE TAKEN IN EACH FLOOD PHASE**

(1) DRHT (ABHT)

| Flood Phase | Station/Post | Necessary Actions |
|---|---|---|
| Flood Watch Phase | Flood Watch Station | • Start or continue frequent observation and reporting. |
| | Master Information Center | • Mobilize the FFWS operation team if not yet,<br>• Confirm the Province's, DPE's and DGH's receiving of the Pre River Flood Notice and advice them to access to the ABHT data processing system by telephone,<br>• Keep in contact with the flood watch stations, DMN Marrakech Station, DPE, the Province, DMN Marrakech Station to collect and exchange information on weather and flood condition,<br>• Conduct flood forecasting simulations,<br>• Announce a River Flood Notice and distribute it to the organizations concerned including DPE, DGH and the Province by fax, once the flood has developed beyond the Alert Level and is anticipated to further develop,<br>• Inform the flood watch stations of termination of the Flood Watch Phase and commencement of the Evacuation Phase, following the announcement of the River Flood Notice,<br>• Announce Cancellation of the Pre Flood Notice and distribute it to the organizations concerned including DPE, DGH and the Province by fax once 3 hours have passed since the stop of the rainfall and the flood has settled down below the pre-alert level, and<br>• Inform the flood watch stations of termination of the Flood Watch Phase and resume of the Normal Phase, following the cancellation of the Flood Notices. |
| | Flood Watch Station | • Continue frequent observation and reporting |
| | Master Information Center | • Confirm the Province's, DPE's and DGH's receiving of the Pre River Flood Notice and advice them to keep connected to the ABHT data processing system,<br>• Supervise the flood watch stations,<br>• Keep in contact with DMN Marrakech, the DPE, the Province and DGH to exchange information on weather and flood condition,<br>• Conduct flood forecasting simulations,<br>• Announce Cancellation of the Flood Notices and distribute it to the organizations concerned including DPE, DGH and the Province once 3 hours have passed since the stop of the rainfall and the flood has settled down below the pre-alert level, and<br>• Inform the flood watch stations of termination of the Evacuation Phase and resume of the Normal Phase after the cancellations of the Flood Notices. |

**Table 7.2.1 (3/5) NECESSARY ACTIONS TO BE TAKEN IN EACH FLOOD PHASE**

(2) DPE Al Haouz

| Flood Phase | Station/Post | Necessary Actions |
|---|---|---|
| Normal Phase | DPE Monitoring Station | • Keep a permanent duty,<br>• Once something unusual is reported from Oukaimedan brigade, inform DRHT of it by telephone,<br>• Inspect and maintain the FFWS equipment in a good condition,<br>• Have a meeting with DRHT, the Province, Royal Mounted Police and Civil Protection on updating of the FFWS operation guidelines and the joint drill in May or June,<br>• Conduct a joint communication drill in June with DRHT, the Province and Royal Mounted Police and Civil Protection, and<br>• Prepare an overall evaluation report on the FFWS operation after every flood that reached the Preparatory Phase or further and every drill with DRHT, the Province, Royal Mounted Police and Civil Protection. |
| | Oukaimedan Road Maintenance Brigade | • Keep a permanent duty, and<br>• Call DPE Monitoring Station immediately by radiotelephone once something unusual including lightening, commencement of rainfall or sudden rise of water level are detected. |
| Preparatory Phase | DPE Monitoring Station | • Inform the Oukaimedan brigade of the pre-alert or alert message by DMN,<br>• Start up the PC to connect it to the MIC server for flood information, and<br>• Once something unusual is reported from the Oukaimedan brigade, inform the DRHT of it. |
| | Oukaimedan Road Maintenance Brigade | • Keep a permanent duty, and<br>• Call DPE Monitoring Station immediately by radiotelephone once something unusual including lightening, commencement of rainfall or sudden rise of water level are detected. |
| Flood Watch Phase | DPE Monitoring Station | • Inform the Oukaimedan brigade of announcement of the Pre River Flood Notice,<br>• Start up the PC to connect it to the MIC server for flood information if not yet,<br>• Keep in contact with the Oukaimedan Brigade and organizations concerned including DRHT and the Province to collect and exchange flood information, and.<br>• Inform the Oukaimedan brigade of the cancellation of the Flood Notices, following the announcement by DRHT. |
| | Oukaimedan Road Maintenance Brigade | • Keep in contact with DPE Monitoring Station by radiotelephone, and<br>• Make a patrol if directed by DPE. |
| Evacuation Phase | DPE Monitoring Station | • Inform the Oukaimedan brigade of announcement of the River Flood Notice.<br>• Keep in contact with organizations concerned including DRHT and the Province to collect and exchange flood information, and<br>• Inform the Oukaimedan brigade of the cancellation of the Flood Notices, following the announcement by DRHT. |
| | Oukaimedan Road Maintenance Brigade | • Keep in contact with DPE Monitoring Station by radiotelephone, and<br>• Make a patrol if directed by DPE. |

**Table 7.2.1 (4/5) NECESSARY ACTIONS TO BE TAKEN IN EACH FLOOD PHASE**

(3) Al Haouz Province

| Flood Phase | Station/Post | Necessary Actions |
|---|---|---|
| Normal Phase | Al Haouz Province Monitoring Station | • Keep a permanent duty,<br>• Once something unusual is reported from Ourika Caidat, inform DRHT of it by telephone,<br>• Inspect and maintain the FFWS equipment in good condition,<br>• Have a meeting with DRHT, DPE, Royal Mounted Police and Civil Protection on updating of the FFWS operation guidelines and the joint drill in May or June,<br>• Conduct a joint communication drill in June with DRHT, DPE, Royal Mounted Police and Civil Protection,<br>• Conduct an internal operation drill with the warning post once a year at least, and<br>• Prepare an overall evaluation report on the FFWS operation after every flood that reached the Preparatory Phase or further and every drill with DRHT, DPE, Royal Mounted Police and Civil Protection. |
| | Ourika Caidat Monitoring Station | • Keep a permanent duty,<br>• Receive reports from the warning post,<br>• Once something unusual is reported by the warning post, relay it to the Province by radiotelephone,<br>• inspect and maintain the FFWS equipment in good condition under the guidance of DRHT |
| | Iraghf Warning Post | • Keep a permanent duty in the warning post,<br>• Report to Ourika Caidat about conditions of the weather, river and tourists three times a day at 11, 15 and 17 o'clock by radiotelephone,<br>• Call Ourika Caidat immediately by radiotelephone once something unusual including lightening, commencement of rainfall or sudden rise of water level are detected,<br>• Inspect and maintain the FFWS equipment in good condition under the guidance of DRHT, |
| Preparatory Phase | Al Haouz Province Monitoring Station | • Keep a permanent duty,<br>• Inform Ourika Caidat of the pre-alert or alert message by DMN,<br>• Start up the PC to connect it to the MIC server for flood information,<br>• And, once something unusual is reported from Ourika Caidat, inform DRHT of it by telephone. |
| | Ourika Caidat Monitoring Station | • Relay the pre-alert or alert message by DMN from the Province to the warning post,<br>• Start up the PC to connect it to the MIC server for flood information,<br>• Keep in contact with the warning post,<br>• And, once something unusual is reported from the warning post, relay it to the Province by radiotelephone. |
| | Iraghf Warning Post | • Keep in contact with Ourika Caidat,<br>• Call Ourika Caidat immediately by radiotelephone once something unusual including lightening, commencement of rainfall or sudden rise of water level is detected, |

**Table 7.2.1 (5/5) NECESSARY ACTIONS TO BE TAKEN IN EACH FLOOD PHASE**

(3) Al Haouz Province

| Flood Phase | Station/Post | Necessary Actions |
|---|---|---|
| Flood Watch Phase | Al Haouz Province Monitoring Station | • Start up the PC to connect it to the MIC server for flood information if not yet,<br>• Keep in contact with organizations concerned including DRHT, DPE, Royal Mounted Police, Ourika Caidat, etc. to collect and exchange flood information,<br>• Issue a River Flood Caution and disseminate it to Tahanaout Cercle, Ourika Caidat, Royal Mounted Police, Civil Protection, etc. by fax, telephone or radiotelephone, and<br>• Issue Cancellation of the River Flood Caution and disseminate it to Tahanaout Cercle, Ourika Caidat, Royal Mounted Police, Civil Protection, etc. by fax, telephone or radiotelephone. |
| | Ourika Caidat Monitoring Station | • Keep in contact with Iraghf Warning Post and the Province,<br>• Start up the PC to connect it to the MIC server for flood information if not yet, and<br>• relay the warning message and directions from the Province to the warning post. |
| | Iraghf Warning Post | • Keep in contact with Ourika Caidat by radiotelephone,<br>• Broadcast the flood caution message under direction of Ourika Caidat,<br>• Broadcast the cancellation message under direction of Ourika Caidat,<br>• Patrol the flood inundation area to confirm inhabitants' and tourist's receipt of the message. |
| Evacuation Phase | Al Haouz Province Monitoring Station | • Keep monitoring flood information provided by the DRHT MIC server,<br>• Keep in contact with organizations concerned including DRHT, DPE, Royal Mounted Police, Ourika Caidat, etc. to collect and exchange flood information,<br>• Issue an Evacuation Advice, and disseminate it to Tahanaout Cercle, Ourika Caidat, Royal Mounted Police, Civil Protection, etc. by fax, telephone or radiotelephone, and<br>• Issue Cancellation of the River Flood Caution and the Evacuation Advice , and disseminate it to Tahanaout Cercle, Ourika Caidat, Royal Mounted Police, Civil Protection, etc. by fax, telephone or radiotelephone. |
| | Ourika Caidat Monitoring Station | • Keep monitoring flood information provided by the DRHT MIC server,<br>• Keep in contact with Iraghf Warning Post and the Province, and<br>• Relay the flood warning and directions from the Province to the warning post. |
| | Iraghf Warning Post | • Keep in contact with Ourika Caidat by radiotelephone,<br>• Broadcast the evacuation advice message under direction of Ourika Caidat,<br>• Broadcast the cancellation message under direction of Ourika Caidat, and<br>• Patrol the flood inundation area to confirm inhabitants' and tourist's receipt of the message. |

## Table 7.4.1 ASSUMED HYDROLOGICAL DATA ON 25 JUNE 2002

### (1) Rainfall Data

| Amenzal | | Tazzitount | | Tiourdiou | | Tourcht | |
|---|---|---|---|---|---|---|---|
| Time | Reading of Accumulative Rainfall (mm) | Time | Reading of Accumulative Rainfall (mm) | Time | Reading of Accumulative Rainfall (mm) | Time | Reading of Accumulative Rainfall (mm) |
| 15:00 | 200 | 15:00 | 310 | 15:00 | 193 | 15:00 | 249 |
| 15:10 | 200 | 15:10 | 310 | 15:10 | 193 | 15:10 | 250 |
| 15:20 | 200 | 15:20 | 311 | 15:20 | 193 | 15:20 | 250 |
| 15:30 | 201 | 15:30 | 312 | 15:30 | 194 | 15:30 | 251 |
| 15:40 | 202 | 15:40 | 313 | 15:40 | 195 | 15:40 | 252 |
| 15:50 | 205 | 15:50 | 318 | 15:50 | 200 | 15:50 | 256 |
| 16:00 | 209 | 16:00 | 322 | 16:00 | 205 | 16:00 | 261 |
| 16:10 | 214 | 16:10 | 327 | 16:10 | 210 | 16:10 | 266 |
| 16:20 | 239 | 16:20 | 348 | 16:20 | 224 | 16:20 | 290 |
| 16:30 | 250 | 16:30 | 368 | 16:30 | 260 | 16:30 | 321 |
| 16:40 | 252 | 16:40 | 370 | 16:40 | 267 | 16:40 | 325 |
| 16:50 | 252 | 16:50 | 370 | 16:50 | 267 | 16:50 | 325 |
| 17:00 | 252 | 17:00 | 370 | 17:00 | 267 | 17:00 | 325 |
| 17:10 | 252 | 17:10 | 370 | 17:10 | 267 | 17:10 | 325 |
| 17:20 | 252 | 17:20 | 370 | 17:20 | 267 | 17:20 | 325 |
| 17:30 | 252 | 17:30 | 370 | 17:30 | 267 | 17:30 | 325 |
| 17:40 | 252 | 17:40 | 370 | 17:40 | 267 | 17:40 | 325 |
| 17:50 | 252 | 17:50 | 370 | 17:50 | 267 | 17:50 | 325 |
| 18:00 | 252 | 18:00 | 370 | 18:00 | 267 | 18:00 | 325 |

### (2) Water Level Data

| Amenzal | | Tazzitount | | Tiourdiou | |
|---|---|---|---|---|---|
| Time | Water Level (cm) | Time | Water Level (cm) | Time | Water Level (cm) |
| 15:00 | 1040 | 15:00 | 325 | 15:00 | 230 |
| 15:10 | 1040 | 15:10 | 326 | 15:10 | 233 |
| 15:20 | 1045 | 15:20 | 328 | 15:20 | 240 |
| 15:30 | 1060 | 15:30 | 340 | 15:30 | 299 |
| 15:40 | 1070 | 15:40 | 349 | 15:40 | 330 |
| 15:50 | 1104 | 15:50 | 364 | 15:50 | 385 |
| 16:00 | 1127 | 16:00 | 400 | 16:00 | 390 |
| 16:10 | 1145 | 16:10 | 420 | 16:10 | 403 |
| 16:20 | 1200 | 16:20 | 480 | 16:20 | 520 |
| 16:30 | 1255 | 16:30 | 580 | 16:30 | 585 |
| 16:40 | 1185 | 16:40 | 400 | 16:40 | 410 |
| 16:50 | 1070 | 16:50 | 360 | 16:50 | 325 |
| 17:00 | 1050 | 17:00 | 340 | 17:00 | 275 |
| 17:10 | 1045 | 17:10 | 340 | 17:10 | 270 |
| 17:20 | 1045 | 17:20 | 340 | 17:20 | 260 |
| 17:30 | 1045 | 17:30 | 340 | 17:30 | 260 |
| 17:40 | 1045 | 17:40 | 340 | 17:40 | 260 |
| 17:50 | 1045 | 17:50 | 340 | 17:50 | 260 |
| 18:00 | 1045 | 18:00 | 340 | 18:00 | 260 |

Above Pre-Alert Level

Above Alert Level

## Table 7.4.2 MEETINGS AND EVENTS RELATED TO GLOBAL SIMULATION DRILL

| Date | Meeting/Event | Place | Moroccan Participants | Agenda |
|---|---|---|---|---|
| May 20 | Meeting with ABHT Director | ABHT | Director and Chief of Hydrological Service | General Explanation about Global Simulation Drill |
| May 23 | Meeting with DGH | DGH | Chief of Hydrological Service | General Explanation about Global Simulation Drill |
| May 27 | Meeting with Governor | Al Haouz Province | Governor | General Explanation about Global Simulation Drill |
| May 28 | WG Meeting | ABHT | Ourika Caid and Representatives from ABHT, DMN and DMN | General Explanation about Global Simulation Drill |
| May 29 | Meeting with Inhabitants | Iraghf | Some 50 inhabitants and a Warning Post Operator | General Explanation about Global Simulation Drill and Request of Participation |
| June 6 | Meeting with Province | Province | Ourika Caid, | Explanation about and Discussion on Simulation Scenarios and Procedures |
| June 6 | Meeting with Royal Mounted Police | Royal Mounted Police, Tahanaout | Commandant of Royal Mounted Police, Al Haouz | General Explanation about Global Simulation Drill and Discussion on Traffic Control |
| June 7 | Meeting with DMN | ABHT | A representative of DMN Marrakech | Discussion on Simulation Scenarios and Procedures |
| June 7 | Meeting with Ourika Brigade of Royal Mounted Police | Ourika Brigade | Chef of Ourika Brigade | General Explanation about Global Simulation Drill and Discussion on Traffic Control |
| June 12 | Meeting with Inhabitants | Iraghf | Some 30 inhabitants and a Waning Post Operator | Explanation of Global Simulation Drill |
| June 13 | WG Meeting | Ourika Caidat | Ourika Caidat and representatives from ABHT, DPE, DMN, Province, Public Health, Royal Mounted Police, Civil Protection, Water & Forest | Discussion on Simulation Scenarios and Procedures |
| June 13 | Meeting with Station Guardians | Tazztount Station | Chef and a Technician of Hydrology Service, ABHT and Station Guardians from 6 Flood Watch Stations | Explanation about Simulation Scenarios and Procedures |
| June 14 | Meeting with Inhabitants | Iraghf | Group Leaders of Inhabitants | Explanation on Global Simulation Drill |
| June 17 | Meeting with Civil Protection | Civil Protection Marrakech | Regional Commandant | General Explanation about Global Simulation Drill |
| June 18 | Meeting with Province | Province | Chef of Transmission Service and Officer in charge of ORSEC Plan | Discussion on Simulation Procedures |
| June 19 | First Test Simulation Drill | - | All organizations Concerned | - |
| June 20 | WG Meeting | Province | Governor and Representatives from ABHT, DPE, DMN, Province, Public Health, Royal Mounted Police, Civil Protection, Local Authorities, etc. and some 60 inhabitants | Evaluation of First Test Simulation drill |
| June 21 | Second Test Simulation Drill | - | All organizations Concerned | - |
| June 24 | Meeting with Governor | Province | Governor, Secretary General | Evaluation of Second Test Simulation drill |
| June 25 | Global Simulation Drill | - | All organizations concerned and Inhabitants and Tourists | - |
| June 26 | WG Meeting | Province | Governor and Representatives from ABHT, DPE, DMN, Province, Public Health, Royal Mounted Police, Civil Protection, Local Authorities, etc. and some 20 inhabitants | Evaluation of Global Simulation drill |
| June 27 | Steering Committee Meeting | DGH | Representatives from DGH, DMN and Ministry of Interior | Reporting on Global Simulation drill |

## Table 7.4.3 CONSUMED TIME IN EACH PROCEDURE IN THREE SIMULATION DRILLS

| Procedure | Date | DMN Alert | Pre Flood Notice/ Flood Caution | Flood Notice/ Evacuation Advice | Cancellation |
|---|---|---|---|---|---|
| Distribution of DMN Alert Message by Fax from **DMN** to **Province** | 19 June | 2 | N/a | N/a | N/a |
| | 21 June | 2 | N/a | N/a | N/a |
| | 25 June | 2 | N/a | N/a | N/a |
| Announcement of Flood Notice by ABHT (Data collection, Decision making and Preparation of Message) | 19 June | N/a | 22 | 18 | 12 |
| | 21 June | N/a | 9 | 9 | 5 |
| | 25 June | N/a | 10 | 10 | 12 |
| Distribution of Flood Notice Message by Fax from **ABHT** to **Province** | 19 June | N/a | 4 | 10 | 3 |
| | 21 June | N/a | 1 | 4 | 1 |
| | 25 June | N/a | 1 | 3 | 1 |
| Issuance of Flood Warning by Province (Decision-making and Preparation of Massage) | 19 June | 9 | 8 | 11 | 7 |
| | 21 June | 1 | 2 | 2 | 3 |
| | 25 June | 8 | 6 | 1 | 1 |
| Dissemination from **Province** to **Cercle** | 19 June | 39 | 24 | 16 | 13 |
| | 21 June | N/a | N/a | N/a | N/a |
| | 25 June | N/a | N/a | N/a | N/a |
| Dissemination from **Cercle** to **Caidat** | 19 June | 10 | 17 | 10 | 10 |
| | 21 June | N/a | N/a | N/a | N/a |
| | 25 June | N/a | N/a | N/a | N/a |
| Dissemination from **Caidat** to **Warning Post** | 19 June | 10 | 1 | Radio is out of order | Radio is out of order |
| | 21 June | N/a | N/a | N/a | N/a |
| | 25 June | N/a | N/a | N/a | N/a |
| Dissemination from **Province** to **Warning Post** | 19 June | N/a | N/a | N/a | N/a |
| | 21 June | 4 | 3 | 3 | 4 |
| | 25 June | 3 | 1 | 1 | 1 |
| Total | 19 June | 70 | 76 | 65* | 45* |
| | 21 June | 7 | 15 | 18 | 13 |
| | 25 June | 13 | 18 | 15 | 15 |

: Procedure skipped after the first test simulation

*: Total consumed time until Ourika Caidat (Since the radiotelephone of the warning became out of order, the Evacuation Advice and Cancellation messages could not be transmitted to the warning post.)

Table 8.1.1 (1/2) INVENTORY OF EQUIPMENT INSTALLED IN 2003

| Item No. | Description of Equipment and Materials | Model | Quantity |
|---|---|---|---|
| 1. Master Information Center (ABHT) | | | |
| 1-1 | Telemetry Supervisory Equipement with Accesaries | GWD-3020-TT | 1set |
| 1-2 | Telemetry Operating Console with Accessaries | GWD-2835 | 1set |
| 1-3 | Software for telemetry | 7YSWD0771 | 1set |
| 1-4 | UPS | SU7001NET | 1set |
| 1-5 | Alarm Indicator | GWD-2836 | 1set |
| 1-6 | VHF Radio Equipment with Accessaries | GWD-73-10 | 1set |
| 1-7 | Communication Control Unit | JAZ-10MPS | 1set |
| 1-8 | DC Power Supply with Accessaries | NBA-4801-2 | 1set |
| 1-9 | 3-element Yagi Antenna | 3BD-0603 | 1set |
| 1-10 | Coaxial Arrester | NYZ-70 | 1set |
| 1-11 | Coaxial Cable 30m with Connetors | 10D-2E | 1set |
| 1-12 | Metal Mast (Panzer mast) | R212 | 1set |
| 1-13 | Installation Materials | | 1 lot |
| | | | |
| 2. Flood Watch Stations | | | |
| 2-1 | Equipment for Tourcht and Agouns Stations (Rainfall Stations) | | |
| 2-1-1 | VHF Radio Equipment with Accessaries | GWD-73-10 | 2 sets |
| 2-1-2 | Software for telemetry | 7YEWD0373 | 2 sets |
| 2-1-3 | 2-element Yagi Antenna | 2BD-0603 | 2 sets |
| 2-1-4 | Coaxial Arrester | NYZ-70 | 2 sets |
| 2-1-5 | Coaxial Cable 20m with Connetors | 10D-2E | 2 sets |
| 2-1-6 | Installation Materials | | 2 lots |
| 2-2 | Equipment for Tazzitount, Tiourdiou and Amenzal Stations (Rainfall and Water level Stations) | | |
| 2-2-1 | VHF Radio Equipment with Accessaries | GWD-73-10 | 3 sets |
| 2-2-2 | Software 7YEW0373 | 7YEW0373 | 3 sets |
| 2-2-3 | 2-element Yagi Antenna | 2BD-0603 | 3 sets |
| 2-2-4 | Coaxial Arrester | NYZ-70 | 3 sets |
| 2-2-5 | Coaxial Cable 20m with Connetors | 10D-2E | 3 sets |
| 2-2-6 | Metal Mast (Panzer mast) | R26 | 3 sets |
| 2-2-7 | Installation Materials | | 3 sets |
| | | | |
| 3. Repeater Stations (Adrar Tazaina and Aoulouss) | | | |
| 3-1 | Repeater Equipment with Accessaries | GWD-650 | 2 sets |
| 3-2 | VHF Radio Equipment with Accessaries | GWD-73-10 | 4 sets |
| 3-3 | Non-direction Antenna | SL-060 | 4 sets |
| 3-4 | Antenna Filter | 7AFWD0370 | 2 sets |
| 3-5 | Coaxial Arrester with Cable and Connectors | NYZ-70 | 4 sets |
| 3-6 | Power Supply Unit | | |
| 3-6-1 | Solar Panel | WDHT136-02 | 2 sets |
| 3-6-2 | Distribution Board | NCB-814A | 2 sets |
| 3-6-3 | Lead-acid Storage Battery | UXL220-2 (6pcs/set) | 2 sets |
| 3-6-4 | Battery Stand and Accessaries | | 2 sets |
| 3-7 | Lightening Conductor for Panzer Mast with Accessaries | JIS-M | 4 sets |
| 3-8 | Grounding Resistance Reduction Material | M-1C (25kg) | 100 bags |
| 3-9 | Installation Materials | | 2 lots |
| | | | |

Table 8.1.1 (2/2) INVENTORY OF EQUIPMENT INSTALLED IN 2003

| Item No. | Description of Equipment and Materials | Model | Quantity |
|---|---|---|---|
| 4. Warning Post and Monitoring Stations (Iragfh Warning Post, Ourika Caidat and Province) | | | |
| 4-1 | Equipment for Iraghf Warning Post | | |
| 4-1-1 | 5-toneUnit | UT-96 | 1 set |
| 4-1-2 | Siren Equipment | 7USWN0001 | 1 set |
| 4-1-3 | Installation Materials | | 1 lot |
| 4-2 | Equipment for Ourika Caidat | | |
| 4-2-1 | VHF Radio Equipment with 5-tone unit | IC-F310 | 1 set |
| 4-2-2 | Siren Equipment | 7USWN0001 | 1 set |
| 4-2-3 | 3-element Yagi Antenna | 3BD-1502 | 1 set |
| 4-2-4 | Coaxial Arrester | NYZ-150 | 1 set |
| 4-2-5 | Coaxial Cable with Connectors | 10D-2E | 1 set |
| 4-2-6 | Charger with Battery | 7ESWN0001 | 1 set |
| 4-2-7 | Metal Mast (Panzer mast) | R218 | 1 set |
| 4-2-8 | Installation Materials | | 1 lot |
| 4-3 | Equipment for Al Haouz Province | | |
| 4-3-1 | VHF Radio Equipment with 5-tone unit | IC-F310 | 1 set |
| 4-3-2 | AC Power Supply | PS-ADF300 | 1 set |
| 4-3-3 | Siren Equipment | 7USWN0001 | 1 set |
| 4-3-4 | 3-element Yagi Antenna | 3BD-1502 | 1 set |
| 4-3-5 | Coaxial Arrester | NYZ-150 | 1 set |
| 4-3-6 | Coaxial Cable with Connectors | 10D-2E | 1 set |
| 4-3-7 | Installation Materials | | 1 lot |
| | | | |
| 5. Spare Parts and Measuring Tools | | | |
| 5-1 | Spare Parts: | | |
| 5-1-1 | VHF Radio Equipment with Accessaries | GWD-73-10 | 2 sets |
| 5-1-2 | Units for Repeater Equipment | | 1 set |
| 5-1-3 | Units for Telemetry Supervisory Equipment | | 1 set |
| 5-1-4 | Solar Panel | WDHT136-02 | 1 set |
| 5-1-5 | VHF Radio Equipment with 5-tone unit | IC-F310 | 1 set |
| 5-1-6 | 3-element Yagi Antenna | 3BD-1502 | 1 set |
| 5-1-7 | LAN Cable 2m | KB-T5M-02BLK | 1 set |
| 5-2 | Measuring Tools: | | |
| 5-2-1 | Through Line Power Meter with Accessaries | TLP-801A-04 | 1 set |
| 5-2-2 | Level Meter with Accessaries | LM-312 | 1 set |
| 5-2-3 | Telemeter Checker with Accessaries | NJZ-1556B | 1 set |
| 5-2-4 | Analog Tester with accessaries | SH-88TR | 1 set |
| 5-2-5 | Digital Tester with aqccessaries | 3238 | 1 set |
| 5-2-6 | Maintenance Tools | S-10 | 1 set |

## Table 8.1.2 RADIO PROPAGATION DATA

| Conditions | Transmission Station | Output Power (W) | Receiving Station | Output Power (W) | Distance (km) | Receiving Level (dB/uv) Up link (more than 30dB/uV) | Receiving Level (dB/uv) Down link (more than 30dB/uV) | S/N Up link (dB) (more than 40dB) | S/N Down link (dB) (morethan 40dB) | Judgment |
|---|---|---|---|---|---|---|---|---|---|---|
| Orignal | Marrakech | 10 | Adrar Tazaina | 10 | 56.00 | - | 38.60 | 45.80 | 45.00 | good |
| After frequency exchange | Marrakech | 10 | Adrar Tazaina | 10 | 56.00 | 33.30 | 40.00 | 45.80 | 45.00 | good |
| Orignal | Adrar Tazaina | 10 | Agouns | 10 | 6.20 | 55.90 | 50.70 | | | good |
| After frequency exchange 10W | Adrar Tazaina | 10 | Agouns | 10 | 6.20 | - | 43.50 | - | 51.20 | good |
| Orignal Total S/N | Marrakech | 10 | Agouns | 10 | 6.20 | - | - | 49.70 | 51.40 | good |
| Final Total S/N | Marrakech | 10 | Agouns | 1 | 6.20 | - | - | 47.40 | 51.20 | good |
| Orignal | Adrar Tazaina | 10 | Tioudiou | 10 | 3.10 | - | 38.00 | | | good |
| After frequency exchange 10W | Adrar Tazaina | 10 | Tioudiou | 10 | 3.10 | 45.50 | 31.90 | | | good |
| Orignal Total S/N | Marrakech | 10 | Tioudiou | 10 | 59.10 | - | - | 47.60 | 50.00 | good |
| Final Total S/N | Marrakech | 10 | Tioudiou | 10 | 59.10 | - | - | 46.00 | 49.00 | good |
| After frequency exchange 1W | Adrar Tazaina | 10 | Amenzal | 1 | 1.00 | 57.40 | 75.00 | | | good |
| Orignal Total S/N | Marrakech | 10 | Amenzal | 10 | 57.00 | - | - | 48.50 | 51.80 | good |
| Final Total S/N | Marrakech | 10 | Amenzal | 1 | 57.00 | - | - | 41.40 | 51.80 | good |
| Orignal | Marrakech | 10 | Aoulouss | 10 | 55.50 | - | 35.80 | 46.60 | 44.10 | good |
| After frequency exchange | Marrakech | 10 | Aoulouss | 10 | 55.50 | 36.50 | 32.00 | | | good |
| Antenna Changed | Marrakech | 10 | Aoulouss | 10 | 55.50 | 35.00 | 36.50 | 42.70 | 51.20 | good |
| After frequency exchange 1W | Aoulouss | 10 | Tourcht | 1 | 2.10 | 47.60 | 55.20 | | | good |
| Orignal Total S/N | Marrakech | 10 | Tourcht | 10 | 57.60 | - | - | 45.20 | 50.80 | good |
| Final Total S/N | Marrakech | 10 | Tourcht | 1 | 57.60 | - | - | 46.70 | 49.00 | good |
| Orignal | Aoulouss | 10 | Tazzitout | 10 | 4.30 | 51.90 | 53.60 | | | good |
| After frequency exchange 10W | Aoulouss | 10 | Tazzitout | 10 | 4.30 | 42.70 | 53.40 | | | good |
| Orignal Total S/N | Marrakech | 10 | Tazzitout | 10 | 59.80 | - | - | 45.80 | 51.10 | good |
| Final Total S/N | Marrakech | 10 | Tazzitout | 10 | 59.80 | - | - | 46.30 | 41.50 | good |

# Table 8.1.2 (1/2) TELEMETRY DATA OBTAINING RATE

## (1) Data Obtaining Rate before Frequency Exchnage

| Date | Tazaina Repeater | | | Agouns | | | Tiourdiou | | | Amenzal | | | Aoulouss repeater | | | Tourchi | | | Tazzitount | | | Condition |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Number of times for Data lacking | Number of times for Observation | Data Obtaining rate (%) | Number of times for Data lacking | Number of times for Observation | Data Obtaining rate (%) | Number of times for Data lacking | Number of times for Observation | Data Obtaining rate (%) | Number of times for Data lacking | Number of times for Observation | Data Obtaining rate (%) | Number of times for Data lacking | Number of times for Observation | Data Obtaining rate (%) | Number of times for Data lacking | Number of times for Observation | Data Obtaining rate (%) | Number of times for Data lacking | Number of times of Observation | Data Obtaining rate (%) | |
| 28-Jun-03 | 1 | 24 | 95.83 | - | - | - | - | - | - | 1 | 24 | 95.83 | 9 | 24 | 62.50 | - | - | - | - | - | - | Interference |
| 29-Jun-03 | 0 | 22 | 100.00 | - | - | - | - | - | - | 1 | 22 | 95.45 | 9 | 22 | 59.09 | - | - | - | - | - | - | Interference |
| 30-Jun-03 | 1 | 102 | 99.02 | - | - | - | - | - | - | 13 | 102 | 87.25 | 74 | 102 | 27.45 | 81 | 102 | 20.59 | - | - | - | Interference |
| 1-Jul-03 | 0 | 144 | 100.00 | - | - | - | - | - | - | 6 | 144 | 95.83 | 88 | 144 | 38.89 | 110 | 144 | 23.61 | - | - | - | Interference |
| 2-Jul-03 | 0 | 95 | 100.00 | - | - | - | - | - | - | 0 | 95 | 100.00 | 17 | 95 | 82.11 | 25 | 95 | 73.68 | 25 | 95 | 73.68 | Interference |
| 3-Jul-03 | 0 | 188 | 100.00 | - | - | - | - | - | - | 5 | 188 | 97.34 | 24 | 188 | 87.23 | 30 | 188 | 84.04 | 31 | 188 | 83.51 | Interference |
| 4-Jul-03 | 0 | 98 | 100.00 | - | - | - | 0 | 98 | 100.00 | 0 | 98 | 100.00 | 0 | 98 | 100.00 | 2 | 98 | 97.96 | 1 | 98 | 98.98 | Interference |
| 5-Jul-03 | 0 | 118 | 100.00 | - | - | - | 0 | 118 | 100.00 | 0 | 118 | 100.00 | 0 | 118 | 100.00 | 0 | 118 | 100.00 | 0 | 118 | 100.00 | |
| 6-Jul-03 | 0 | 38 | 100.00 | 0 | 38 | 100.00 | 3 | 38 | 92.11 | 0 | 38 | 100.00 | 0 | 38 | 100.00 | 0 | 38 | 100.00 | 0 | 38 | 100.00 | |
| 7-Jul-03 | 0 | 134 | 100.00 | 0 | 134 | 100.00 | 2 | 134 | 98.51 | 0 | 134 | 100.00 | 0 | 134 | 100.00 | 2 | 134 | 98.51 | 0 | 134 | 100.00 | Interference |
| 8-Jul-03 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 1 | 144 | 99.31 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | Interference |
| 9-Jul-03 | 0 | 80 | 100.00 | 0 | 80 | 100.00 | 0 | 80 | 100.00 | 0 | 80 | 100.00 | 0 | 80 | 100.00 | 0 | 80 | 100.00 | 0 | 80 | 100.00 | Interference |
| 10-Jul-03 | 0 | 70 | 100.00 | 1 | 70 | 98.57 | 1 | 70 | 98.57 | 0 | 70 | 100.00 | 0 | 70 | 100.00 | 0 | 70 | 100.00 | 0 | 70 | 100.00 | Interference |
| 11-Jul-03 | 0 | 102 | 100.00 | 3 | 102 | 97.06 | 0 | 102 | 100.00 | 0 | 102 | 100.00 | 0 | 102 | 100.00 | 0 | 102 | 100.00 | 0 | 102 | 100.00 | Thunderstorm |
| 12-Jul-03 | 0 | 143 | 100.00 | 0 | 143 | 100.00 | 0 | 143 | 100.00 | 0 | 143 | 100.00 | 0 | 143 | 100.00 | 0 | 143 | 100.00 | 0 | 143 | 100.00 | |
| 13-Jul-03 | 0 | 144 | 100.00 | 1 | 144 | 99.31 | 1 | 144 | 99.31 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | Thunderstorm |
| 14-Jul-03 | 0 | 141 | 100.00 | 0 | 141 | 100.00 | 0 | 141 | 100.00 | 0 | 141 | 100.00 | 0 | 141 | 100.00 | 0 | 141 | 100.00 | 0 | 141 | 100.00 | |
| 15-Jul-03 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | Frequency exchange for all stations |
| 16-Jul-03 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | |
| 17-Jul-03 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | |
| 18-Jul-03 | 0 | 143 | 100.00 | 0 | 71 | 100.00 | 1 | 143 | 99.30 | 1 | 143 | 99.30 | 3 | 143 | 97.90 | 4 | 143 | 97.20 | 3 | 143 | 97.90 | Thunderstorm |
| 19-Jul-03 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 2 | 144 | 98.61 | 0 | 144 | 100.00 | Operation miss |
| 20-Jul-03 | 0 | 143 | 100.00 | 0 | 143 | 100.00 | 0 | 143 | 100.00 | 0 | 143 | 100.00 | 0 | 143 | 100.00 | 0 | 143 | 100.00 | 0 | 143 | 100.00 | |
| 21-Jul-03 | 0 | 142 | 100.00 | 0 | 142 | 100.00 | 0 | 142 | 100.00 | 0 | 142 | 100.00 | 0 | 142 | 100.00 | 0 | 142 | 100.00 | 0 | 142 | 100.00 | |
| 22-Jul-03 | 0 | 118 | 100.00 | 0 | 118 | 100.00 | 0 | 118 | 100.00 | 0 | 118 | 100.00 | 0 | 118 | 100.00 | 0 | 118 | 100.00 | 0 | 118 | 100.00 | Antenna adjustment at Aoulouss repeater |
| **Average** | **2** | **2477** | **99.92** | **5** | **1614** | **99.69** | **9** | **1902** | **99.53** | **27** | **2477** | **98.91** | **224** | **2477** | **90.96** | **256** | **2431** | **89.47** | **60** | **2185** | **97.25** | |

# Table 8.1.2 (2/2) TELEMETRY DATA OBTAINING RATE

## (2) Data Obtaining Rate After Frequency Exchange

| Date | Tazaina Repeater | | | Agouns | | | Tiourdiou | | | Amenzal | | | Aoulouss repeater | | | Tourchi | | | Tazzitount | | | Condition |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Number of times for Data lacking | Number of times for Observation | Data Obtaining rate (%) | Number of times for Data lacking | Number of times for Observation | Data Obtaining rate (%) | Number of times for Data lacking | Number of times for Observation | Data Obtaining rate (%) | Number of times for Data lacking | Number of times for Observation | Data Obtaining rate (%) | Number of times for Data lacking | Number of times for Observation | Data Obtaining rate (%) | Number of times for Data lacking | Number of times for Observation | Data Obtaining rate (%) | Number of times for Data lacking | Number of times of Observation | Data Obtaining rate (%) | |
| 23-Jul-03 | 0 | 142 | 100.00 | 0 | 142 | 100.00 | 0 | 142 | 100.00 | 0 | 142 | 100.00 | 0 | 142 | 100.00 | 0 | 142 | 100.00 | 0 | 142 | 100.00 | |
| 24-Jul-03 | 0 | 139 | 100.00 | 0 | 139 | 100.00 | 0 | 139 | 100.00 | 0 | 139 | 100.00 | 0 | 139 | 100.00 | 0 | 139 | 100.00 | 1 | 139 | 99.28 | Thunderstorm |
| 25-Jul-03 | 1 | 102 | 99.02 | 0 | 102 | 100.00 | 0 | 102 | 100.00 | 0 | 102 | 100.00 | 0 | 102 | 100.00 | 0 | 102 | 100.00 | 0 | 102 | 100.00 | |
| 26-Jul-03 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | |
| 27-Jul-03 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | |
| 28-Jul-03 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | |
| 29-Jul-03 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 1 | 144 | 99.31 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | Thunderstorm |
| 30-Jul-03 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 1 | 144 | 99.31 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | Thunderstorm |
| 31-Jul-03 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | |
| 1-Aug-03 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | |
| 2-Aug-03 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | |
| 3-Aug-03 | 0 | 144 | 100.00 | 1 | 144 | 99.31 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 1 | 144 | 99.31 | 1 | 144 | 99.31 | 0 | 144 | 100.00 | Thunderstorm |
| 4-Aug-03 | 1 | 144 | 99.31 | 1 | 144 | 99.31 | 2 | 144 | 98.61 | 1 | 144 | 99.31 | 1 | 144 | 99.31 | 1 | 144 | 99.31 | 1 | 144 | 99.31 | Thunderstorm |
| 5-Aug-03 | 0 | 144 | 100.00 | 1 | 144 | 99.31 | 1 | 144 | 99.31 | 1 | 144 | 99.31 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | Thunderstorm |
| 6-Aug-03 | 0 | 144 | 100.00 | 2 | 144 | 98.61 | 1 | 144 | 99.31 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 1 | 144 | 99.31 | Thunderstorm |
| 7-Aug-03 | 0 | 144 | 100.00 | 1 | 144 | 99.31 | 0 | 144 | 100.00 | 1 | 144 | 99.31 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | Thunderstorm |
| 8-Aug-03 | 0 | 143 | 100.00 | 0 | 143 | 100.00 | 0 | 143 | 100.00 | 0 | 143 | 100.00 | 0 | 143 | 100.00 | 0 | 143 | 100.00 | 0 | 143 | 100.00 | Thunderstorm |
| 9-Aug-03 | 0 | 144 | 100.00 | 2 | 144 | 98.61 | 2 | 144 | 98.61 | 2 | 144 | 98.61 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | Thunderstorm |
| 10-Aug-03 | 1 | 144 | 99.31 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | |
| 11-Aug-03 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 1 | 144 | 99.31 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | |
| 12-Aug-03 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 1 | 144 | 99.31 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | |
| 13-Aug-03 | 0 | 144 | 100.00 | 1 | 144 | 99.31 | 1 | 144 | 99.31 | 1 | 144 | 99.31 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | Thunderstorm |
| 14-Aug-03 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | |
| 15-Aug-03 | 0 | 144 | 100.00 | 1 | 144 | 99.31 | 1 | 144 | 99.31 | 1 | 144 | 99.31 | 0 | 144 | 100.00 | 1 | 144 | 99.31 | 1 | 144 | 99.31 | Thunderstorm |
| 16-Aug-03 | 0 | 144 | 100.00 | 1 | 144 | 99.31 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 1 | 144 | 99.31 | 1 | 144 | 99.31 | Thunderstorm |
| 17-Aug-03 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | Thunderstorm |
| 18-Aug-03 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 1 | 144 | 99.31 | 0 | 144 | 100.00 | 1 | 144 | 99.31 | Thunderstorm |
| 19-Aug-03 | 5 | 144 | 96.53 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | |
| 20-Aug-03 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | |
| 21-Aug-03 | 1 | 144 | 99.31 | 1 | 144 | 99.31 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | |
| 22-Aug-03 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 1 | 144 | 99.31 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | |
| 23-Aug-03 | 1 | 144 | 99.31 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 1 | 144 | 99.31 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | |
| 24-Aug-03 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 2 | 144 | 98.61 | |
| 25-Aug-03 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 1 | 144 | 99.31 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | |
| 26-Aug-03 | 0 | 144 | 100.00 | 1 | 144 | 99.31 | 2 | 144 | 98.61 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | |
| 27-Aug-03 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | |
| 28-Aug-03 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | |
| 29-Aug-03 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | 0 | 144 | 100.00 | |
| **Average** | **10** | **5422** | **99.82** | **13** | **5422** | **99.76** | **13** | **5422** | **99.76** | **9** | **5422** | **99.83** | **5** | **5422** | **99.91** | **4** | **5422** | **99.93** | **8** | **5422** | **99.85** | |

## Table 9.3.1 (1/2) PERFORMANCE OF PILOT PROJECT FFWS DURING FLOODS

| Subsystem | Equipment/ Manual Operation | Input by Pilot Project | | 14 June 2003 (under Phase I System) | | | 4 August 2003 (under Phase II System) | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Item | Phase | Consumed Time (min) | Performance | Identified Problems | Consumed Time (min) | Performance | Identified Problems |
| Hydrological Observation and Data Collection (ABHT) | Equipment (Including Software) | Tipping Bucket Rainfall Gauge | I | 90 | A | None | 15 | unknown | A big gap of observed rainfall of 41.5 mm was identified between the automatic tipping bucket gauge and the manual gauge at the Tazzitount Station. |
| | | Ultrasonic Water Level Gauge | I | | A | None | | A | None |
| | | Remote Terminal Unit (RTU) | I | | B | • RTU of Agouns Station was not operational due to breakdown by lightning. | | A | None |
| | | VHF Data Transmission System | II | | N/a | N/a | | B | • A few data before and at the beginning of the rainfall were lost due to the interference by lightning. |
| | Manual Reading of Data on RTU and Verbal Communication between Stations and ABHT | Trainings and Guidelines | I&II | | D | • The radio operator of ABHT was absent when the Aghbalau Station tried to inform him of the occurrence of the flood. ABHT knew the flood only 2 hour later. | | D | • ABHT did not know the DMN Pre-alert Meaasage.<br>• ABHT could not contact the flood watch stations until about 1 hour after the beginning of the rainfall because the key of the radio room was not found. |
| Data Processing, Forecasting, Dissemination of Flood Information and Notices (ABHT) | Equipment (Including Software) | Data Processing System | I & II | 10 | A | None | 5 | A | None |
| | | Flood Forecasting Software | I | | C | • Accuracy is low. Modification of parameters is necessary after accumulation of hydrological data. | | C | The same as the 14 July Flood. |
| | | Flood Information Monitoring System (Dial-up Connection) | I | | C | • Only 2 monitoring stations of the 4 stations could access to ABHT simultaneously because only 2 telephone lines are available at ABHT. | | C | The same as the 14 July Flood. |
| | | Telemetry Supervisory System | II | | N/a | N/a | | A | None |
| | Dissemination of Flood Notices by Telephone/Fax | Training and Guidelines | I & II | | D | • ABHT informed only after the flood by telephone. Fax machine was inaccessible by the FFWS operation team. | | C | • ABHT informed only by telephone. Fax machine was inaccessible by the FFWS operation team. |

A: Excellent, B: good, C: Fair, D: Poor

## Table 9.3.1 (2/2) PERFORMANCE OF PILOT PROJECT FFWS DURING FLOODS

| Subsystem | Equipment/ Manual Operation | Input by Pilot Project | | 14 June 2003 (under Phase I System) | | | 4 August 2003 (under Phase II System) | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Item | Phase | Consumed Time (min) | Performance | Identified Problems | Consumed Time (min) | Performance | Identified Problems |
| Issuance of Warning (Province) | Issuance of Flood Warnings by Province | Training and Guidelines | I | 5 | C | • The Flood Information Display of the monitoring PC was not referred because the operators were not yet familiar with the operation of the display. | 5 | C | The same as the 14 July Flood. |
| Diffusion of Flood Warning (Province, Warning Post) | Equipment | VHF Radiotelephone at Iraghf Warning Post | I | 10 | N/a | Not the radiotelephone but a mobile telephone was used for communication. | 30 | N/a | Due to a breakdown of the Sidi Bou Outhamane Repeater Station, the radio network was not operational. |
| | | Warning Broadcasting Equipment at Warning Post | I | | A | None | | B | • A metal mast for suspending the cable from the warning post to the second laud speakers was crashed by debris, but broadcasting was still operational. |
| | | Selective Call System among Warning Post, Caidat and Provine | I & II | | N/a | N/a | | N/a | Due to a breakdown of the Sidi Bou Outhamane Repeater Station, the radio network was not operational. |
| | Dissemination of Flood Warnings | Trainings and Guidelines | I&II | | C | • The dissemination route (Province – Caidat - Warning Post) was different from that of the Global Simulation Drill in 2002 (directly Province – Warning Post).<br>• Communication between the warning post and the Province was not made. | | C | • The dissemination route (Province – Caidat - Warning Post) was different from that of the Global Simulation Drill (directly Province – Warning Post).<br>• The obscure direction confused the guardian of the warning post.<br>• The tape message of cancellation was broadcast at the warning post without any precaution or any evacuation advice. |
| Execution of Evacuation | Evacuation Activities | Trainings and Guidelines | I | 5 | C | • An evacuation organization has not been formed yet. | 10 | C | • An evacuation organization was not formed yet.<br>• Inhabitants and tourists evacuated by themselves before the broadcast. |
| Total System | Total Consumed Time from Detection of Occurrence of Flood/Rainfall to Evacuation | | | **30** | C | • ABHT could not contribute at all to the dissemination of flood information. (The network of the province worked in stead.) | **30** | C | • ABHT could have announced the flood notice 5 to 10 minutes earlier if they had contacted the Tazzitount Station.<br>• 30 minutes was wasted for convey the flood warning from the province to the warning post via the khalifa of Ourika Caidat. |

A: Excellent, B: good, C: Fair, D: Poor

**Table 9.3.2 MAJOR TROUBLES OF EQUIPMENT AND THEIR MEASURES DURING EXPERIMENTAL OPERATION**

| Subsystem | Station | Troubled Equipment | Trouble of Equipment | | | Measure | |
|---|---|---|---|---|---|---|---|
| | | | Date of Occurrence | Trouble | Assumed Cause | Date | Measure |
| Data Processing | Master Information Center (ABHT) | Connection between the client PC and the Server | 15 Aug. 2002 | No connection | Mis-opeation of the client PC | 4 Sep. 2002 | Restoration by Sohime under direction of JRC |
| Data Processing | Master Information Center (ABHT) | Switching Hub | 15 Aug. 2002 | Failure | High temperature in the room | unknown | Naturally restored |
| Hydraulic Observation and Data Collection | Agouns | Remote Terminal Unit (RTU) | May 2003 | Breakdown of DC/CD Converter | Over-voltage caused by lightening | May 2003 | Replacement of the broken RTU with the spare one by ABHT technician. |
| | | | | | | 5 July 2003 | Replacement of three circuits with newly modified ones by Study Team (JRC) |
| Hydraulic Observation and Data Collection | Amenzal | Remote Terminal Unit (RTU) | June 2003 | Breakdown of DC/CD Converter | Over-voltage caused by lightening | 18 June 2003 | Replacement of three circuit boards with newly modified ones by Study Team (JRC) |
| Diffusion of Flood Warning | Iraghf Warning Post | DC UPS | June 2003 | Not charged. | Low and unstable voltage of power supply | July 2003 | Provision of an automatic voltage regulator by Study Team |
| Diffusion of Flood Warning | Iraghf Warning Post | One metal mast for supporting the cable between the post and the second laud speakers. | 4 Aug. 2003 | Crushed by debris | Debris flow during the rainstorm | 21 Aug. 2003 | Replacement of the metal mast with two concrete masts by the Study Team |
| Diffusion of Flood Warning | Iraghf Warning Post | Radiotelephone | Aug. 2003 | Unstable communication with Caidat and Province | Low signal strength | 18 Aug. 2003 | Replacement of the non-directional antenna with a directional antenna by Study Team. |

Sohime : The Moroccan company that signed the maintenance contract of the Pilot Project equipment with DGH.
JRC: Japan Radio Co., Ltd, the Japanese supplier of the Pilot Project equipment

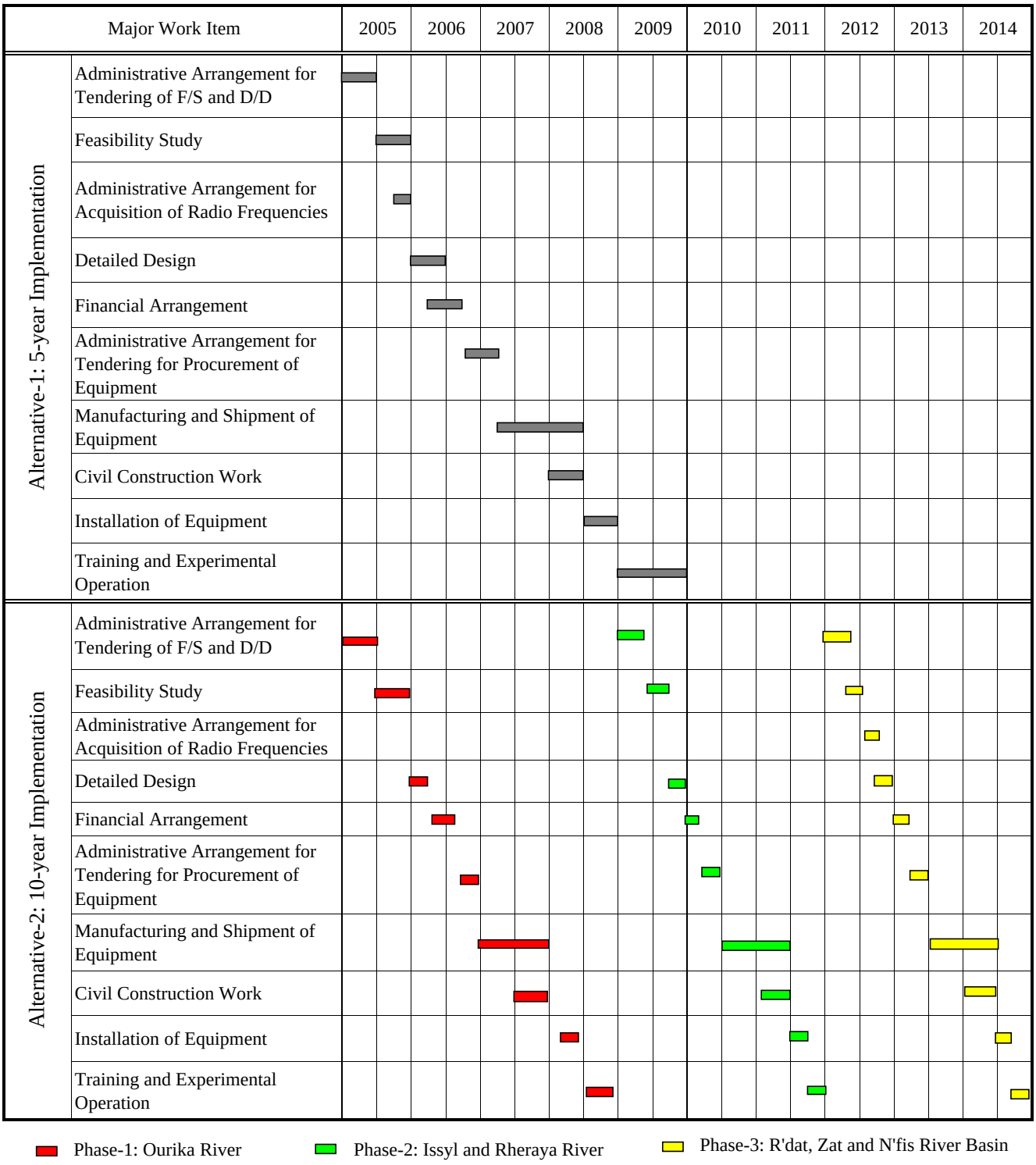
**Table 9.3.3 FLOODS EXCEEDING PRE-ALERT AND ALERT LEVELS**

| Date | Tourcht | | | Agouns | | | Tiourdiou | | | | Amenzal | | | | Tazzitount | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Rainfall (mm) | | | Rainfall (mm) | | | Rainfall (mm) | | | Water Level (cm) | Rainfall (mm) | | | Water Level (cm) | Rainfall (mm) | | | Water Level (cm) |
| | 10 min. | 60 min. | Hourly | 10 min. | 60 min. | Hourly | 10 min. | 60 min. | Hourly | | 10 min. | 60 min. | Hourly | | 10 min. | 60 min. | Hourly | |
| 2002/4/11 | N/a | N/a | 5 | N/a | N/a | 0 | N/a | N/a | 4 | 337 | N/a | N/a | 2 | Data Lacking | N/a | N/a | 10 | 338 |
| 2002/8/5 | N/a | N/a | 0 | N/a | N/a | 1 | N/a | N/a | 3 | 250 | N/a | N/a | 0 | Data Lacking | N/a | N/a | 10 | 306 |
| 2002/8/31 | N/a | N/a | 1 | N/a | N/a | 14 | N/a | N/a | 2 | 232 | N/a | N/a | 3 | Data Lacking | N/a | N/a | 1 | 305 |
| 2002/11/15 | N/a | N/a | 5 | N/a | N/a | 4 | N/a | N/a | 4 | 244 | N/a | N/a | 3 | Data Lacking | N/a | N/a | 11 | 314 |
| 2003/6/14 | N/a | N/a | 6 | N/a | N/a | 28 | N/a | N/a | 1 | 291 | N/a | N/a | 0 | Data Lacking | N/a | N/a | 0 | 330 |
| 2003/6/15 | N/a | N/a | 0 | N/a | N/a | 2 | N/a | N/a | 15 | 291 | N/a | N/a | 0 | Data Lacking | N/a | N/a | 0 | 332 |
| 2003/8/4 | 14 | 19 | 19 | 6 | 21 | 21 | 24 | 28 | 27 | 336 | 3 | 9 | 9 | 1,079 | 24 | 45 | 42 | 412 |
| 2003/8/6 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 340 | 4 | 6 | 6 | 1,088 | 0 | 0 | 0 | 318 |
| 2003/8/9 | 1 | 1 | 1 | 5 | 13 | 10 | 3 | 5 | 5 | 355 | 1 | 1 | 1 | 1,094 | 8 | 18 | 17 | 322 |
| 2003/8/10 | 3 | 6 | 5 | 3 | 11 | 11 | 4 | 9 | 8 | 310 | 2 | 5 | 5 | 1,107 | 1 | 2 | 1 | 322 |
| 2003/8/12 | 1 | 1 | 1 | 6 | 8 | 8 | 1 | 3 | 3 | 297 | 5 | 17 | 10 | 1,117 | 1 | 1 | 1 | 323 |
| 2003/8/13 | 5 | 16 | 16 | 0 | 0 | 0 | 0 | 0 | 0 | 294 | 0 | 0 | 0 | 1,114 | 1 | 0 | 0 | 316 |

Note: Data Preiod is about 21 months from 15 December 2001 to 9 September 2003.

: Over the Pre-alert Level  : Over the Alert Level

## Table 10.4.1 IMPLEMENTATION SCHEDULE OF MASTER PLAN



## TABLE 10.4.2 EQUIPMENT COST OF MODIFIED MASTER PLAN AFTER PILOT PROJECT

| Item | Sub-system | Station | Nos. | Equipemnt | Unit Cost (Dhs) | Phase-1 (Ourika River Basin) | | Phase-2 (Issyl, Rheraya River Basins) | | Phase-3 (R'datt, Zat, N'fis River Basins) | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Q'ty | Amount (Dhs) | Q'ty | Amount (Dhs) | Q'ty | Amount (Dhs) | Q'ty | Amount (Dhs) |
| 1 | Data Processing Sub-system | Data Processing Equipment | 1 | Modification of Software | L.S. | 1 | 300,000 | 1 | 300,000 | 1 | 300,000 | 3 | 900,000 |
| | | Telemetry S/V Equipment | 2 | Modification of Telemetry S/V Equipment | L.S. | 1 | 300,000 | 1 | 300,000 | 1 | 300,000 | 3 | 900,000 |
| | | Monitoring Station | 3 | Client PC with MODEM | 34,500 | 0 | 0 | 2 | 69,000 | 2 | 69,000 | 4 | 138,000 |
| | | **Total for Item 1** | | | | | **600,000** | | **669,000** | | **669,000** | | **1,938,000** |
| 2 | Data Collection Sub-system | Rain Gauging Station | 1 | Rainfall Guaging Equipment | 10,000 | 4 | 40,000 | 1 | 10,000 | 2 | 20,000 | 7 | 70,000 |
| | | | 2 | Remote Terminal Equipment | 188,000 | 4 | 752,000 | 1 | 188,000 | 2 | 376,000 | 7 | 1,316,000 |
| | | | 3 | Telemetry Radio Equipment | 190,000 | 4 | 760,000 | 1 | 190,000 | 2 | 380,000 | 7 | 1,330,000 |
| | | Rain & Water Level Gauging Station (Separate Type) | 4 | Rainfall Guaging & Water Level Equipment | 416,000 | 2 | 832,000 | 3 | 1,248,000 | 3 | 1,248,000 | 8 | 3,328,000 |
| | | | 5 | Remote Terminal Equipment | 188,000 | 2 | 376,000 | 3 | 564,000 | 3 | 564,000 | 8 | 1,504,000 |
| | | | 6 | Telemetry Radio Equipment | 190,000 | 2 | 380,000 | 3 | 570,000 | 3 | 570,000 | 8 | 1,520,000 |
| | | Telemetry Repeater | 8 | Repeater Equipment | 687,000 | 1 | 687,000 | 1 | 687,000 | 1 | 687,000 | 3 | 2,061,000 |
| | | **Total for Item 2** | | | | | **3,827,000** | | **3,457,000** | | **3,845,000** | | **11,129,000** |
| 3 | Warning Dissemination Sub-system | Warning Supervisory & Control Station (Provincial Office) | 1 | Warning Supervisory &Control Equipment | 1,217,000 | 1 | 1,217,000 | 0 | 0 | 0 | 0 | 1 | 1,217,000 |
| | | Remore Controled Warning Post | 3 | Warning Equipment | 280,000 | 6 | 1,680,000 | 0 | 0 | 0 | 0 | 6 | 1,680,000 |
| | | | 4 | Radio and antenna equipment | 350,000 | 6 | 2,100,000 | 0 | 0 | 0 | 0 | 6 | 2,100,000 |
| | | Manual Warning Post | 5 | Warning Equipment | 140,000 | 0 | 0 | 6 | 840,000 | 5 | 700,000 | 11 | 1,540,000 |
| | | | 6 | Warning VHF Radio Equipment | 110,000 | 0 | 0 | 6 | 660,000 | 5 | 550,000 | 11 | 1,210,000 |
| | | Warning Repeater | 7 | Repeater Equipment | 687,000 | 1 | 687,000 | 1 | 687,000 | 1 | 687,000 | 3 | 2,061,000 |
| | | VHF Radio Repeater | 8 | Radio and antenna equipment | 238,000 | 1 | 238,000 | 0 | 0 | 1 | 238,000 | 2 | 476,000 |
| | | **Total for Item 3** | | | | | **5,922,000** | | **2,187,000** | | **2,175,000** | | **10,284,000** |
| 4 | All Sub-system | Test Instruments | 1 | Telemetry and Warning system | 400,000 | 1 | 400,000 | 0 | 0 | 0 | 0 | 1 | 400,000 |
| | | | 2 | Data Processing System | 100,000 | 1 | 100,000 | 0 | 0 | 0 | 0 | 1 | 100,000 |
| | | | | **Sub-total** | | | **500,000** | | **0** | | **0** | | **500,000** |
| | | Spare Parts | 3 | Telemetry system | L.S. | 1 | 500,000 | 1 | 250,000 | 1 | 250,000 | 3 | 1,000,000 |
| | | | 4 | Warning system | L.S. | 1 | 450,000 | 1 | 250,000 | 1 | 270,000 | 1 | 970,000 |
| | | | 5 | Data Processing system | L.S. | 1 | 50,000 | 1 | 50,000 | 1 | 50,000 | 1 | 150,000 |
| | | | 6 | Radio equipment | L.S. | 1 | 283,000 | 0 | | 0 | | 1 | 283,000 |
| | | | | **Sub-total** | | | **1,283,000** | | **550,000** | | **570,000** | | **2,403,000** |
| | | | 8 | For Data Collection Sub- | L.S. | 1 | 720,000 | 1 | 350,000 | 1 | 350,000 | 1 | 1,420,000 |
| | | | 9 | For Warning Dissemination Sub-system | L.S. | 1 | 645,000 | 1 | 285,000 | 1 | 320,000 | 1 | 1,250,000 |
| | | | | **Sub-total** | | | **1,365,000** | | **635,000** | | **670,000** | | **2,670,000** |
| | | **Total for Item 4** | | | | | **3,148,000** | | **1,185,000** | | **1,240,000** | | **5,573,000** |
| | | **TOTAL OF FOUR ITEMS** | | | | | **13,497,000** | | **7,498,000** | | **7,929,000** | | **28,924,000** |

## Table 10.4.3 EQUIPMENT COST OF MODIFIEDT MASTER PLAN BY AGENCY

| Item | Sub-system | Station | Nos. | Equipemnt | Unit Cost (Dhs) | ABHT | | AL HAOUZ | | SYB ALI | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Q'ty | Amount (Dhs) | Q'ty | Amount (Dhs) | Q'ty | Amount (Dhs) | Q'ty | Amount (Dhs) |
| 1 | Data Processing Sub-system | DRHT | 1 | Data Processing System | 3,286,300 | 1 | 3,286,300 | 0 | 0 | 0 | 0 | 1 | 3,286,300 |
| | | | 2 | Telemetry Supervisory and Control Equipment | 1,164,200 | 1 | 1,164,200 | 0 | 0 | 0 | 0 | 1 | 1,164,200 |
| | | Monitoring Stations | 3 | Client PC with MODEM | 34,500 | 2 | 69,000 | 5 | 172,500 | 1 | 34,500 | 8 | 276,000 |
| | | **Total for Item 1** | | | | | **4,519,500** | | **172,500** | | **34,500** | | **4,726,500** |
| 2 | Data Collection Sub-system | Rain Gauging Station | 1 | Rainfall Guaging Equipment | 10,000 | 8 | 80,000 | 0 | 0 | 0 | 0 | 8 | 80,000 |
| | | | 2 | Remote Terminal Equipment | 188,000 | 8 | 1,504,000 | 0 | 0 | 0 | 0 | 8 | 1,504,000 |
| | | | 3 | Telemetry Radio Equipment | 190,000 | 8 | 1,520,000 | 0 | 0 | 0 | 0 | 8 | 1,520,000 |
| | | Rain & Water Level Gauging Station (Separate Type) | 4 | Rainfall Guaging & Water Level Equipment | 923,000 | 12 | 11,076,000 | 0 | 0 | 0 | 0 | 12 | 11,076,000 |
| | | | 5 | Remote Terminal Equipment | 188,000 | 12 | 2,256,000 | 0 | 0 | 0 | 0 | 12 | 2,256,000 |
| | | | 6 | Telemetry Radio Equipment | 190,000 | 12 | 2,280,000 | 0 | 0 | 0 | 0 | 12 | 2,280,000 |
| | | VHF Radio Repeater Station | 7 | VHF Radio relay equipment | 160,000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | Telemetry Repeater Station | 8 | Repeater Equipment | 687,000 | 5 | 3,435,000 | 0 | 0 | 0 | 0 | 5 | 3,435,000 |
| | | Exspansion of Existing Gauges and Radiotelephone | 9 | Storage Type Rain Gauge | 5,000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | 10 | Radiotelephone | 30,000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | 11 | Staff Gauge Type Water Level Gauge | 10,000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | **Total for Item 2** | | | | | **22,151,000** | | **0** | | **0** | | **22,151,000** |
| 3 | Warning Dissemination Sub-system | Warning Supervisory & Control Station (Provincial Office) | 1 | Warning Supervisory &Control Equipment | 1,217,000 | 0 | 0 | 1 | 1,217,000 | 0 | 0 | 1 | 1,217,000 |
| | | Warning Supervisory & Control Station (Caidat) | 2 | Simple Warning Control Equipment | 600,000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | Remore Controled Warning Post | 3 | Warning Equipment | 280,000 | 0 | 0 | 6 | 1,680,000 | 0 | 0 | 6 | 1,680,000 |
| | | | 4 | Radio and antenna equipment | 350,000 | 0 | 0 | 6 | 2,100,000 | 0 | 0 | 6 | 2,100,000 |
| | | Manual Warning Post | 5 | Warning Equipment | 140,000 | 0 | 0 | 8 | 1,120,000 | 3 | 420,000 | 11 | 1,540,000 |
| | | | 6 | Warning VHF Radio Equipment | 110,000 | 0 | 0 | 8 | 880,000 | 3 | 330,000 | 11 | 1,210,000 |
| | | Warning Repeater Station | 7 | Repeater Equipment | 687,000 | 0 | 0 | 3 | 2,061,000 | 0 | 0 | 3 | 2,061,000 |
| | | VHF Radio Relay Station | 8 | Radio and antenna equipment | 238,000 | 0 | 0 | 2 | 476,000 | 0 | 0 | 2 | 476,000 |
| | | VHF Radio equipment | 9 | Radio and antenna equipment | 55,000 | 0 | 0 | 14 | 770,000 | 3 | 165,000 | 17 | 935,000 |
| | | **Total for Item 3** | | | | | **0** | | **9,534,000** | | **750,000** | | **10,284,000** |
| 4 | All Sub-system | Test Instruments | 1 | Telemetry and Warning system | 400,000 | 1 | 400,000 | 0 | 0 | 0 | 0 | 1 | 400,000 |
| | | | 2 | Data Processing System | 100,000 | 1 | 100,000 | 0 | 0 | 0 | 0 | 1 | 100,000 |
| | | | | **Sub-total** | | | **500,000** | | **0** | | **0** | | **500,000** |
| | | Spare Parts | 3 | Telemetry system | L.S. | 1 | 1,000,000 | 0 | 0 | 0 | 0 | 1 | 1,000,000 |
| | | | 4 | Warning system | L.S. | 0 | 0 | 0 | 870,000 | 0 | 100,000 | 1 | 970,000 |
| | | | 5 | Data Processing system | L.S. | 1 | 50,000 | 0 | 0 | 0 | 0 | 1 | 50,000 |
| | | | 6 | Radio equipment | L.S. | 1 | 283,000 | 0 | 0 | 0 | 0 | 1 | 283,000 |
| | | | | **Sub-total** | | | **1,333,000** | | **870,000** | | **100,000** | | **2,303,000** |
| | | Installation Materials | 7 | For Data Processing Sub-system | L.S. | 1 | 115,000 | 0 | 0 | 0 | 0 | 1 | 115,000 |
| | | | 8 | For Data Collection Sub-system | L.S. | 1 | 1,420,000 | 0 | 0 | 0 | 0 | 1 | 1,420,000 |
| | | | 9 | For Warning Dissemination Sub-system | L.S. | 0 | 0 | 1 | 230,000 | 1 | 20,000 | 1 | 250,000 |
| | | | | **Sub-total** | | | **1,535,000** | | **230,000** | | **20,000** | | **1,785,000** |
| | | **Total for Item 4** | | | | | **3,368,000** | | **1,100,000** | | **120,000** | | **4,588,000** |
| | | **TOTAL OF FOUR ITEMS** | | | | | **30,038,500** | | **10,806,500** | | **904,500** | | **41,749,500** |

## Table 10.5.1 FINANCIAL COST SUMMARY (MODIFIED MASTER PLAN)

(Dh '000)

| Item | Net Price | VAT | Total |
|---|---|---|---|
| A. Construction Cost | 37,097 | 7,227 | 44,324 |
| (1) Equipment | 28,924 | 5,785 | 34,709 |
| (2) Installation & Commissioning of Equipment | 3,503 | 701 | 4,203 |
| (3) Facility Construction | 3,208 | 449 | 3,657 |
| (4) Software Development | 731 | 146 | 878 |
| (5) Technical Training | 731 | 146 | 878 |
| B. Engineering Service | 8,971 | 1,794 | 10,765 |
| C. Total Construction Cost (A+B) | 46,068 | 9,021 | 55,089 |
| D. Physical Contingency (10% of C) | 4,607 | - | 5,509 |
| E. Total Construction Cost (C+D) | 50,675 | 9,021 | 60,598 |
| F. Land Acquisition Cost | — | — | — |
| G. Compensation Cost | — | — | — |
| H. Project Cost | **50,675** | **9,021** | **60,598** |

VAT Rate 1) Equipment supply: 20%
2) Facility construction: 14%
3) Consulting services: 20%

Note: Cost of the Pilot Project is excluded.

Source: JICA Study Team

## Table 10.5.2 ECONOMIC COST SUMMARY (MODIFIED MASTER PLAN)

(Dh '000 for costs)

| Item | Financial Cost | Conversion Factor Applied | Economic Cost |
|---|---|---|---|
| A. Construction Cost | 44,324 | — | 28,436 |
| (1) Equipment | 34,709 | 0.63 | 21,867 |
| (2) Installation & Commissioning of Equipment | 4,203 | 0.83 | 2,648 |
| (3) Facility Construction | 3,657 | 0.77 | 2,816 |
| (4) Software Development | 878 | 0.83 | 553 |
| (5) Technical Training | 878 | 0.83 | 553 |
| B. Engineering Service | 10,765 | 0.83 | 8,935 |
| C. Total Construction Cost (A+B) | 55,089 | — | 37,371 |
| D. Physical Contingency (10% of C) | 5,509 | — | 3,737 |
| E. Total Construction Cost (C+D) | 60,598 | — | 41,108 |
| F. Land Acquisition Cost | — | — | — |
| G. Compensation Cost | — | — | — |
| H. Project Cost | **60,598** | — | **41,108** |

Note: Cost of the Pilot Project is excluded.

Source: JICA Study Team

## Table 10.5.3 CASH FLOW (MODIFIED MASTER PLAN ALTERNATIVE-1)

(Dh million)

| Year | Benefit | Cost | | | | Net Benefit | Description |
|---|---|---|---|---|---|---|---|
| | | Initial | O&M | Replace | Total | | |
| 2005 | | 4.91 | | | 4.91 | -4.91 | Engineering service |
| 2006 | | 4.91 | | | 4.91 | -4.91 | Engineering service |
| 2007 | | 24.05 | | | 24.05 | -24.05 | Procurement of equipment |
| 2008 | | 6.62 | | | 6.62 | -6.62 | Installation of equipment |
| 2009 | 0.53 | 0.61 | 1.20 | | 1.81 | -1.29 | Training |
| 2010 | 0.53 | | 1.20 | | 1.20 | -0.68 | |
| 2011 | 0.53 | | 1.20 | | 1.20 | -0.68 | |
| 2012 | 0.53 | | 1.20 | | 1.20 | -0.68 | |
| 2013 | 0.53 | | 1.20 | | 1.20 | -0.68 | |
| 2014 | 0.53 | | 1.20 | | 1.20 | -0.68 | |
| 2015 | 0.53 | | 1.20 | | 1.20 | -0.68 | |
| 2016 | 0.53 | | 1.20 | | 1.20 | -0.68 | |
| 2017 | 0.53 | | 1.20 | | 1.20 | -0.68 | |
| 2018 | 0.53 | | 1.20 | 24.05 | 25.26 | -24.73 | |
| 2019 | 0.53 | | 1.20 | | 1.20 | -0.68 | |
| 2020 | 0.53 | | 1.20 | | 1.20 | -0.68 | |
| 2021 | 0.53 | | 1.20 | | 1.20 | -0.68 | |
| 2022 | 0.53 | | 1.20 | | 1.20 | -0.68 | |
| 2023 | 0.53 | | 1.20 | | 1.20 | -0.68 | |
| 2024 | 0.53 | | 1.20 | | 1.20 | -0.68 | |
| 2025 | 0.53 | | 1.20 | | 1.20 | -0.68 | |
| 2026 | 0.53 | | 1.20 | | 1.20 | -0.68 | |
| 2027 | 0.53 | | 1.20 | | 1.20 | -0.68 | |
| 2028 | 0.53 | | 1.20 | 24.05 | 25.26 | -24.73 | |
| 2029 | 0.53 | | 1.20 | | 1.20 | -0.68 | |
| 2030 | 0.53 | | 1.20 | | 1.20 | -0.68 | |
| 2031 | 0.53 | | 1.20 | | 1.20 | -0.68 | |
| 2032 | 0.53 | | 1.20 | | 1.20 | -0.68 | |
| 2033 | 0.53 | | 1.20 | | 1.20 | -0.68 | |
| 2034 | 0.53 | | 1.20 | -9.62 | -8.42 | 8.94 | |

## Table 10.5.4 CASH FLOW (MODIFIED MASTER PLAN ALTERNATIVE-2)

(Dh million)

| Year | Phase 1 | | | | | Phase 2 | | | | | Phase 3 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Benefit | Cost | | | | Benefit | Cost | | | | Benefit | Cost | | | | Benefit | Cost | Net Benefit | Descirption |
| | | Initial | O&M | Replace | Total | | Initial | O&M | Replace | Total | | Initial | O&M | Replace | Total | Total | Total | | |
| 2005 | | 2.29 | | | 2.29 | | | | | | | | | | | 0.00 | 2.29 | -2.29 | Engieering service |
| 2006 | | 2.29 | | | 2.29 | | | | | | | | | | | 0.00 | 2.29 | -2.29 | Engieering service |
| 2007 | | 17.84 | | | 17.84 | | | | | | | | | | | 0.00 | 17.84 | -17.84 | Installation of equipment |
| 2008 | 0.24 | 0.61 | 0.56 | | 1.17 | | | | | | | | | | | 0.24 | 1.17 | -0.93 | Training |
| 2009 | 0.24 | | 0.56 | | 0.56 | | 2.55 | | | 2.55 | | | | | | 0.24 | 3.11 | -2.86 | Engieering service |
| 2010 | 0.24 | | 0.56 | | 0.56 | | 7.98 | | | 7.98 | | | | | | 0.24 | 8.54 | -8.30 | Installation of equipment |
| 2011 | 0.24 | | 0.56 | | 0.56 | 0.14 | 0.16 | 0.31 | | 0.47 | | | | | | 0.38 | 1.03 | -0.65 | Training |
| 2012 | 0.24 | | 0.56 | | 0.56 | 0.14 | | 0.31 | | 0.31 | | 2.69 | | | 2.69 | 0.38 | 3.57 | -3.19 | Engieering service |
| 2013 | 0.24 | | 0.56 | | 0.56 | 0.14 | | 0.31 | | 0.31 | | 8.44 | | | 8.44 | 0.38 | 9.32 | -8.94 | Installation of equipment |
| 2014 | 0.24 | | 0.56 | | 0.56 | 0.14 | | 0.31 | | 0.31 | 0.14 | 0.17 | 0.33 | | 0.50 | 0.53 | 1.37 | -0.84 | Training |
| 2015 | 0.24 | | 0.56 | | 0.56 | 0.14 | | 0.31 | | 0.31 | 0.14 | | 0.33 | | 0.33 | 0.53 | 1.20 | -0.68 | |
| 2016 | 0.24 | | 0.56 | | 0.56 | 0.14 | | 0.31 | | 0.31 | 0.14 | | 0.33 | | 0.33 | 0.53 | 1.20 | -0.68 | |
| 2017 | 0.24 | | 0.56 | | 0.56 | 0.14 | | 0.31 | | 0.31 | 0.14 | | 0.33 | | 0.33 | 0.53 | 1.20 | -0.68 | |
| 2018 | 0.24 | | 0.56 | 11.22 | 11.79 | 0.14 | | 0.31 | | 0.31 | 0.14 | | 0.33 | | 0.33 | 0.53 | 12.43 | -11.90 | |
| 2019 | 0.24 | | 0.56 | | 0.56 | 0.14 | | 0.31 | | 0.31 | 0.14 | | 0.33 | | 0.33 | 0.53 | 1.20 | -0.68 | |
| 2020 | 0.24 | | 0.56 | | 0.56 | 0.14 | | 0.31 | 6.24 | 6.55 | 0.14 | | 0.33 | | 0.33 | 0.53 | 7.44 | -6.91 | |
| 2021 | 0.24 | | 0.56 | | 0.56 | 0.14 | | 0.31 | | 0.31 | 0.14 | | 0.33 | | 0.33 | 0.53 | 1.20 | -0.68 | |
| 2022 | 0.24 | | 0.56 | | 0.56 | 0.14 | | 0.31 | | 0.31 | 0.14 | | 0.33 | | 0.33 | 0.53 | 1.20 | -0.68 | |
| 2023 | 0.24 | | 0.56 | | 0.56 | 0.14 | | 0.31 | | 0.31 | 0.14 | | 0.33 | 6.59 | 6.92 | 0.53 | 7.80 | -7.27 | |
| 2024 | 0.24 | | 0.56 | | 0.56 | 0.14 | | 0.31 | | 0.31 | 0.14 | | 0.33 | | 0.33 | 0.53 | 1.20 | -0.68 | |
| 2025 | 0.24 | | 0.56 | | 0.56 | 0.14 | | 0.31 | | 0.31 | 0.14 | | 0.33 | | 0.33 | 0.53 | 1.20 | -0.68 | |
| 2026 | 0.24 | | 0.56 | | 0.56 | 0.14 | | 0.31 | | 0.31 | 0.14 | | 0.33 | | 0.33 | 0.53 | 1.20 | -0.68 | |
| 2027 | 0.24 | | 0.56 | | 0.56 | 0.14 | | 0.31 | | 0.31 | 0.14 | | 0.33 | | 0.33 | 0.53 | 1.20 | -0.68 | |
| 2028 | 0.24 | | 0.56 | 11.22 | 11.79 | 0.14 | | 0.31 | | 0.31 | 0.14 | | 0.33 | | 0.33 | 0.53 | 12.43 | -11.90 | |
| 2029 | 0.24 | | 0.56 | | 0.56 | 0.14 | | 0.31 | | 0.31 | 0.14 | | 0.33 | | 0.33 | 0.53 | 1.20 | -0.68 | |
| 2030 | 0.24 | | 0.56 | | 0.56 | 0.14 | | 0.31 | 6.24 | 6.55 | 0.14 | | 0.33 | | 0.33 | 0.53 | 7.44 | -6.91 | |
| 2031 | 0.24 | | 0.56 | | 0.56 | 0.14 | | 0.31 | | 0.31 | 0.14 | | 0.33 | | 0.33 | 0.53 | 1.20 | -0.68 | |
| 2032 | 0.24 | | 0.56 | | 0.56 | 0.14 | | 0.31 | | 0.31 | 0.14 | | 0.33 | | 0.33 | 0.53 | 1.20 | -0.68 | |
| 2033 | 0.24 | | 0.56 | | 0.56 | 0.14 | | 0.31 | | 0.31 | 0.14 | | 0.33 | 6.59 | 6.92 | 0.53 | 7.80 | -7.27 | |
| 2034 | 0.24 | | 0.56 | -4.49 | -3.93 | 0.14 | | 0.31 | -3.74 | -3.43 | 0.14 | | 0.33 | -5.28 | -4.95 | 0.53 | -12.30 | 12.83 | |

**Table 10.5.5 CASH FLOW**
**(INCLUDING VALUE OF HUMAN LIVES MODIFIED MASTER PLAN ALTERNATIVE-1)**

(Dh million)

| Year | Benefit | Cost | | | | Net Benefit | Description |
|---|---|---|---|---|---|---|---|
| | | Initial | O&M | Replace | Total | | |
| 2005 | | 4.91 | | | 4.91 | -4.91 | Engineering service |
| 2006 | | 4.91 | | | 4.91 | -4.91 | Engineering service |
| 2007 | | 24.05 | | | 24.05 | -24.05 | Installation of equipment |
| 2008 | | 6.62 | | | 6.62 | -6.62 | Training |
| 2009 | 10.71 | 0.61 | 1.20 | | 1.81 | 8.90 | |
| 2010 | 10.71 | | 1.20 | | 1.20 | 9.51 | |
| 2011 | 10.71 | | 1.20 | | 1.20 | 9.51 | |
| 2012 | 10.71 | | 1.20 | | 1.20 | 9.51 | |
| 2013 | 10.71 | | 1.20 | | 1.20 | 9.51 | |
| 2014 | 10.71 | | 1.20 | | 1.20 | 9.51 | |
| 2015 | 10.71 | | 1.20 | | 1.20 | 9.51 | |
| 2016 | 10.71 | | 1.20 | | 1.20 | 9.51 | |
| 2017 | 10.71 | | 1.20 | | 1.20 | 9.51 | |
| 2018 | 10.71 | | 1.20 | 24.05 | 25.26 | -14.55 | |
| 2019 | 10.71 | | 1.20 | | 1.20 | 9.51 | |
| 2020 | 10.71 | | 1.20 | | 1.20 | 9.51 | |
| 2021 | 10.71 | | 1.20 | | 1.20 | 9.51 | |
| 2022 | 10.71 | | 1.20 | | 1.20 | 9.51 | |
| 2023 | 10.71 | | 1.20 | | 1.20 | 9.51 | |
| 2024 | 10.71 | | 1.20 | | 1.20 | 9.51 | |
| 2025 | 10.71 | | 1.20 | | 1.20 | 9.51 | |
| 2026 | 10.71 | | 1.20 | | 1.20 | 9.51 | |
| 2027 | 10.71 | | 1.20 | | 1.20 | 9.51 | |
| 2028 | 10.71 | | 1.20 | 24.05 | 25.26 | -14.55 | |
| 2029 | 10.71 | | 1.20 | | 1.20 | 9.51 | |
| 2030 | 10.71 | | 1.20 | | 1.20 | 9.51 | |
| 2031 | 10.71 | | 1.20 | | 1.20 | 9.51 | |
| 2032 | 10.71 | | 1.20 | | 1.20 | 9.51 | |
| 2033 | 10.71 | | 1.20 | | 1.20 | 9.51 | |
| 2034 | 10.71 | | 1.20 | -9.62 | -8.42 | 19.13 | |

## Table 10.5.6 CASH FLOW
## (INCLUDING VALUE OF HUMAN LIVES MODIFIED MASTER PLAN ALTERNATIVE-2)

(Dh million)

| Year | Phase 1 | | | | | Phase 2 | | | | | Phase 3 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Benefit | Cost | | | | Benefit | Cost | | | | Benefit | Cost | | | | Benefit | Cost | Net Benefit | Descirption |
| | | Initial | O&M | Replace | Total | | Initial | O&M | Replace | Total | | Initial | O&M | Replace | Total | Total | Total | | |
| 2005 | | 2.29 | | | 2.29 | | | | | | | | | | | 0.00 | 2.29 | -2.29 | Engieering service |
| 2006 | | 2.29 | | | 2.29 | | | | | | | | | | | 0.00 | 2.29 | -2.29 | Engieering service |
| 2007 | | 14.24 | | | 14.24 | | | | | | | | | | | 0.00 | 14.24 | -14.24 | Installation of equipment |
| 2008 | 4.98 | 0.28 | 0.56 | | 0.85 | | | | | | | | | | | 4.98 | 0.85 | 4.13 | Training |
| 2009 | 4.98 | | 0.56 | | 0.56 | | 2.55 | | | 2.55 | | | | | | 4.98 | 3.11 | 1.87 | Engieering service |
| 2010 | 4.98 | | 0.56 | | 0.56 | | 7.98 | | | 7.98 | | | | | | 4.98 | 8.54 | -3.56 | Installation of equipment |
| 2011 | 4.98 | | 0.56 | | 0.56 | 2.78 | 0.16 | 0.31 | | 0.47 | | | | | | 7.76 | 1.03 | 6.73 | Training |
| 2012 | 4.98 | | 0.56 | | 0.56 | 2.78 | | 0.31 | | 0.31 | | 2.69 | | | 2.69 | 7.76 | 3.57 | 4.20 | Engieering service |
| 2013 | 4.98 | | 0.56 | | 0.56 | 2.78 | | 0.31 | | 0.31 | | 8.44 | | | 8.44 | 7.76 | 9.32 | -1.55 | Installation of equipment |
| 2014 | 4.98 | | 0.56 | | 0.56 | 2.78 | | 0.31 | | 0.31 | 2.95 | 0.17 | 0.33 | | 0.50 | 10.71 | 1.37 | 9.34 | Training |
| 2015 | 4.98 | | 0.56 | | 0.56 | 2.78 | | 0.31 | | 0.31 | 2.95 | | 0.33 | | 0.33 | 10.71 | 1.20 | 9.51 | |
| 2016 | 4.98 | | 0.56 | | 0.56 | 2.78 | | 0.31 | | 0.31 | 2.95 | | 0.33 | | 0.33 | 10.71 | 1.20 | 9.51 | |
| 2017 | 4.98 | | 0.56 | | 0.56 | 2.78 | | 0.31 | | 0.31 | 2.95 | | 0.33 | | 0.33 | 10.71 | 1.20 | 9.51 | |
| 2018 | 4.98 | | 0.56 | 11.22 | 11.79 | 2.78 | | 0.31 | | 0.31 | 2.95 | | 0.33 | | 0.33 | 10.71 | 12.43 | -1.72 | |
| 2019 | 4.98 | | 0.56 | | 0.56 | 2.78 | | 0.31 | | 0.31 | 2.95 | | 0.33 | | 0.33 | 10.71 | 1.20 | 9.51 | |
| 2020 | 4.98 | | 0.56 | | 0.56 | 2.78 | | 0.31 | 6.24 | 6.55 | 2.95 | | 0.33 | | 0.33 | 10.71 | 7.44 | 3.27 | |
| 2021 | 4.98 | | 0.56 | | 0.56 | 2.78 | | 0.31 | | 0.31 | 2.95 | | 0.33 | | 0.33 | 10.71 | 1.20 | 9.51 | |
| 2022 | 4.98 | | 0.56 | | 0.56 | 2.78 | | 0.31 | | 0.31 | 2.95 | | 0.33 | | 0.33 | 10.71 | 1.20 | 9.51 | |
| 2023 | 4.98 | | 0.56 | | 0.56 | 2.78 | | 0.31 | | 0.31 | 2.95 | | 0.33 | 6.59 | 6.92 | 10.71 | 7.80 | 2.91 | |
| 2024 | 4.98 | | 0.56 | | 0.56 | 2.78 | | 0.31 | | 0.31 | 2.95 | | 0.33 | | 0.33 | 10.71 | 1.20 | 9.51 | |
| 2025 | 4.98 | | 0.56 | | 0.56 | 2.78 | | 0.31 | | 0.31 | 2.95 | | 0.33 | | 0.33 | 10.71 | 1.20 | 9.51 | |
| 2026 | 4.98 | | 0.56 | | 0.56 | 2.78 | | 0.31 | | 0.31 | 2.95 | | 0.33 | | 0.33 | 10.71 | 1.20 | 9.51 | |
| 2027 | 4.98 | | 0.56 | | 0.56 | 2.78 | | 0.31 | | 0.31 | 2.95 | | 0.33 | | 0.33 | 10.71 | 1.20 | 9.51 | |
| 2028 | 4.98 | | 0.56 | 11.22 | 11.79 | 2.78 | | 0.31 | | 0.31 | 2.95 | | 0.33 | | 0.33 | 10.71 | 12.43 | -1.72 | |
| 2029 | 4.98 | | 0.56 | | 0.56 | 2.78 | | 0.31 | | 0.31 | 2.95 | | 0.33 | | 0.33 | 10.71 | 1.20 | 9.51 | |
| 2030 | 4.98 | | 0.56 | | 0.56 | 2.78 | | 0.31 | 6.24 | 6.55 | 2.95 | | 0.33 | | 0.33 | 10.71 | 7.44 | 3.27 | |
| 2031 | 4.98 | | 0.56 | | 0.56 | 2.78 | | 0.31 | | 0.31 | 2.95 | | 0.33 | | 0.33 | 10.71 | 1.20 | 9.51 | |
| 2032 | 4.98 | | 0.56 | | 0.56 | 2.78 | | 0.31 | | 0.31 | 2.95 | | 0.33 | | 0.33 | 10.71 | 1.20 | 9.51 | |
| 2033 | 4.98 | | 0.56 | | 0.56 | 2.78 | | 0.31 | | 0.31 | 2.95 | | 0.33 | 6.59 | 6.92 | 10.71 | 7.80 | 2.91 | |
| 2034 | 4.98 | | 0.56 | -4.49 | -3.93 | 2.78 | | 0.31 | -3.74 | -3.43 | 2.95 | | 0.33 | -5.28 | -4.95 | 10.71 | -12.30 | 23.01 | |

**Table 11.3.1 DEBRIS FLOW POTENTIAL STREAM MONITORING REPORT**

| Item | Contents | Remarks |
|---|---|---|
| Date | Day Month Year （Name of Inspector： ） | Rainfall mm （Date of event） |
| Name of Torrent | No. and Name Location | |
| Assets to be Protected | Road（ m） Houses（ Nos.）Land（ ha）<br>Features as tourist spot（ Ex. Bathing spots） | |
| Torrent | Ruins of Debris Flow<br>Estimated Volume of Sediment (Width ,Depth )<br>Change of Height of Bed (Up Down )<br>Discharge （Water Level cm, Width m） | Height of Staff Gauge |
| Slope | Ruins of Slope Failure<br>Vegetation | |
| Others | Observation：Potentiality of Disaster | |
| Photograph | Upstream (Fixed Point): Riverbed、 Slope | |
| Photograph | Middle-stream (Fixed Point): Riverbed, Slope | |
| Photograph | Downstream (Fixed Point): Riverbed, Slope | |
| Photograph | LocationS detected drastic change from previous observation | |