Feasibility Study on Water Resources Development in the Rural Area in the Kingdom of Morocco

Final Report

Volume III Supporting Report (1) Basic Study

Supporting Report VII Development Scale of the Projects

FEASIBILITY STUDY
ON
WATER RESOURCES DEVELOPMENT
IN
RURAL AREA
IN
THE KINGDOM OF MOROCCO

FINAL REPORT

VOLUME III
SUPPORTING REPORT (1)
BASIC STUDY

SUPPORTING REPORT VII
DEVELOPMENT SCALE OF THE PROJECTS

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SUPPORTING REPORT VII DEVELOPMENT SCALE OF THE PROJECTS

VII1 Results of the Study

Development plan of dam, irrigation area and potable water supply for each project that are fixed through the study, are presented in the attached tables and figures.

Feasibility Study on Water Resources Development in the Rural Area in the Kingdom of Morocco

Final Report

Volume III Supporting Report (1)

Basic Study

Supporting Report VII

Development Scale of the Projects

Tables

Table VII1.1.1 Development Plan for the Proposed Project (No. 1 NECKOR)

General (Dam Site)

Objective	Zone	Watershed	River	Province	(1:50.000)	Coordinate	Location	Study level
sediment retaining for El Khattabi large dam	I	Neckor A=710km2	Neckor	Al Hoceima	Al Hoceima	X=649.000 Y=496.035	5 km from Beni Bouayach and 1.5 Km by walk	F/S terminated (APD terminee)

Hydrology

Catchment of dam	Flow Station	Annual Flow	Flow Pattern
(1)	(2)	(3)	(4)
Basin area (Adam): 710 km2 River system: Neckor River	Name: Takenfoust Asta: 292 km2 (Asta/Adam: 0.4) Data period: 6 yrs.	0.37 m3/s 11.7 Mm3/yr 16 mm/yr	Peak flow in: Dec, Mar High flow in: 9 mon.(Oct-Jun) 50%-flow day: 99 days

Geology

Left Abutment of Damsite	Riverbed	Right Abutment	Reservoir
(11)	(12)	(13)	(14)
Weathered Rock: Ep=8m	Alluvial deposits: Ep=max.32m Bedrock is weathered in general.	Weathered Rock: Ep=16m Overburden: Ep=about 10m	River deposits: very thick Overburden: develops well as Talus and Colluvial deposits Terrace deposits: developing along both banks Bedrock: Alternation of Schist, Sandstone and Quartzite

Comment	The river is on some geologically tectonic zone so that the sedimentation on the river bed is much and very thick. Dam body is to be on the foundation of alluvial deposits, then the bearing capacity and permeability is the problem. Basement rocks consist of sandy schist and quartzite with many quartz vein strongly folded and mineralized by iron.	Note: Ep: Thickness

Dam Planning

Dam Type	Length/Height of Dam	Dam Volume	Gross Reservoir Volume	Normal Water Level	Design Flood Discharge	Regulated Water Vol.
(21)	(22)	(23)	(24)	(25)	(26)	(27)
The dam-site has very deep alluvium deposits (about 20 m) under the wide river bed. A homogeneous fill dam which can be possible to place mostly on them is suitable	356m/36.45m	1,577,000 m3	15.6MCM	183.00 NGM	R.P.;1000 year, Qin=4500m3/s, Qout=3740m3/s	

Comment	There demands sub-dam by fill type dam on the left abutment. The main dam and sub-dam are required to dig deep excavation in the core trench . At the actual construction stage the excavation for deep alluvium foundation might demand careful work and treatment against emersion of ground water. The spillway may planned on the left abutment of rock foundation being located between main dam and sub-dam.

Agriculture (Based on the data on beneficial commune(s))

Location	Number of Commune(s)	Farmland (ha)	Present Irrigated Area (ha)	Number of Farmers	Expected Present Farm Income (DH/ha)	Present crops	Expected Crops with Irrigation	Expected Income Increasing with Irrigation (DH/ha)
(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)
Nekor	1	5,994	590	836	-	-	-	-

Comment	No Irrigation Scheme Project

Irrigation Planning

Beneficiary Area	Recipient Farmer	Annual Water Demand	Type of Irrigation	Design Discharge m3/s	Main Canal	Secondery Canal	Headwork	Other Facilities
(41)	(42)	(43)	(41)	(43)	(44)	(45)	(41)	(41)
–	–	–	–	–	–	–	–	–

Water Supply Planning

Target Area	Number of Commune(s)	Recipient House	Population	Organization of Implementation	Maintainer	Quantity of Demand (Mm3/year)	Facilities	Others
(51)	(52)	(53)	(54)	(55)	(56)	(57)	(58)	(59)
-	-	-	-	-	-	-	-	-

Comment	This project includes no water supply scheme.

Flood and Sediment Control

Disasters	Suffering object	Effects of dam	Reservoir sedimentation	Others
(61)	(62)	(63)	(64)	(65)
Sedimentation problem of El Kattabi dam. No serious flood damage after dam completion.	El Kattabi dam.	Sediment control for El Kattabi dam	DS: 3333 m3/km/yr VS: 3.800 Mm3/yr	

Comment	Alternative studies are not available for the measures to cope with the sedimentation problem of El Kattabi dam.

Table VII1.1.2 Development Plan for the Proposed Project (No. 2 TIZIMELLAL)

General (Dam Site)

Objective	Zone	Watershed	River	Province	(1:50.000)	Coordinate	Location	Study level
sediment retaining for Al Wahda dam, irrigation	I	Oulgha,tributary of Sebou, A=170km2	Oued Mengou	Al Hoceima	Targuist	X=592.650 Y=471.900	direct distance 13 km from Targuist	F/S terminated

Hydrology

Catchment of dam	Flow Station	Annual Flow	Flow Pattern
(1)	(2)	(3)	(4)
Basin area (Adam): 170 km2 River system: Sebou/ Mengou River	Name: Tamchachete Asta: 138 km2 (Asta/Adam: 0.8) Data period: 7 yrs.	1.22 m3/s 38.4 Mm3/yr 226 mm/yr	Peak flow in: Feb High flow in: 6 mon.(Dec-May) 50%-flow day: 48 days

Geology

Left Abutment of Damsite	Riverbed	Right Abutment	Reservoir
(11)	(12)	(13)	(14)
Weathered Rock: Ep=2 to 3m, sometimes over 30m Bedrock: Upper Portion is more cracky than that of Right Abutment	Alluvial deposits: Ep=1 to 2m Upper zone of relatively sound rock(Vp=1.9): Ep=2 to 3m Fresh Rock: Vp=4.4	Loosened rock(Vp=0.5 to 0.7): Ep=about 4m Mid hard relatively sound rock(Vp=2.6): gradually deeper reaching up to 20m as proceeding to mountain side Sound rock: Vp=4.6	River/Terrace deposits: along river course Talus deposits: thick Bedrock: 2/3 of the area is argillaceous and pelitic, remains 1/3 is Schist and Quartzite.

Comment	The dam site is a ravine with both abutments of vertical cliff. No problems is identified on strength of foundation and leakage since the foundation rocks are hard and massive.	Note: Ep: Thickness

Dam Planning

Dam Type	Length/Height of Dam	Dam Volume	Gross Reservoir Volume	Normal Water Level	Design Flood Discharge	Regulated Water Vol.
(21)	(22)	(23)	(24)	(25)	(26)	(27)
The site ia V shape valley. The good foundation rock is out-cropped in the river-bed.. A concrete gravity type,RCC, is suitable.	233.3 m/78.0 m	150,000 m3	21.28MCM	1090.00 NGM	R.P;10000 year, Qin=2500m3/s Qout=2000m3/s	

Comment	

Agriculture (Based on the data on beneficial commune(s))

Location	Number of Commune(s)	Farmland (ha)	Present Irrigated Area (ha)	Number of Farmers	Expected Present Farm Income (DH/ha)	Present crops	Expected Crops with Irrigation	Expected Income Increasing with Irrigation (DH/ha)
(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)
Targuist	1	453	2	61	2,339	Barley Soft Wheat Almond	1) Wheat 2) Olive 3) Almond 4) Fodder 5) Vegetable	14,200
comment	Very limited irrigable area Hilly cultivated area							

Irrigation Planning

Beneficiary Area	Recipient Farmer	Annual Water Demand	Type of Irrigation	Design Discharge m3/s	Main Canal	Secondery Canal	Headwork	Other Facility
(41)	(42)	(43)	(41)	(43)	(44)	(45)	(41)	(41)
–	–	–	–	–	–	–	–	–

Water Supply Planning

Target Area	Number of Commune(s)	Recipient House	Population	Organization of Implementation	Maintainer	Quantity of Demand (Mm3/year)	Facilities	Others
(51)	(52)	(53)	(54)	(55)	(56)	(57)	(58)	(59)
-	-	-	-	-	-	-	-	-
comment	This project includes no water supply scheme.							

Flood and Sediment Control

Disasters	Suffering object	Effects of dam	Reservoir sedimentation	Others
(61)	(62)	(63)	(64)	(65)
No serious flood damage.	Farmlands	Sediment control effect to Al Wahdas will be negligible small.	DS: 2876 m3/km/yr VS: 0.489 Mm3/yr	

Comment	Judging from catchment size and distance from Al Wahda dam, sediment control effect will be negligible small.

Table VII1.1.3 Development Plan for the Proposed Project (No.3 AIT BATDDU)

General (Dam Site)

Objective	Zone	Watershed	River	Province	(1:50.000)	Coordinate	Location	Study level
sediment retaining for Sidi Driss	III	Oum Er R'bia A=194km2	Oued Ta'Init	Azilal	Tannant	X=353.600 Y=140.000	Azilal	P/S terminated

Hydrology

Catchment of dam	Flow Station	Annual Flow	Flow Pattern
(1)	(2)	(3)	(4)
Basin area (Adam): 194 km2 River system: Oum Er Rbia/ Tesaout/ Lakhdar Rivers	Name: Ait Segmine Asta: 461km2 (Asta/Adam: 2.4) Data period: >20 yrs.	0.89 m3/s 27.9 Mm3/yr 144 mm/yr	Peak flow in: Mar, Jul High flow in: 9 mon.(Nov, Jan-Aug) 50%-flow day: 25 days

Geology

Left Abutment of Damsite	Riverbed	Right Abutment	Reservoir
(11)	(12)	(13)	(14)
Overburden: very thin surface soil	Overburden: few meters silty soil	Overburden: Talus/Terrace deposits, reddish brown silty soil Travertine: covering bedrock at the foot	Travertine/Colluvial deposits: mainly in the right bank slope Bedrock: Alternation of Limestone and Marly Limestone Karst: some possibility in Limestone

Comment	Basement rocks are composed of the alternation of limestone and marly limestone. It is observed that the bedding plane is sometimes soluble then leakage may occur. Some springs are observed in the upstream side and the downstream side.

Dam Planning

Dam Type	Length/Height of Dam	Dam Volume	Gross Reservoir Volume	Normal Water Level	Design Flood Discharge	Regulated Water Vol.
(21)	(22)	(23)	(24)	(25)	(26)	(27)
Both abutments are moderate. The foundation rock is relatively soft. However a gravity type dam is possible.	220m/54m	360,000 m3	12.44 MCM	790.00 NGM		

Comment	The foundation of dam site and reservoir is limestone. In the reservoir area there exist several springs utilized for local society. Leakage from reservoir will be anticipated.

Agriculture (Based on the data on beneficial commune(s))

Location	Number of Commune(s)	Farmland (ha)	Present Irrigated Area (ha)	Number of Farmers	Expected Present Farm Income (DH/ha)	Present crops	Expected Crops with Irrigation	Expected Income Increasing with Irrigation (DH/ha)
(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)
Ait Baddou	2	10,890	427	2,867	2,281	Soft Wheat Hard Wheat Fodder Almond	1) Wheat 2) Olive 3) Almond 4) Vegetable 5) Fodder	10,700
Comment	Very limited irrigable area 20ha of farmland will be inundated by dam construction							

Irrigation Planning

Beneficiary Area	Recipient Farmer	Annual Water Demand	Type of Irrigation	Design Discharge m3/s	Main Canal	Secondery Canal	Headwork	Other Facility
(41)	(42)	(43)	(41)	(43)	(44)	(45)	(41)	(41)
–	–	–	–	–	–	–	–	–

Water Supply Planning

Target Area	Number of Commune(s)	Recipient House	Population	Organization of Implementation	Maintainer	Quantity of Demand (Mm3/year)	Facilities	Others
(51)	(52)	(53)	(54)	(55)	(56)	(57)	(58)	(59)
-	-	-	-	-	-	-	-	-
comment	This project includes no water supply scheme.							

Flood and Sediment Control

Disasters	Suffering object	Effects of dam	Reservoir sedimentation	Others
(61)	(62)	(63)	(64)	(65)
Flooding, but not so serious.	Sidi Driss dam with severe sedimentation problem, and farmlands	Sediment control for Sidi Driss dam, and flood control for local farmlands.	DS: 1200 m3/km/yr VS: 0.250 Mm3/yr	
Comment				

Table VII1.1.4 Development Plan for the Proposed Project (No.4 AIN KWACHIYA)

General (Dam Site)

Objective	Zone	Watershed	River	Province	(1:50.000)	Coordinate	Location	Study level
irrigation	II	Slopes toward Atlantic, A=162 km2	Oued Khellata	Ben Slimene	Temara	X=360.200 Y=353.500	3km from Sidi Yahia,5.5km on trail	F/S terminated

Hydrology

Catchment of dam	Flow Station	Annual Flow	Flow Pattern
(1)	(2)	(3)	(4)
Basin area (Adam): 162 km2 River system: Iquem/ Khellata River	Name: Cheikh Reguig Asta: 518 km2 (Asta/Adam: 3.2) Data period: >20 yrs.	0.21 m3/s 6.6 Mm3/yr 41 mm/yr	Peak flow in: Jan High flow in: 5 mon.(Oct, Dec-Mar) 50%-flow day: 9 days

Geology

Left Abutment of Damsite	Riverbed	Right Abutment	Reservoir
(11)	(12)	(13)	(14)
Colluvial Top layer: Ep=1 to 3m Weathered rock: very loosened rubbly Schist, Ep=2 to 3m	Generally covered by gravel tracing silty cohesive soil, thickness of which 3 to 4m.	Top soil: very thin	Bedrock: Sandy Schist, Micaceous Sandstone, Qurartzite, Limestone and Coglomerate Bedding and Schistosity: crossing right to river course(N140 to N180), vertical

Comments	Foundation is mainly composed of Sandy Schist and alternating with Quartzite. Both banks are covered by surface 1m thick soil and 2 to 3m thick of bedrock is very weathered underlain by slightly weathered rocks. Some meters of cohesive soils sediment in the bottom of valley. Fresh Quartzite outcrops crossing with the river in low angle.	Note: Ep: Thickness

Dam Planning

Dam Type	Length/Height of Dam	Dam Volume	Gross Reservoir Volume	Normal Water Level	Design Flood Discharge	Regulated Water Vol.
(21)	(22)	(23)	(24)	(25)	(26)	(27)
The design discharge is not large. And both abutments have moderate slopes. Fill dam ia rather preferable than RCC.	212.5m/29.5m	RCC;78,000 m3	11.0 MCM	185.00 NGM	R.P.;1000year Qin=450m3/s Qout=250m3/s	

Comment	For the case of fill type dam a spillway may be placed on the right abutment to obtain the sound foundation with less excavation. A gravity dam by RCC (dam volume; 78,000m3) is also possible. However, sands and gravel for concrete are not easily taken nearby. Final selection of dam type should be done after the comparative study.

Agriculture (Based on the data on beneficial commune(s))

Location	Number of Commune(s)	Farmland (ha)	Present Irrigated Area (ha)	Number of Farmers	Expected Present Farm Income (DH/ha)	Present crops	Expected Crops with Irrigation	Expected Income Increasing with Irrigation (DH/ha)
(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)
Sidi Yahia Zaer	1	15,926	883	1,281	8,508	Soft Wheat Vegetables Grapes Fodder	1) Wheat 2) Vegetable 3) Olive 4) Grape 5) Fodder	9,700

Comments	Limited groundwater for irrigation Farms are damaging by salt accumulation in soil Greenhouse are commonly facilitated. High potential for marketability

Irrigation Planning

Beneficiary Area	Recipient Farmer	Annual Water Demand	Type of Irrigation	Design Discharge m3/s	Main Canal	Secondery Canal	Headwork	Other Facilities
(41)	(42)	(43)	(41)	(43)	(44)	(45)	(41)	(41)
500 ha	41	3.5 MCM	Furrow Border Basin	0.5 m3/s	_	5 km	Weir : 1 Pump Station : 1	5 nos

Water Supply Planning

Target Area	Number of Commune(s)	Recipient House	Population	Organization of Implementation	Maintainer	Quantity of Demand (Mm3/year)	Facilities	Others
(51)	(52)	(53)	(54)	(55)	(56)	(57)	(58)	(59)
Irrigation area and suurounding area of the dam			100	Ministry of Equipment	Commune or farmers' association	0.001	Filter facility, Reservoir, Transmission line, Stand pipes	

Comments	Domestic water supply within the irrigation area and surrounding area of the dam is considered. Irrigation facilities will be utilized for water conveyance as maximal as possible for securing its economy.

Flood and Sediment Control

Disasters	Suffering object	Effects of dam	Reservoir sedimentation	Others
(61)	(62)	(63)	(64)	(65)
Flooding.	Sidi Yahya town, public facilities and farmlands	Flood control for Sidi Yahya town and surrounding areas.	DS: 1049 m3/km/yr VS: 0.170 Mm3/yr	

Comment	

Table VII1.1.5 Development Plan for the Proposed Project (No.5 Upper N'FIFIKH)

General (Dam Site)

Objective	Zone	Watershed	River	Province	(1:50.000)	Coordinate	Location	Study level
irrigation, flood controle	II	A=300 km2	Oued Daliya	Ben Slimene	Al Gara	X=345.820 Y=311.930	direct distance 25 km from Ben Slimane	not yet

Hydrology

Catchment of dam	Flow Station	Annual Flow	Flow Pattern
(1)	(2)	(3)	(4)
Basin area (Adam): 300 km2 River system: N'fifikh River	Name: Feddane Taba Asta: 606 km2 (Asta/Adam: 2.0) Data period: >20 yrs.	0.28 m3/s 8.8 Mm3/yr 7 mm/yr	Peak flow in: Feb High flow in: 5 mon.(Nov-Mar) 50%-flow day: 6 days

Geology

Left Abutment of Damsite	Riverbed	Right Abutment	Reservoir
(11)	(12)	(13)	(14)
No Cover	River deposit: sand and gravel Alluvial Terrace deposit: along right bank side, fine sand to sandy silt, Ep=2 to 3m	No Cover	River deposits: on the river Terrace deposits: extending widely Bedrock: mainly the alternation of Sandstone and Schist, interbedded with Quartzite

Comment	Along dam axis, bedrock is composed of rightstanding Quartzite bar of approximately 10 m thickness. In both of the upstream and downstream side, the alternation of quartzitic sandstone and schistosed slate of unit layer of 2 to 20 cm thickness form bedrock. Those are strongly folded, and Slate is fissile. In the case of concrete dam, the foundation may be unstable due to the thickness of Quartzite not enough.	Note: Ep: Thickness

Dam Planning

Dam Type	Length/Height of Dam	Dam Volume	Gross Reservoir Volume	Normal Water Level	Design Flood Discharge	Regulated Water Vol.
(21)	(22)	(23)	(24)	(25)	(26)	(27)
Both abutments have moderate slopes, and are somewhat, especially for the left abutment, deep to reach the sound foundation rock. A zoned fill type might be preferable. Spillway could be on the right abutment.	250m/33m	420,000 m3	8 MCM	NGM 238.5	R.P.;1000year Qin=693m3/s R.P;5000year Qin=941m3/s	

Comment	The site of N'Fifikh downstream has progressed studies. But the site recommended by our JICA team is N'Fifikh upstream, and its comparative study has performed only. To proceed to F/S geological and topographical surveys are required. Final selection of dam type should be done after the comparative study.

Agriculture (Based on the data on beneficial commune(s))

Location	Number of Commune(s)	Farmland (ha)	Present Irrigated Area (ha)	Number of Farmers	Expected Present Farm Income (DH/ha)	Present crops	Expected Crops with Irrigation	Expected Income Increasing with Irrigation (DH/ha)
(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)
N'Fifikh	3	32,797	913	3,504	6,462	Soft Wheat Hard Wheat Legume Vegetables Fodder	1) Wheat 2) Vegetable 3) Olive 4) Grape 5) Fodder	11,700

Comment	Irrigable are is located in river basin. High potential for marketability

Irrigation Planning

Beneficiary Area	Recipient Farmer	Annual Water Demand	Type of Irrigation	Design Discharge m3/s	Main Canal	Secondery Canal	Headwork	Other Facilities
(41)	(42)	(43)	(41)	(43)	(44)	(45)	(41)	(41)
800 ha	85	5.7 MCM	Furrow Border Basin	0.8 m3/s	10 km	8 km	Weir : 2	8 nos

Water Supply Planning

Target Area	Number of Commune(s)	Recipient House	Population	Organization of Implementation	Maintainer	Quantity of Demand (Mm3/year)	Facilities	Others
(51)	(52)	(53)	(54)	(55)	(56)	(57)	(58)	(59)
Irrigation area and suurounding area of the dam			200	Ministry of Equipment	Commune or farmers' association	0.002	Filter facility, Reservoir, Transmission line, Stand pipes	

Comment	Domestic water supply within the irrigation area and surrounding area of the dam is considered. Irrigation facilities will be utilized for water conveyance as maximal as possible for securing its economy.

Flood and Sediment Control

Disasters	Suffering object	Effects of dam	Reservoir sedimentation	Others
(61)	(62)	(63)	(64)	(65)
Flooding and bank erosion.	Settlement and farmlands.	Flood control and stabilization of river channel.	**DS: 319 m3/km/yr** **VS: 0.098 Mm3/yr**	

Comment	

Table VII1.1.6 Development Plan for the Proposed Project (No.6 TAZARANE)

General (Dam Site)

Objective	Zone	Watershed	River	Province	(1:50.000)	Coordinate	Location	Study level
irrigation, sediment retaining for Al Wahda dam	I	Oulgha,tributary of Sebou, A=30km2	Oued Malha	Chefchaouen	Tamorot	X=540.100 Y=484.000	55km from Chefchaouen via Bab Bered	F/S terminated

Hydrology

Catchment of dam	Flow Station	Annual Flow	Flow Pattern
(1)	(2)	(3)	(4)
Basin area (Adam): 30 km2 River system: Sebou/ Aoudour River	Name: Tabouda Asta: 861km2 (Asta/Adam: 28.7) Data period: 18 yrs.	0.38 m3/s 11.9 Mm3/yr 398 mm/yr	Peak flow in: Feb High flow in: 6 mon.(Nov-Mar, May) 50%-flow day: 16 days

Geology

Left Abutment of Damsite	Riverbed	Right Abutment	Reservoir
(11)	(12)	(13)	(14)
No Cover Weathered Rock: loose rock, Vp=2.9, Ep=around 20m Bedrock: Alternation of Black Schist and gray Sandy schist, phyllitic	Alluvial deposits: Ep=1 to 3m Weathered Rock: Vp=1.4 to 3.0, Ep=5 to 8m Fresh rock: Vp=4.2, normally homogeneous, sometimes interbedded with thin Quartzite	Overburden: argillaceous Colluvium, Ep=3 to 4m H.Weathered rock: Vp=0.4, Ep=about 1m Cracky rock: Vp=2.5 Fresh rock: Vp=4.5, below 40m from the top	Alluvial deposits: covering 1/3 of the area, mainly rock blocks, sand and gravel Colluvial deposits: relatively thick, silty soil and rockfragments of schist Bedrock: Schist

Comment	Dam foundation consists of weathered schist. Loose rocks are found even at the portions washed by the river water.	Note: Ep: Thickness Vp: Primary Seismic Velocity

Dam Planning

Dam Type	Length/Height of Dam	Dam Volume	Gross Reservoir Volume	Normal Water Level	Design Flood Discharge	Regulated Water Vol.
(21)	(22)	(23)	(24)	(25)	(26)	(27)
Schist of damsite is weathered deeply and may not have enough strength for the foundation of gravity type. Slopes of both abutments are moderate. A zoned rock fill dam is recommendable.	215 m / 64 m	416000 m3	9.2 MCM	580.00 NGM	R.P.;10000year Qin=950m3/s Qout=780m3/s	

Comment	Schist material around the site is not suitable for dam embankment because of it's laminating structure. Most of rock materials may be brought some quarry site. Impervious materials are not abundant near the dam-site, but probably they are obtained in the reservoir area. Concrete facing is also considerable in case core materials is not available nearby. In any case the cost of the dam is somewhat higher than ordinary dam.

Agriculture (Based on the data on beneficial commune(s))

Location	Number of Commune(s)	Farmland (ha)	Present Irrigated Area (ha)	Number of Farmers	Expected Present Farm Income (DH/ha)	Present crops	Expected Crops with Irrigation	Expected Income Increasing with Irrigation (DH/ha)
(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)
Tazarane	3	11,758	940	4,117	3,234	Soft Wheat Hard Wheat Almond	1) Wheat 2) Olive 3) Almond 4) Fodder 5) Vegetable	13,300
Comment	Traditional irrigation facilities are existing. Removing gravels and rocks from farms are necessary in some area Well managed cooperative activities							

Irrigation Planning

Beneficiary Area	Recipient Farmer	Annual Water Demand	Type of Irrigation	Design Discharge m3/s	Main Canal	Secondery Canal	Headwork	Other Facilities
(41)	(42)	(43)	(41)	(43)	(44)	(45)	(41)	(41)
900 ha	315	6.7 MCM	Furrow Border Basin	0.9 m3/s	_	9 km	Weir : 2	9 nos
Comment								

Water Supply Planning

Target Area	Number of Commune(s)	Recipient House	Population	Organization of Implementation	Maintainer	Quantity of Demand (Mm3/year)	Facilities	Others
(51)	(52)	(53)	(54)	(55)	(56)	(57)	(58)	(59)
Irrigation area and suurounding area of the dam			700	Ministry of Equipment	Commune or farmers' association	0.005	Filter facility, Reservoir, Transmission line, Stand pipes	
Comment	This project is located in Rif Mountains where ground water resource is very scarce; therefore domestic water supply within the irrigation area and surrounding area of the dam is considered. Irrigation facilities will be utilized for water conveyance as maximal as possible for securing its economy.							

Flood and Sediment Control

Disasters	Suffering object	Effects of dam	Reservoir sedimentation	Others
(61)	(62)	(63)	(64)	(65)
No serious flood damage.	Farmlands	Sediment control effect to Al Wahdas will be negligible small.	DS: 3800 m3/km/yr VS: 0.114 Mm3/yr	
Comment	Judging from catchment size and distance from Al Wahda dam, sediment control effect will be negligible small.			

Table VII1.1.7 Development Plan for the Proposed Project (No.7 AMEZMIZ)

General (Dam Site)

Objective	Zone	Watershed	River	Province	(1:50.000)	Coordinate	Location	Study level
irrigation	III	Tensift, A=80km2	Oued Anougal	El Haouz	Azegour	X=226.500 Y= 65.400	Amezmiz	F/S terminated

Hydrology

Catchment of dam	Flow Station	Annual Flow	Flow Pattern
(1)	(2)	(3)	(4)
Basin area (Adam): 80 km2 River system: Tensift/ N'fiss River	Name: Sidi Hssain Asta: 115 km2 (Asta/Adam: 1.4) Data period: 8 yrs.	0.49 m3/s 15.5 Mm3/yr 194 mm/yr	Peak flow in: Mar, Dec High flow in: 7 mon.(Oct, Dec-May) 50%-flow day: 82 days

Geology

Left Abutment of Damsite	Riverbed	Right Abutment	Reservoir
(11)	(12)	(13)	(14)
No Cover	River deposits: sand, gravel of Quartzite, Schist and Granite, Ep=around 10m max.	No Cover	River deposits: relatively thick Overburden: Talus deposits in unstream of Left Bank, relatively thick Bedrock: red color fine Conglomerate, Sandstone, and Shale with gentle bedding dip

Comment	Dam site is in a steep narrow V-shape valley, however the upper side becomes gentle. Foundation is of relatively fresh Schist and Microgranite dyke which has enough strength. Their joint contacts closely. They are overlain by soft rocks which may necessary to be eliminated.	Note: Ep: Thickness

Dam Planning

Dam Type	Length/Height of Dam	Dam Volume	Gross Reservoir Volume	Normal Water Level	Design Flood Discharge	Regulated Water Vol.
(21)	(22)	(23)	(24)	(25)	(26)	(27)
Both abutments have steep slopes with exposures of hard foundation rocks which may bear high stress. Concrete gravity is suitable type. RCC is one of prospective dam type.	265.5m/72.5m	main dam; 241,800m3, sub-dam(fill);40,000 m3	11 MCM	1356.00 BGM	R.p.;1000year Qin=750m3/s	

Comment	The site has effective topography to store water. However, on the left abutment it is necessary to settle a sub-dam. Sands and gravel materials are very abundant in the river-bed. To make a economical dam such materials should be utilized. As the dam is fairly large, high stress will act inside the dam body. A careful study and test for concrete quality, especially for RCC, will be required.

Agriculture (Based on the data on beneficial commune(s))

Location	Number of Commune(s)	Farmland (ha)	Present Irrigated Area (ha)	Number of Farmers	Expected Present Farm Income (DH/ha)	Present crops	Expected Crops with Irrigation	Expected Income Increasing with Irrigation (DH/ha)
(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)
Amezmiz	3	11,213	5,178	1,986	2,323	Barley Vegetables Olive	1) Wheat 2) Olive 3) Almond 4) Vegetable 5) Fodder	10,600
Comment	Traditional irrigation facilities are existing. Removing gravels and rocks from farm are necessary in some area High potential for marketability							

Irrigation Planning

Beneficiary Area	Recipient Farmer	Annual Water Demand	Type of Irrigation	Design Discharge m3/s	Main Canal	Secondery Canal	Headwork	Other Facilities
(41)	(42)	(43)	(41)	(43)	(44)	(45)	(41)	(41)
1,500 ha	266	14.2 MCM	Furrow Border Basin	1.5 m3/s	16 km	15 km	Weir : 1	11 nos

Water Supply Planning

Target Area	Number of Commune(s)	Recipient House	Population	Organization of Implementation	Maintainer	Quantity of Demand (Mm3/year)	Facilities	Others
(51)	(52)	(53)	(54)	(55)	(56)	(57)	(58)	(59)
Irrigation area and suurounding area of the dam			900	Ministry of Equipment	Commune or farmers' association	0.007	Filter facility, Reservoir, Transmission line, Stand pipes	
Comment	This project is located in Atlas Mountains where ground water resource is very scarce; therefore domestic water supply within the irrigation area and surrounding area of the dam is considered. Irrigation facilities will be utilized for water conveyance as maximal as possible for securing its economy.							

Flood and Sediment Control

Disasters	Suffering object	Effects of dam	Reservoir sedimentation	Others
(61)	(62)	(63)	(64)	(65)
Flooding, but not so serious.	Farm lands, settlements, public facilities and livestock.	Flood control, and sediment control of Lalla Takercoust dam.	DS: 280 m3/km/yr VS: 0.025 Mm3/yr	
Comment				

Table VII1.1.8 Development Plan for the Proposed Project (No.8 BOULAOUANE)

General (Dam Site)

Objective	Zone	Watershed	River	Province	(1:50.000)	Coordinate	Location	Study level
irrigation	III	Tensift, A=565km2	Seksaoua A=565km2	Chichaoua	Imin Tanoute	X=176.000 Y= 70.000	Sidi Bou Othmane	P/S terminated

Hydrology

Catchment of dam	Flow Station	Annual Flow	Flow Pattern
(1)	(2)	(3)	(4)
Basin area (Adam): 565 km2 River system: Tensift/ El Rhira River	Name: Illoudjane Asta: 436 km2 (Asta/Adam: 0.8) Data period: 19 yrs.	1.33 m3/s 41.8 Mm3/yr 74 mm/yr	Peak flow in: Mar, Nov High flow in: 11 mon.(Oct-Aug) 50%-flow day: 51 days

Geology

Left Abutment of Damsite	Riverbed	Right Abutment	Reservoir
(11)	(12)	(13)	(14)
No Cover	River deposits: relatively thick, mainly sand and gravel Terrace deposits: extending widely	Overburden: Talus deposits, few meters at the foot of slope, loosely cemented by lime partly	River deposits: relatively thick Overburden: Talus deposits, relatively thick Bedrock: Schist, schistose Sandstone, Conglomerate, Dolomite, Limestones and Marl with Gypsum and Anhydrite

Comments	Both banks of dam axis is composed of the same vertical limestone bars interbedding argillaceous and arenaceous limestone. They are rightstandinding. The bedding plane and the joint plane are commonly open which leakage may occur. Careful foundation treatment shall be necessary.	Note: Ep=Thickness

Dam Planning

Dam Type	Length/Height of Dam	Dam Volume	Gross Reservoir Volume	Normal Water Level	Design Flood Discharge	Regulated Water Vol.
(21)	(22)	(23)	(24)	(25)	(26)	(27)
A gravity dam is suitable as the right is thin in width. In the river-bed of proposed reservoir sands and gravel deposits are abundant. They are useful materials for RCC.	335m/50.5m	274,000 m3	10 MCM	786.5 NGM	R.P.;1000year Qin=1740m3/s Qout=1610m3/s	

Comment	The dam site has a limestone foundation. The dam axis and dam height should be carefully studied considering the formation of limestone layer against leakage of reservoir water. Somewhat costly grouting work will be anticipated. Geological drilling surveys (around 20 holes) has just commenced by Ministry of Equipment.

Agriculture (Based on the data on beneficial commune(s))

Location	Number of Commune(s)	Farmland (ha)	Present Irrigated Area (ha)	Number of Farmers	Expected Present Farm Income (DH/ha)	Present crops	Expected Crops with Irrigation	Expected Income Increasing with Irrigation (DH/ha)
(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)
Douirane	1	6,975	4,064	1,428	1,797	Barley Olive Almond	1) Wheat 2) Olive 3) Almond 4) Vegetable 5) Fodder	11,100
Comments	Traditional irrigation facilities are existing. Removing gravels and rocks from farms are necessary at most of the project area.							

Irrigation Planning

Beneficiary Area	Recipient Farmer	Annual Water Demand	Type of Irrigation	Design Discharge m3/s	Main Canal	Secondery Canal	Headwork	Other Facilities
(41)	(42)	(43)	(41)	(43)	(44)	(45)	(41)	(41)
900 ha	184	8.5 MCM	Furrow Border Basin	0.9 m3/s	15 km	9 km	Weir : 1	10 nos

Water Supply Planning

Target Area	Number of Commune(s)	Recipient House	Population	Organization of Implementation	Maintainer	Quantity of Demand (Mm3/year)	Facilities	Others
(51)	(52)	(53)	(54)	(55)	(56)	(57)	(58)	(59)
Irrigation area and suurounding area of the dam			1,000	Ministry of Equipment	Commune or farmers' association	0.007	Filter facility, Reservoir, Transmission line, Stand pipes	
Comments	This project is located in Atlas Mountains where ground water resource is very scarce; therefore domestic water supply within the irrigation area and surrounding area of the dam is considered. Irrigation facilities will be utilized for water conveyance as maximal as possible for securing its economy.							

Flood and Sediment Control

Disasters	Suffering object	Effects of dam	Reservoir sedimentation	Others
(61)	(62)	(63)	(64)	(65)
Flooding and bank erosion	Farmlands, irrigation facilities and settlements.	Flood control and stabilisation of river channel.	DS: 283 m3/km/yr VS: 0.160 Mm3/yr	

Comment	

Table VII1.1.9 Development Plan for the Proposed Project (No.9 TASKOURT)

General (Dam Site)

Objective	Zone	Watershed	River	Province	(1:50.000)	Coordinate	Location	Study level
irrigation	III	Tensift A=439km2	Oued Al Mal	Marrakech	Azegour	X=207.000 Y= 69.800	Sidi Bou Othmane	P/S on going

Hydrology

Catchment of dam	Flow Station	Annual Flow	Flow Pattern
(1)	(2)	(3)	(4)
Basin area (Adam): 439 km2 River system: Tensift/ Assif El Ma R.	Name: Sidi Bouathmane Asta: 510 km2 (Asta/Adam: 1.2) Data period: 11 yrs.	1.17 m3/s 37.0 Mm3/yr 84 mm/yr	Peak flow in: Mar, Nov High flow in: 6 mon.(Oct-Dec, Feb-Apr) 50%-flow day: 41 days

Geology

Left Abutment of Damsite	Riverbed	Right Abutment	Reservoir
(11)	(12)	(13)	(14)
Bedrock: mainly hard Sandy rock	River deposits: large volume, very thick, sand and gravel.	Overburden: Talus deposits, few meters, covering the slope Bedrock: Alternation of Sandy Schist and balck Pelitic Schist	River deposits: very thick Weathered rocks: sometimes lying deeply Bedrock: mainly Quartz-Micaceous Schist, Pelitic Schist with many sheared/ fractured zones

Comments	The river may flow around the geologically tectonic zone so that the much sedimentation on the river bed is observed. Foundation of dam axis is of quartzitic sandstone and pelitic schist showing left bank rightstanding, right bank steep slope and wide riverbed. The joint in the left bank inclines towards river side, then the study for slope stability shall be necessary.

Dam Planning

Dam Type	Length/Height of Dam	Dam Volume	Gross Reservoir Volume	Normal Water Level	Design Flood Discharge	Regulated Water Vol.
(21)	(22)	(23)	(24)	(25)	(26)	(27)
A gravity dam is suitable as the site is V shape valley with hard rock foundation. In the river-bed of proposed reservoir, sands and gravel deposits are abundant. They are useful materials for RCC.	356m/98m	720,000 m3	106 MCM	1028.0.00 NGM	R.P.;1000year Qin=1130m3/s	

Comment	The dam site is located in the deep of mountain. But the river-bed can be used for access . To make a economical dam such materials should be utilized. As the dam is fairly large, high stress will act inside the dam body. A careful study and test for concrete quality, especially for RCC, will be required.

Agriculture (Based on the data on beneficial commune(s))

Location	Number of Commune(s)	Farmland (ha)	Present Irrigated Area (ha)	Number of Farmers	Expected Present Farm Income (DH/ha)	Present crops	Expected Crops with Irrigation	Expected Income Increasing with Irrigation (DH/ha)
(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)
Taskoourt	2	13,584	7,684	2,611	1,731	Barley Soft Wheat Olive	1) Wheat 2) Fodder 3) Almond 4) Olive 5) Vegetable	11,200

Comments	Traditional irrigation facilities are existing. High irrigated occupancy Large scale irrigation will be available. Removing of gravel and rocks from farms are necessary in some area.

Irrigation Planning

Beneficiary Area	Recipient Farmer	Annual Water Demand	Type of Irrigation	Design Discharge m3/s	Main Canal	Secondery Canal	Headwork	Other Facilities
(41)	(42)	(43)	(41)	(43)	(44)	(45)	(41)	(41)
4,600 ha	884	43.5 MCM	Furrow Border Basin	4.6 m3/s	30 km	46 km	Weir : 1	20 nos

Comment	

Water Supply Planning

Target Area	Number of Commune(s)	Recipient House	Population	Organization of Implementation	Maintainer	Quantity of Demand (Mm3/year)	Facilities	Others
(51)	(52)	(53)	(54)	(55)	(56)	(57)	(58)	(59)
Irrigation area and suurounding area of the dam			2,400	Ministry of Equipment	Commune or farmers' association	0.017	Filter facility, Reservoir, Transmission line, Stand pipes	

Comments	This project is located in Atlas Mountains where ground water resource is very scarce; therefore domestic water supply within the irrigation area and surrounding area of the dam is considered. Irrigation facilities will be utilized for water conveyance as maximal as possible for securing its economy.

Flood and Sediment Control

Disasters	Suffering object	Effects of dam	Reservoir sedimentation	Others
(61)	(62)	(63)	(64)	(65)
Flooding and bank erosion	Farmlands and settlements.	Flood control and stabilisation of river channel.	DS: 280 m3/km/yr VS: 0.120 Mm3/yr	

Comment	

Table VII1.1.10 Development Plan for the Proposed Project (No.10 TIMKIT)

General (Dam Site)

Objective	Zone	Watershed	River	Province	(1:50.000)	Coordinate	Location	Study level
irrigation, recharge for ground water	V	Rheris A=592km2	Assif N'ifer	Errachidia	Tinejdad	X=507.250 Y=115.450	Tinjdad	F/S terminated

Hydrology

Catchment of dam	Flow Station	Annual Flow	Flow Pattern
(1)	(2)	(3)	(4)
Basin area (Adam): 592 km2 River system: Rheris/ Ferklo R.	Name: Ait Bouijane Asta: 702 km2 (Asta/Adam: 1.2) Data period: >20 yrs.	0.68 m3/s 21.4 Mm3/yr 36 mm/yr	Peak flow in: Oct, Jun. High flow in: 12 mon. (Sep-Aug) 50%-flow day: 96 days

Geology

Left Abutment of Damsite	Riverbed	Right Abutment	Reservoir
(11)	(12)	(13)	(14)
No Cover	River deposits: relatively thick (probably few meters), sand and grvael (medium grain size 5 to10cm) with 1 to 2m size large rock block	No Cover	Bedrock: thin alternation of Dolomitic Limestone partly interbedded with many thin layers of Marl.

comment	Dam site is composed of limestone layered, crystalline, and hard. Some layers are closely jointed, however some layers develop karst well. Their distribution shall be carefully checked for prohibiting leakage from the dam. In the downstream exists Siltstone which has a possibility to seal leakage. Limestone is strong enough as a foundation.

Dam Planning

Dam Type	Length/Height of Dam	Dam Volume	Gross Reservoir Volume	Normal Water Level	Design Flood Discharge	Regulated Water Vol.
(21)	(22)	(23)	(24)	(25)	(26)	(27)
The site is V shape valley with hard rock foundation. The dam has a big design discharge. A gravity dam is suitable for the site.	183 m/56m	136,500 m3	14 MCM	1251.00 NGM	R.P.;1000year Qin=2000m3/s Q=1390m3/s	

Comment	The site has good topography for storage. The foundation is limestone with open fissures. But beneath of it, rock formation with less fissures are conformed. This could be reduce the leakage from reservoir..

Agriculture (Based on the data on beneficial commune(s))

Location	Number of Commune(s)	Farmland (ha)	Present Irrigated Area (ha)	Number of Farmers	Expected Present Farm Income (DH/ha)	Present crops	Expected Crops with Irrigation	Expected Income Increasing with Irrigation (DH/ha)
(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)
Timkit	4	3,195	2,572	3,514	9,160	Hard Wheat Dates Vegetables Fodder	1) Wheat 2) Fodder 3) Dates 4) Olive 5) Vegetable	9,200
Comment	Traditional oasis agriculture. High irrigated occupancy Farms are strongly damaged by occasional drought. Groundwater has been exhausted by over pumping.							

Irrigation Planning

Beneficiary Area	Recipient Farmer	Annual Water Demand	Type of Irrigation	Design Discharge m3/s	Main Canal	Secondery Canal	Headwork	Other Facilities
(41)	(42)	(43)	(41)	(43)	(44)	(45)	(41)	(41)
1,300 ha	1,430	13.5 MCM	Furrow Border Basin	1.3 m3/s	_	13 km	Weir : 3	8 nos

Water Supply Planning

Target Area	Number of Commune(s)	Recipient House	Population	Organization of Implementation	Maintainer	Quantity of Demand (Mm3/year)	Facilities	Others
(51)	(52)	(53)	(54)	(55)	(56)	(57)	(58)	(59)
Irrigation area and surronding area of the dam			2,100	Ministry of Equipment	Commune or farmer's organization	0.015	Filter facilility, Reservoir, Transmission line, Stand pipes	

comment	Domestic water supply within the irrigation area and surrounding area of the dam is considered. Irrigation facilities will be utilized for water conveyance as maximal as possible for securing its economy.

Flood and Sediment Control

Disasters	Suffering object	Effects of dam	Reservoir sedimentation	Others
(61)	(62)	(63)	(64)	(65)
Flooding and bank erosion	Riverine farm lands and settlements.	Flood control	DS: 338 m3/km/yr VS: 0.200 Mm3/yr	

Comment	

Table VII1.1.11 Development Plan for the Proposed Project (No.11 TADIGHOUST)

General (Dam Site)

Objective	Zone	Watershed	River	Province	(1:50.000)	Coordinate	Location	Study level
irrigation	V	Rheris A=2239km2	Rheris	Errachidia	Goulmima	X=541.300 Y=139.200	Tadighoucht	P/S terminated

Hydrology

Catchment of dam	Flow Station	Annual Flow	Flow Pattern
(1)	(2)	(3)	(4)
Basin area (Adam): 2239 km2 River system: Rheris R.	Name: Tadighoust Asta: 2345 km2 (Asta/Adam: 1.0) Data period: >20 yrs.	1.17 m3/s 36.8 Mm3/yr 16 mm/yr	Peak flow in: Oct, Lun High flow in: 11 mon.(Sep-Jun, Aug) 50%-flow day: 9 days

Geology

Left Abutment of Damsite	Riverbed	Right Abutment	Reservoir
(11)	(12)	(13)	(14)
Overburden: Talus deposits, thick, large rock blocks	Alluvial deposits: Ep=few meters, sand and gravel showing medium grain size 5 to 8cm Alluvial Terrace deposit: Ep=2m, silty soil	Overburden: Talus deposits	Bedrock: Sedimentary Rocks, Siltstone, Sandstone, Conglomerate, Marl, Limestone, Dolomite, Phonolite

Comment	Almost horizontally layered alternation of hard limestone and relatively soft marly rock consist the dam site foundation. Folding and fault is relatively few however vertical joints develop and be open in the layer near by ground surface. Karst is relatively few. Both bank is rightstanding and Talus deposits exist at the foot. Wide terrace is observed in the middle of left bank with no sediments.	Note: Ep: Thickness

Dam Planning

Dam Type	Length/Height of Dam	Dam Volume	Gross Reservoir Volume	Normal Water Level	Design Flood Discharge	Regulated Water Vol.
(21)	(22)	(23)	(24)	(25)	(26)	(27)
A gravity dam is inevitable because of huge design flood. There exist thick and wide deposits of sands and gravel. They are useful to RCC.	558.2m/68.5m	604,000 m3	54 MCM	1142.00 NGM	R.P.;1000year Qin=8090m3/s Qout=7470M3/s	

Comment	It is necessary to remove thick and wide alluvium deposit. This will make a high dam cost.

Agriculture (Based on the data on beneficial commune(s))

Location	Number of Commune(s)	Farmland (ha)	Present Irrigated Area (ha)	Number of Farmers	Expected Present Farm Income (DH/ha)	Present crops	Expected Crops with Irrigation	Expected Income Increasing with Irrigation (DH/ha)
(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)
Tadighoust	4	2,471	2,232	3,629	9,575	Hard Wheat Dates Fodder	1) Wheat 2) Fodder 3) Dates 4) Olive 5) Vegetable	9,100
Comment	Traditional oasis agriculture. High irrigated occupancy Farms are well managed by farmers' cooperatives.							

Irrigation Planning

Beneficiary Area	Recipient Farmer	Annual Water Demand	Type of Irrigation	Design Discharge m3/s	Main Canal	Secondery Canal	Headwork	Other Facilities
(41)	(42)	(43)	(41)	(43)	(44)	(45)	(41)	(41)
1,500 ha	2,203	15.6 MCM	Furrow Border Basin	1.5 m3/s	_	15 km	Weir : 3	9 nos

Water Supply Planning

Target Area	Number of Commune(s)	Recipient House	Population	Organization of Implementation	Maintainer	Quantity of Demand (Mm3/year)	Facilities	Others
(51)	(52)	(53)	(54)	(55)	(56)	(57)	(58)	(59)
Irrigation area and surronding area of the dam			2,100	Ministry of Equipment	Commune or farmer's organization	0.015	Filter facilility, Reservoir, Transmission line, Stand pipes	

Comment	Domestic water supply within the irrigation area and surrounding area of the dam is considered. Irrigation facilities will be utilized for water conveyance as maximal as possible for securing its economy.

Flood and Sediment Control

Disasters	Suffering object	Effects of dam	Reservoir sedimentation	Others
(61)	(62)	(63)	(64)	(65)
Flooding and bank erosion.	Riverine farmlands and settlements.	Flood control	DS: 335 m3/km/yr VS: 0.750 Mm3/yr	

Comment	

Table VII1.1.12 Development Plan for the Proposed Project (No.12 TIOUZAGUINE)

General (Dam Site)

Objective	Zone	Watershed	River	Province	(1:50.000)	Coordinate	Location	Study level
irrigation, potable water supply	V	Guir A=258km2	tributary of Guir	Errachidia	Gourrama	X=618.071 Y=206.923	Gourrama	P/S terminated

Hydrology

Catchment of dam	Flow Station	Annual Flow	Flow Pattern
(1)	(2)	(3)	(4)
Basin area (Adam): 258 km2 River system: Guir R.	Name: Tazouguert Asta: 2392 km2 (Asta/Adam: 9.3) Data period: >20 yrs.	0.13 m3/s 4.1 Mm3/yr 16 mm/yr	Peak flow in: Nov, Apr High flow in: 7 mon.(Sep-Jan, Apr-May) 50%-flow day: 5 days

Geology

Left Abutment of Damsite	Riverbed	Right Abutment	Reservoir
(11)	(12)	(13)	(14)
Overburden: Talus deposits	River deposits: Ep=approx.15m, sand and gravel Travertine: located on the Right Banks side	Travertine: relatively thick, forming terrace, usually loose and porous, height reaching 27m	Overburden: Terrace deposits, River deposits Travertine: extending in the area Bedrock: red Mudstone, Basalt, Limestone; Many karsts and travertine are observed.

Comment	Bedrock is composed of limestone relatively closely jointed. Loose travertine are observed in the right bank side. As a foundation it is strong enough, however travertine shows some the solubability limestone. Careful study shall be necessary.	Note: Ep: Thickness

Dam Planning

Dam Type	Length/Height of Dam	Dam Volume	Gross Reservoir Volume	Normal Water Level	Design Flood Discharge	Regulated Water Vol.
(21)	(22)	(23)	(24)	(25)	(26)	(27)
A gravity dam is suitable as the site consists of relatively hard rock foundation.	174m/58.7m	128,000 m3	10.2 MCM	1565.00 NGM	Qin=2200m3/s	

Comment	The foundation of site is limestone which may be somewhat soluble. A possibility of leakage should be carefully examined,

Agriculture (Based on the data on beneficial commune(s))

Location	Number of Commune(s)	Farmland (ha)	Present Irrigated Area (ha)	Number of Farmers	Expected Present Farm Income (DH/ha)	Present crops	Expected Crops with Irrigation	Expected Income Increasing with Irrigation (DH/ha)
(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)
Gourama	1	2,359	1,283	1,390	6,964	Hard Wheat Soft Wheat Dates Fodder	1) Wheat 2) Fodder 3) Dates 4) Olive 5) Vegetable	11,700

Comment	Traditional oasis agriculture. High irrigated occupancy Farms are located narrow riverbeds.

Irrigation Planning

Beneficiary Area	Recipient Farmer	Annual Water Demand	Type of Irrigation	Design Discharge m3/s	Main Canal	Secondery Canal	Headwork	Other Facilities
(41)	(42)	(43)	(41)	(43)	(44)	(45)	(41)	(41)
150 ha	88	1.6 MCM	Furrow Border Basin	0.2 m3/s	10 km	2km	_	7 nos

Comment	The above planning is for the case that water supply to Gourrama is included. Without such water supply scheme, beneficiary area of irrigation can be extended to 220 ha

Water Supply Planning

Target Area	Number of Commune(s)	Recipient House	Population	Organization of Implementation	Maintainer	Quantity of Demand (Mm3/year)	Facilities	Others
(51)	(52)	(53)	(54)	(55)	(56)	(57)	(58)	(59)
Gourrama	1		2,800	ONEP	ONEP	0.2	Pumping station, Treatment plant, Reservoir, Transmission line	

Comment	Reinforcement of potable water supply for Gourrama (0.2Mm^3/year) by exploiting surface water is considered. It is noted, however, that recharging of ground water from Tiouzaguine Dam may also contribute to AEP supply in future, therefore exploitation of ground water is still required to be studied as economical alternative. Other than the above, domestic water supply within the irrigation area and surrounding area of the dam (0.004Mm3/year) is also considered.

Flood and Sediment Control

Disasters	Suffering object	Effects of dam	Reservoir sedimentation	Others
(61)	(62)	(63)	(64)	(65)
Flooding and bank erosion.	Riverine farmlands, settlements and irrigation facilities.	Flood control	DS: 543 m**3/km/yr** **VS: 0.140 Mm3/yr**	

Comment	

Table VII1.1.13 Development Plan for the Proposed Project (No.13 KHENG GROU)

General (Dam Site)								
Objective	Zone	Watershed	River	Province	(1:50.000)	Coordinate	Location	Study level
Irrigation, recharge for ground water	V	Guir A=4,900km2	Oued Kheng Grou	Figuig	Bouanane	X=716.000 Y=194.050	Bouanane	F/S terminated

Hydrology			
Catchment of dam	Flow Station	Annual Flow	Flow Pattern
(1)	(2)	(3)	(4)
Basin area (Adam): 4900 km2 River system: Guir/ Bouanane R.	Name: Beni Yatti Asta: 6788 km2 (Asta/Adam: 1.4) Data period: >20 yrs.	2.08 m3/s 65.5 Mm3/yr 13 mm/yr	Peak flow in: Apr, Oct High flow in: 7 mon.(Sep-Jan, Apr-May) 50%-flow day: 3 days

Geology			
Left Abutment of Damsite	Riverbed	Right Abutment	Reservoir
(11)	(12)	(13)	(14)
No Cover	River deposits: Ep=about 15m, mainly sand and gravel, medium grain size 3 to 5cm	No Cover	Covers: silt and marly soil Bedrock: mainly Limestone

Comment	Basement rocks is blackish gray limestone hard to medium hard, and almost horizontally layered. Joints develop crossing right angle to the bedding and slightly open. Both banks are rightstanding. Some leakage may happen.	Note: Ep: Thickness

Dam Planning						
Dam Type	Length/Height of Dam	Dam Volume	Gross Reservoir Volume	Normal Water Level	Design Flood Discharge	Regulated Water Vol.
(21)	(22)	(23)	(24)	(25)	(26)	(27)
A gravity dam is suitable as the abutments are very steep slopes with hard rock foundation.	155m/70m	325,000 m3	90 MCM	1023.50 NGM	Qin=9300m3/s Qout=5400m3/s	

Comment	The foundation rock develops joints. This can be treated by groutings.

Agriculture (Based on the data on beneficial commune(s))								
Location	Number of Commune(s)	Farmland (ha)	Present Irrigated Area (ha)	Number of Farmers	Expected Present Farm Income (DH/ha)	Present crops	Expected Crops with Irrigation	Expected Income Increasing with Irrigation (DH/ha)
(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)
Benit Tadjite	1	4,756	1,265	924	5,278	Dates Barley Fodder Vegetable	1) Wheat 2) Vegetable 3) Dates 4) Olive 5) Fodder	13,400
Comment	Small irrigable areas are scattered on the riverbeds. Many farms are left as fallow land.							

Irrigation Planning								
Beneficiary Area	Recipient Farmer	Annual Water Demand	Type of Irrigation	Design Discharge m3/s	Main Canal	Secondery Canal	Headwork	Other Facilities
(41)	(42)	(43)	(41)	(43)	(44)	(45)	(41)	(41)
1,210 ha	235	12.6 MCM	Furrow Border Basin	1.2 m3/s	_	12 km	Weir : 1	5 nos

Water Supply Planning								
Target Area	Number of Commune(s)	Recipient House	Population	Organization of Implementation	Maintainer	Quantity of Demand (Mm3/year)	Facilities	Others
(51)	(52)	(53)	(54)	(55)	(56)	(57)	(58)	(59)
Irrigation area and suurounding area of the dam			400	Ministry of Equipment	Commune or farmers' association	0.003	Filter facility, Reservoir, Transmission line, Stand pipes	
Comment	Domestic water supply within the irrigation area and surrounding area of the dam is considered. Irrigation facilities will be utilized for water conveyance as maximal as possible for securing its economy.							

Flood and Sediment Control				
Disasters	Suffering object	Effects of dam	Reservoir sedimentation	Others
(61)	(62)	(63)	(64)	(65)
Flooding and bank erosion.	Riverine farmlands, settelment and irrigation facilities.	Flood control	DS: 333 m3/km/yr VS: 1.500 Mm3/yr	
Comment				

Table VII1.1.14 Development Plan for the Proposed Project (No.14 ADAROUCH)

General (Dam Site)

Objective	Zone	Watershed	River	Province	(1:50.000)	Coordinate	Location	Study level
supplementary supply of potable watar, irrigation	I	Sebou ,A=630km2	Oued Tigrigra	Ifrane	Bouchaber	X=489.800 Y=316.500	Azrou	F/S terminated

Hydrology

Catchment of dam	Flow Station	Annual Flow	Flow Pattern
(1)	(2)	(3)	(4)
Basin area (Adam): 630 km2 River system: Sebou/ Beht/ Tigriga R.	Name: Sidi Mokhfi Asta: 282 km2 (Asta/Adam: 0.4) Data period: 6 yrs.	2.04 m3/s 64.4 Mm3/yr 102 mm/yr	Peak flow in: Mar, Oct High flow in: 7 mon.(Oct, Dec-May) 50%-flow day: 101 days

Geology

Left Abutment of Damsite	Riverbed	Right Abutment	Reservoir
(11)	(12)	(13)	(14)
Weathered zone: Ep=5m	Alluvial deposits: very thin, Ep=0.5m Terrace deposits: discontinuous, sandy Weathered zone: Ep 1 to 2m	Weathered zone: Ep=around 18m, 5 to 8m in highly weathered zone	Bedrock: Alternating beds, basically flysh deposits between Limestone Massif, sometimes intruded by Granite

Comment	There may be no serious problem except that there is a possibility of slaking of slate and leakage from conglomerate.	Note: Ep: Thickness

Dam Planning

Dam Type	Length/Height of Dam	Dam Volume	Gross Reservoir Volume	Normal Water Level	Design Flood Discharge	Regulated Water Vol.
(21)	(22)	(23)	(24)	(25)	(26)	(27)
The site has moderate slopes on both abutment. But it has hard rock foundations in shallow depth with narrow river-bed. The site will be suitable to gravity type.	263m/51m	130,000 m3	48 MCM	873.00 NGM	R.P.;1000year Qin=700m3/s Qout=310m3/s	

Comment	Sands and gravel materials can not obtained in the vicinity of dam site. However, access is very easy as the site is closed to principal national route.

Agriculture (Based on the data on beneficial commune(s))

Location	Number of Commune(s)	Farmland (ha)	Present Irrigated Area (ha)	Number of Farmers	Expected Present Farm Income (DH/ha)	Present crops	Expected Crops with Irrigation	Expected Income Increasing with Irrigation (DH/ha)
(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)
Adarouch	2	25,337	5,193	2,542	4,146	(Livestock Farm) Hard Wheat Barley Fodder	1) Wheat 2) Olive 3) Almond 4) Fodder 5) Vegetable	12,400

Comment	All of irrigable areas are located in livestock farming company. Removing gravels and stones from farms are necessary in some area.

Irrigation Planning

Beneficiary Area	Recipient Farmer	Annual Water Demand	Type of Irrigation	Design Discharge m3/s	Main Canal	Secondery Canal	Headwork	Other Facilities
(41)	(42)	(43)	(41)	(43)	(44)	(45)	(41)	(41)
1,200 ha	120	8.9 MCM	Furrow Border Basin	1.2 m3/s	13 km	12 km	Weir : 1	9 nos

Comment	The above planning is for the case that water supply to Kansara dam is included. Without such water supply scheme, beneficiary area for irrigation can be extended to 2,200 ha

Water Supply Planning

Target Area	Number of Commune(s)	Recipient House	Population	Organization of Implementation	Maintainer	Quantity of Demand (Mm3/year)	Facilities	Others
(51)	(52)	(53)	(54)	(55)	(56)	(57)	(58)	(59)
Khemisset and Tiflet	2		130,000	ONEP	ONEP	5	Pumping station, Treatment plant, Reservoir, Transmission line	

Comment	Water supply for potable water in Khemisset and Tiflet through Kansera Dam (5 Mm^3/year) is considered. As the reinforcement of water supply facilities by ONEP is to be implemented by another project with assistance of BAD (Bank of Africa for Development), no provision of facilities is considered in this study. It is necessary to study possibility of water supply from Ouljet Soltane dam as alternative source. Other than the above, domestic water supply within the irrigation area and surrounding area of the dam (0.003Mm3/year) is also considered.

Flood and Sediment Control

Disasters	Suffering object	Effects of dam	Reservoir sedimentation	Others
(61)	(62)	(63)	(64)	(65)
No serious damage.	Farmlands and livestock.	Flood protection for farmlands and livestock. Sediment control effect for El Kansera dam is not large	DS: 317 m3/km/yr VS: 0.200 Mm3/yr	

Comment	Because of long distance and small catchment, sediment control effect for El Kansera dam is not large. Coordination with Ouljet Soltane dam program may also be needed.

Table VII1.1.15 Development Plan for the Proposed Project (No.15 SIDI OMAR)

General (Dam Site)

Objective	Zone	Watershed	River	Province	(1:50.000)	Coordinate	Location	Study level
Irrigation	II	Boureg Reg A=350km2	Oued Tabahart	Khemisset	Sebt Ait Ikkou	X=425.100 Y=336.100	Maaziz	P/S terminated

Hydrology

Catchment of dam	Flow Station	Annual Flow	Flow Pattern
(1)	(2)	(3)	(4)
Basin area (Adam): 350 km2 River system: Bou Regreg/ Tabahart R.	Name: Sidi Amar Asta: 329 km2 (Asta/Adam: 0.9) Data period: 18 yrs.	0.88 m3/s 27.8 Mm3/yr 79 mm/yr	Peak flow in: Jan High flow in: 3 mon.(Dec-Feb) 50%-flow day: 9 days

Geology

Left Abutment of Damsite	Riverbed	Right Abutment	Reservoir
(11)	(12)	(13)	(14)
Overburden: thin Top soil	Alluvial deposits: sand to silt with cobble and gravel of schist, sandstone, and limestone	Overburden: thin Bedrock: Schist is phyllitic at dam axis.	Overburden: Colluvial deposits, developed rarely Bedrock: Schist interbedded Sandstone overlain by Conglomerate, fine Conglomerate, Sandstone and red Mudstone
Comment	Site is in the hilly area with relatively wide river bed and alluvial terrace. Bedrocks are composed of the alternation of schistosed sandstone and slate. Right bank side is more schistosed, folded and partly sheared. This kind of zone may lie under the river deposits.		

Dam Planning

Dam Type	Length/Height of Dam	Dam Volume	Gross Reservoir Volume	Normal Water Level	Design Flood Discharge	Regulated Water Vol.
(21)	(22)	(23)	(24)	(25)	(26)	(27)
A gravity dam is probably suitable as the site has hard rock foundation in shallow depth.	260m/59m	222,000 m3	35 MCM	310.00 NGM	R.p.;5000year Qin=1735m3/s	
Comment	There is a possibility that a wide fault is existing closed to the sam site. IN such case a fill type dam may be prospective. Selection of dam type depends on the further analysis of geology.					

Agriculture (Based on the data on beneficial commune(s))

Location	Number of Commune(s)	Farmland (ha)	Present Irrigated Area (ha)	Number of Farmers	Expected Present Farm Income (DH/ha)	Present crops	Expected Crops with Irrigation	Expected Income Increasing with Irrigation (DH/ha)
(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)
Maaziz	1	6,459	358	795	3,966	Soft Wheat Vegetables Fodder	1) Wheat 2) Vegetable 3) Olive 4) Grape 5) Fodder	14,200
Comment	Wide and flat areas are located at irrigable area. Dam site is located relatively far away from irrigable area.							

Irrigation Planning

Beneficiary Area	Recipient Farmer	Annual Water Demand	Type of Irrigation	Design Discharge m3/s	Main Canal	Secondery Canal	Headwork	Other Facilities
(41)	(42)	(43)	(41)	(43)	(44)	(45)	(41)	(41)
1,500 ha	185	10.6 MCM	Furrow Border Basin	1.5 m3/s	27 km	15 km	Weir : 1	18 nos

Water Supply Planning

Target Area	Number of Commune(s)	Recipient House	Population	Organization of Implementation	Maintainer	Quantity of Demand (Mm3/year)	Facilities	Others
(51)	(52)	(53)	(54)	(55)	(56)	(57)	(58)	(59)
Irrigation area and suurounding area of the dam			300	Ministry of Equipment	Commune or farmers' association	0.002	Filter facility, Reservoir, Transmission line, Stand pipes	
Comment	Domestic water supply within the irrigation area and surrounding area of the dam is considered. Irrigation facilities will be utilized for water conveyance as maximal as possible for securing its economy.							

Flood and Sediment Control

Disasters	Suffering object	Effects of dam	Reservoir sedimentation	Others
(61)	(62)	(63)	(64)	(65)
Flooding and bank erosion.	Local farmlands and settlements.	Flood control for farmlands and settlements, and stabilization of river channel.	DS: 649 m3/km/yr VS: 0.230 Mm3/yr	
Comment				

Table VII1.1.16 Development Plan for the Proposed Project (No.16 TIOUINE)

General (Dam Site)

Objective	Zone	Watershed	River	Province	(1:50.000)	Coordinate	Location	Study level
Irrigation, flood control	IV	Draa ,A=1,540km2	Oued Iriri	Ouarzazate	Tikirt	X=323.572 Y=438.525	Ouarzazate	P/S terminated

Hydrology

Catchment of dam	Flow Station	Annual Flow	Flow Pattern
(1)	(2)	(3)	(4)
Basin area (Adam): 1540 km2 River system: Draa R.	Name: Tamdrouste Asta: 1693 km2 (Asta/Adam: 1.1) Data period: >20 yrs.	3.07 m3/s 96.8 Mm3/yr 63 mm/yr	Peak flow in: Mar, Jun High flow in: 7 mon.(Nov-Apr, Jun) 50%-flow day: 17 days

Geology

Left Abutment of Damsite	Riverbed	Right Abutment	Reservoir
(11)	(12)	(13)	(14)
Bedrock: very hard Rhyolite forming very high cliff minerallized by mangano-iron ore	River deposits: very thin, sand to boulder Some salt-gypsum powder can be observed along the water course.	Bedrock: Rhyolite changing to somewhat andesite with some faults and sheared zone as far away from the dam axis	Bedrock: Rhyolitic to Andesitic rock; massive and hard Conglomerate and Sandstone; loose and porous, with many piping hole, cavitiful

Comments	Both banks consist of very hard Rhyolite of Precambrian forming rightstanding high cliffs. Many iron and manganese layers are interbedded. River deposit is relatively few. Highly permeable conglomerate layers exist in the left bank side of reservoir area, then its distribution have to be checked.

Dam Planning

Dam Type	Length/Height of Dam	Dam Volume	Gross Reservoir Volume	Normal Water Level	Design Flood Discharge	Regulated Water Vol.
(21)	(22)	(23)	(24)	(25)	(26)	(27)
The site is U shape valley. A gravity dam is suitable as both abutments have upstanding slopes with extremely hard rock foundation.	165.0m/68.5m	405,530 m3	102.9 MCM	1320.00 NGM	Qin=4400m3/s Qout=1580m3/s	

Comment	The site has topographically good storage. Sands and gravel materials are abundant in the vicinity of dam site. But, in the reservoir there spreads very pervious conglomerate near to left abutment. In case it connects to outside of reservoir, leakage problem is not negligible.

Agriculture (Based on the data on beneficial commune(s))

Location	Number of Commune(s)	Farmland (ha)	Present Irrigated Area (ha)	Number of Farmers	Expected Present Farm Income (DH/ha)	Present crops	Expected Crops with Irrigation	Expected Income Increasing with Irrigation (DH/ha)
(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)
Tiwine	2	2,048	1,813	1,517	9,229	Barley Soft Wheat Fruits Fodder Vegetables	1) Wheat 2) Vegetable 3) Olive 4) Dates 5) Fodder	9,300

Comments	High irrigated occupancy Removing gravels and stones from farms are necessary in some area.

Irrigation Planning

Beneficiary Area	Recipient Farmer	Annual Water Demand	Type of Irrigation	Design Discharge m3/s	Main Canal	Secondery Canal	Headwork	Other Facilities
(41)	(42)	(43)	(41)	(43)	(44)	(45)	(41)	(41)
2,000 ha	1,481	21.3 MCM	Furrow Border Basin	2.0 m3/s	11 km	20 km	Weir : 1	8 nos

Comment		

Water Supply Planning

Target Area	Number of Commune(s)	Recipient House	Population	Organization of Implementation	Maintainer	Quantity of Demand (Mm3/year)	Facilities	Others
(51)	(52)	(53)	(54)	(55)	(56)	(57)	(58)	(59)
Irrigation area and suurounding area of the dam			2,100	Ministry of Equipment	Commune or farmers' association	0.015	Filter facility, Reservoir, Transmission line, Stand pipes	

Comments	Domestic water supply within the irrigation area and surrounding area of the dam is considered. Irrigation facilities will be utilized for water conveyance as maximal as possible for securing its economy.

Flood and Sediment Control

Disasters	Suffering object	Effects of dam	Reservoir sedimentation	Others
(61)	(62)	(63)	(64)	(65)
Flooding.	National road	Flood control, stabilisation of river course, and sediment control for Mansour Eddahbi dam.	DS: 700 m3/km/yr VS: 1.000 Mm3/yr	

Comment	

Table VII1.1.17 Development Plan for the Proposed Project (No.17 AZGHAR)

General (Dam Site)

Objective	Zone	Watershed	River	Province	(1:50.000)	Coordinate	Location	Study level
irrigation	I	Sebou A=295 km2	Oued Zloul	Sefrou	Al Khayr	X=598.800 Y=357.000	Sefrou	P/S terminated

Hydrology

Catchment of dam	Flow Station	Annual Flow	Flow Pattern
(1)	(2)	(3)	(4)
Basin area (Adam): 295 km2 River system: Sebou/ Zloul R.	Name: Dar Hmra Asta: 670 km2 (Asta/Adam: 2.3) Data period: 12 yrs.	1.24 m3/s 39.1 Mm3/yr 133 mm/yr	Peak flow in: Mar High flow in: 5 mon.(Dec-Apr) 50%-flow day: 19 days

Geology

Left Abutment of Damsite	Riverbed	Right Abutment	Reservoir
(11)	(12)	(13)	(14)
Weathered zone: up to the depth approximately 2.5m	River deposits: very thin, sand and gravel Alluvial terrace: extending in Right Bank side, sand, gravel and cobble, Ep=1.5m	Bedrock: same as Left Bank	Overburden: Colluvial deposits, relatively few Bedrock: mainly Schist interbedded with calcareous Sandstone

Comment	The dam axis is located at the hilly area with wide river bed. The right bank of the river consist of alluvial terrace and cliff. The foundation rocks are the alternation of black limestone and argillaceous limestone. The dip is gentle towards downstream.	Note: Ep: Thickness

Dam Planning

Dam Type	Length/Height of Dam	Dam Volume	Gross Reservoir Volume	Normal Water Level	Design Flood Discharge	Regulated Water Vol.
(21)	(22)	(23)	(24)	(25)	(26)	(27)
Both abutments has moderate slopes with hard rock foundation. The river-bed is somewhat wide. Both of gravity and zoned fill are prospective and competitive.	425m/53m	1,600,000m3	40 MCM	869.50 NGM	Qin=700m3/s Qout=250m3/s	

Comment	The foundation rock is good and considered to be less pervious. No special problem is anticipated.

Agriculture (Based on the data on beneficial commune(s))

Location	Number of Commune(s)	Farmland (ha)	Present Irrigated Area (ha)	Number of Farmers	Expected Present Farm Income (DH/ha)	Present crops	Expected Crops with Irrigation	Expected Income Increasing with Irrigation (DH/ha)
(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)
Igheznane	1	7,420	321	1,639	2,457	Hard Wheat Barley Almond	1) Wheat 2) Olive 3) Almond 4) Fodder 5) Vegetable	14,100
Comment	Strong request from farmers for irrigation facilities. Suitable land for irrigation							

Irrigation Planning

Beneficiary Area	Recipient Farmer	Annual Water Demand	Type of Irrigation	Design Discharge m3/s	Main Canal	Secondery Canal	Headwork	Other Facilities
(41)	(42)	(43)	(41)	(43)	(44)	(45)	(41)	(41)
1,600 ha	353	11.9 MCM	Furrow Border Basin	1.6 m3/s	7 km	16 km	_	9 nos
Comment								

Water Supply Planning

Target Area	Number of Commune(s)	Recipient House	Population	Organization of Implementation	Maintainer	Quantity of Demand (Mm3/year)	Facilities	Others
(51)	(52)	(53)	(54)	(55)	(56)	(57)	(58)	(59)
Irrigation area and suurounding area of the dam			600	Ministry of Equipment	Commune or farmers' association	0.004	Filter facility, Reservoir, Transmission line, Stand pipes	
Comment	Domestic water supply within the irrigation area and surrounding area of the dam is considered. Irrigation facilities will be utilized for water conveyance as maximal as possible for securing its economy.							

Flood and Sediment Control

Disasters	Suffering object	Effects of dam	Reservoir sedimentation	Others
(61)	(62)	(63)	(64)	(65)
Flooding and bank erosion	Farmlands	Flood control and channelstabilization.	DS: 441 m3/km/yr VS: 0.130 Mm3/yr	
Comment				

Table VII1.1.18 Development Plan for the Proposed Project (No.18 BOUKARKOUR)

General (Dam Site)

Objective	Zone	Watershed	River	Province	(1:50.000)	Coordinate	Location	Study level
irrigation, potable water supply, flood control	II	Slopes toward Atlantic, A=1120 km2	Zamrine	Settat	Mggarto	X=341.350 Y=291.000	Ben Ahmed	F/S terminated

Hydrology

Catchment of dam	Flow Station	Annual Flow	Flow Pattern
(1)	(2)	(3)	(4)
Basin area (Adam): 1120 km2 River system: Mellah/ Zamrine R.	Name: Feddane Taba Asta: 606 km2 (Asta/Adam: 2.0) Data period: >20 yrs.	1.04 m3/s 32.9 Mm3/yr 29 mm/yr	Peak flow in: Feb High flow in: 5 mon.(Nov-Mar) 50%-flow day: 6 days

Geology

Left Abutment of Damsite	Riverbed	Right Abutment	Reservoir
(11)	(12)	(13)	(14)
No Cover	River deposits: sand and gravel Talus deposits: at the foot of Banks Colluvial deposits: at the foot of Banks	No Cover	Terrace deposits: mainly sand and gravel, extending in the upstream Colluvial deposits: relatively few Bedrock: mainly Schist sometimes interbedded with Quartzite
Comment	Bedrocks are composed of the alternation of Sandstone and Mudstone. The foundation of dam axis is of very hard Quartzite including much iron ore layered of thickness 5 to 100 cm. As a foundation, it is strong enough, but joints of which are little open around the surface, however their treatment may be done well by grouting.		

Dam Planning

Dam Type	Length/Height of Dam	Dam Volume	Gross Reservoir Volume	Normal Water Level	Design Flood Discharge	Regulated Water Vol.
(21)	(22)	(23)	(24)	(25)	(26)	(27)
A gravity dam is suitable as the site has narrow river-bed with hard rock foundation.	213m/59.5m	172,000 m3	30.1 MCM	330.00 NGM	R.P.;1000 year Qin=1900m3/s	
Comment	Surface rocks are pervious. This can be easily treated by grouting.					

Agriculture (Based on the data on beneficial commune(s))

Location	Number of Commune(s)	Farmland (ha)	Present Irrigated Area (ha)	Number of Farmers	Expected Present Farm Income (DH/ha)	Present crops	Expected Crops with Irrigation	Expected Income Increasing with Irrigation (DH/ha)
(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)
Boukatkaour	2	26,663	175	3,222	3,431	Hard Wheat Soft Wheat Vegetables	1) Wheat 2) Vegetable 3) Olive 4) Almond 5) Fodder	14,700
Comment	Removing gravels and stones from farms are necessary in some area.							

Irrigation Planning

Beneficiary Area	Recipient Farmer	Annual Water Demand	Type of Irrigation	Design Discharge m3/s	Main Canal	Secondery Canal	Headwork	Other Facilities
(41)	(42)	(43)	(41)	(43)	(44)	(45)	(41)	(41)
1,000 ha	121	7.1 MCM	Furrow Border Basin	1.0 m3/s	8 km	10 km	Pump Station : 1	10 nos

Water Supply Planning

Target Area	Number of Commune(s)	Recipient House	Population	Organization of Implementation	Maintainer	Quantity of Demand (Mm3/year)	Facilities	Others
(51)	(52)	(53)	(54)	(55)	(56)	(57)	(58)	(59)
Irrigation area and suurounding area of the dam			200	Ministry of Equipment	Commune or farmers' association	0.002	Filter facility, Reservoir, Transmission line, Stand pipes	
Comment	Domestic water supply within the irrigation area and surrounding area of the dam is considered. Irrigation facilities will be utilized for water conveyance as maximal as possible for securing its economy.							

Flood and Sediment Control

Disasters	Suffering object	Effects of dam	Reservoir sedimentation	Others
(61)	(62)	(63)	(64)	(65)
Flooding and bank erosion, but not serious.	Farmlands and rural road	Flood control for local farmlands, stabilization of river channel, and sediment control for Mellah dam.	DS: 100 m3/km/yr VS: 0.112 Mm3/yr	
Comment	This dam does not have direct effects on flood control for Mohamedia city and national road, because Mellah dam exists downstream.			

Table VII1.1.19 Development Plan for the Proposed Project (No.19 AOULAI)

General (Dam Site)

Objective	Zone	Watershed	River	Province	(1:50.000)	Coordinate	Location	Study level
irrigation, sediment retaining for Al Wahda dam	I	Oulgha,tributary of Sebou A=490km2	Oued Ooulai	Taounate	Tamrot	X=542.150 Y=467.850	Ain Aicha	P/S terminated

Hydrology

Catchment of dam	Flow Station	Annual Flow	Flow Pattern
(1)	(2)	(3)	(4)
Basin area (Adam): 490 km2 River system: Sebou/ Ouergha/ Aoulai R.	Name: rhafsai Asta: 770 km2 (Asta/Adam: 1.6) Data period: >20 yrs.	5.63 m3/s 177.7 Mm3/yr 363 mm/yr	Peak flow in: Feb High flow in: 7 mon.(Nov-May) 50%-flow day: 21 days

Geology

Left Abutment of Damsite	Riverbed	Right Abutment	Reservoir
(11)	(12)	(13)	(14)
Overburden: Top soil, redidual soil of Schist with rock fragments	Alluvial deposits: River/Terrace deposits, mainly sand and gravel Terrace deposits: generally rounded gravel and cobbles in a silty matrix	Overburden: Ep=3m Terrace deposits: extending 400m in the downstream	Unconsolidated deposits: Terrace deposits, Colluvial deposits, and River deposits Bedrock: Schist interbedded with Black Limestone of around 10cm thickness

Comment	Bedrock of the dam is mainly slate. Slaking is prominent and as a whole weathering is predominant. Strength of foundation rocks is uncertain. There is a failure on the right bank slope.	Note: Ep: Thickness

Dam Planning

Dam Type	Length/Height of Dam	Dam Volume	Gross Reservoir Volume	Normal Water Level	Design Flood Discharge	Regulated Water Vol.
(21)	(22)	(23)	(24)	(25)	(26)	(27)
A gravity dam which can install a spillway on dambody is suitable as design flood is fairly big.	390m/66m	388,000 m3	145 MCM	340.00 NGM	R.P.;10000year Qin=2500m3/s	

Comment	It is possible to place the dam in the rock foundation. However, the rock is not highly bearing foundation here. Deep excavation or somewhat moderate dam-slope is expected.

Agriculture (Based on the data on beneficial commune(s))

Location	Number of Commune(s)	Farmland (ha)	Present Irrigated Area (ha)	Number of Farmers	Expected Present Farm Income (DH/ha)	Present crops	Expected Crops with Irrigation	Expected Income Increasing with Irrigation (DH/ha)
(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)
Ratba	1	4,847	14	1,565	1,886	Soft Wheat Hard Wheat Olive	1) Wheat 2) Olive 3) Almond 4) Fodder 5) Vegetable	14,600
Comment	Wide alluvial area is located at irrigable area.							

Irrigation Planning

Beneficiary Area	Recipient Farmer	Annual Water Demand	Type of Irrigation	Design Discharge m3/s	Main Canal	Secondery Canal	Headwork	Other Facility
(41)	(42)	(43)	(41)	(43)	(44)	(45)	(41)	(41)
5,000 ha	1,605	37.2 MCM	Furrow Border Basin	5.0 m3/s	45 km	50 km	-	50 nos.

Water Supply Planning

Target Area	Number of Commune(s)	Recipient House	Population	Organization of Implementation	Maintainer	Quantity of Demand (Mm3/year)	Facilities	Others
(51)	(52)	(53)	(54)	(55)	(56)	(57)	(58)	(59)
Irrigation area and suurounding area of the dam			2,100	Ministry of Equipment	Commune or farmers' association	0.015	Filter facility, Reservoir, Transmission line, Stand pipes	

Comment	This project is located in Rif Mountains where ground water resource is very scarce; therefore domestic water supply within the irrigation area and surrounding area of the dam is considered. Irrigation facilities will be utilized for water conveyance as maximal as possible for securing its economy.

Flood and Sediment Control

Disasters	Suffering object	Effects of dam	Reservoir sedimentation	Others
(61)	(62)	(63)	(64)	(65)
Flooding and bank erosion, but not so serious	Rural road	Flood control for local farmlands. Sediment control effect to Al Wahda will be small.	DS: 863 m3/km/yr VS: 0.430 Mm3/yr	

Comment	

Table VII1.1.20 Development Plan for the Proposed Project (No.20 SIDI ABBOU)

General (Dam Site)

Objective	Zone	Watershed	River	Province	(1:50.000)	Coordinate	Location	Study level
	I	Sebou A=363km2	Lebene	Taounate	Tissa	X=585.000 Y=424.700	Ain Aicha	P/S on going

Hydrology

Catchment of dam	Flow Station	Annual Flow	Flow Pattern
(1)	(2)	(3)	(4)
Basin area (Adam): 363 km2 River system: Sebou/ Lebene R.	Name: Boukarkour/Tissa Asta: 736 km2 (Asta/Adam: 2.0) Data period: 10 yrs.	1.10 m3/s 34.8 Mm3/yr 96 mm/yr	Peak flow in: Feb High flow in: 5 mon.(Dec-Apr) 50%-flow day: 13 days

Geology

Left Abutment of Damsite	Riverbed	Right Abutment	Reservoir
(11)	(12)	(13)	(14)
Bedrock: sometimes forming as Conglomerate and Sandstone	River deposits: gravel, sand, and rock blocks of 2m size, filling the depression of bedrock	Bedrcok: joints dipping toward river side, very big Karsts developing along joints or faults on the downstream	Unconsolidated Sediments: River deposits, Alluvial terrace deposits, widely extending in the area Bedrock: mainly Marl interbedded with Limestone

Comment	Dam site is in narrow and long gorge of limestone. The lower portions are fresh and hard, however in the upper portions rocks are slightly weathered and the joint are filled by muddy material. Partly observed large karst.

Dam Planning

Dam Type	Length/Height of Dam	Dam Volume	Gross Reservoir Volume	Normal Water Level	Design Flood Discharge	Regulated Water Vol.
(21)	(22)	(23)	(24)	(25)	(26)	(27)
For the site where geological surveys were performed, a gravity dam is suitable as the site is narrow gouge with hard rock foundation.	55m/40m	32,000 m3	58 MCM	338.00 NGM		

Comment	Although the site has a good topography to store the reservoir water, it has karsts in the dam foundation. Leakage problem is anticipated. A fill dam with inclined core and horizontal impervious blanket will be prospective for the mouth of gorge. Further geological surveys are expected.

Agriculture (Based on the data on beneficial commune(s))

Location	Number of Commune(s)	Farmland (ha)	Present Irrigated Area (ha)	Number of Farmers	Expected Present Farm Income (DH/ha)	Present crops	Expected Crops with Irrigation	Expected Income Increasing with Irrigation (DH/ha)
(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)
Sidi Abbou	2	16,680	491	2,103	2,395	Soft Wheat Hard Wheat Olive	1) Wheat 2) Olive 3) Almond 4) Fodder 5) Vegetable	14,100

Comment	No definitive formulation of irrigation scheme

Irrigation Planning

Beneficiary Area	Recipient Farmer	Annual Water Demand	Type of Irrigation	Design Discharge m3/s	Main Canal	Secondery Canal	Headwork	Other Facilities
(41)	(42)	(43)	(41)	(43)	(44)	(45)	(41)	(41)
2,000 ha	252	14.9 MCM	Furrow Border Basin	2.0 m3/s	29 km	20 km	Weir : 1	20 nos

Water Supply Planning

Target Area	Number of Commune(s)	Recipient House	Population	Organization of Implementation	Maintainer	Quantity of Demand (Mm3/year)	Facilities	Others
(51)	(52)	(53)	(54)	(55)	(56)	(57)	(58)	(59)
Irrigation area and suurounding area of the dam			400	Ministry of Equipment	Commune or farmers' association	0.003	Filter facility, Reservoir, Transmission line, Stand pipes	

Comment	Domestic water supply within the irrigation area and surrounding area of the dam is considered. Irrigation facilities will be utilized for water conveyance as maximal as possible for securing its economy.

Flood and Sediment Control

Disasters	Suffering object	Effects of dam	Reservoir sedimentation	Others
(61)	(62)	(63)	(64)	(65)
Flooding and bank erosion.	Settlements and farmlands	Flood control and stabilization of river channel	DS: - m3/km/yr VS:- Mm3/yr	

Comment	

Table VII1.1.21 Development Plan for the Proposed Project (No.21 SIDI EL MOKHFI)

General (Dam Site)

Objective	Zone	Watershed	River	Province	(1:50.000)	Coordinate	Location	Study level
Irrigation	I	Oulgha, tributary of Sebou A=378km2	Oued Amzez	Taounate	Ghafsay	X=558.450 Y=448.300	Sidi El Mokhfi	P/S terminated

Hydrology

Catchment of dam	Flow Station	Annual Flow	Flow Pattern
(1)	(2)	(3)	(4)
Basin area (Adam): 378 km2 River system: Sebou/ Amezetz R.	Name: Galez Asta: 440 km2 (Asta/Adam: 1.2) Data period: 13 yrs.	5.75 m3/s 181.4 Mm3/yr 480 mm/yr	Peak flow in: Feb High flow in: 7 mon.(Nov-May) 50%-flow day: 21 days

Geology

Left Abutment of Damsite	Riverbed	Right Abutment	Reservoir
(11)	(12)	(13)	(14)
Overburden: Colluvial deposits, Ep=2 to 5m Weathered Zone: Ep=1 to 2m	River deposits: Ep=2 to 5m	Talus deposits: few meters Terrace deposits: 1 to 2m Weathered Zone: Ep=1m	Bedrock: mainly Marl Terrace/River deposits: extending on the area Watertightness: probably good

Comment	Bedrock is massive, medium hard, and closely jointed black Limestone and calcareous Slate. Faults are infered at just upstream of dam axis. Slope around there is steep and looks unstable partly land slided.	Note: Ep: Thickness

Dam Planning

Dam Type	Length/Height of Dam	Dam Volume	Gross Reservoir Volume	Normal Water Level	Design Flood Discharge	Regulated Water Vol.
(21)	(22)	(23)	(24)	(25)	(26)	(27)
There exist exposures of hard foundation rocks on the right abutment and the river bed. The topography of right abutment is thin in width. A gravity is suitable.	260 m/64.5m	376,000 m3	36.7 MCM	313.00 NGM	1500m3/s	

Comment	Sands and gravel materials deposit in the river of dam site and its main river Ouergh. RCC is prospective. Just upstream of the dam site a fault running through the river will exist. The dam axis should be avoid a meeting with this fault.

Agriculture (Based on the data on beneficial commune(s))

Location	Number of Commune(s)	Farmland (ha)	Present Irrigated Area (ha)	Number of Farmers	Expected Present Farm Income (DH/ha)	Present crops	Expected Crops with Irrigation		Expected Income Increasing with Irrigation (DH/ha)
(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)		(39)
Sidi El Mokhfi	3	13,355	105	4,327	1,556	Soft Wheat Hard Wheat Olive	1) Wheat 2) Olive 3) Almond 4) Fodder 5) Vegetable		15,000
Comment	Irrigable areas are located hilly area								

Irrigation Planning

Beneficiary Area	Recipient Farmer	Annual Water Demand	Type of Irrigation	Design Discharge m3/s	Main Canal	Secondery Canal	Headwork	Other Facilities
(41)	(42)	(43)	(41)	(43)	(44)	(45)	(41)	(41)
3,600 ha	1,166	26.8 MCM	Furrow Border Basin	3.6 m3/s	11 km	36 km	Weir : 1	8 nos

Water Supply Planning

Target Area	Number of Commune(s)	Recipient House	Population	Organization of Implementation	Maintainer	Quantity of Demand (Mm3/year)	Facilities	Others
(51)	(52)	(53)	(54)	(55)	(56)	(57)	(58)	(59)
Irrigation area and suurounding area of the dam			1,500	Ministry of Equipment	Commune or farmers' association	0.011	Filter facility, Reservoir, Transmission line, Stand pipes	

Comment	This project is located in Rif Mountains where ground water resource is very scarce; therefore domestic water supply within the irrigation area and surrounding area of the dam is considered. Irrigation facilities will be utilized for water conveyance as maximal as possible for securing its economy.

Flood and Sediment Control

Disasters	Suffering object	Effects of dam	Reservoir sedimentation	Others
(61)	(62)	(63)	(64)	(65)
Flooding and bankerosion, but not so serious.	Public facilities and farmlands	Flood control for local farmlands. Sediment control for Al Wahda dam.	DS: - m3/km/yr VS: - Mm3/yr	
Comment				

Table VII1.1.22 Development Plan for the Proposed Project (No.22 N'OUANTZ)

General (Dam Site)

Objective	Zone	Watershed	River	Province	(1:50.000)	Coordinate	Location	Study level
irrigation, water supply for livestock	III	Oum Er Rbia A=204km2	N'Ouantz	Beni Mellal	Aghbala	X=471.664 Y=206.696	Aghbala	F/S terminated

Hydrology

Catchment of dam	Flow Station	Annual Flow	Flow Pattern
(1)	(2)	(3)	(4)
Basin area (Adam): 204 km2 River system: Oum Er Rbia/ El Abid R.	Name: Tizi N'isly Asta: 1444 km2 (Asta/Adam: 7.1) Data period: >20 yrs.	0.57 m3/s 17.8 Mm3/yr 87 mm/yr	Peak flow in: Mar, Nov High flow in: 6 mon.(Nov, Jan-May) 50%-flow day: 54 days

Geology

Left Abutment of Damsite	Riverbed	Right Abutment	Reservoir
(11)	(12)	(13)	(14)
River deposits: very thin, distributed locally	Alluvial deposits: mainly silt, Ep=1.5 to 2.0m Terrace deposits: sand and gravel with silt	Alluvium: Ep=few meters, sand and gravels with rock blocks	Overburden: Alluvium and Colluvium Bedrock: Silty Sandstone, covered by Alluvium and Colluvium

Comment	Foundation of dam site is composed of sandstone intebedding with thin argillaceous rocks showing red color. Impermeability may be no problem. In case concrete facilities will be constructed on this foundation, some detail study may be necessary.	Note: Ep: Thickness

Dam Planning

Dam Type	Length/Height of Dam	Dam Volume	Gross Reservoir Volume	Normal Water Level	Design Flood Discharge	Regulated Water Vol.
(21)	(22)	(23)	(24)	(25)	(26)	(27)
A fill type is suitable as both abutments are very gentle and soft rock foundations.	270m/35,5m	75,200 m3	2.92 MCM	1440.00 NGM	R.P.;1000year Qin=650m3/s	

Comment	A homogeneous fill is suitable as the dam height is small.

Agriculture (Based on the data on beneficial commune(s))

Location	Number of Commune(s)	Farmland (ha)	Present Irrigated Area (ha)	Number of Farmers	Expected Present Farm Income (DH/ha)	Present crops	Expected Crops with Irrigation	Expected Income Increasing with Irrigation (DH/ha)
(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)
N'ountz	2	14,042	1,551	1,698	4,928	Soft Wheat Hard Wheat Fodder Citrus	1) Wheat 2) Olive 3) Almond 4) Citrus 5) Fodder	8,000

Comment	High irrigated occupancy Irrigation is presently by groundwater. Very limited irrigable area

Irrigation Planning

Beneficiary Area	Recipient Farmer	Annual Water Demand	Type of Irrigation	Design Discharge m3/s	Main Canal	Secondery Canal	Headwork	Other Facility
(41)	(42)	(43)	(41)	(43)	(44)	(45)	(41)	(41)
–	–	–	–	–	–	–	–	–

Water Supply Planning

Target Area	Number of Commune(s)	Recipient House	Population	Organization of Implementation	Maintainer	Quantity of Demand (Mm3/year)	Facilities	Others
(51)	(52)	(53)	(54)	(55)	(56)	(57)	(58)	(59)
-	-	-	-	-	-	-	-	-

Comment	This project includes no water supply scheme.

Flood and Sediment Control

Disasters	Suffering object	Effects of dam	Reservoir sedimentation	Others
(61)	(62)	(63)	(64)	(65)
No serious flood damage	Farmlands, settlements, public facilities and livestock.	Little effect for flood control.	DS: 392 m3/km/yr VS: 0.080 Mm3/yr	

Comment	The reservoir will be full of sediment within 50 years

Table VII1.1.23 Development Plan for the Proposed Project (No.23 IGUI N'OUAQA)

General (Dam Site)

Objective	Zone	Watershed	River	Province	(1:50.000)	Coordinate	Location	Study level
irrigation, recharge for ground water	IV	Souss A=161km2	Aguerd	Taroudant	Igli	X=187.380 Y=416.250	Taroudant	F/S terminated

Hydrology

Catchment of dam	Flow Station	Annual Flow	Flow Pattern
(1)	(2)	(3)	(4)
Basin area (Adam): 161 km2 River system: Souss/ Aguerd R.	Name: Amsoul Asta: 480 km2 (Asta/Adam: 3.0) Data period: 19 yrs.	0.26 m3/s 8.3 Mm3/yr 52 mm/yr	Peak flow in: Jan, Nov High flow in: 6 mon.(Nov-Apr) 50%-flow day: 12 days

Geology

Left Abutment of Damsite	Riverbed	Right Abutment	Reservoir
(11)	(12)	(13)	(14)
Overburden: rock blocks accumulated at the foot of the cliff	River deposits: few or 10meters, rock blocks, sand and gravel	No Cover	Terrace deposits: existing widely Bedrock: mainly Marl interbedded with Limestone, Fine conglomerate, Sandstone and Mudstone There are many karsts.

Comments	Dam axis is in the gorge mainly of limestone which karst is commonly developed. Leakage is the main problem after constructing dam.

Dam Planning

Dam Type	Length/Height of Dam	Dam Volume	Gross Reservoir Volume	Normal Water Level	Design Flood Discharge	Regulated Water Vol.
(21)	(22)	(23)	(24)	(25)	(26)	(27)
The site is very narrow gorge with hard limestone. Both abutments are mostly up right . An arch type is suitable.	300m/57m	186,200 m3	10.5 MCM	764.00 NGM	R.P.;1000year Qin=630m3/s	

Comment	Karsts are observed in the foundation. Treatments for leakage will be tough works. Access for dam site is not easy. The construction cost for access road and compensation road will be high.

Agriculture (Based on the data on beneficial commune(s))

Location	Number of Commune(s)	Farmland (ha)	Present Irrigated Area (ha)	Number of Farmers	Expected Present Farm Income (DH/ha)	Present crops	Expected Crops with Irrigation	Expected Income Increasing with Irrigation (DH/ha)
(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)
Iguin' Quaqa	4	15,161	7,561	2,942	5,409	Barley Soft Wheat Vegetables Olive Fodder	1) Wheat 2) Vegetable 3) Olive 4) Almond 5) Fodder	12,900

Comments	High irrigated occupancy No definitive formulation of irrigation scheme

Irrigation Planning

Beneficiary Area	Recipient Farmer	Annual Water Demand	Type of Irrigation	Design Discharge m3/s	Main Canal	Secondery Canal	Headwork	Other Facilities
(41)	(42)	(43)	(41)	(43)	(44)	(45)	(41)	(41)
600 ha	116	6.4 MCM	Furrow Border Basin	0.6 m3/s	10 km	6 km	Weir : 1	8 nos

Water Supply Planning

Target Area	Number of Commune(s)	Recipient House	Population	Organization of Implementation	Maintainer	Quantity of Demand (Mm3/year)	Facilities	Others
(51)	(52)	(53)	(54)	(55)	(56)	(57)	(58)	(59)
Irrigation area and suurounding area of the dam			300	Ministry of Equipment	Commune or farmers' association	0.002	Filter facility, Reservoir, Transmission line, Stand pipes	

Comments	Domestic water supply within the irrigation area and surrounding area of the dam is considered. Irrigation facilities will be utilized for water conveyance as maximal as possible for securing its economy.

Flood and Sediment Control

Disasters	Suffering object	Effects of dam	Reservoir sedimentation	Others
(61)	(62)	(63)	(64)	(65)
Flooding and bank erosion.	Farmlands, settlement and irrigation facilities.	Flood control and stabilisation of river channel.	DS: 460 m3/km/yr VS: 0.075 Mm3/yr	

Comment	

Table VII1.1.24 Development Plan for the Proposed Project (No.24 AMONT ABDEL MOUMEN (AIT MOUSSI))

General (Dam Site)								
Objective	Zone	Watershed	River	Province	(1:50.000)	Coordinate	Location	Study level
compensation for Abdel-moumen Dam	IV	Assif, tributary of Souss A=938km2	Oued Issene	Taroudant	Imourrer Ida Ou-Tanane	X=146.400 Y=426.800	Argana	P/S on going

Hydrology			
Catchment of dam	Flow Station	Annual Flow	Flow Pattern
(1)	(2)	(3)	(4)
Basin area (Adam): 938 km2 River system: Souss/ Issen R.	Name: Aguenza Asta: 1130 km2 (Asta/Adam: 1.2) Data period: 17 yrs.	1.90 - m3/s 59.8 - Mm3/yr 64 mm/yr	Peak flow in: Mar, Nov High flow in: 6 mon.(Nov-Apr) 50%-flow day: 23 days

Geology			
Left Abutment of Damsite	Riverbed	Right Abutment	Reservoir
(11)	(12)	(13)	(14)
No Cover	River deposits: relatively few, almost rock blocks and cobbles	No Cover	Bedrock: almost same as the dam site, conglomerate layers including permeability

Comments	Both banks along dam axis are rightstanding. Foundation is composed of generally red colored sandstone, argillaceous rocks, and conglomerates which are monoclinic dipped gently downstream side. Folding is very few. Conglomerates have sometimes open joint which leakage may occur. Part of slope along dam axis in the right bank side fails. Very clear faults can be observed at some area.

Dam Planning						
Dam Type	Length/Height of Dam	Dam Volume	Gross Reservoir Volume	Normal Water Level	Design Flood Discharge	Regulated Water Vol.
(21)	(22)	(23)	(24)	(25)	(26)	(27)
A gravity is suitable as both abutments have steep slopes with rock foundation.	not yet decided					

Comment	Land sliding around the site should be studied.

Agriculture (Based on the data on beneficial commune(s))								
Location	Number of Commune(s)	Farmland (ha)	Present Irrigated Area (ha)	Number of Farmers	Expected Present Farm Income (DH/ha)	Present crops	Expected Crops with Irrigation	Expected Income Increasing with Irrigation (DH/ha)
(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)
Amont Abdelmoumen	2	1,360	339	1,131	3,724	Barley Soft Wheat Olive Almond	1) Wheat 2) Vegetable 3) Olive 4) Almond 5) Fodder	14,600
Comments	No Irrigation Scheme Project							

Irrigation Planning								
Beneficiary Area	Recipient Farmer	Annual Water Demand	Type of Irrigation	Design Discharge m3/s	Main Canal	Secondery Canal	Headwork	Other Facility
(41)	(42)	(43)	(41)	(43)	(44)	(45)	(41)	(41)
–	–	–	–	–	–	–	–	–

Water Supply Planning								
Target Area	Number of Commune(s)	Recipient House	Population	Organization of Implementation	Maintainer	Quantity of Demand (Mm3/year)	Facilities	Others
(51)	(52)	(53)	(54)	(55)	(56)	(57)	(58)	(59)
-	-	-	-	-	-	-	-	-
Comments	This project includes no water supply scheme.							

Flood and Sediment Control				
Disasters	Suffering object	Effects of dam	Reservoir sedimentation	Others
(61)	(62)	(63)	(64)	(65)
-	Abdelmoumen dam with technical problem.	Complement of functions of Abdelmoumen dam	DS: 161 m3/km/yr VS: 0.151 Mm3/yr	
Comment	Alternative studies are not available for the measures to complement the functions of Abdelmoumen dam. Study is still ongoing.			

Table VII1.1.25 Development Plan for the Proposed Project (No.25 SIDI ABDELLAH)

General (Dam Site)

Objective	Zone	Watershed	River	Province	(1:50.000)	Coordinate	Location	Study level
irrigation, recharge for ground water	IV	Souss A=233km2	Oued Ouaar	Taroudant	Igli	X=171.700 Y=408.600	Taroudant	F/S terminated

Hydrology

Catchment of dam	Flow Station	Annual Flow	Flow Pattern
(1)	(2)	(3)	(4)
Basin area (Adam): 233 km2 River system: Souss/ L'ouaar R.	Name: Amsoul Asta: 480 km2 (Asta/Adam: 3.0) Data period: 19 yrs.	0.38 m3/s 12.0 Mm3/yr 52 mm/yr	Peak flow in: Jan, Nov High flow in: 6 mon.(Nov-Apr) 50%-flow day: 12 days

Geology

Left Abutment of Damsite	Riverbed	Right Abutment	Reservoir
(11)	(12)	(13)	(14)
Overburden: Talus deposits at the foot	Alluvial deposits: Ep=few meters, rock blocks, cobbles, and sand, medium size 20 to 30cm	Overburden: Talus deposits at the foot	River deposits: relatively few Terrace deposits: mainly along Right Bank side Bedrock: Shale, Sandstone, Conglomerate, and Limestone Bar sometimes karstified

Comments	Hard basalt dyke runs obliquely crossing with river bed. Foundation is mainly of shale very brittle and low strength. While the upper abutment is the limestone highly karstified underlain by shale. The talus deposit lies on the relatively thick terrace deposit at the foot of right bank.

Dam Planning

Dam Type	Length/Height of Dam	Dam Volume	Gross Reservoir Volume	Normal Water Level	Design Flood Discharge	Regulated Water Vol.
(21)	(22)	(23)	(24)	(25)	(26)	(27)
The right abutment has thick soil layer. The foundation rock is mainly brittle schist. A zoned fill type is suitable.	381.3m/69m	2,055,000 m3	10.37 MCM	534.00 NGM	Qin=900m3/s Qout=528m3/s	

Comment	Materials for the fill dam can be obtained in the vicinity of the site. Access is easy.

Agriculture (Based on the data on beneficial commune(s))

Location	Number of Commune(s)	Farmland (ha)	Present Irrigated Area (ha)	Number of Farmers	Expected Present Farm Income (DH/ha)	Present crops	Expected Crops with Irrigation	Expected Income Increasing with Irrigation (DH/ha)
(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)
Sidi Abdellah	5	9,897	5,953	2,352	5,877	Barley Soft Wheat Vegetables Olive	1) Wheat 2) Vegetable 3) Olive 4) Almond 5) Fodder	12,400
Comments	High irrigated occupancy No definitive formulation of irrigation scheme							

Irrigation Planning

Beneficiary Area	Recipient Farmer	Annual Water Demand	Type of Irrigation	Design Discharge m3/s	Main Canal	Secondery Canal	Headwork	Other Facilities
(41)	(42)	(43)	(41)	(43)	(44)	(45)	(41)	(41)
600 ha	143	6.4 MCM	Furrow Border Basin	0.6 m3/s	12km	6 km	Weir : 1	8 nos

Water Supply Planning

Target Area	Number of Commune(s)	Recipient House	Population	Organization of Implementation	Maintainer	Quantity of Demand (Mm3/year)	Facilities	Others
(51)	(52)	(53)	(54)	(55)	(56)	(57)	(58)	(59)
Irrigation area and suurround-ing area of the dam			400	Ministry of Equipment	Commune or farmers' association	0.003	Filter facility, Reservoir, Transmission line, Stand pipes	

Comments	Domestic water supply within the irrigation area and surrounding area of the dam is considered. Irrigation facilities will be utilized for water conveyance as maximal as possible for securing its economy.

Flood and Sediment Control

Disasters	Suffering object	Effects of dam	Reservoir sedimentation	Others
(61)	(62)	(63)	(64)	(65)
Flooding and bank erosion.	Farmlands, settlement and irrigation facilities.	Flood control and stabilisation of river channel.	DS: 430 m3/km/yr VS: 0.103 Mm3/yr	

Comment	

Table VII1.1.18 Development Plan for the Proposed Project (No.18 BOUKARKOUR)

General (Dam Site)

Objective	Zone	Watershed	River	Province	(1:50.000)	Coordinate	Location	Study level
irrigation, potable water supply, flood control	II	Slopes toward Atlantic, A=1120 km2	Zamrine	Settat	Mggarto	X=341.350 Y=291.000	Ben Ahmed	F/S terminated

Hydrology

Catchment of dam	Flow Station	Annual Flow	Flow Pattern
(1)	(2)	(3)	(4)
Basin area (Adam): 1120 km2 River system: Mellah/ Zamrine R.	Name: Feddane Taba Asta: 606 km2 (Asta/Adam: 2.0) Data period: >20 yrs.	1.04 m3/s 32.9 Mm3/yr 29 mm/yr	Peak flow in: Feb High flow in: 5 mon.(Nov-Mar) 50%-flow day: 6 days

Geology

Left Abutment of Damsite	Riverbed	Right Abutment	Reservoir
(11)	(12)	(13)	(14)
No Cover	River deposits: sand and gravel Talus deposits: at the foot of Banks Colluvial deposits: at the foot of Banks	No Cover	Terrace deposits: mainly sand and gravel, extending in the upstream Colluvial deposits: relatively few Bedrock: mainly Schist sometimes interbedded with Quartzite
Comment	Bedrocks are composed of the alternation of Sandstone and Mudstone. The foundation of dam axis is of very hard Quartzite including much iron ore layered of thickness 5 to 100 cm. As a foundation, it is strong enough, but joints of which are little open around the surface, however their treatment may be done well by grouting.		

Dam Planning

Dam Type	Length/Height of Dam	Dam Volume	Gross Reservoir Volume	Normal Water Level	Design Flood Discharge	Regulated Water Vol.
(21)	(22)	(23)	(24)	(25)	(26)	(27)
A gravity dam is suitable as the site has narrow river-bed with hard rock foundation.	213m/59.5m	172,000 m3	30.1 MCM	330.00 NGM	R.P.;1000 year Qin=1900m3/s	
Comment	Surface rocks are pervious. This can be easily treated by grouting.					

Agriculture (Based on the data on beneficial commune(s))

Location	Number of Commune(s)	Farmland (ha)	Present Irrigated Area (ha)	Number of Farmers	Expected Present Farm Income (DH/ha)	Present crops	Expected Crops with Irrigation	Expected Income Increasing with Irrigation (DH/ha)
(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)
Boukatkaour	2	26,663	175	3,222	3,431	Hard Wheat Soft Wheat Vegetables	1) Wheat 2) Vegetable 3) Olive 4) Almond 5) Fodder	14,700
Comment	Removing gravels and stones from farms are necessary in some area.							

Irrigation Planning

Beneficiary Area	Recipient Farmer	Annual Water Demand	Type of Irrigation	Design Discharge m3/s	Main Canal	Secondery Canal	Headwork	Other Facilities
(41)	(42)	(43)	(41)	(43)	(44)	(45)	(41)	(41)
1,000 ha	121	7.1 MCM	Furrow Border Basin	1.0 m3/s	8 km	10 km	Pump Station : 1	10 nos

Water Supply Planning

Target Area	Number of Commune(s)	Recipient House	Population	Organization of Implementation	Maintainer	Quantity of Demand (Mm3/year)	Facilities	Others
(51)	(52)	(53)	(54)	(55)	(56)	(57)	(58)	(59)
Irrigation area and suurounding area of the dam			200	Ministry of Equipment	Commune or farmers' association	0.002	Filter facility, Reservoir, Transmission line, Stand pipes	
Comment	Domestic water supply within the irrigation area and surrounding area of the dam is considered. Irrigation facilities will be utilized for water conveyance as maximal as possible for securing its economy.							

Flood and Sediment Control

Disasters	Suffering object	Effects of dam	Reservoir sedimentation	Others
(61)	(62)	(63)	(64)	(65)
Flooding and bank erosion, but not serious.	Farmlands and rural road	Flood control for local farmlands, stabilization of river channel, and sediment control for Mellah dam.	DS: 100 m3/km/yr VS: 0.112 Mm3/yr	
Comment	This dam does not have direct effects on flood control for Mohamedia city and national road, because Mellah dam exists downstream.			