Table 9.4(b) Gross Crop Production Value, Production Cost and Net Crop Production Value (Midi Quada)

Crops	(A) Cultivated area (ha)	(B) Gross production value ($\times 10^3$ YRs)	(C) Unit production cost (YRs/ha)	(D) Total production cost, (A)×(C) ($\times 10^3$ YRs)	(E) Production tax, (B)×10% (YRs)	(F) Gross production cost, (D)+(E) ($\times 10^3$ YRs)	(G) Net production value, (B)-(F) ($\times 10^3$ YRs)
Cotton	100	120	220	22	12	34	86
Coffee	-	-	-	-	-	-	-
Qut	-	-	-	-	-	-	-
Wheat	-	-	-	-	-	-	-
Barley	-	-	-	-	-	-	-
Grapes	-	-	-	-	-	-	-
Vegetables	150	6,000	2,500	375	600	975	5,025
Legumes	550	2,640	1,500	825	264	1,089	1,551
Tobacco	100	2,520	2,500	250	252	502	2,018
Sesame	100	1,250	2,000	200	125	325	925
Potatoes	100	3,200	2,500	250	320	570	2,630
Maize	100	225	270	27	23	50	175
Sorghum/Millet	41,300	66,080	240	9,912	6,608	16,520	49,560
Fruits, etc.	1,000	48,000	14,000	14,000	4,800	18,800	29,200
Total	43,500	130,035	-	25,861	13,004	38,865	91,170

- to be continued -

Table 9.4(c) Gross Crop Production Value, Production Cost and Net Crop Production Value (Al-Mahabisha Quada)

Crops	(A) Cultivated area (ha)	(B) Gross production value (×10³ YRs)	(C) Unit production cost (YRs/ha)	(D) Total production cost, (A)×(C) (×10³ YRs)	(E) Production tax, (B)×10% (YRs)	(F) Gross production cost (D)+(E) (×10³ YRs)	(G) Net production value, (B)-(F) (×10³ YRs)
Cotton	-	-	-	-	-	-	-
Coffee	300	3,360	4,000	1,200	336	1,536	1,824
Qut	5,500	847,000	4,000	22,000	84,700	106,700	740,300
Wheat	100	160	200	20	16	36	124
Barley	100	180	200	20	18	38	142
Grapes	400	23,040	15,000	6,000	2,304	8,304	14,736
Vegetables	50	2,000	2,500	125	200	325	1,675
Legumes	100	480	1,500	150	48	198	282
Tobacco	-	-	-	-	-	-	-
Sesame	-	-	-	-	-	-	-
Potatoes	50	1,600	2,500	125	160	285	1,315
Maize	100	225	270	27	23	50	175
Sorghum/Millet	3,500	5,600	240	840	560	1,400	4,200
Fruits, etc.	100	4,800	14,000	1,400	480	1,880	2,920
Total	10,300	888,445	-	31,907	88,845	120,752	767,693

- to be continued -

Table 9.4(d) Gross Crop Production Value, Production Cost and Net Crop Production Value (Washha Quada)

Crops	(A) Cultivated area (ha)	(B) Gross production value (×10³ YRs)	(C) Unit production cost (YRs/ha)	(D) Total production cost, (A)×(C) (×10³ YRs)	(E) Production tax, (B)×10% (YRs)	(F) Gross production cost, (D)+(E) (×10³ YRs)	(G) Net production value, (B)−(F) (×10³ YRs)
Cotton	-	-	-	-	-	-	-
Coffee	100	1,120	4,000	400	112	512	608
Qut	200	30,800	4,000	800	3,080	3,880	26,920
Wheat	100	160	200	20	16	36	124
Barley	100	180	200	20	18	38	142
Grapes	200	11,520	15,000	3,000	1,152	4,152	7,368
Vegetables	50	2,000	2,500	125	200	325	1,675
Legumes	50	240	1,500	75	24	99	141
Tabacco	-	-	-	-	-	-	-
Sesame	-	-	-	-	-	-	-
Potatoes	-	-	-	-	-	-	-
Maize	100	225	270	27	23	50	175
Sorghum/Millet	4,200	6,720	240	1,008	672	1,680	5,040
Fruits, etc.	500	24,000	14,000	7,000	2,400	9,400	14,600
Total	5,600	76,965	-	12,475	7,697	20,172	56,793

- to be continued -

Table 9.4(e) Gross Crop Production Value, Production Cost and Net Crop Production Value (Shahara Quada)

Crops	(A) Cultivated area (ha)	(B) Gross production value ($\times 10^3$ YRs)	(C) Unit production cost (YRs/ha)	(D) Total production cost, (A)×(C) ($\times 10^3$ YRs)	(E) Production tax, (B)×10% (YRs)	(F) Gross production cost, (D)+(E) ($\times 10^3$ YRs)	(G) Net production value, (B)-(F) ($\times 10^3$ YRs)
Cotton	-	-	-	-	-	-	
Coffee	100	1,120	4,000	400	112	512	608
Qut	200	30,800	4,000	800	3,080	3,880	26,920
Wheat	100	160	200	20	16	36	124
Barley	100	180	200	20	18	38	142
Grapes	200	11,520	15,000	3,000	1,152	4,152	7,368
Vegetables	50	2,000	2,500	125	200	325	1,675
Legumes	100	480	1,500	150	48	198	282
Tabacco	-	-	-	-	-	-	-
Sesame	-	-	-	-	-	-	-
Potatoes	50	1,600	2,500	125	160	285	1,315
Maize	100	225	270	27	23	50	175
Sorghum/Millet	4,900	7,840	240	1,176	784	1,960	5,880
Fruits, etc.	-	-	-	-	-	-	-
Total	5,900	55,925	-	5,843	5,593	11,436	44,489

Table 9.5 Gross Livestock Production Value, Production Cost and Net Livestock Production Value (Hajjah Province)

(1) Meat Production

	Livestock population (heads)	No. of slaughtered animals (heads)	Meat production per head (kg)	Meat production ($\times 10^3$ tons)	Unit price (YRs/kg)	Production value ($\times 10^3$ YRs)
Cattle	88,000	—				
adult	—	6,330	200	1,260	15	18,990
calves	—	1,600	50	80	10	800
Sheep	168,000	58,800	10	588	30	17,640
Goats	195,000	68,250	10	683	20	13,650
Chickens	402,000	402,000	0.8	322	37.5	12,060
						63,140

(2) Milk and Eggs Production

	Livestock population (heads)	Off-take (%)	No. of adult (heads)	Production per head (litre, kg)	Production ($\times 10^3$ litre, kg)	Unit price (YRs)	Production value ($\times 10^3$ YRs)
Cattle	88,000	9.0	7,920	200	1,584	2	3,168
Sheep	168,000	35.0	58,800	17	999	2	1,998
Goats	195,000	35.0	68,250	17	1,160	2	2,320
Chickens	402,000	2.5	10,050	10	100	20	2,000
							9,486

(3) Production Cost

	No. of slaughtered animals (heads)	Feed per head (YRs)	Amount ($\times 10^3$ YRs)
Cattle			
adult	6,330	1,050	6,646
calves	1,600	100	160
Sheep	58,800	100	5,880
Goats	68,250	100	6,825
Chickens	402,000	5	2,010
			21,521

(4) Net Production Value

	Production value: Meat (1)	Production value: Milk & eggs (2)	Cost (3)	Net production value (1)+(2)-(3)($\times 10^3$ YRs)
Cattle				
adult	18,990	3,168	6,646	15,512
calves	800	—	160	640
Sheep	17,640	1,998	5,880	13,758
Goats	13,650	2,320	6,825	9,145
Chickens	12,060	2,000	2,010	12,050
	63,140	9,486	21,521	51,105

:Source; Appraisal of Livestock Credit and Processing Project, Yemen Arab Republic (World Bank authorization)

- to be continued -

Table 9.5(a) Gross Livestock Production Value, Production Cost and Net Livestock Production Value (Hajjah Quada)

(1) Meat Production

	Livestock population (heads)	No. of slaughtered animals (heads)	Meat production per head (kg)	Meat production ($\times 10^3$ tons)	Unit price (YRs/kg)	Production value ($\times 10^3$ YRs)
Cattle	19,400	—				
adult	—	1,390	200	278.0	15	4,170
calves	—	360	50	18.0	10	180
Sheep	48,000	16,800	10	168.0	30	5,040
Goats	55,000	19,250	10	192.5	20	3,850
Chickens	137,000	137,000	0.8	109.6	37.5	4,110
						17,350

(2) Milk and Eggs Production

	Population (heads)	Off-take (%)	No. of adult (heads)	Production per head (litre, kg)	Production ($\times 10^3$ litre, kg)	Unit price (YRs)	Production value ($\times 10^3$ YRs)
Cattle	19,400	9.0	1,746	200	349	2	698
Sheep	48,000	35.0	16,800	17	286	2	572
Goats	55,000	35.0	19,250	17	327	2	654
Chickens	137,000	2.5	3,425	10	34	20	680
							2,604

(3) Production Cost

	No. of slaughtered animals (heads)	Feed per head (YRs)	Amount ($\times 10^3$ YRs)
Cattle			
adult	1,390	1,050	1,459
calves	360	100	36
Sheep	16,800	100	1,680
Goats	19,250	100	1,925
Chickens	137,000	5	685
			5,785

(4) Net Production Value

	Production value: Meat (1)	Production value: Milk & eggs (2)	Cost (3)	Net production Value (1)+(2)-(3) ($\times 10^3$ YRs)
Cattle				
adult	4,170	698	1,459	3,409
calves	180	—	36	144
Sheep	5,040	572	1,680	3,932
Goats	3,850	654	1,925	2,579
Chickens	4,110	680	685	4,105
	17,350	2,604	5,785	14,169

- to be continued -

Table 9.5(b) Gross Livestock Production Value, Production Cost and Net Livestock Production Value (Midi Quada)

(1) Meat Production

	Livestock population (heads)	No. of slaughtered animals (heads)	Meat production per head (kg)	Meat production ($\times 10^3$ tons)	Unit price (YRs/kg)	Production value ($\times 10^3$ YRs)
Cattle	39,700	—				
adult	—	2,860	200	572.0	15	8,580
calves	—	710	50	35.5	10	355
Sheep	51,000	17,850	10	178.5	30	5,355
Goats	61,000	21,350	10	213.5	20	4,270
Chickens	72,000	72,000	0.8	57.6	37.5	2,160
						20,720

(2) Milk and Eggs Production

	Population (heads)	Off-take (%)	No. of adult (heads)	Production per head (litre, kg)	Production ($\times 10^3$ litre, kg)	Unit price (YRs)	Production value ($\times 10^3$ YRs)
Cattle	39,700	9.0	3,573	200	715	2	1,430
Sheep	51,000	35.0	17,850	17	303	2	606
Goats	61,000	35.0	21,350	17	363	2	726
Chickens	72,000	2.5	1,800	10	18	20	360
							3,122

(3) Production Cost

	No. of slaughtered animals (heads)	Feed per head (YRs)	Amount ($\times 10^3$ YRs)
Cattle			
adult	2,860	1,050	3,003
calves	710	100	71
Sheep	17,850	100	1,785
Goats	21,350	100	2,135
Chickens	72,000	5	360
			7,354

(4) Net Production Value

	Production value: Meat (1)	Production value: Milk & eggs (2)	Cost (3)	Net production value (1)+(2)-(3) ($\times 10^3$ YRs)
Cattle				
adult	8,580	1,430	3,003	7,007
calves	355	—	71	284
Sheep	5,355	606	1,785	4,176
Goats	4,270	726	2,135	2,861
Chickens	2,160	360	360	2,160
	20,720	3,122	7,354	16,488

- to be continued -

Table 9.5(c) Gross Livestock Production Value, Production Cost and Net Livestock Production Value (Al-Mahabisha Quada)

(1) Meat Production

	Livestock population (heads)	No. of slaughtered animals (heads)	Meat production per head (kg)	Meat production ($\times 10^3$ tons)	Unit price (YRs/kg)	Production value ($\times 10^3$ YRs)
Cattle	14,000	—				
adult	—	1,010	200	202.0	15	3,030
calves	—	250	50	12.5	10	125
Sheep	34,000	11,900	10	119.0	30	3,570
Goats	39,000	13,650	10	136.5	20	2,730
Chickens	96,000	96,000	0.8	76.8	37.5	2,880
						12,335

(2) Milk and Eggs Production

	Population (heads)	Off-take (%)	No. of adult (heads)	Production per head (litre, kg)	Production ($\times 10^3$ litre, kg)	Unit price (YRs)	Production value ($\times 10^3$ YRs)
Cattle	14,000	9.0	1,260	200	252	2	504
Sheep	34,000	35.0	11,900	17	202	2	404
Goats	39,000	35.0	13,650	17	232	2	464
Chickens	96,000	2.5	2,400	10	24	20	480
							1,852

(3) Production Cost

	No. of slaughtered animals (heads)	Feed per head (YRs)	Amount ($\times 10^3$ YRs)
Cattle			
adult	1,010	1,050	1,061
calves	250	100	25
Sheep	11,900	100	1,190
Goats	13,650	100	1,365
Chickens	96,000	5	480
			4,121

(4) Net Production Value

	Production value: Meat (1)	Production value: Milk & eggs (2)	Cost (3)	Net production value (1)+(2)-(3) ($\times 10^3$ YRs)
Cattle				
adult	3,030	504	1,061	2,473
calves	125	—	25	100
Sheep	3,570	404	1,190	2,784
Goats	2,730	464	1,365	1,829
Chickens	2,880	480	480	2,880
	12,335	1,852	4,121	10,066

- to be continued -

Table 9.5(d) Gross Livestock Production Value, Production Cost and Net Livestock Production Value (Washha Quada)

(1) Meat Production

	Livestock population (heads)	No. of slaughtered animals (heads)	Meat production per head (kg)	Meat production ($\times 10^3$ tons)	Unit price (YRs/kg)	Production value ($\times 10^3$ YRs)
Cattle	7,400	—				
adult	—	530	200	106.0	15	1,590
calves	—	140	50	7.0	10	70
Sheep	17,000	5,950	10	59.5	30	1,785
Goats	20,000	7,000	10	70.0	20	1,400
Chickens	48,000	48,000	0.8	38.4	37.5	1,440
						6,285

(2) Milk and Eggs Production

	Population (heads)	Off-take (%)	No. of adult (heads)	Production per head (litre, kg)	Production ($\times 10^3$ litre, kg)	Unit price (YRs)	Production value ($\times 10^3$ YRs)
Cattle	7,400	9.0	666	200	133	2	266
Sheep	17,000	35.0	5,950	17	101	2	202
Goats	20,000	35.0	7,000	17	119	2	238
Chickens	48,000	2.5	1,200	10	12	20	240
							946

(3) Production Cost

	No. of slaughtered animals (heads)	Feed per head (YRs)	Amount ($\times 10^3$ YRs)
Cattle			
adult	530	1,050	556
calves	140	100	14
Sheep	5,950	100	595
Goats	7,000	100	700
Chickens	48,000	5	240
			2,105

(4) Net Production Value

	Production value: Meat (1)	Production value: Milk & eggs (2)	Cost (3)	Net production value (1)+(2)-(3) ($\times 10^3$ YRs)
Cattle				
adult	1,590	266	556	1,300
calves	70	—	14	56
Sheep	1,785	202	595	1,392
Goats	1,400	238	700	938
Chickens	1,440	240	240	1,440
	6,285	946	2,105	5,126

- to be continued -

Table 9.5(e) Gross Livestock Production Value, Production Cost and Net Livestock Production Value (Shahara Quada)

(1) Meat Production

	Livestock population (heads)	No. of slaughtered animals (heads)	Meat production per head (kg)	Meat production ($\times 10^3$ tons)	Unit price (YRs/kg)	Production value ($\times 10^3$ YRs)
Cattle	7,500					
adult	—	540	200	108.0	15	1,620
calves	—	140	50	7.0	10	70
Sheep	18,000	6,300	10	63.0	30	1,890
Goats	20,000	7,000	10	70.0	20	1,400
Chickens	49,000	49,000	0.8	39.2	37.5	1,470
						6,450

(2) Milk and Eggs Production

	Population (heads)	Off-take (%)	No. of adult (heads)	Production per head (litre, kg)	Production ($\times 10^3$ litre, kg)	Unit price (YRs)	Production value ($\times 10^3$ YRs)
Cattle	7,500	9.0	675	200	135	2	270
Sheep	18,000	35.0	6,300	17	107	2	214
Goats	20,000	35.0	7,000	17	119	2	238
Chickens	49,000	2.5	1,225	10	12	20	240
							962

(3) Production Cost

	No. of slaughtered animals (heads)	Feed per head (YRs)	Amount ($\times 10^3$ YRs)
Cattle			
adult	540	1,050	567
calves	140	100	14
Sheep	6,300	100	630
Goats	7,000	100	700
Chickens	49,000	5	245
			2,156

(4) Net Production Value

	Production value: Meat (1)	Production value: Milk & eggs (2)	Cost (3)	Net production value (1)+(2)−(3) ($\times 10^3$ YRs)
Cattle				
adult	1,620	270	567	1,323
calves	70	—	14	56
Sheep	1,890	214	630	1,474
Goats	1,400	238	700	938
Chickens	1,470	240	245	1,465
	6,450	962	2,156	5,256

- to be continued -

Table 9.6 Results of Farm Economy Survey

(1) Distribution of Farm Size

Farm size	Mabyan No. of farm	Mabyan %	Al Mahabisha No. of farm	Al Mahabisha %	Farm size	Abs No. of farm	Abs %
0 - 0.25	4	8	5	17	0 - 2.5	4	15
0.25 - 0.5	2	4	4	13	2.5 - 5.0	8	31
0.5 - 0.75	7	14	4	13	5.0 - 7.5	5	19
0.75 - 1.0	7	14	2	7	7.5 - 10.0	1	4
1.0 - 1.25	4	8	1	3	12.5 - 15.0	1	4
1.25 - 1.5	6	12	2	7	15.0 - 17.5	3	11
1.5 - 1.75	4	8	2	7	17.5 - 20.0	1	4
1.75 - 2.0	1	2	1	3	20.0 - 22.5	1	4
2.0 - 2.25	5	10	2	7	22.5 - 25.0	1	4
2.25 - 2.5	2	4	2	7	25.0 over	1	4
2.5 - 2.75	1	2	0	-			
2.75 - 3.0	0	-	1	3			
3.0 - 4.0	1	2	1	3			
4.0 - 5.0	1	2	1	3			
5.0 - 10.0	3	6	2	7			
10.0 over							
Total	50	100	30	100		26	100

- to be continued -

(2) Distribution of Family Size

Family member	Mabyan		Al Mahabisha		Abs	
	No. of household	%	No. of household	%	No. of household	%
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3 - 4	0	0	1	3	3	12
5 - 9	6	12	14	47	8	31
10 - 14	22	44	9	30	6	23
15 - 19	16	32	4	13	4	15
20 -	6	12	2	7	5	19
Total	50	100	30	100	26	100

- to be continued -

(3) Value of Buildings

Location	Nos/Farm	M^2/house	Value (YRs)	Remarks	
Hajjah	1	165	150,000	Three storied,	Stone
Mabyan	1	-	10,000		Stone
Mabyan	1	80	20,000		Stone
Mabyan	1	64	20,000		Stone
Mabyan	1	227	50,000	Tenement	Stone
Al-Mahabisha	1	136	100,000		Stone
Al-Mahabisha	1	112	70,000	Two storied,	Stone
Al-Mahabisha	1	64	3,000		
Abs	2	19	10,000		Grass
Abs	2	19	10,000		Grass
Abs	1	300	50,000	Tenement	Brick-clay
Abs	1	160	150,000	Three storied,	Stone

- to be continued -

(4) Present Typical Farm Budget in Mabyan (Hajjah Quada)

Crop income

Crop	Area (ha)	Yield (tons/ha)	Products (tons)	Price (YRs/kg)	Value (YRs)
Millet	0.03	0.9	0.03	1,500	40
Sorghum	0.60	1.0	0.60	2,000	1,200
Coffee	0.05	0.4	0.02	28,000	560
Fruit	0.05	8.0	0.40	12,000	4,800
Qut	0.07	2,200 bundles	154	70	10,780
Stover 1/	0.60	8.0	4.8	0.05	240
Sub-total					17,620

Production cost

Crop	Area (ha)	Unit production cost 2/ (YRs/ha)	Total production cost (YRs)	Tax (YRs)	Total cost (YRs)
Millet	0.03	240	7	4	11
Sorghum	0.60	240	144	120	264
Coffee	0.05	4,000	200	56	256
Fruit	0.05	14,000	700	480	1,180
Qut	0.07	4,000	280	1,078	1,358
Miscellaneous					460
Sub-total					6,598

Crop income (A) 11,022

Livestock income

Livestock	No. of animals (head)	Yield/head/year milk (ℓ)	Yield/head/year meat (kg)	Products milk (ℓ)	Products meat (kg)	Value milk (YRs)	Value meat (YRs)	Total (YRs)
Milkcow	1.7	1,500	28	2,550	48	5,100	720	5,820
Cattle	1.0	18	18	18	18	36	270	306
Donkey	0.9							50
Goats	4.3	6	3.5	26	15	52	540	592
Sheep	0.7	6	3.5	4	2	8	40	48
Chicken	4.0		0.8	-	3		114	114
Sub-total								6,930

Production cost

Livestock	No. of animals (head)	Feed/head/year (kg)	Unit price of feed (YRs/kg)	Total cost (YRs)
Milkcow	1.7	3,000	0.05	255
Cattle	1.0	1,000	0.05	50
Donkey	0.9	1,000	0.05	50
Goats	4.3	500	0.05	108
Sheep	0.7	500	0.05	18
Chicken	4.0	30	0.07	8
Miscellaneous				766
Sub-total				1,255

Livestock income (B) 5,675

Gross farm income (A) + (B) 16,697

Remarks: 1/ Grain/Stover ratio of sorghum is estimated at 1/8.

2/ Cost includes seeds, fertilizers, Agro-chemicals, tools and hired labor wages, etc.

- to be continued -

(5) Present Typical Farm Budget in Al-Mahabisha (Mahabisha Quada)

Crop income

Crop	Area (ha)	Yield (tons/ha)	Products (tons)	Price (YRs/kg)	Value (YRs)
Millet	0.10	0.6	0.06	1,500	90
Sorghum	0.10	0.7	0.07	2,000	140
Fruit	0.03	8.0	0.02	12,000	240
Qut	0.40	2,200 bundles	880	70	61,600
Stover 1/	0.10	8.0	5.60	0.05	280
Sub-total					62,350

Production cost

Crop	Area (ha)	Unit production cost 2/ (YRs/ha)	Total production cost (YRs)	Tax (YRs)	Total cost (YRs)
Millet	0.10	240	24	9	33
Sorghum	0.10	240	24	14	38
Fruit	0.03	14,000	420	24	444
Qut	0.40	4,000	1,600	6,160	7,760
Miscella-neous					1,241
Sub-total					9,516
Crop income (A)					52,834
Gross farm income (A) + (B)					56,965

Livestock income

Livestock	No. of animals (head)	Yield/head/year milk (ℓ)	Yield/head/year meat (kg)	Products milk (ℓ)	Products meat (kg)	Value milk (YRs)	Value meat (YRs)	Total (YRs)
Milkcow	1.2	1,500	28	1,800	34	3,600	510	4,110
Cattle	1.0	18	18	18	18	36	270	306
Donkey	0.5							
Goats	2.1	6	3.5	13	7	26	140	166
Sheep	0.4	6	3.5	2	1	4	30	34
Chicken	14.0		0.8		11			418
Sub-total								5,034

Production cost

Livestock	No. of animals (head)	Feed/head/year (kg)	Unit price of feed (YRs/kg)	Total cost (YRs)
Milkcow	1.2	3,000	0.05	180
Cattle	1.0	1,000	0.05	50
Donkey	0.5	1,000	0.05	25
Goats	2.1	500	0.05	53
Sheep	0.4	500	0.05	10
Chicken	14.0	30	0.07	29
Miscella-neous				556
Sub-total				903
Livestock income (B)				4,131

Remarks: 1/ Grain/Stover ratio of sorghum is estimated at 1/8.

2/ Cost includes seeds, fertilizers, Agro-chemicals, tools and hired labour wages, etc.

- to be continued -

(6) Present Typical Farm Budget in Abs (Midi Quada)

Crop income

Crop	Area (ha)	Yield (tons/ha)	Products (tons)	Price (YRs/kg)	Value (YRs)
Millet	1.0	0.8	0.80	1,500	1,200
Sorghum red	0.6	0.9	0.54	2,000	1,080
Sorghum white	0.5	0.9	0.45	2,000	900
Vegetables	0.1	7.0	0.7	7,000	4,900
Stover 1/	1.1	8.0	8.8	0.05	440
Sub-Total					8,520

Production cost

Crop	Area (ha)	Unit production cost 2/ (YRs/ha)	Total production cost (YRs)	Tax (YRs)	Total cost (YRs)
Millet	1.0	240	240	120	360
Sorghum red	0.6	240	144	108	252
Sorghum white	0.5	240	120	90	210
Vegetables	0.1	2,500	250	490	740
Miscellaneous					234
Sub-total					1,796
Crop income (A)					6,724
Gross farm income (A) + (B)					17,623

Livestock income

Livestock	No. of animals (head)	Yield/head/year milk (ℓ)	Yield/head/year meat (kg)	Products milk (ℓ)	Products meat (kg)	Value milk (YRs)	Value meat (YRs)	Total (YRs)
Milkcow	2.6	1,500	28	3,900	73	7,800	1,095	8,895
Cattle	3.9	18	18	70	70	140	1,050	1,190
Camel	1.6							
Donkey	3.7							
Goats	20.0	6	3.5	120	70	240	1,720	1,960
Sheep	21.3	6	3.5	128	75	256	1,800	2,056
Chicken	15.3		0.8		12		456	456
Sub-total								14,557

Production cost

Livestock	No. of animals (head)	Feed/head/year (kg)	Unit price of feed (YRs/kg)	Total cost (YRs)
Milkcow	2.6	3,000	0.05	390
Cattle	3.9	1,000	0.05	195
Camel	1.6	1,000	0.05	80
Donkey	3.7	1,000	0.05	185
Goats	20.0	500	0.05	500
Sheep	21.3	500	0.05	533
Chicken	15.3	30	0.07	32
Miscellaneous				1,743
Sub-total				3,658
Livestock income				10,899

Remarks: 1/ Grain/Stover ratio of sorghum is estimated at 1/8.

2/ Cost includes seeds, fertilizers, Agro-chemicals, tools and hired labor wages, etc.

- to be continued -

(7) Living Expenditure

Expenditure	Mabyan		Al Mahabisha		Abs	
	(YRs)	(%)	(YRs)	(%)	(YRs)	(%)
Food	19,900	43	22,000	42	26,100	56
Clothes	5,000	11	6,400	12	2,900	6
Education	800	2	2,000	4	500	1
Housing	3,500	8	4,100	8	3,600	8
Medical	400	0.5	3,200	6	4,300	9
Consumable	2,100	5	1,100	2	1,400	3
Electric	5,700	12	5,500	10	1,200	3
Properties	400	0.5	300	-	500	1
Ceremonial	7,400	16	6,000	11	4,400	10
Social expenses	700	2	2,400	5	1,500	3
Total	45,900	100	53,000	100	46,400	100

- to be continued -

(8) Present Typical Farm Budget

	Description	Mabyan (YRs)	Al Mahabisha (YRs)	Abs (YRs)
I	Crop income	17,600	62,400	8,500
II	Livestock income	6,900	5,000	14,600
III	Wage and other income	29,300	100	28,900
IV	Total gross income	53,800	67,500	52,000
V	Farming expenditure	7,900	10,400	5,600
VI	Living expenditure	45,900	53,000	46,400
VII	Total gross outgo V + VI	53,800	63,400	52,000
	Net reserve, IV - VII	0	4,100	0

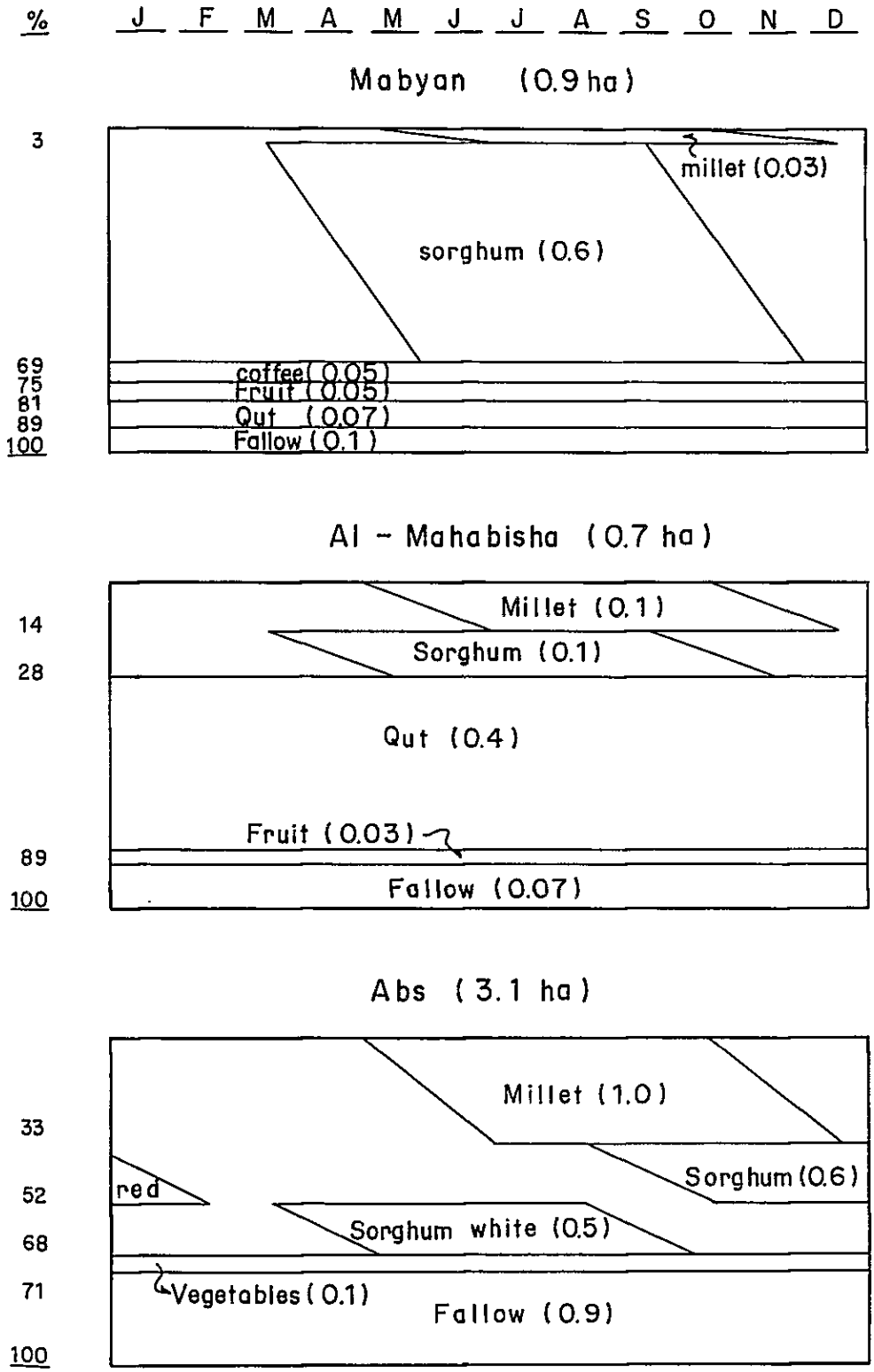

Fig. 9·1 Present Cropping Pattern

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Central Planning Organization	Statistical Year Book, 1976-1977, YAR
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IBRD (1978)	Effect of Migration of Rural Labour on Agricultural Development
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Tihama Development Authority (1977)	Educational and Economic Effects of Cotton and Maize
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IBRD (1979)	A World Bank Country Study, YAR
Tihama Development Authority (1975)	Economic Analysis of the Existing and Potential Cropping Patterns, Wadi Zabid Project, YAR

X PRESENT DEVELOPMENT PLAN AND ACTIVITIES

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X PRESENT DEVELOPMENT PLAN AND ACTIVITIES

(1) Development Organizations

Public administration and institutions to serve agriculture

10.01 The Hajjah Province is located in the north-western part of the country, neighbouring northern provinces where the localities rather prefers to retain autonomy from national level authorities. In the Province itself, local administration is not fully developed and operates in the manner of traditional village organization, rather than as an extension of national public administration. In reality, public administration can only operates effectively with the support of the traditional form of local organization which has worked successfully over the years to settle the questions and problems relating to land and water rights, intra-communal disputes and to support local works of various kinds.

10.02 No branch offices of institutions to serve agriculture, except a branch office of ACB in Abs established in March, 1979, are existent in the Province, though they are desparately needed with a view to improving present farming practices as well as to introducing modern production techniques.

Local Development Association

10.03 Of some 150 LDAs established in the ten provinces of the country, 32 associations or about one fifth of the total are located in the Hajjah Province as of 1979. They have been working very effectively and also have strong influence over the National LDA Assembly Committee which comprises the heads of the LDA Administrative Committees.

10.04 Similar to the LDAs in other Provinces, LDAs in the Province have concentrated their activities in the project categories of rural access road, water supply, school and health facilities. They have been working quite successfully, constructing most of the existing rural access roads and water supply systems in the Province.

Foreign aid organizations

10.05 Since independence, YAR has received substantial amounts of foreign aid. Classified as a "least developed country" with low per capita income and as a "most severely affected country" which suffered a heavy economic damage by quadruple hike of oil price in 1974, most of the assistance was provided in the form of grants and concessional loans. Although complete record of all assistance received by YAR is not available, it can be estimated that cumulative aid disbursements reached nearly US$750 million by the end of the 1976/77 fiscal year. Saudi Arabia, the Gulf States, Arab Fund, USSR, China, West Germany, United States and IDA are the major donors. Utilizing the foreign aid, several projects are under way in the Hajjah Province, brief descriptions of which are given in Section (2) of this chapter.

Problems and constraints of the development organizations

10.06 The development organizations in the Hajjah Province share common problems and constraints with these in other provinces as follows:

a. acute shortage of all kinds of skills including shortage of qualified staffs for planning, administration and supervision.

b. acute shortage of financial resources to cover the costs of rapidly growing number of development projects.

c. insufficient coordination between the development organizations and associations.

These factors work as major institutional constraints which hinder the Province from further development.

(2) Present Development Plans

Rural road

10.07 Five-Year Plan envisaged to connect the town of Hajjah, the provincial capital of the Hajjah Province, with Sana'a, the Capital of the Republic, by constructing a 77 km long paved road between Hajjah and Amran with a total investment of YR77 million. As of 1979, the construction is under way by technical and financial assistance of China. Upon completion, Hajjah will be connected with Sadah, the provincial capital of Sadah Province, and Taiz, center of the economic activities in the southern parts of YAR as well as with Sana'a through north-south artery of YAR. The distance between Sana'a and Hajjah would be reduced to about 4 hours by car trip. This road is expected to make a great contribution to the overall development of the Province by opening up new markets for agricultural commodities produced in the Province as well as by moving civilization into the Province.

10.08 Besides Hajjah-Amran road, the Highway Authority has worked out a network of secondary and feeder roads which are highly desirable to be implemented.

Rural water supply

10.09 A water supply project is in progress in the town of Al Mahabisha by German assistance. The Japanese Government is also undertaking survey works for the implementation of water supply projects. The Rural Water Supply

Corporation has three (3) water supply projects in contemplation, one in Qufl Shamal, another in Sharhil and the other in Miftah.

Electrification

10.10 For the town of Hajjah, a electrification project is envisaged in the Five-Year Plan with a total investment of YR12 million.

Master plan and other projects

10.11 Besides these individual programme, study works are under way to draw up a comprehensive master plan with the technical assistance of the Japanese Government, aiming at achieving integrated rual development of the Hajjah Province.

10.12 During the first field survey conducted from December 1978 through January 1979, the Japanese team made a series of interviews to the people concerned with the development of the Province and gathered numbers of requests for development projects, comprising road construction, water supply, schools and hospitals, and agricultural projects. These projects are will be carefully examined in the studies of each development sector.

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USAID (1978)	Socio-Economic Profiles, Hajjah and Hodeidah
IBRD (1979)	Effects of Migration of Rural Labour on Agricultural Development
Central Planning Organization, Yemen Arab Republic (1977)	First Five-Year Plan, 1976/77 - 1980/81

XI BASIC CONCEPT AND STRATEGY FOR DEVELOPMENT

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XI BASIC CONCEPT AND STRATEGY FOR DEVELOPMENT

(1) Present Environment for Development

11.01 About 96 % of the whole population of the Province are living in the rural areas and more than 90 % of them are engaged in the agriculture. Other industries including home industry, local manufacture, transport service, building and construction industry, commerce and public services still remain at their initial stage of development and they play rather minor role in the overall economic operations of the Province.

11.02 The Province, however, is by no means richly endowed with agricultural resources with small and erratic rainfall and limited area of cultivable land. Out of the total area of about 9,590 km^2, only 1,410 km^2 are under cultivation. Of the 1,410 km^2 of the cultivated land, only 150 km^2 is under irrigation including spate irrigation. The rest or about 89 % of the total farm land is cultivated under rainfed condition. Average annual rainfall is about 700 mm in the mountainous area and about 160 mm in the Tihama plain. Most of the rainfall is concentrated during two rainy seasons, April through May and July through August. Only 5 percent of the rainfall is available as surface water, most of which is in the form of flood discharge. The total maximum ground water which is normally rechargeable is estimated at only 20 million m^3 per annum. The water resources available in the Province is quite limited and are unevenly distributed both in time and space. Manpower resources are still under-developed. The literacy rate is as low as 19 percent, which is far below the national average. The manpower situation is characterized by an overall scarcity of qualified labour, as a result of the fact that basic facilities for development of human resources, such as education and training, are in severe shortage.

11.03 Moreover, the traditional production techniques are still prevalent without the use of high yielding varieties, fertilizer and pesticides. The agricultural support services, required for the introduction and dissemination of the modern production techniques, have no branch offices in the Province, except the Agricultural Credit Bank (ACB) which has a branch office in Abs. Consequently, the productivity in agriculture in the Province remains low, falling behind the national average.

11.04 About 70 % of the total cultivable land in the Province is owned by tribal leaders and merchants. About 20 % is the property of religious institutions. A large majority of the farmers are engaged in agriculture as tenants under crop sharing arrangements. About one-third to one half of the total proceeds are usually taken by the land-owners as farm rent. The rest, or only one half to two thirds is left for the tenants. Moreover the 10 % zakat tax is frequently borne by the tenants. There are also considerable number of peasants. Their land holding size is quite limited, just sufficient for maintaining their subsistence, taking into account the current low crop intensity and low productivity. The agriculture in the Province is thus characterized by a large number of tenants and small independent farmers whose incomes are quite low.

11.05 All the roads running in the Province are primitive tracks, suitable only for four-wheel drive vehicles and animal transport. Even these roads are usually closed during rainy seasons. Most of the villages and towns are socially and culturally isolated from each other and marketing areas are confined within wadi flood basins and sub-range of mountains. In rural areas, no villages are equipped with domestic water supply system. Villagers are forced to consume a large portion of day time in the laborious

work of water fetching. The water is usually contaminated and causes various water borne diseases. Health facilities are inadequate both in number and quality. The number of population per hospital bed is bigger than the national average. Although the number of primary schools can be considered sufficient, most of them are incomplete having only three grades or less and are suffering from acute shortage of qualified teaching staffs. In the Province, telecommunication facilities are hardly available. Very few villagers can afford electricity supply mainly through small portable generators. The Province is in no sense well equipped with social infrastructure and only few people enjoy satisfactory social services.

11.06 Industry in YAR as a whole, is still in its infancy. Besides, there are serious limiting factors which work as constraints against industrial development. In the Province, the environment for industrialization is worse, suffering an acute shortage of management and technical skills as well as industrial requisites such as electricity, internal transport and water. Up to date, industrial development has been concentrated on the major cities located in the southern part of the country and the situation is most likely to be unchanged in the foreseeable future.

11.07 In the economic and cultural context, the Province lags far behind the advanced provinces in the southern part of the country. This disparity together with the opportunities for earning higher wages abroad have accelerated the massive outmigration of these rural inhabitants who have been putting up with the poor standard of living for long.

(2) Basic Concept for Development

Major Objectives

11.08 Under these conditions, a comprehensive and integrated rural development of the Province has long been aspired for by the inhabitants and is of urgent necessity. The major objectives of the development, some of which are interrelated and interdependent each other, should comprise:

a. to raise the low incomes of a large majority of rural inhabitants.
b. to improve social and economic partiality among the rural people.
c. to improve the standard of living of the rural inhabitants, giving due attention to their basic needs for food, water supply, health, elementary education and other social services.
d. to move civilization into the rural areas.
e. to realize solidarity between the historically scattered communities.
f. to prevent the massive outmigration of the rural people.
g. to reduce the economic-social-cultural imbalance between the southern advanced provinces and the Province.
h. to reinforce the central authority in the Province.

11.09 Considering all these, the ultimate objectives of the integrated rural development can be formulated as follows:

a. to increase agricultural production and stimulate economic growth, and
b. to improve the condition of rural life.

11.10 Agriculture should play the pivotal role in attaining these objectives. Even with the limited resources endowed, agriculture could grow substantially. The present low productivity could greatly be improved by adopting modern agricultural production techniques, i.e., use of high yielding plant varieties, chemical fertilizer and insecticides and farm mechanization with the aid of the proper agricultural support activities including extension and research services. Improvement of road transport will open up new markets and expand marketing area for farm products, accelerating the reorientation from subsistence farming to market-oriented agriculture. Crop diversification from low-value crops to more profitable high-value crops will further stimulate the expansion of agricultural production.

11.11 The improvement of social infrastructure should also play a substantial role in accomplishing the development objectives. The effects derived from the betterment of social infrastructure will be twofold. It will raise by a large margin the standard of living in the rural areas by improving health condition, realizing solidarity between the scattered communities, moving civilization and various amenities into the rural areas and the like. Meanwhile, it will raise the productivity of the rural economy by providing labour with higher physical performance and skills as well as by relieving women and children from laborious work of water fetching and thereby providing additional labour to the labour-short economy.

11.12 The higher incomes attained by the restoration and modernization of agriculture together with the improved standard of living achieved by the betterment of social infrastructure will alleviate the heavy outmigration of the able-bodied rural inhabitants, which will reinforce the human resources base of the agricultural production and

further promote agricultural development.

(3) Development Strategy

11.13 It would not be practicable nor efficient, however, to start the implementation of all the development projects immediately throughout the Province because of the following reasons:

a. statistics and data base required for minute planning and implementation of development projects are very feeble.

b. organizations equipped with necessary technical and managerial expertise to handle and promote development planning and implementation of the projects as well, is not yet fully developed.

c. present agricultural frame does not permit the immediate dissemination of modern agriculture because of the lack of essential factors including the institutions to serve agriculture, adequate road transport and the like.

d. limited availability of investment fund.

11.14 A stage-wise development policy will, therefore, have to be adopted under these situations for development. The development projects should be of small scale initially and be gradually expanded as more knowledge and experience are obtained together with building of skilled manpower. The initial projects will have to be carefully determined in accordance with the priority of each development projects to be identified in the studies on various development sectors. The initial projects which will have the top priority, will then be integrated in a particular area where physical and economical environment is favourable. In the first place, all the development efforts will be

concentrated to this priority area. Development of other areas will be made successively on the basis of the achievement and results of the initial integrated projects to be carried out in the priority area.

11.15 The priority area will have to be selected after full studies on all the development possibilities which will be made in the following chapters. The project categories which will be given priority, are discussed below.

11.16 The following three categories of development projects should be placed the highest priority, considering their importance in the overall development of the Province as well as their urgent necessity for implementation evidenced by strong demand by the inhabitants and should, therefore, be implemented during the first stage of the integrated rural development.

a. basic projects for agricultural development
b. rural water supplies
c. construction and upgrading of rural roads

11.17 Agriculture should play the leading role in the restoration and further development of the rural areas of the Province. Under the present development environment, however, much remains to be done before the full agricultural development is materialized. Necessary measures should be taken in order to enhance and make better use of the meager agricultural resources in the Province. Afforestation and restoring of vegetation cover, which would have beneficial effects of soil retention and fostering of water resources, should be accelerated. Measures should be taken to restore and enhance the soil fertility that is at present in an exhausted condition. With a view to procuring a proper understanding of the water resources in the Province,

a meteorological and hydrological observation network should be set up. The data will be analyzed and will be fully utilized for water resources development planning as well as for better use of the existing resources. In advance of the full introduction of the modern agriculture into the Province, basic research activities as well as training of qualified personnel to serve agriculture will also be required.

11.18 Supply of hygienic water will bring about the direct benefits of improvement of public health, saving in time and money and improvement of animal health. Improvement of public health will lead to higher physical performance and resistance against diseases as well as to longer life expectancy. Women and children could spend additional time saved through the water supply projects either on sewing, handicraft, better housekeeping, farming or attending school. Money saved could be utilized for investment on capital investment. Improvement of animal health will lead to better and faster meat production. Water supply projects will thus produce the indirect benefit of higher productivity of the economy. Supply of hygienic water is indispensable for securing public health as well as for raising the productivity of the economy.

11.19 The effects and benefits divided from the reinforcement of the present road network will be magnificent and manifold. From a social and cultural point of view, it will make a great contribution to breaking up regional isolation by linking the historically scattered rural communities. It will move civilization into the rural areas and improve health and educational environment by providing the inhabitants better access to these facilities. Better availability of consumption goods at cheaper prices will also be achieved. It will make substantial contribution to the economic

development of the Province by expanding marketing area for farm products as well as providing timely marketing information. It will further realize smooth supply of farm inputs and promote the dissemination of agricultural support service. Opening up of new roads and the upgrading of the existing ones are the pre-requisites to the cultural life in the rural inhabitants as well as to the restoration and further development of agriculture.

XII RURAL WATER SUPPLIES

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XII RURAL WATER SUPPLIES

(1) General

12.01 At present, very few people can afford hygienic water supply in YAR. A large majority of the people generally get their drinking water either from cisterns or from wadi streams, which are usually insanitary causing serious health problem. Women and children carry the laborious work of fetching water from water sources which are usually located far away from their dwellings spending quite a long time. In the Hajjah Province, only the town of Hajjah, capital of the Province, is equipped with domestic water supply system. Even in this town, however, the system does not cover the whole population. In rural areas, no water supply system is in existence. Supplying the population with hygienic drinking water has long been a strong wish of the whole population of the Province.

(2) Necessity of Rural Water Supplies

12.02 The necessities of and the major benefits derived from the execution of rural water projects are described as follows:

a. Improvement of public health: The Yemen National Health Programme 1976/77 - 1981/82 lists ten (10) priority diseases to be expelled from the country; the first three out of ten in order of priority are a) diarrhoeal diseases b) tuberculosis and c) schistosomiasis malaria. Of these diseases, diarahoeal diseases and schistosomiasis are prevalent in the Hajjah Province. Diarrhoeal diseases are largely caused by contaminated water and are the principal reasons for the high infant mortality in the Province. Schistosomiasis is mainly caused by infestation with schistosomes in standing

waters, particularly cisterns. The estimated prevalence in the Hajjah Province is 255 patients per 1,000 persons, much higher than the national average of 97 patients per 1,000 persons, and the highest in the country. Supply of hygienic water coordinated with health facilities would make a great contribution to improving the health condition of the people and bring down by big margin the high infant mortality in the Province.

b. Time savings: Majority of the villages get their water either from cisterns fed by rainfall, wadis or springs. Daily time consumption spent on water fetching, for which women and children are usually responsible, is quite considerable. The average daily time consumption per woman or child for water fetching is estimated at nearly two hours. As the standard of living goes up, demand for water per capita is expected to grow rapidly. As the population grows, total time consumption for water fetching will go up proportionately. Construction of water supply systems would provide people with better access to water sources and reduce sharply the average walking distance. Consequently, time consumption per capita for fetching water would substantially be reduced and women and children would be relieved from the daily laborious work.

c. Money savings: Water supply in the Hajjah Province is partly cared for by water lorries that bring water from distant wadis and wells into towns and villages. The customers are usually rich people per capita consumption of whom is much higher than the average. Water supply system would provide these people with hygienic water at

cheaper price than that through water lorries and the balance could be saved.

d. Improvement of animal health: At present, livestock drink water either from cisterns or wadi streams. The water is usually contaminated or at least insanitary and causes various animal diseases. The implementation of water supply projects would provide hygienic water for livestock and could thereby improve the animal health coordinated with veterinary care.

12.03 The implementation of water supply projects would bring about significant indirect benefits besides the direct ones, coordinated with various supporting activities. The execution of water supply projects would substantially improve the health condition of the population of the Province, which will lead to higher physical performance and resistance against diseases as well as to higher life expectancy. Women and children would be released from laborious work of water fetching. Additional time could be spent on longer recreation periods and better child care. Younger women with less family responsibility would be engaged in agricultural works. With the help of training programmes, they could spend their spare time on sewing, handicraft and better housekeeping. Children could spend the additional time either on animal husbandry or hopefully on attending school. The execution of water supply projects would thus enhance labour force which is insufficient in the Province both in quality and quantity. Improvement of animal health through hygienic water supply will also lead to better and faster meat production. Construction of water supply system would significantly contribute to the increase of the productivity of the economy.

(3) General Development Plan

12.04 Water supplies would be provided to twenty-five (25) towns and villages, as marked and numbered on Fig. 12.1, with population totalling 132,000 inhabitants and containing about 32 percent of the total population of the Province. It is difficult to increase the number of the beneficiaries at the present stage, because most of the settlements are very scattered and generally too small in size. Capacity of each water supply unit to be installed, however, will have enough room for future expansion when needs arise, and will be able to supply water to about half of the population at the ultimate stage.

12.05 The first stage project for rural water supplies will comprise twenty-five (25) water supply schemes, and will cover almost all of the large settlements with the population more than 1,000. The second stage will therefore be rather small scale, especially for the small settlements with the population less than 1,000. The present chapter deals with only the first stage schemes.

12.06 Water supply installation would consist of intake boxes or tube wells as the intake facilities, pumps, storage tanks, pipes and public hydrants as shown on Fig. 12.2. The designs are planned to provide eighty litres per day per person, which is considered to be sufficient to cover all domestic uses including village livestock. Water sources are surface water, ground water and springs.

12.07 The water will be pumped up from intake facilities to the storage tanks which will be built on the high places from where water will be conveyed by gravity to the public hydrants in villages.

(4) Water Supply Facilities

12.08 The present designs are of very preliminary nature and will not be used for construction purpose, but will give basic idea for rural water supplies in the Province.

12.09 Intake facilities will be the intake boxes or tube wells. If the water table is too low at the intake site, a cut-off structure will be constructed to dam up the underground wadi flow.

12.10 The pumps will be multistage volute type with very high-head capacity, and will be operated for eight hours daily. There are two ways of operating the pumps; i.e., diesel driven and electric driven.

a. Diesel driven pumps: The initial cost is comparatively low. However, pump operations are rather complicated and may be difficult to master for the local inhabitants.

b. Electric driven pumps: A power generating station will be required, resulting in higher initial costs. The pump operations are rather easy.

Although the initial cost is higher, the electric-driven pump units are recommendable for their easier operation. The electric power can also be used for lighting at night and for other domestic uses.

12.11 As far as pipes are concerned, ductile cast iron pipe, steel pipe and hard vinyl chloride pipe will be used. The storage tank structures will be made of reinforced concrete and the capacity have been designed to meet the daily consumption.

12.12 Each rural water supply scheme was studied on the

basis of the topographic maps scaled 1 to 50,000. The general plans of each scheme are shown in Fig. 12.3.

(5) Operation and Maintenance

12.13 It is proposed that the pumps and pipes with same specifications should be used at every water supply schemes sites for easier arrangement of spare parts and operators. It is also proposed that the pumps should be operated by salaried pump operators recruited from the local community, and that these operators should receive a basic training in advance.

Table 12.1 List of Water Supply Schemes

Name of town or village	Planned service population (persons)	Planned supply amount (m^3 per day)	Water resources
1. Hajjah	15,000	(existing)	
2. Suq Al Aman	1,800	144	Wadi Waru
3. Ash Shafadirah	9,500	760	Wadi Husayb
4. North Mabyan	5,400	432	Wadi Mawr
5. Jabal Al Dafir	4,800	384	Wadi Sharas
6. Mabyan	5,100	408	Wadi Mawr
7. Bani Kais	5,200	416	Wadi Laah
8. Bayt Idhaqah	5,200	416	Wadi Hijlah
9. Kuhlan	5,900	472	Wadi Umyan
10. Affar	3,700	296	Wadi Umyan
11. Sharhil	4,000	320	Wadi Yamaniyah
12. Qufl Shamal	2,300	184	Wadi Yamaniyah
13. Al Shaafeen	3,100	248	Wadi Yamaniyah
14. Al Mahabisha	15,000	(under construction)	
15. Miftah	2,000	160	Wadi Mawr
16. Kusher	3,400	272	Wadi Mawr
17. Al Muhanaq	4,000	320	Wadi Bawhal
18. Aslam	1,600	128	Wadi Bawhal
19. Habour	2,100	168	Wadi Hashid
20. Shahara	2,000	160	Wadi Hashid
21. Al Madan	6,700	536	Wadi Mawr
22. Washha	12,500	1,000	Wadi Harad
23. Abs	5,300	424	Wadi Bawhal
24. Harad	2,300	184	Wadi Harad
25. Midi	3,800	304	Wadi Harad
	(131,700)		

Table 12.2 Design of Pumps

Name of town or village	Discharge of water source	Pump station (Type-Number of pumps) P_1	P_2	P_3	P_4	P_5
	(m^3 per min.)					
1. Hajjah	(existing)					
2. Suq Al Aman	0.3	C-1				
3. Ash Shafadirah	1.6	E-2	E-2	F-1	D-1	
4. North Mabyan	0.9	F-1	F-1	D-1		
5. Jabal Al Dafir	0.8	E-1	E-1	E-1	C-1	
6. Mabyan	0.9	F-1	E-1	E-1	D-1	
7. Bani Kais	0.9	F-1				
8. Bayt Idhaqah	0.9	F-1	D-1	D-1	B-1	
9. Kuhlan	1.0	F-1	F-1	F-1	E-1	
10. Affar	0.7	E-1	E-1	E-1		
11. Sharhil	0.7	E-1	D-1			
12. Qufl Shamal	0.4	C-1				
13. Al Shaafeen	0.6	D-1				
14. Al Mahabisha	(under construction)					
15. Miftah	0.4	C-1	C-1	C-1	C-1	
16. Kusher	0.6	D-1				
17. Al Muhanaq	0.7	E-1	E-1	E-1		
18. Aslam	0.3	C-1				
19. Habour	0.4	C-1	C-1	C-1		
20. Shahara	0.4	C-1	C-1	C-1	C-1	
21. Al Madan	1.2	D-2	D-2	D-2	D-2	D-1
22. Washha	2.1	F-2	F-2	F-1	D-1	
23. Abs	0.9	F-1				
24. Harad	0.4	C-1				
25. Midi	0.7	E-1				

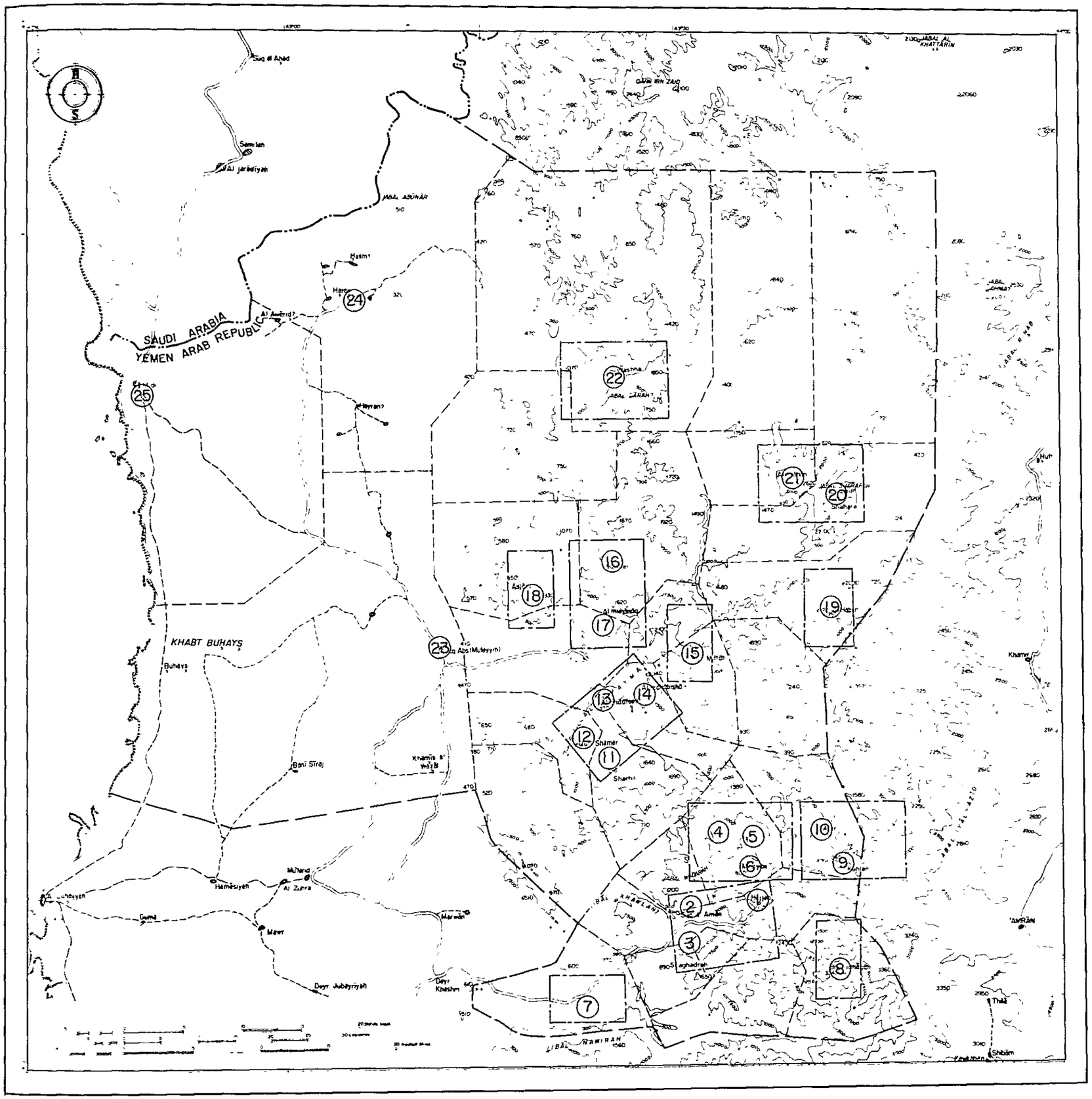
Pump Type

(Actual head 300m)

Type	A	B	C	D	E	F
Bore-Power (mm) (kw)	50-22	50-30	80-45	80-55	100-75	100-90
Discharge (m^3 per min.)	0.1	0.2	0.3,0.4	0.5,0.6	0.7,0.8	0.9,1.0

Table 12.3 Design of Pipes and Public Hydrants

Name of town or village	Pipes Diameter (mm)	Pipes Total length (m)	Number of public hydrants
1. Hajjah	(existing)		
2. Suq Al Aman	50-75	6,900	4
3. Ash Shafadirah	50-150	21,500	14
4. North Mabyan	50-75	16,400	8
5. Jabal Al Dafir	50-100	16,100	11
6. Mabyan	50-100	20,500	10
7. Bani Kais	50-100	15,000	13
8. Bayt Idhaqah	50-100	15,300	8
9. Kuhlan	50-100	20,000	12
10. Affar	50-100	12,100	6
11. Sharhil	50-100	8,900	5
12. Qufl Shamal	50-75	8,800	6
13. Al Shaafeen	50-75	12,300	10
14. Al Mahabisha	(under construction)		
15. Miftah	50-75	14,300	4
16. Kusher	50-75	19,000	8
17. Al Muhanaq	50-100	15,700	8
18. Aslam	50-75	8,600	4
19. Habour	50-75	12,600	5
20. Shahara	50-75	11,200	3
21. Al Madan	50-100	14,800	7
22. Washha	50-150	33,100	15
23. Abs	50-100	5,000	5
24. Harad	50-75	5,000	5
25. Midi	50-100	5,000	5



List of Water Supply Schemes

Name of Town or Village	Planned Service Population (Persons)
1 Hajjah	15,000
2 Suq Al Aman	1,800
3 Ash Shafadirah	9,500
4 North Mabyan	5,400
5 Jabal Al Dafir	4,800
6 Mabyan	5,100
7 Bani Kais	5,200
8 Bayt Idhaqah	5,200
9 Kuhlan	5,900
10 Affar	3,700
11 Sharhil	4,000
12 Qufl Shamal	2,300
13 Al Shaafeen	3,100
14 Al Mahabisha	15,000
15 Miftah	2,000
16 Kusher	3,400
17 Al Muhanaq	4,000
18 Aslam	1,600
19 Habour	2,100
20 Shahara	2,000
21 Al Madan	6,700
22 Washha	12,500
23 Abs	5,300
24 Harad	2,300
25 Midi	3,800

Boundary of Maps Scaled 1/50,000

Fig. 12.1 Location of Water Supply Scheme

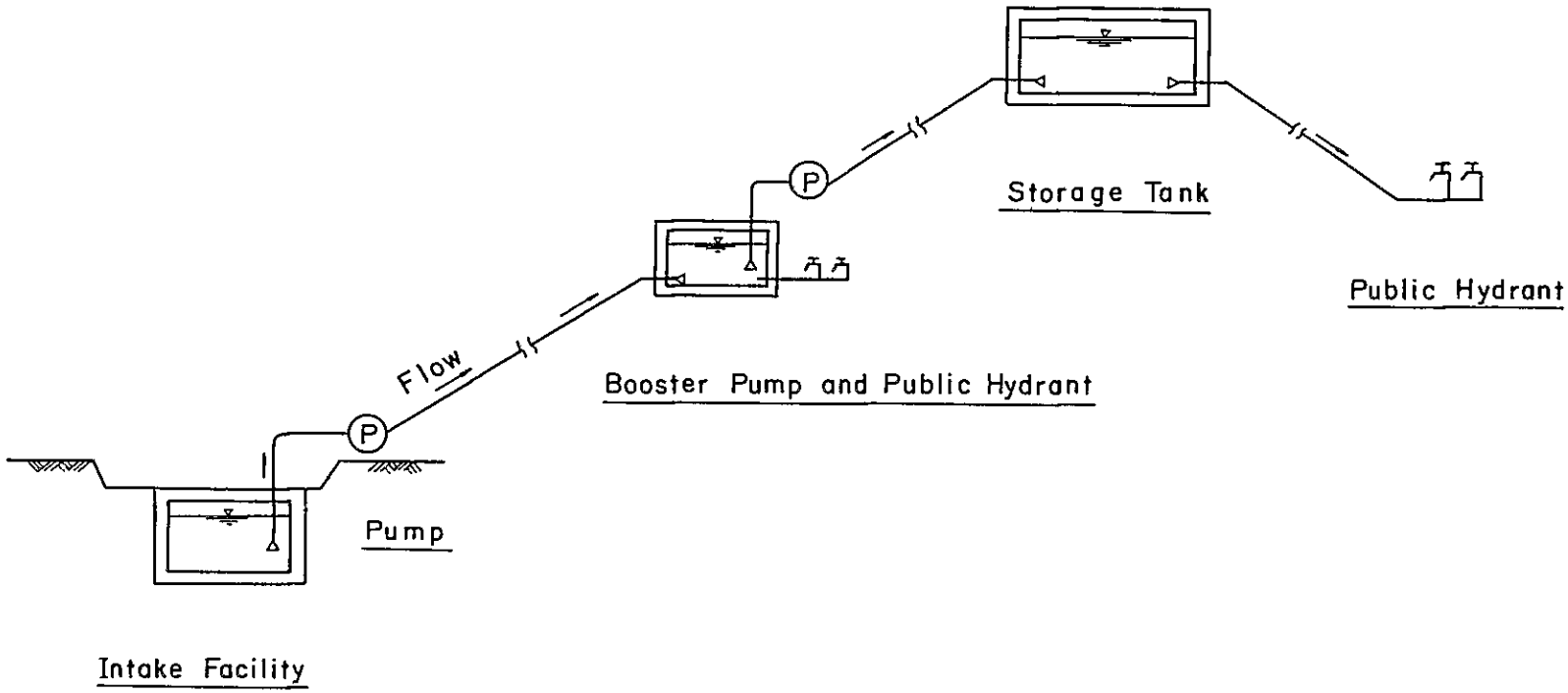
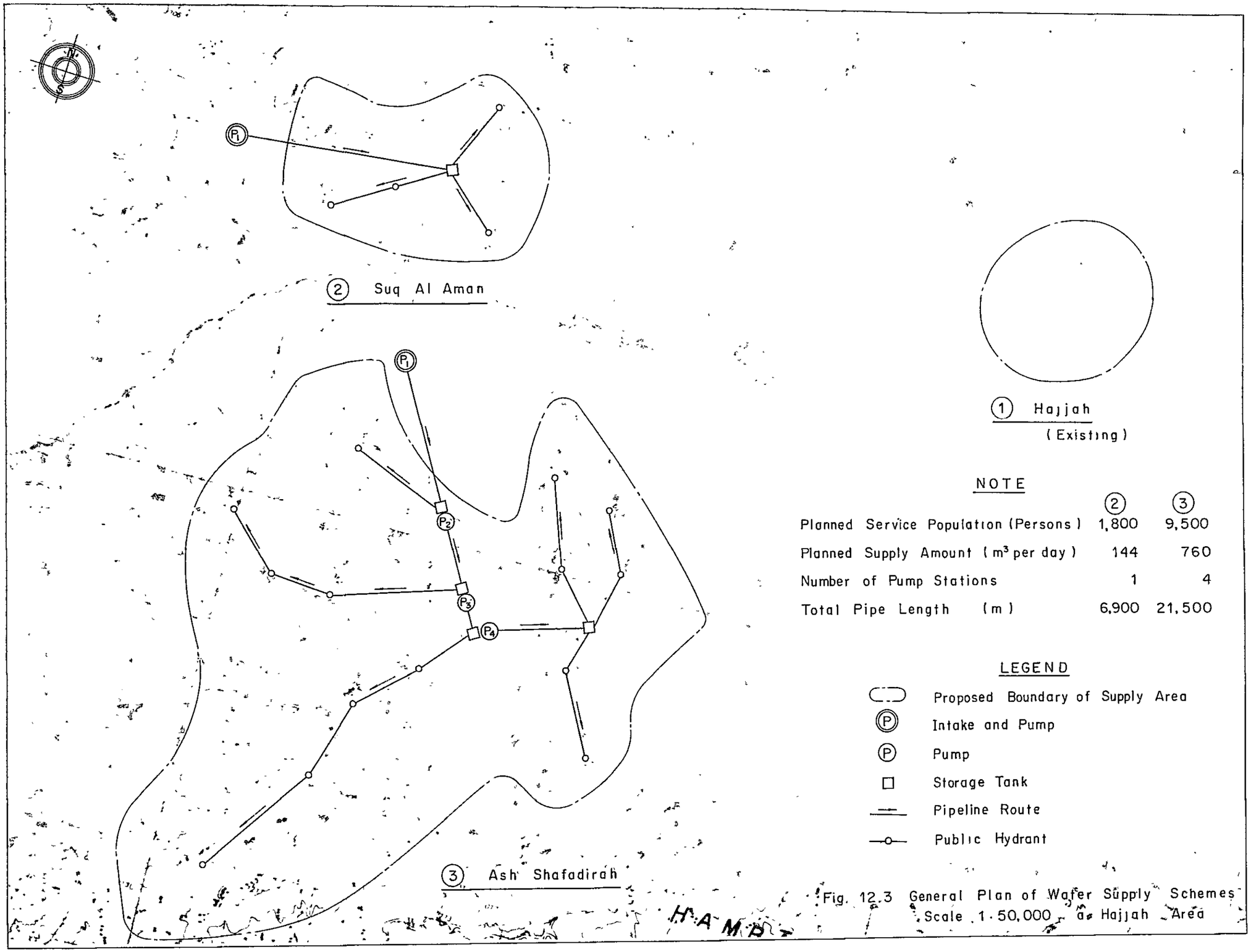


Fig. 12. 2 Typical Profile of Water Supply System



NOTE

	②	③
Planned Service Population (Persons)	1,800	9,500
Planned Supply Amount (m^3 per day)	144	760
Number of Pump Stations	1	4
Total Pipe Length (m)	6,900	21,500

LEGEND

- Proposed Boundary of Supply Area
- Intake and Pump
- Pump
- Storage Tank
- Pipeline Route
- Public Hydrant

Fig. 12.3 General Plan of Water Supply Schemes
Scale 1 : 50,000 at Hajjah Area

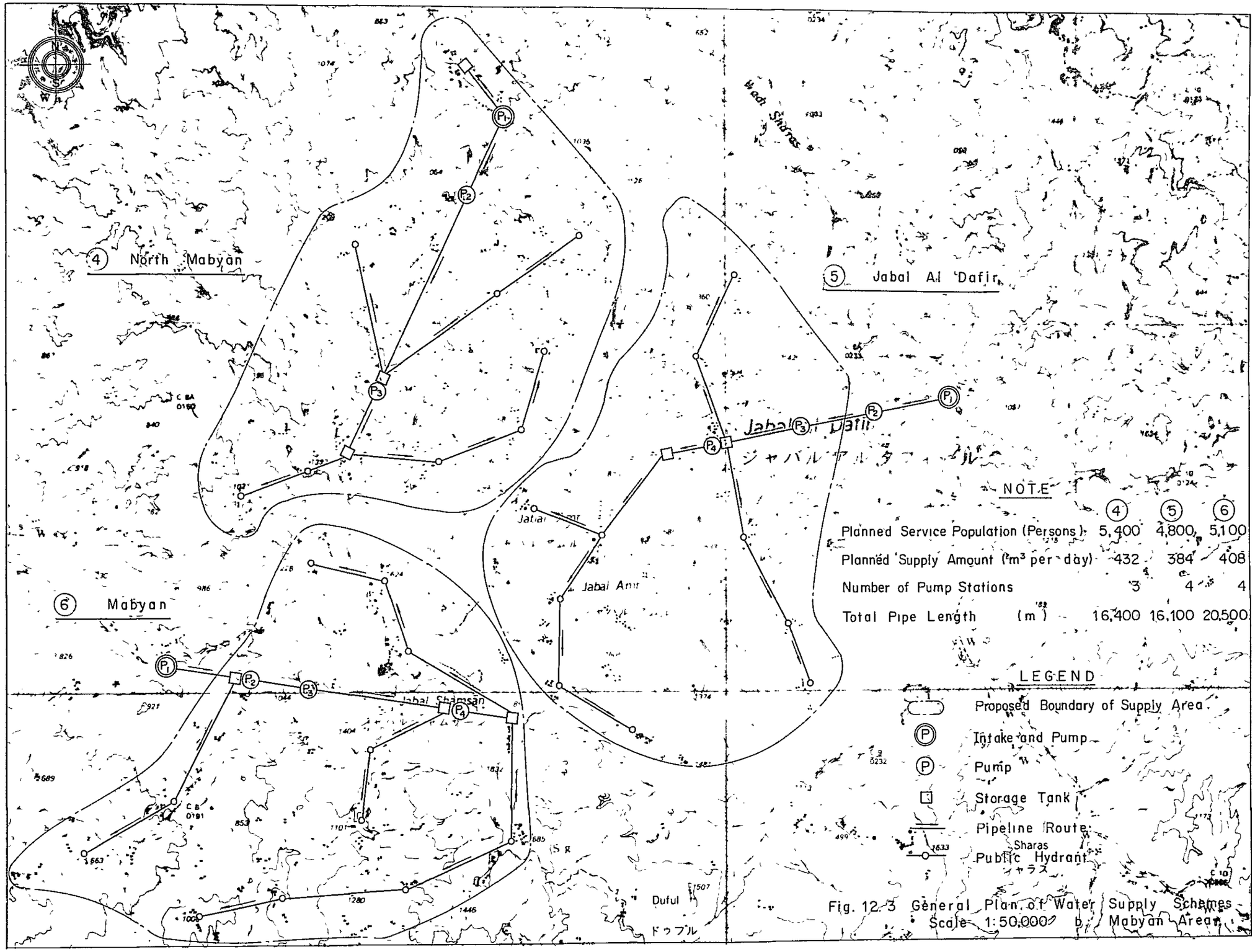


Fig. 12.3 General Plan of Water Supply Schemes Scale 1:50,000 b) Mabyan Area

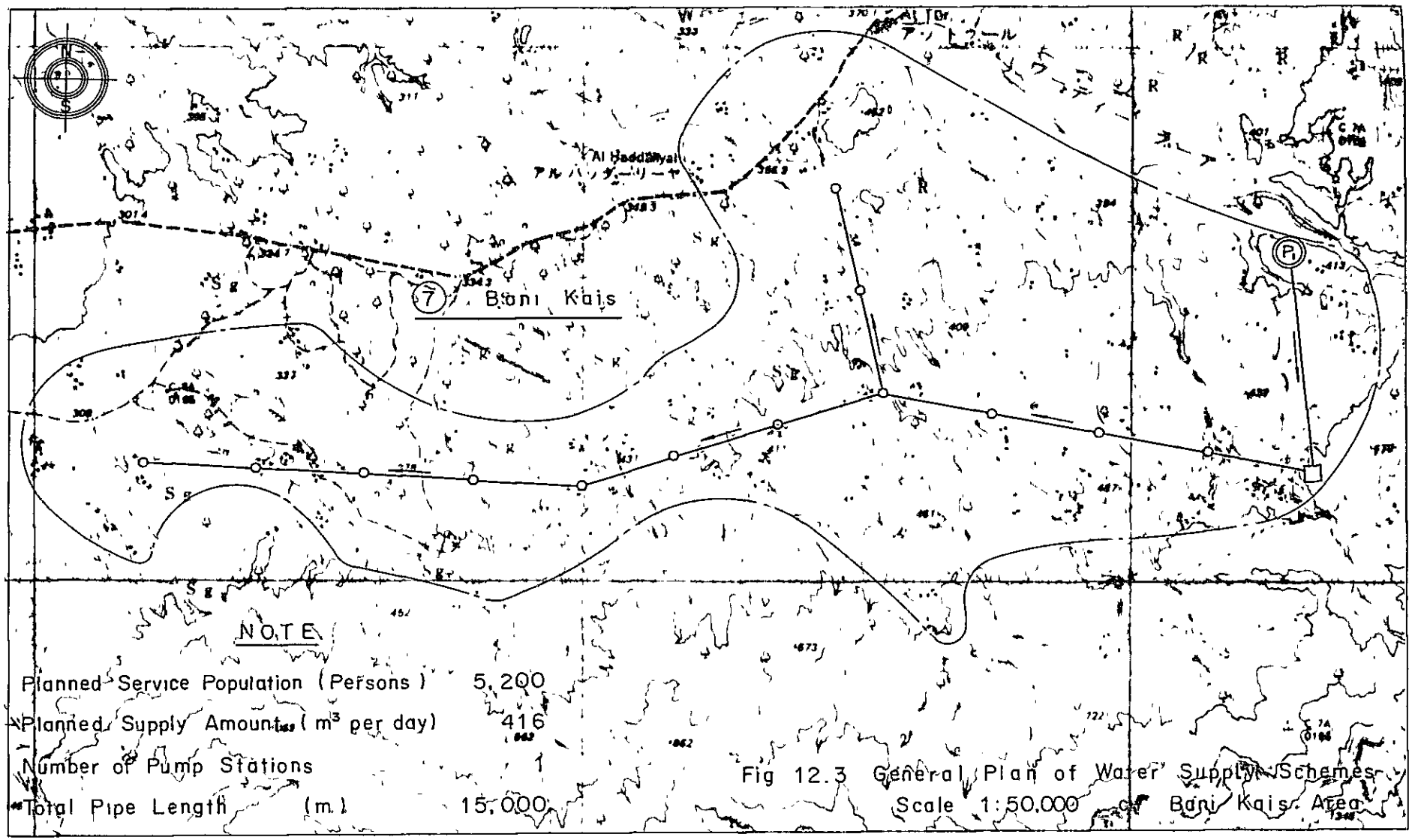
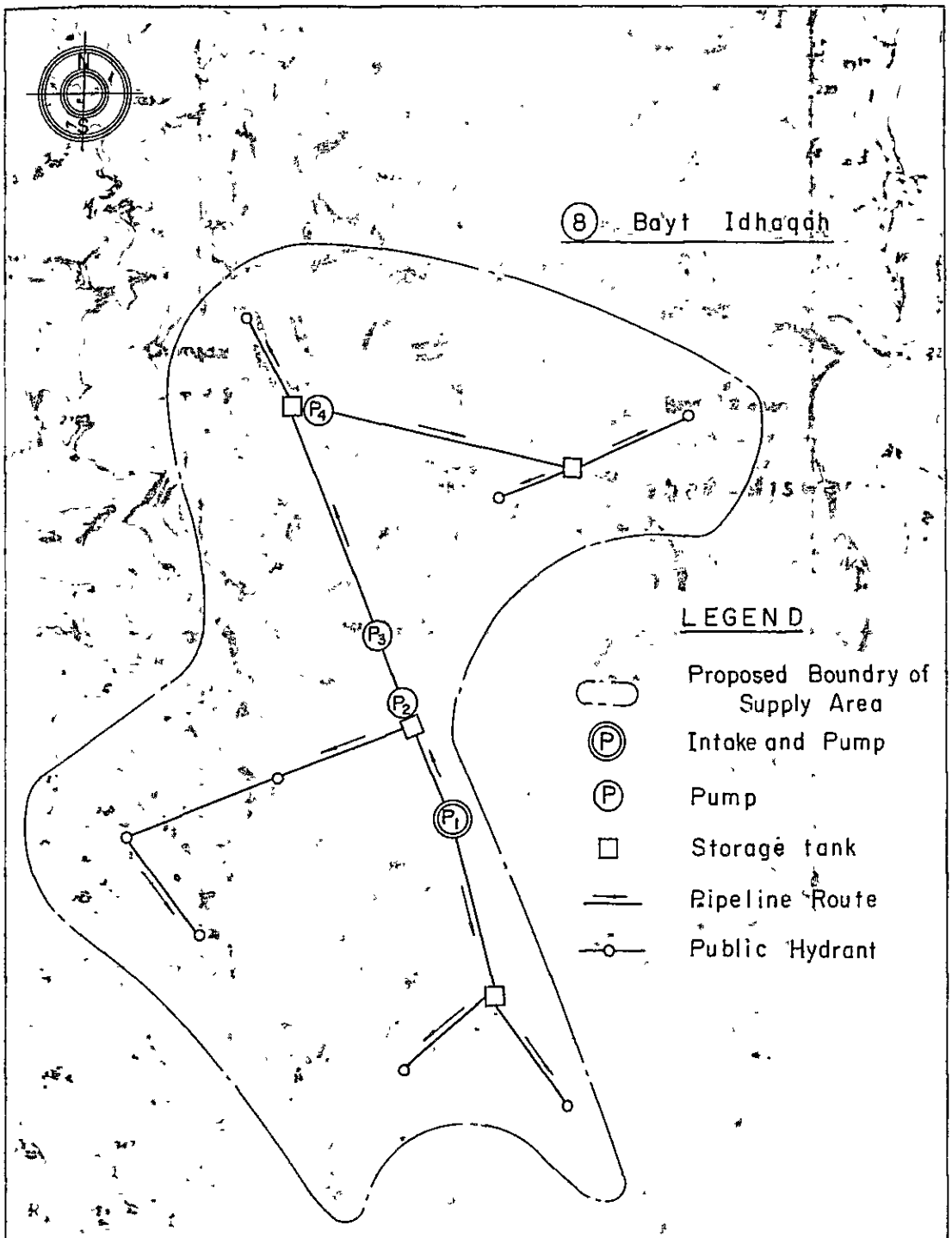


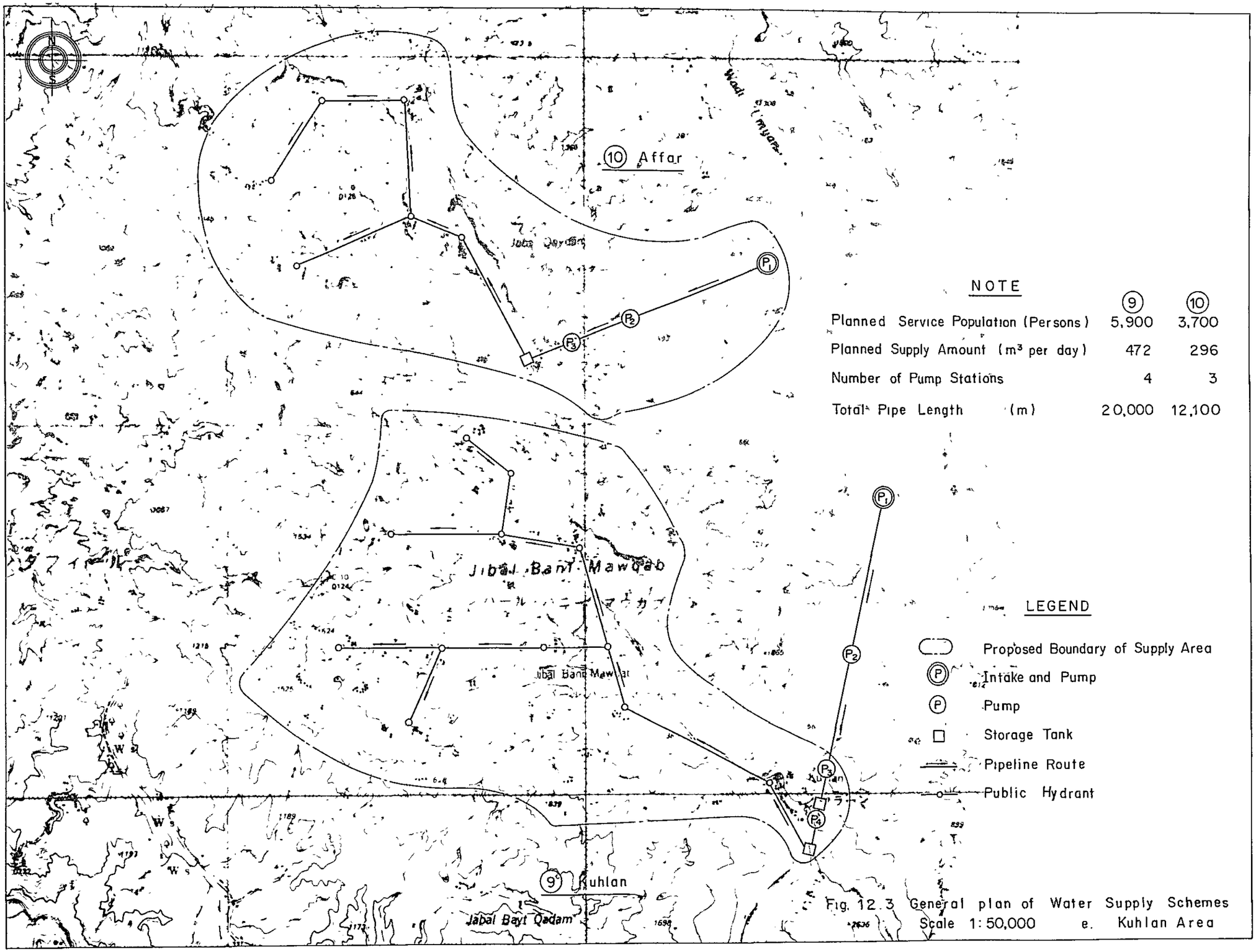
Fig 12.3 General Plan of Water Supply Schemes of Bani Kais Area
Scale 1:50,000



NOTE

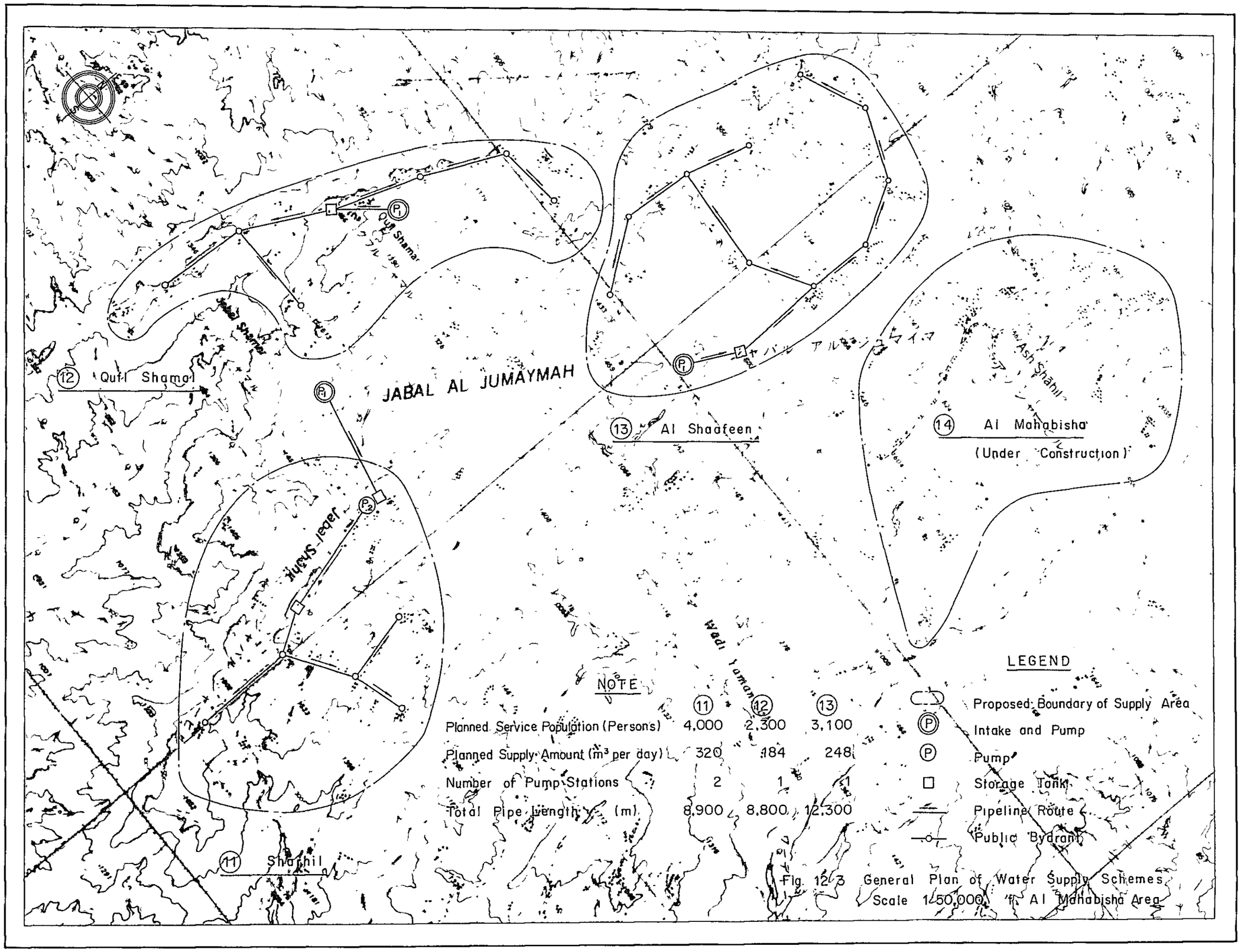
Planned Service Population (Persons)	5,200
Planned Supply Amount (m^3 per day)	416
Number of Pump Stations	4
Total Pipe Length (m)	15,300

Fig 12.3 General Plan of Water Supply Schemes
Scale 1 : 50,000 d. Bayt Idhaqah Area



	9	10
Planned Service Population (Persons)	5,900	3,700
Planned Supply Amount (m^3 per day)	472	296
Number of Pump Stations	4	3
Total Pipe Length (m)	20,000	12,100

Fig. 12.3 General plan of Water Supply Schemes
Scale 1:50,000 e. Kuhlan Area



	11	12	13
Planned Service Population (Persons)	4,000	2,300	3,100
Planned Supply Amount (m^3 per day)	320	184	248
Number of Pump Stations	2	1	1
Total Pipe Length (m)	8,900	8,800	12,300

Fig. 12-3 General Plan of Water Supply Schemes in Al Mahabisha Area
Scale 1:50,000

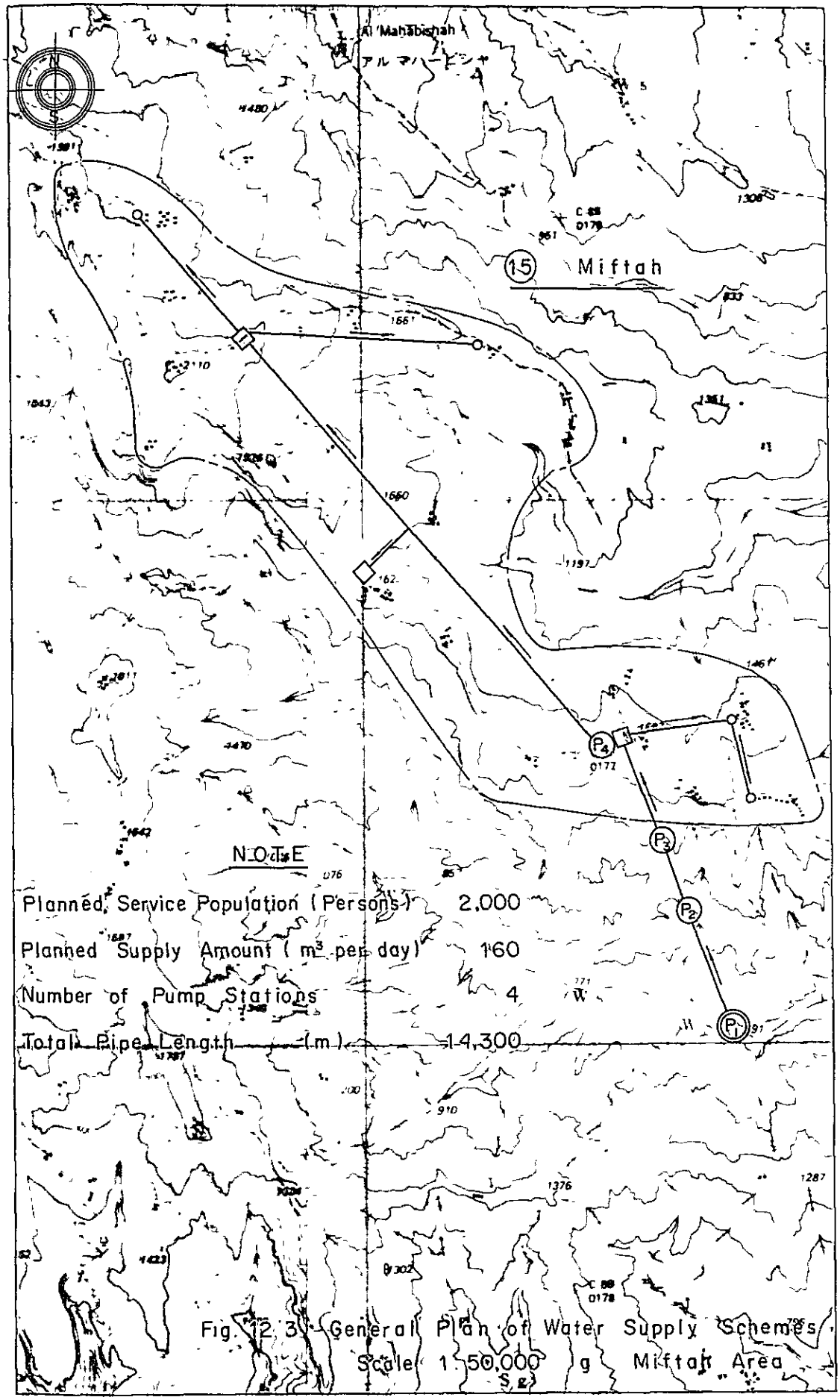
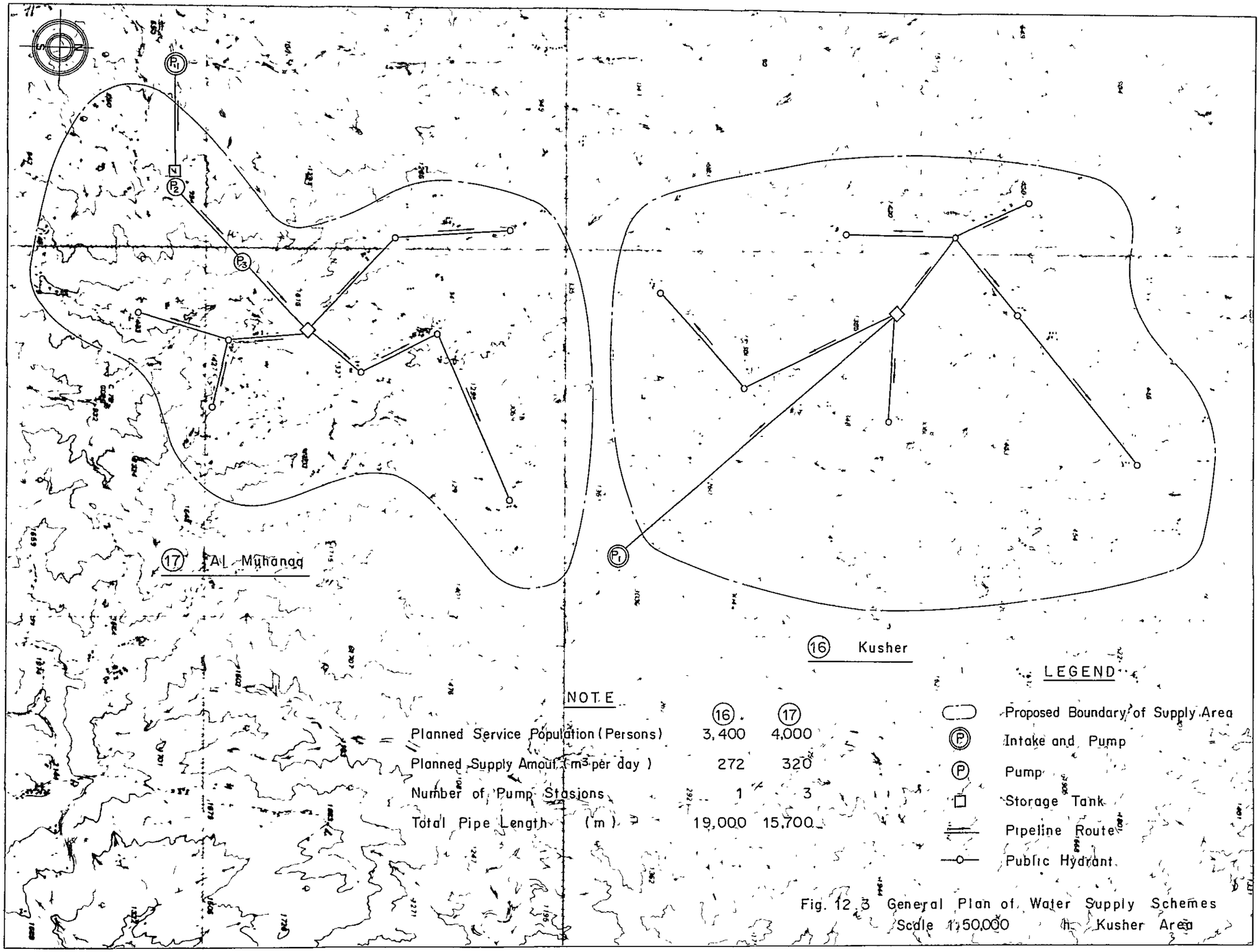


Fig. 12.3 General Plan of Water Supply Schemes
Scale 1:50,000 g Miftah Area



NOTE

	16	17
Planned Service Population (Persons)	3,400	4,000
Planned Supply Amout (m³ per day)	272	320
Number of Pump Stasions	1	3
Total Pipe Length (m)	19,000	15,700

Fig. 12.3 General Plan of Water Supply Schemes
Scale 1:50,000 h. Kusher Area

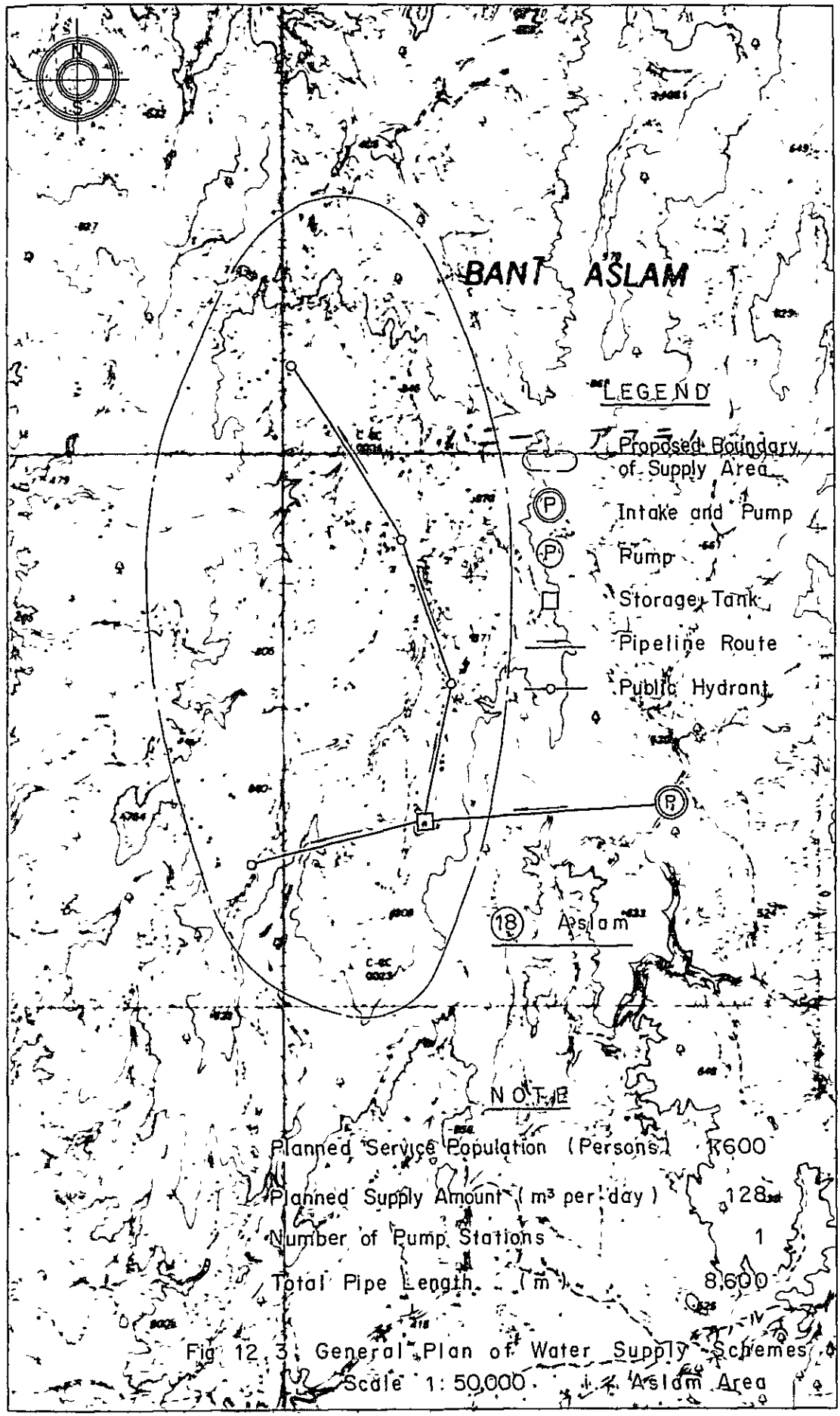


Fig 12.3 General Plan of Water Supply Schemes
Scale 1:50,000 Aslam Area

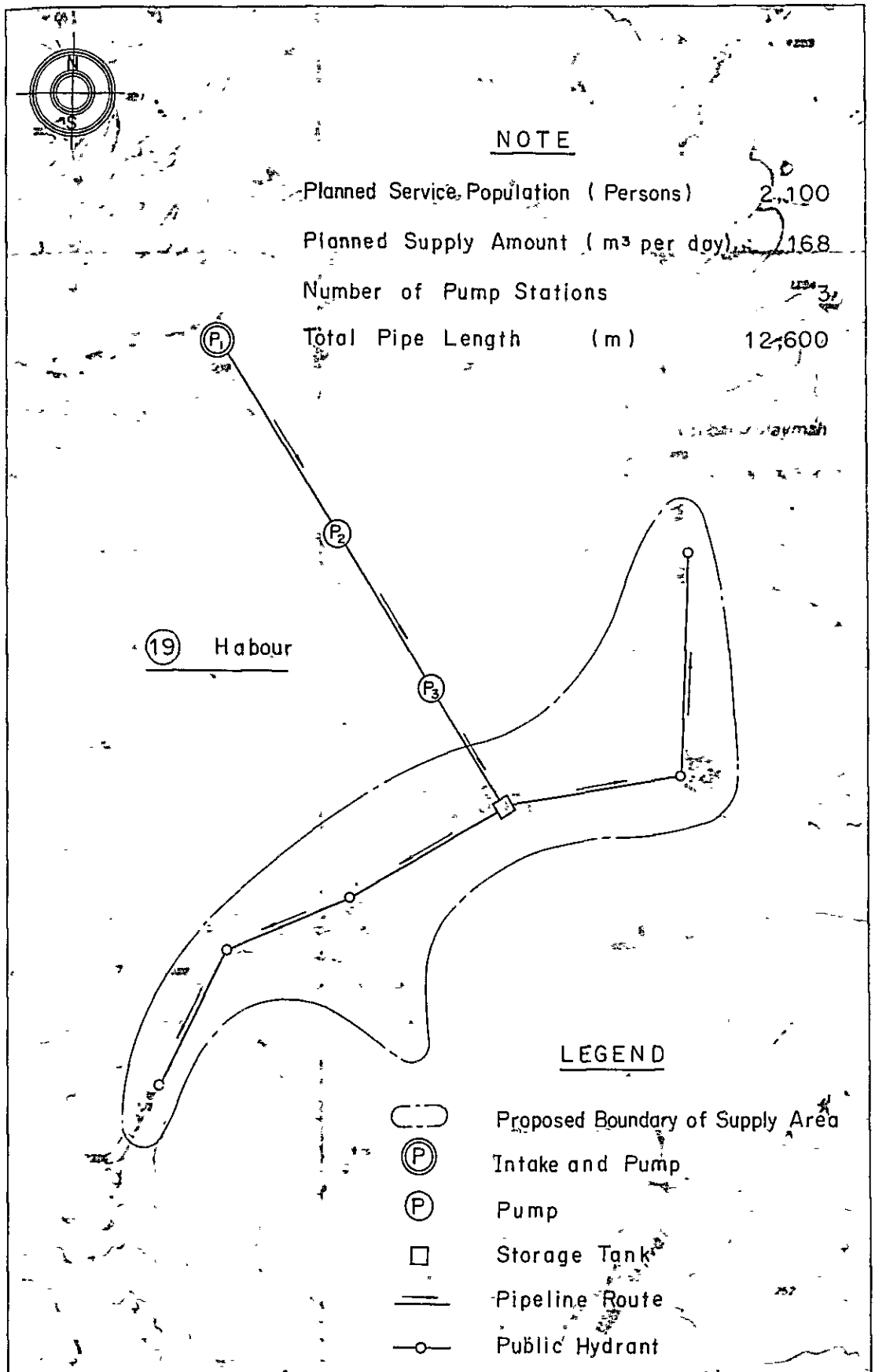


Fig. 12. 3 General Plan of Water Supply Schemes
Scale 1 : 50,000 1. Habur Area

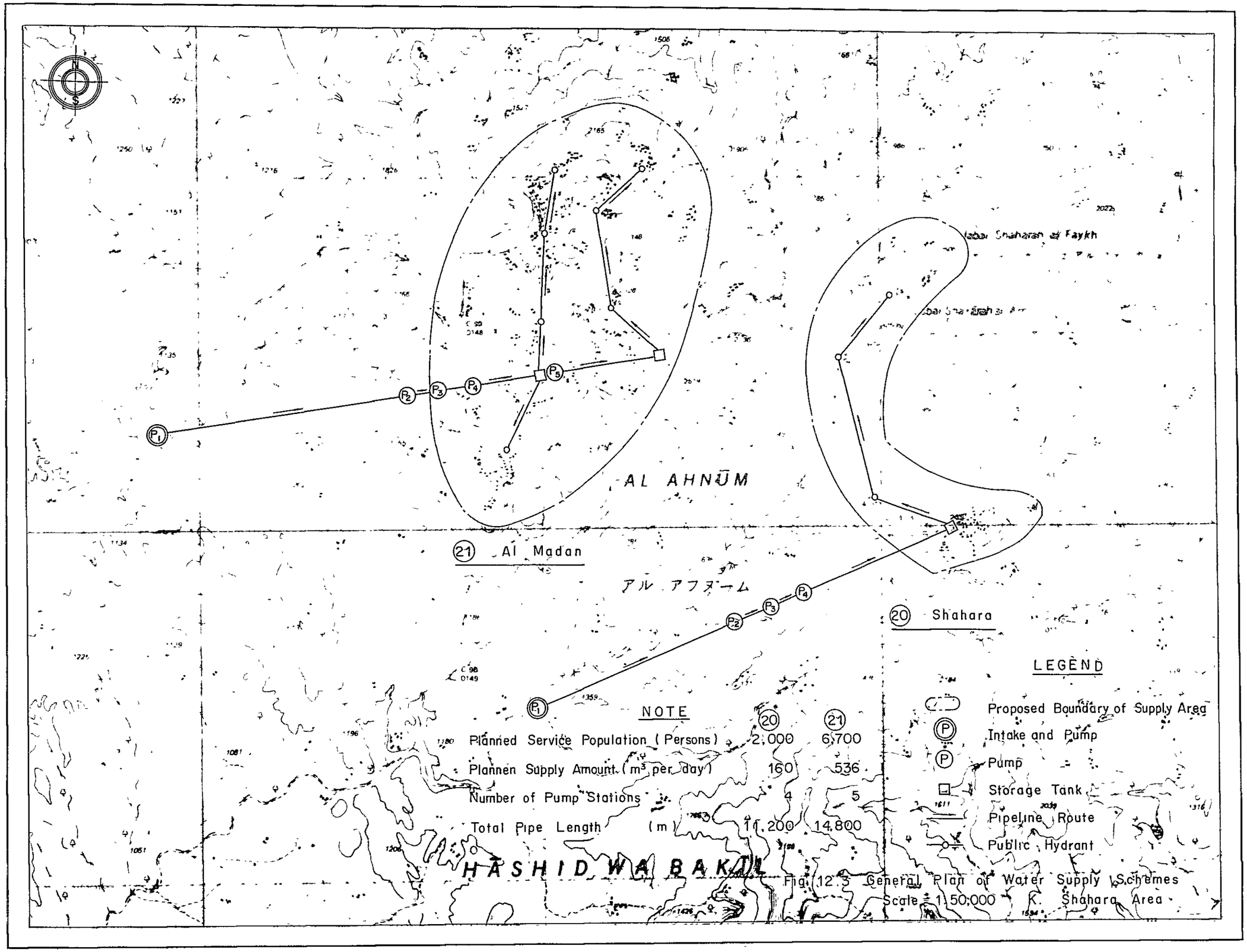


Fig. 12.3 General Plan of Water Supply Schemes
Scale 1:50,000 K. Shahara Area

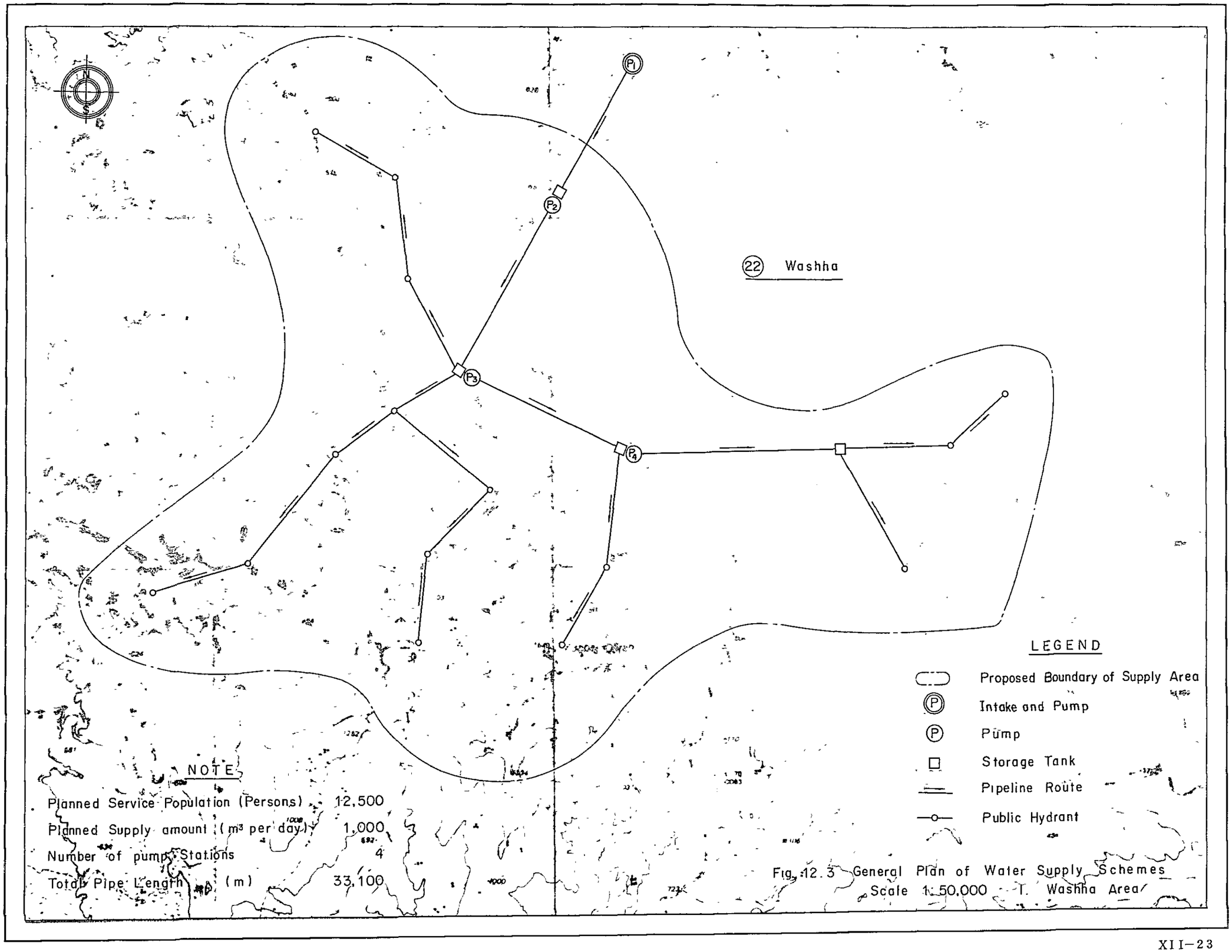


Fig. 12.3 General Plan of Water Supply Schemes
Scale 1:50,000 T. Washha Area

REFERENCES

Urs Geiser and Hans Steffen University of Zurich (1977)	Population Distribution, Administration Division and Land use in the Yemen Arab Republic
Advisory Team to C.P.O. (1978)	Al-Mahabisha Water Supply Project (Pre-Feasibility Study)

XIII RURAL ROAD NETWORK

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3.	Necessity for Improvement of Road Network	XIII - 2
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13.3	Proposed Road Network	XIII-14

XIII RURAL ROAD NETWORK

(1) General

13.01 The modernization of road network in Yemen started 20 years ago under bilateral aid. Design standards have mostly determined on a project-by-project basis. The road network is not classified officially. However, it is customary to refer to some roads as main road, and to others as secondary or feeder roads.

13.02 Reliable data on vehicle registration, fuel consumption, commodities hauled or length of haul are not available, though they are necessary for the analysis of road network planning.

13.03 Ministry of Public Works is responsible for all the road networks. The Highway Authority which was established only in 1972 within the Ministry as the executing agency, is directly responsible for the planning, design, construction and maintenance of the national highway network. Local Development Association takes care of feeder roads construction under supervision of the Highway Authority. However, feeder roads are constructed usually following existing trails and tracks with limited improvement of horizontal and vertical alignment, decided largely on the spot by the technicians in charge.

(2) Existing Road Network

13.04 The existing roads of YAR totals about 3,700 km, out of which 1,040 km are paved main roads. These are listed in Table 13.1. The roads totaling length of 752 km are under construction. They are listed in Table 13.2. The existing paved roads and the roads under construction are shown in Fig. 13.1. The nation-wide road network is still poor.

13.05 In the Hajjah Province, modern road network is non-existent at present. The only available land transport means are primitive tracks suitable only for four-wheel drive vehicles and animal transport, which are usually closed during rainy season. General lack of transport facilities has been a major cause of social and cultural isolation between the regions in the Province and of confinement of marketing areas within wadi flood basins and sub-range of mountains.

13.06 The road network in the Hajjah Province is shown in Fig. 13.2. There are two principal roads. One is running through the Tihama lowland from Al Zahra to Harad in the north-south direction. The other is Amran-Khashm road which is traversing the mountainous area and Tihama lowland in the east-west direction. No pave roads run in the Hajjah Province. The Amran-Hajjah road which is now under construction is planned to be paved by the cooperation of People's Republic of China.

13.07 The road network is very poor in comparison with other developed provinces. The road structure itself is also poor. Smooth transportation is hindered by narrow width, steep vertical alignment, small horizontal radii and bumpy surfaces.

(3) Necessity for Improvement of Road Network

13.08 Development of adequate transport facilities is of urgent necessity for the economic and social development of the Province. The necessity of and the benefits obtained through the extension and improvement of road network in the Province are described hereunder:

a. Breaking up of regional isolation: At present, regions in the Province are isolated from each

other and also isolated from outside the Province. It is of vital importance to break up to the regional isolation, aiming and realizing one unified province in the social and cultural context and effective central authority over the Province which is in line with the objective of the Five-Year Plan.

b. Improvement of health and education environment: At present, health and educational facilities are very poor and dispersedly located in the Province. Opening of new roads and improvement of the existing ones would provide better access for the rural inhabitants to these facilities and hence enhance the health and educational standard of the people in the Province.

c. Better availability of consumption goods at cheaper prices: The construction of new roads and betterment of the existing ones would bring about better availability of consumption goods including farm and dairy products as well as imported goods through the reduced transportation cost.

d. Promotion of local self-help and solidarity between local communities: Project implementation would require the active participation of the local communities, especially supply labourers. The organization of these activities might be covered by the representatives of the LDAs concerned. LDAs concerned usually take responsibility for project maintenance. If necessary, however, a special institution might be founded. Reinforcing present institutions and building up new ones will be a big step to train people in the relatively new fields up self-help, responsibility and administration of local communities.

Moreover, joint operation between the local communities will promote the solidarity of the historically scattered villages and tribes.

e. Expansion of marketing area: The present poor condition of land transport facilities in the Province has placed a severe restriction on the expansion of marketing area for agricultural products. The extension and betterment of the road network would make a great contribution to the expansion of marketing area for farm products, leading to increased products for marketing as well as to increased overall agricultural outputs.

f. Providing marketing information: There is an acute shortage of marketing information needed for adequate distribution of products. The opening of new roads and the improvement of the existing ones would provide traders as well as farmers with timely and precise information for marketing.

g. Better farm input supply: The introduction of modern agricultural production techniques will accompany the rapid expansion in the use of new agricultural inputs to be brought in and from outside, such as fertilizer, pesticides and farm machinery. The extended and improved road network will make it possible to procure these inputs whenever needed at cheaper prices.

h. Dissemination of agricultural support services: No branch offices of agricultural institutions except the one of ACB in Abs have yet been established in the Province and no support services are available. However, in order to evolve from the subsistence agriculture into the modern agriculture, it is indispensable to set up these

offices and disseminate support services to where-ever they are required through the extended and improved road network.

13.09 These effects and benefits yielded from the road projects would ultimately realize a) increased productivity and greater production of agriculture, b) promotion of agr-culture for marketing, and c) crop diversification through enlarged market size. The construction of a new improved road network would bring about magnificent benefits for the development of economy as well as for the improvement of the standard of living of the people in the Province and hence is of vital importance for the development of the Province.

(4) Proposed Road Network

13.10 Three (3) secondary roads have been planned to be improved or newly constructed so as to form a rectangular shape together with Sana'a-Sadah main road which is running through the mountainous area in the east of the Hajjah Province. The first one is existing Harad-Al Zuhra road, which is running through the Tihama lowland in the north-south direction. The second one is Amran-Hajjah-Al Zuhra road, traversing the mountainous area. The third one is Huth-Washha-Harad road in east-west direction.

13.11 Besides these three secondary roads, Hajjah-Al Mahabisha-Abs secondary road has also been planned to be improved so that the political and economic centers in the Province could be connected. The road must run across the Wadi Mawr between Hajjah and Al Mahabisha. A bridgework with a total length of about 200 m will be required at the wadi crossing to secure passage of traffic during the flood season.

13.12 It is anticipated that these four secondaries will form main arteries of the economy of the Province and these arteries would fulfill their functions to maximum extent possible, giving due consideration for the growth trend of the economy.

13.13 Feeder roads are so planned as to link all the principal towns and villages in the area, making best possible use of the existing roads. Special attention has been paid to the connection of feeder roads with secondary roads or other feeder roads in order to avoid the simple side-track roads.

13.14 The proposed road network of secondary and feeder roads is shown in Fig. 13.3. The secondary roads are listed in Table 13.3. The total length of the feeder roads reaches to 1,700 km in the area, and together with the secondary roads, the road density in the area becomes 220 m/km^2.

(5) Proposed Design Standards

13.15 Proposed design standards for the secondary roads and feeder roads are listed in Table 13.4 and Table 13.5 respectively, though they are tentative, and further comprehensive study will be required. The secondary roads would have two lanes in principle with double bituminous surface treatment, and the feeder roads one lane with gravel pavement.

Table 13.1 Existing Roads of YAR

Name of Road	Type of Surface: Dirt track (km)	Graded track (km)	Gravel (km)	Paved (km)	Total (km)
Main Road					
Sana'a - Taiz	-	-	-	256.0	256.0
Sana'a - Sa'dah	-	-	-	242.0	242.0
Sana'a - Al Hodeidah	-	-	-	226.0	226.0
Km.16 - Km.63	-	-	-	191.0	191.0
Km.63 - Taiz	-	-	-	63.0	63.0
Sana'a - Al Wadi	-	-	-	14.0	14.0
Sana'a - Haddah	-	-	-	8.0	8.0
Sana'a - Airport Road	-	-	-	10.3	10.3
Airport Road - Arhab	-	-	14.0	15.0	29.0
Al Maraba - Manakha	-	-	-	5.0	5.0
Hodeidah - Port	-	-	-	5.0	5.0
Hodeidah - Airport	-	-	-	4.0	4.0
Sana'a - Al Rawda					
(Sub-Total)			(14.0)	(1039.3)	(1053.3)
Secondary and Feeder Road	958.2	428.9	662.2	-	2049.3
Total	958.2	428.9	676.2	1039.3	3102.6

Source: 1976/77 Statistical Year Book, C.P.O.

Table 13.2 Roads Under Construction

Name of Road	Total (km)	Gravel (km)	Paved (km)
Sana'a - Marib	172	-	172
Dhamar-Radaa-Al Baida	168	-	168
Taiz - Sharjah	59	-	59
Sana'a - Jhana	31	-	31
Taiz - Al Turbah	70	-	70
Amran - Hajjah	77	-	77
Sana'a - Shibam	34	-	34
Sana'a/Shibam Junct.-Thula	9	-	9
Al Ribat - Al Jaaby	27	27	-
Hodeidah - As Salif	69	69	-
Hodeidah - Ras Alkathib	15	15	-
Al Ahgor - At Tawilah	10	10	-
Al Hommady - Al Sharqi	11	11	-
Total	752	132	620

Table 13.3 Proposed Secondary Roads

Route	Length (km)	Remarks
Amran — Hajjah	50	under construction
Hajjah — Khashim — Al Zuhra	60	improvement
Al Zuhra — Abs	45	improvement
Abs — Al Mahabisha	35	improvement
Al Mahabisha — Hajjah	45	under construction
Abs — Harad	70	improvement
Harad — Washha — Huth	125	under planning
Total	430	

Table 13.4 Design Standards for Secondary Roads

	Unit	Terrain		
		Flat	Hilly	Mountainous
Geometric design Standards				
Speed	(km/h)			
Normal		100	60	30
Minimum		-	30	20
Horizontal Radius	(m)			
Normal		400	100	35
Minimum		-	35	20
Gradient	(%)			
Normal		3	5	9
Maximum		-	7	12
Roadway Features				
Width	(m)			
Total Roadway		8.5	7.5	6.5
Pavement		6.5	6.0	5.5
Pavement Type		Double bituminous surface treatment		

Table 13.5 Design Standards for Feeder Roads

	Unit	Terrain		
		Flat	Hilly	Mountainous
Geometric Design Standards				
Speed	(km/h)			
Normal		70	40	25
Minimum		-	20	10
Horizontal Radius	(m)			
Normal		200	50	25
Minimum		-	20	10
Gradient	(%)			
Normal		3	6	10
Maximum		-	10	15
Roadway Features				
Width	(m)			
Total Roadway		6.0	5.0	4.5
Pavement		4.5	4.0	4.0
Pavement Type		Gravel		

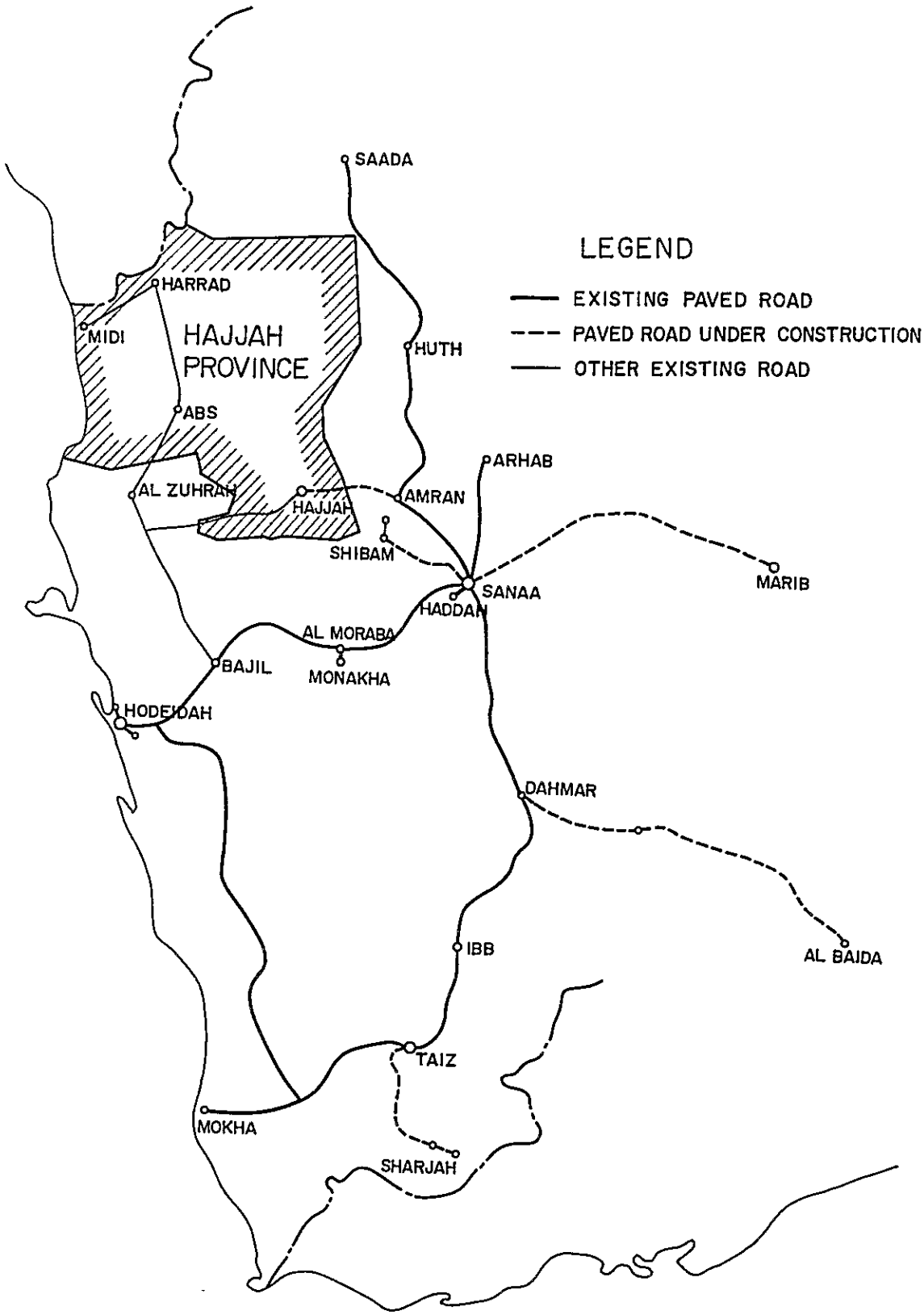

Fig. 13. 1 Existing Road Network of YAR

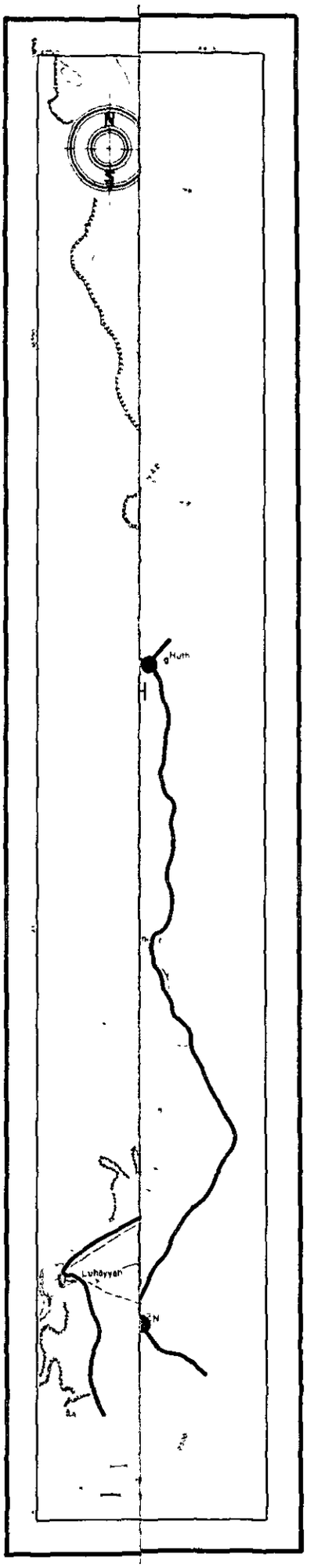

Fig.13.2 Existing Road Network in Hajjah Province

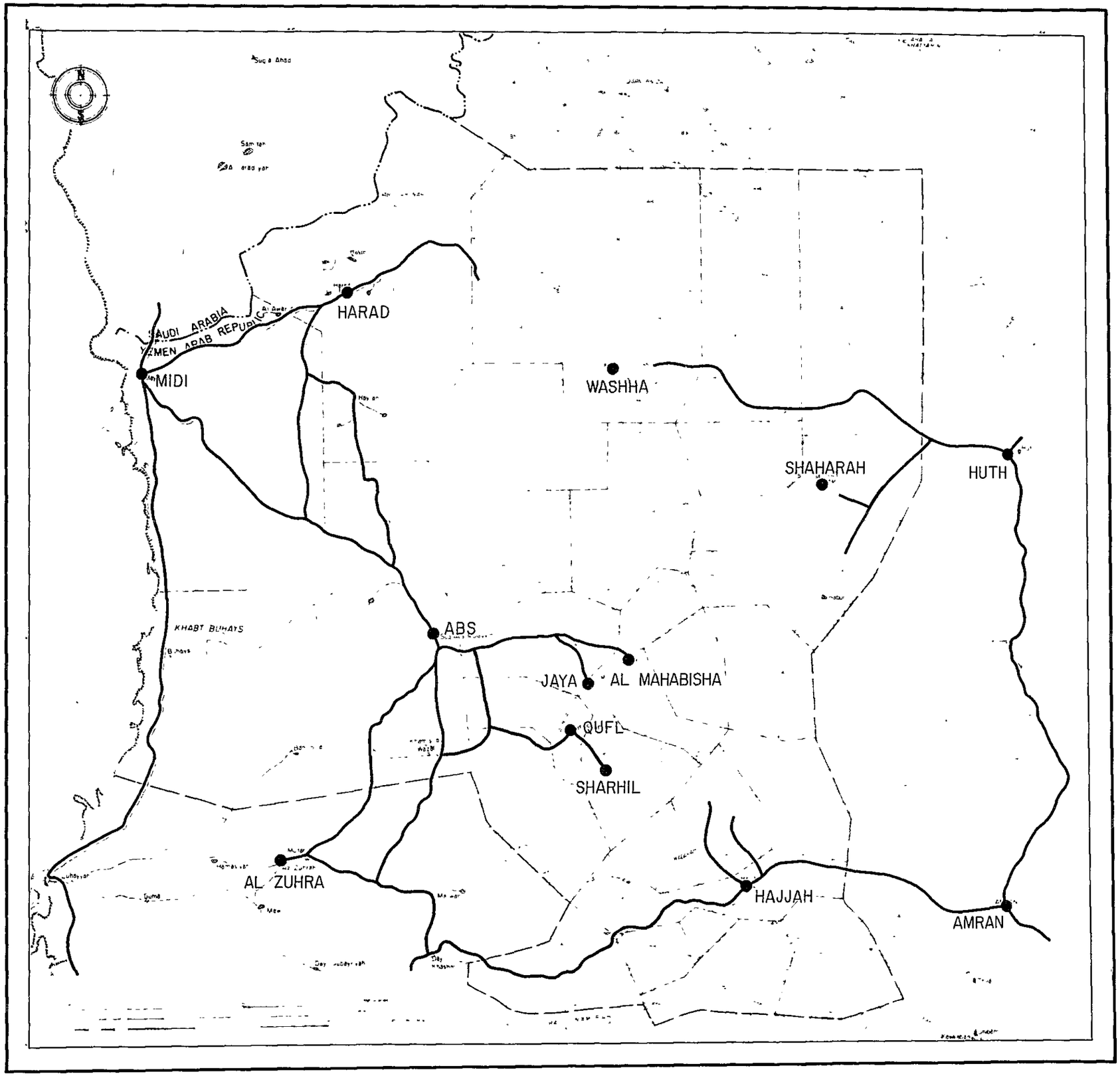

Fig.13.2 Existing Road Network in Hajjah Province

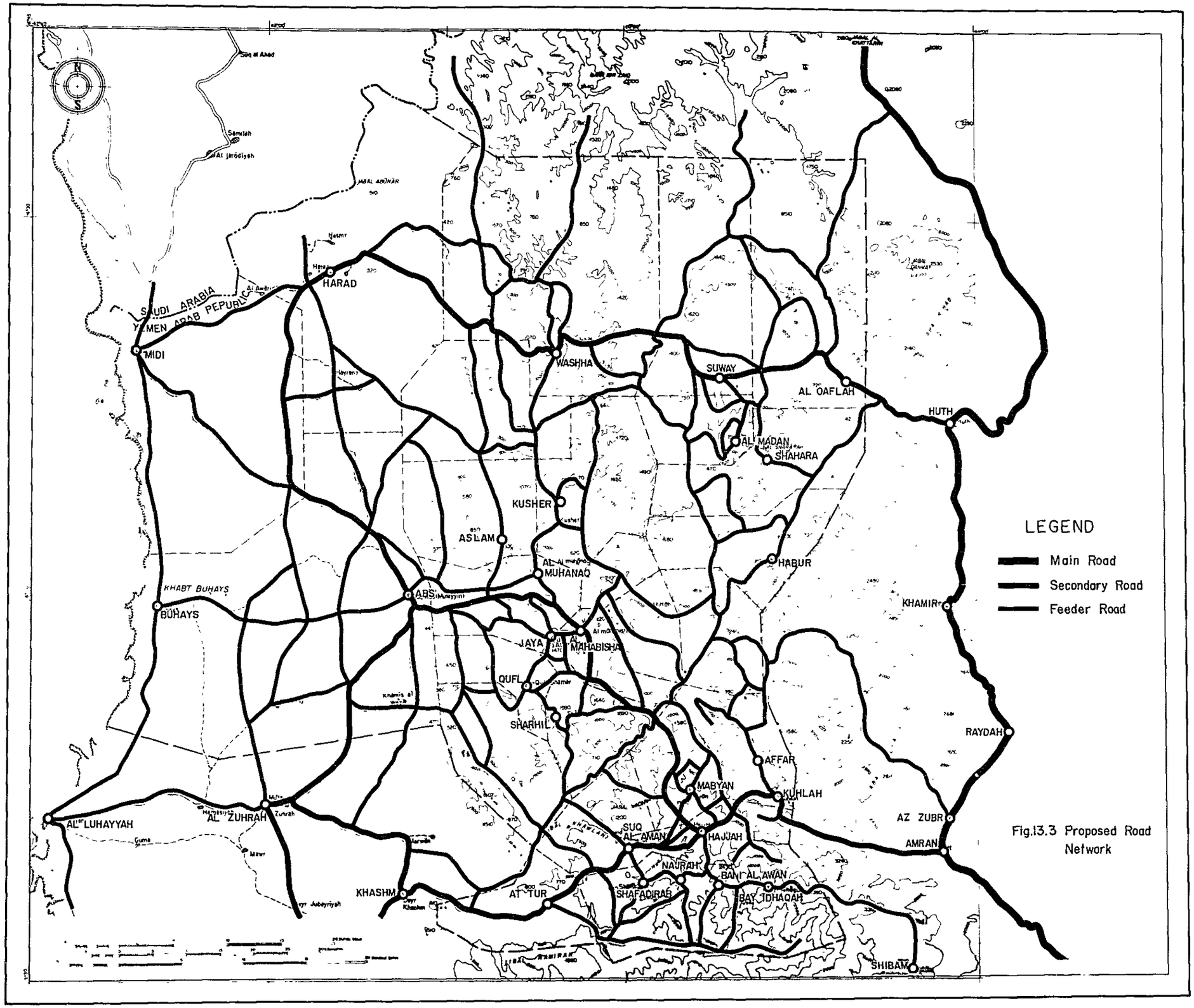

Fig.13.3 Proposed Road Network

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XIV AGRICULTURAL DEVELOPMENT

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XIV AGRICULTURAL DEVELOPMENT

(1) Present Situations (Chapter IX "AGRICULTURAL ECONOMY," to be referred)

14.01 Out of a total land area of 9,590 km^2, only about 840 km^2 are regularly cultivated. An additional 570 km^2 of marginal agricultural land is cultivated only during high rainfall years. Woody vegetation or shrub growth covers 1,480 km^2. About 6,700 km^2 are rocky mountains and semi-arid range lands with sparse vegetation. About 88 % (1,250 km^2) of the cultivated land depends solely on low and erratic rainfall, 9 % (120 km^2) is supplied with spate irrigation by seasonal flood flow, and 3 % (40 km^2) is put under regular irrigation by wells.

14.02 The main rainfed crops are sorghum and bulrush millet in the lowland, and wheat, barley and sorghum in the midland and highland. Irrigated agriculture is limited due to the scarcity of water resources. Groundwater, very small perennial flow and seasonal floods coming down the wadi courses are generally the water sources for irrigation. Irrigation practices are still very limited in the mountain regions. Spate irrigation is common in the areas along the wadi courses mainly in the lowland. Groundwater irrigation (shallow wells) by pumps is practised in some areas in the lowland, but the commandable areas are generally very small. Maize, cotton and tobacco are grown on the irrigated lands in the lowland; coffee and qut are the main crops of the high rainfall areas in the mountain regions. Vegetables are cultivated on the irrigated sites on a limited scale.

14.03 Farming method is still very primitive. Seeds are provided locally and is of inferior quality. Fertilizer is used only in the irrigated fields. No pest and insect

control measures are applied. Crop yields are generally low. For example, sorghum and millet yields of 800 kg per ha, wheat yield of 800 kg per ha, barley yield of 1,000 kg per ha, maize yield of 1,500 kg per ha are among the lowest in the country.

14.04 There are a considerable number of domestic animals. it is estimated that over 340,000 goats and sheep, 88,000 cattle, 48,000 donkeys and 49,000 domestic fowls exist in the Province. Semi-nomadic husbandry is common. Animal diseases are widespread owing to the lack of health care and poor animal feeds.

14.05 There is no extension services in the Province. Agricultural research programme has not been initiated yet. A branch office of the Agricultural Credit Bank was opened only in March 1979 and has made very little achievement. There is no institutional support to the farmers for farm inputs supply. Harvested crops are stored in the villages and are subject to damages by rodents and insects. Surplus grains and other marketable products are transported by donkey or camel to the nearest local market.

(2) Dvelopment Potential

14.06 The Hajjah Province is not richly endowed in agricultural resources. Definite limits to the agricultural development are set by the limited arable land and water resources. In areas where rainfall and irrigation water are adequate for crop production, available arable land is already in full use. In areas where unused arable land exists, additional water resources are not available for development (Tables 14.1 and 14.2, to be referred).

14.07 The absolute limit of the physical resources means that the prospect for expansion of agricultural production

lies in better utilization of land and water for the highest return crops under proper farm management. The present low level of agricultural productivity suggests considerable potential for development. Even under the limiting conditions of low and erratic rainfall, crop yields could be increased through the improvement of cultivation techniques including use of high yielding seeds, fertilizers and agrochemicals. Better animal husbandry and health care together with improvement of animal feeds can increase weight gains and improve eggs and milk production.

14.08 A large body of good crop research has been carried out by on-going research projects on the country basis. The fertilizer research results indicate a very substantial potential for increasing crop yields in high rainfall regions. In areas where rainfall is less than 400 mm per annum, the farmers may not be willing to take the financial risk of applying fertilizers. These low rainfall areas occupy about 59 % of total arable lands. In such low rainfall areas, crops do not respond well to fertilizers. The present meteorological study indicates that about 12 % of the total arable land is in areas with annual rainfall of over 600 mm. While these high rainfall areas already have the highest and most stable crop yields within the confines of traditional techniques, they also have the highest potential for still higher yields. The areas receiving marginal rainfall of 400-600 mm per annum, extend mainly on midland, occupying about 29 % of the total arable land. These marginal rainfall areas have also some potential.

14.09 In Ibb area, for example, the fertilizer trials under farmers' condition show an increase of 0.66 ton per ha of sorghum, 0.49 ton per ha of wheat and 0.52 ton per ha of barley, giving an increment of 26, 28 and 47 %,

respectively. In the Wadi Zabid Project area which represents the Tihama lowland, the trials on farmers' demonstration fields give an average yields of 3.52 tons of maize per ha which compared to the local average of 1.18 tons per ha. The cotton demonstration fields demonstrate an average yield of 2.99 tons of seed cotton per ha as compared to 1.11 tons per ha obtained by local farmers.

14.10 A further potential exists in crop diversification, a shift to higher-return crops. After centuries of subsistence farming, farmers are now faced with drastic social changes including labour shortage, high wages, relatively easy access of Sana'a and changing consumer tastes. These changes offer new opportunities for the shift to market-oriented agriculture. A trend in this direction is already apparent. Many farmers have already started planting new high-value crops like vegetables and fruits. With rising urban incomes, dietary habits are changing. The urban population increasingly consume a wide variety of vegetables and fruits. The Province has now very easy access to Sana'a by the completion of road between Hajjah and Amran. Continued increase in demand for vegetables and fruits will support the agricultural development in the Hajjah Province.

14.11 Livestock also has the potential for a greater contribution to the rural economy. The demand for livestock products is also increasing and the Province will have better position as the supplier because of its favourable location. However, this will require an improvement of range lands, use of crop by-products and growing of fodder crops in rotation with other crops. In addition to these improvement of animal feeds, better veterinary care would be essential for livestock development. Dairy farming and poulty production would have

some potential in the Hajjah-Mabyan area.

(3) Development Constraints

14.12 The agricultural development plan will have to aim at increasing crop and livestock production and raizing farm incomes of the rural inhabitants. To achieve an increase in production, a number of constraints have to be eliminated. The major constraints involved in the exploitation of agricultural potential are summarized as follows:

a. Human Factors

i. Most of the farmers are not knowledgeable or experienced in modern farming practices. They are unlikely to take financial risks of adopting new practices.

ii. A large number of the rural inhabitants who should carry out the task of agricultural development have left their villages due to higher wages offered by the neighbouring oil-producing countries. This brought about serious labour shortage problem in rural area and pushed the rural wages up to relatively high level (rural wages have risen about 20-25 times since 1972 compared with 3.6 times for the general price index).

iii. The large cash remittances sent to rural villages by the migrant workers are reducing the incentives to continue cultivating the marginal agricultural lands.

iv. Higher costs of production due to higher labour wages led to a reduction in area planted in low-value crops, mainly cereals and abandonment of marginal lands, and have jointly resulted in a overall decline in food grain outputs.

b. Institutional Factors

i. Nearly all the institutions to serve agricultural development have not been put operation in the Province.

ii. Most farms are tenant-operated. The traditional 50/50 sharing system does not give the share-cropper an incentive or the means to adopt more costly farm practices, especially use of fertilizers and insecticides.

iii. The share-cropper cultivates the lands under a verbal agreement with the landowner on the terms and conditions that are determined by tradition. Even if both owners and tenants have an interest in long-range farm improvement like irrigation work, soil erosion protection measures, land reclamation, etc., the cooperation between the two can hardly expected on such a year-to-year verbal understanding.

iv. There is an extreme shortage of professional staff and technician required for new agricultural institutions and services.

c. Physical Factors

i. The expansion of agricultural production is definitely limited by the all-important factor "water" as already mentioned.

ii. Secondary and feeder roads connecting the farming areas have not been developed. Many villages are not accessible by motorized transport. Construction of infrastructural facilities, institutional agricultural services and marketing activities are largely constrained by the lack of motorized rural roads.

iii. Many of the rural inhabitants are living in a harsh environment where the people's basic needs are not yet satisfied, especially in social services like clean drinking water, health facilities, elementary education and electricity. The rural inhabitants have more serious concerns for the immediate improvement of their living environment than the long-range on-farm improvement.

(4) Proposed Measures for Improvement of Agricultural Production

14.13 Although the exploitation of agricultural potential is presently constrained by a number of human, institutional and physical factors, the development prospects of the Province will heavily rely on the agricultural sector. In the long run, the agricultural development will have to be promoted, in spite of the limits set by a number of constraints, on the basis of a) crop diversification, b) use of better farm inputs, c) improvement of irrigation practices (to make the best possible use of limited irrigation water available, d) agricultural mechanization, and e) better marketing arrangement. In other words, the present subsistence agriculture should be replaced with the market-oriented one which would realize higher productivity and guarantee the higher incomes to the farmers.

14.14 To achieve such prospective agricultural development, the introduction of institutional agricultural services will be the first need, because nearly all the institutions to serve the agricultural development, including extension services, credit facilities, farm input supply services, research, etc., are lacking in the Province.

14.15 Although these institutional services are prerequisites for agricultural development, it would be very difficult to consolidate the needed institutions and services at once under the present low level of manpower resources in the Province. The agricultural development should therefore be considered on the long term basis.

14.16 In implementing agricultural development, opinions may differ as regards the scale, phasing and the requirements of various other sectors. In due consideration of the constraints involved in the agricultural development, it is proposed that, among others, small scale development schemes be established initially, which will be gradually expanded as more trial results become known and more experience is obtained together with building of skilled manpower.

Comprehensive Implementation Body

14.17 Considering all these, the basis for the promotion of agricultural development will be a comprehensive implementation body, which will carry out the following tasks necessary for the rural development:

a. Physical resources survey
b. agricultural census and statistics
c. collection of meteorological and hydrological records through the establishment of observation network
d. comprehensive agricultural research on crops, livestock, irrigation and mechanization
e. agricultural extension services
f. agricultural credit services
g. farm inputs supply services
h. demonstration and training
i. rural water supplies

j. Feeder roads construction
k. improvement of other rural infrastructural facilities
l. coordination with Local Development Association

The proposed set-up of this comprehensive implementation body will be discussed in Chapter XX, "Organization and Management." The activities to be carried out under the proposed set-up will be comprehensive and directed towards overall improvement of the rural incomes and welfare.

14.18 A constant flow of field-tested knowledge relevant to crop and livestock production will be a pre-condition for the success of agricultural development. Many of the rural inhabitants are living in a harsh environment where investment will produce very little extra income until technical discoveries create reliable new opportunity. In this view, it is proposed that the following specific schemes be established within the Hajjah Province:

a. agricultural research station for development of midland agriculture
b. Research and training center for mechanization and irrigation, particularly for development of lowland

Agricultural Research Station

14.19 The midland region occupys 42.6 % of the total land area or 4,090 km^2 in the Hajjah Province. Although its soil condition is not very favourable, the midland region will continue to be important for crop and livestock production, receiving relatively high rainfall of about 400 - 600 mm per annum. However, there is no research institution to serve the development of midland agriculture in this country, while a large body of agricultural research for both lowland and highland zones

has been carried out by the existing research institutions.

14.20 The proposed agricultural research station will be established around Al Mahabisha where irrigation water is available. The agricultural research station will carry out, in close coordination with the Central Agricultural Research Station in Taiz, various field trials and basic meteorological observation necessary for agricultural development of midland region. The technical information to be obtained through the field trials will have to form an integral part of the extension services. The research station will also serve the advanced training of extension workers who will be recruited from the local community and offered a basic training in the existing training facilities. In the light of special importance of afforestation in the mountain regions, a forest nursery will be included in the proposed research station.

14.21 The agricultural research to be carried out will mainly be confined to:

a. Field trials of crop varieties selected elsewhere in the country for their adaptability to the local condition,
b. field trials of fodder crops and trees for improvement of animal feeds,
c. veterinary studies for cattle, domestic fowls, sheep and goats,
d. demonstration and research for irrigation method and crop water requirement by using small pumps,
e. farm economy survey and study on farm management

14.22 The agricultural research station will have the following sections in its organizational set-up.

a. Crop research
b. Livestock

c. Irrigation improvement
d. Farm management
e. afforestation
f. Information and administration

The organizational set-up will be discussed in Chapter XX, "ORGANIZATION AND MANAGEMENT."

14.23 The proposed size of the agricultural research station will be 10 ha including the sites for offices and laboratories. The general layout is shown in Fig. 14.1. The proposed site is located on the Jaya area, about 3 km southeast of Al Mahabisha.

14.24 The agricultural research station will be gradually expanded and at the stage which all the activities will get on the right truck, the following branch stations will be established:

a. stock seed farms for keeping pure-line seeds of recommendable varieties
b. seed multiplication fields to be managed by the progressive farmers under the contract with the agricultural research station
c. veterinary service station to be attached to each branch office (refer to Chapter XX)
d. demonstration fields for small scale pump irrigation and new horticulture technique
e. pilot afforestation schemes (refer to Chapter XVI)

Research and Training Center for Irrigation and Mechanization

14.25 The lowland agriculture is characterized by relatively large farm holding, cereal-single-cropping, rainfed cultivation under tropical climate with scant rainfall, extreme labour shortage and relatively low agricultural incomes. According to the soil studies, there exist 2,690 km^2 of

arable land in the lowland, out of which only 790 km^2 are presently under cultivation. Expansion of cropland will be the essential basis for promotion of agricultural development in the lowland. The labour shortage and the limited availability of water will be the limiting factors for the expansion of cropland.

14.26 In order to make the best possible use of water available, crop water requirement will have to be re-studied. If the water consumption could be saved, more areas of arable lands would be put under irrigation, resulting in the increase of total output. Water losses in the water conveyance system should be kept as low as possible. Irrigation structures and land levelling have to be improved in view of an efficient water distribution and it will have to be studied which irrigation methods can best be applied.

14.27 The labour constraint can only partly be removed by a greater emphasis on mechanization. Quick land preparation by mechanization will make the timely sowing of crop possible. Mechanization will also be effective for catching seasonal flood water under spate irrigation. However, mechanization will have to be carefully introduced. The gradual introduction of intermediate technology will be a valuable solution in a situation in which skilled manpower, maintenance facilities and capital resources are lacking.

14.28 With this in view, it is proposed to establish a research and training center for irrigation and mechanization. The proposed site will be within the Abs area where about 1,300 ha of the spate-irrigated land will possibly be improved by constructing headworks on the Wadi Qur and canal system. The size of the proposed center will be

20 ha. The general plan of facilities is shown in Fig. 14.2.

14.29 The major activities to be carried out will be as follows:

a. meteoro-hydrological observation and analysis through the establishment of observation network
b. trial cultivation of crop varieties selected by the Tihama Development Authority for their adaptability to the local condition
c. experiment on crop water requirement and irrigation method
d. testing of mechanized cultivation using various equipment and attachments
e. training of machine operators and mechanics.

14.30 The trainee of the center will have to be recruited from the local community and will have to gain an insight into the way in which to make use of machinery in the lowland. The center will then serve to the rural community as a supply unit. The technical information to be obtained from the field trials will be promptly transferred to extension services.

(5) Slection of Suitable Crops and Proposed Production Pattern

Selection of Suitable Crops

14.31 The crops to be grown in the Hajjah Province should be highly profitable, and also have good marketability. The crops should also be of water-saving type and be suited to the local condition. Selection of suitable crops will have to be made on the basis of the results of studies on water saving crops and farming practices, marketability relative to crop varieties and quality, profitability of

crops in terms of profit and loss, and adaptability to local condition. All these factors for selecting the suitable crops have not been, however, clarified yet.

14.32 Selection of suitable crops were therefore studied within the confines of limited information obtained from the farm economic survey (Table 9.6, to be referred) and research results published by the government research institutions. The studies were made for different agricultural zones, i.e., lowland, midland and highland, in terms of four factors; water-saving characteristics, marketability, profitability and technical adaptability. The water saving characteristics are graded by crop-water requirement. Marketability is evaluated by using the expected net production value and profitability by output-inputs ratio. Technical adaptability is assessed from agronomic viewpoint on the zone-by-zone basis. Results are given in Table 14.3.

14.33 On the basis of these crop studies, the following crops are considered to be suitable:

<u>Lowland</u>

Millet (low rainfall area)
Sorghum
Cotton
Tomatoes (irrigated)
Okura (irrigated)
Pepper (irrigated)
Papaya (irrigated)
Banana (irrigated)
Sunflower

<u>Midland</u>

Maize
Potatoes

Onion (irrigated)
Cucumber (irrigated)
Soybean
Groundnuts

Highland

Wheat
Barley
Grapes
Coffee
Rape seed
Qut

14.34 In areas where irrigation water is available, crop diversification is promising. Other physical resources are rather favourable for growing high-value crops such as vegetables and fruits. In rainfed croplands, crop diversification is relatively limited. However, growing of sunflower, soybean and rape seed could be introduced in the lowland, midland and highland, respectively. There might also be possibility for growing groundnuts and sugar beet, but no commercial production would be expected owing to the limited suitable lands available.

Proposed Farming Pattern

14.35 The proposed farming patterns for each agricultural zone have been studied on the basis of the selected crops and prospective agricultural development in each zone. They are shown in the following table. These farming patterns and crops to be adapted will have to be re-studied in the proposed research institutions.

Agricultural zone/Quada	Proposed farming pattern	Major crops
Lowland (0 - 500m) Quada: Midi	- Large scale mechanized cereal (sorghum, millet) production under rainfed condition - Small scale vegetable and tropical fruits production under irrigated condition - Large scale mechanized sorghum and cotton production under spate irrigated condition - Large scale rainfed sunflower production - Grazing (cattle, sheep, goats) on perennial low vegetation	Sorghum Millet Cotton Sunflower Tomatoes Okra Pepper Papaya Banana
Midland (500 - 1,000m) Quada: Hajjah Shahara Washha	- Small scale cereal and vegetables production on the irrigated wadi lands - Small scale rainfed maize and potaotes production on terraced lands - Small scale soybean and groundnuts production under rainfed condition - Grazing (sheep, goats)	Maize Potatoes Onion Cucumber Soybean Groundnuts
Highland (1,500 - 2,500m) Quada: Al Mahabisha	- Intensive cereal (wheat, barley) production under rainfed condition - Intensive coffee and grapes production on gentle slope lands complementary irrigated by hill-slope run-off - Vegetables and fruits production under irrigated condition - Cattle raising with fodder crop production - Commercial poultry	Wheat Barley Grapes Coffee Vegetables Fruits Fodder crops

(6) Future Agricultural Production

14.36 There exist about 1,410 km^2 of cropland in the Hajjah Province, out of which only 840 km^2 are regularly cultivated mainly due to labour shortage caused by out-migration as described before. Although the Province has 3,810 km^2 of arable land, most of unused arable lands extend on the lowland area with annual rainfall of less than 400 mm and cultivation on such low rainfall lands will not be very profitable. Such being the situation, expansion of croplands will not be feasible. The basis for improvement of agricultural production will, therefore, be full use of existing cropland and improvement of land productivity. Labour constraint can be only partly be removed by a greater emphasis on mechanization.

14.37 Prospective cropping patterns have been prepared for each Quada on the basis of suitable crops, proposed farming patterns and areas of existing croplands. These are shown in Fig. 14.3. The cropping intensity will be possibly increased from present level of 60 % to 139 % at the full development stage.

14.38 The future agricultural production has been calculated and shown in Table 14.4. The future net production value will be YR 2,131 million compared to YR 1,121 million of present production value, as summarized below:

	Net Production Value	
	Total Crop Production ($\times 10^3$ YRs)	Per Household (YRs)
Present	1,121	20,240
Future	2,131	38,470
Increment	1,010	18,230

In this estimate, production values of livestock products are excluded due to lack of dependable base for estimation.

However, the increased production of crops would produce a lot of by-products which could be fed to animals and would contribute to the increase of livestock production in future.

Table 14.1 Land Use and Rainfall

Land use category	Annual Rainfall (mm) 0 - 200 (km^2)	200 - 400 (km^2)	400 - 600 (km^2)	600 - 800 (km^2)	800 - (km^2)	Total area (km^2)
A. Irrigated cropland	15 (1.1%)	70 (5.0%)	75 (5.3%)	- (-)	- (-)	160 (11.4%)
B. Rainfed cropland/ annual cultivation	50 (3.5%)	245 (17.4%)	330 (23.5%)	95 (6.7%)	30 (2.1%)	750 (53.2%)
C. Rainfed cropland/ opportunistic cultivation	35 (2.5%)	75 (5.3%)	10 (0.7%)	- (-)	- (-)	120 (8.5%)
D. Rainfed cropland/ terraced	- (-)	- (-)	150 (10.6%)	110 (7.8%)	20 (1.4%)	280 (19.8%)
E. Cropland/ rangeland	100 (7.1%)	- (-)	- (-)	- (-)	- (-)	100 (7.1%)
Total	200 (14.2%)	390 (27.7%)	565 (40.1%)	205 (14.5%)	50 (3.5%)	1,410 (100.0%)

Table 14.2 Land Class and Rainfall

Land class	Annual Rainfall (mm) 0 - 200 (km^2)	200 - 400 (km^2)	400 - 600 (km^2)	600 - 800 (km^2)	800 - (km^2)	Total area (km^2)
A. Class 1 (arable)	250(6.6%)	410(10.8%)	390(10.2%)	60(1.6%)	10(0.2%)	1,120(29.4%)
B. Class 2 (arable)	10(0.2%)	180(4.7%)	250(6.6%)	160(4.2%)	10(0.2%)	610(16.0%)
C. Class 3 (arable	510(13.4%)	900(23.6%)	450(11.8%)	180(4.7%)	40(0.8%)	2,080(54.6%)
Total	770(20.2%)	1,490(39.1%)	1,090(28.6%)	360(10.5%)	60(1.2%)	3,810(100.0%)
D. Unused arable land	570(24.1%)	1,100(46.6%)	525(22.2%)	155(6.6%)	10(0.5%)	2,360(100.0%)
E. Total cropland / Total arable land	26.0%	262%	51.8%	56.9%	83.3%	Ave. 37.0%
F. Unused arable land / Total arable land	74.0%	73.8%	48.2%	43.1%	16.7%	Ave. 63.0%

Table 14.3 Evaluation of Selected Crops

Crops	Water saving	Market-ability	Profit-ability	Technical adaptability
Lowland				
Sorghum	B	C	B	A
Millet	A	C	B	A
Maize	B	B	B	A
Cotton	B	C	B	A
Sesame	C	B	B	B
Potatoes	C	A	A	B
Tomatoes	C	A	A	A
Okra	C	B	A	A
Onion	C	A	A	C
Cucumber	C	A	A	B
Pepper	C	B	A	A
Papaya	C	A	B	A
Banana	C	A	A	A
Groundnuts*	B	B	B	B
Sunflower*	A	B	B	A
Midland				
Sorghum	B	C	B	B
Maize	B	B	B	A
Sesame	C	B	B	A
Potatoes	C	A	A	A
Tomatoes	C	A	A	B
Okra	C	B	A	B
Onion	C	A	A	A
Cucumber	C	A	A	A
Pepper	C	B	A	B
Papaya	C	A	B	B
Banana	C	A	A	B
Soybean*	A	B	B	A
Groundnuts*	B	B	B	A
Highland				
Sorghum	B	C	B	B
Wheat	B	B	B	A
Barley	B	B	B	A
Potatoes	B	A	A	B
Grapes	B	A	C	A
Coffee	B	B	C	A
Qut	B	A	A	A
Rape seeds*	B	B	B	A
Soybean*	A	B	B	B
Pear*	C	A	B	B
Peaches*	C	A	B	B
Plum*	C	B	A	B

A: Good B: Fair C: Poor

*: New crops

Table 14.4 Future Crop Production (Hajjah Province)

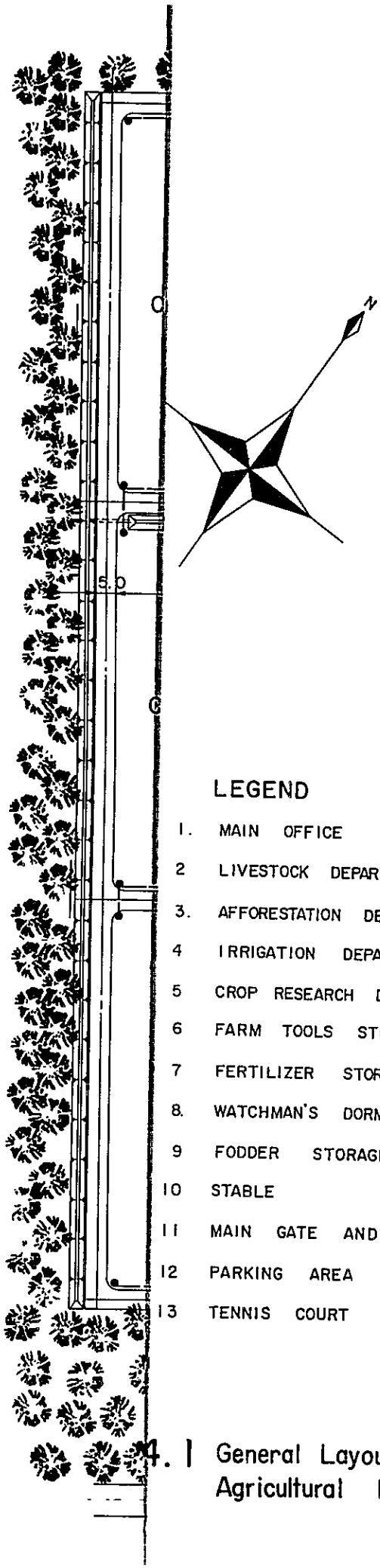
Crops	Cultivation area (ha)	Unit yield (tons/ha)	Gross production value ($\times 10^3$ YRs)	Unit production cost (YRs/ha)	Total production cost ($\times 10^3$ YRs)	Net production value ($\times 10^3$ YRs)
Millet	65,500	0.8	104,700	700	56,300	48,400
Sorghum	37,100	1.0	74,200	700	33,400	40,800
Maize	34,600	2.0	103,800	1,000	45,000	58,800
Wheat & Barley	20,200	1.2	48,500	300	10,900	37,600
Legumes	11,200	1.4	94,100	2,200	34,000	60,100
Vegetables	7,100	10.0	568,000	5,000	92,300	475,700
Qut	6,800	2,200 bundles	1,047,200	4,000	132,000	915,200
Potatoes	5,700	16.0	364,800	5,000	64,900	299,900
Sesames	4,100	1.0	102,500	3,000	22,600	79,900
Coffee	1,500	0.6	25,200	6,000	11,500	13,700
Fruits	1,200	12.0	86,400	21,000	33,800	52,600
Grapes	1,000	6.3	75,600	19,500	27,100	48,500
Total	196,000		2,695,000		563,800	2,131,200

- to be continued -

Quada/Crops	Cultivation area (ha)	Unit yield (tons/ha)	Gross production value ($\times 10^3$ YRs)	Unit production cost (YRs/ha)	Total production cost ($\times 10^3$ YRs)	Net production value ($\times 10^3$ YRs)
(A) Hajjah						
Vegetables	900	16.0	72,000	5,000	11,700	60,300
Potatoes	500	16.0	32,000	5,000	5,700	26,300
Wheat & Barley	16,700	1.2	40,100	300	9,000	31,100
Millet	16,700	0.8	26,700	700	14,300	12,400
Legumes	5,400	1.4	45,400	2,200	16,400	29,000
Coffee	700	0.6	11,800	6,000	15,400	6,400
Fruits	700	12.0	50,400	21,000	19,700	30,700
Qut	900	2,200 bundles	138,600	4,000	17,500	121,100
Total	42,500		417,000		99,700	317,300
(B) Midi						
Potatoes	4,100	16.0	262,400	5,000	46,700	215,700
Vegetables	4,100	16.0	328,000	5,000	53,300	274,700
Sesames	4,100	1.0	102,500	3,000	22,600	79,900
Sorghum	27,100	1.0	54,200	700	24,400	29,800
Maize	24,600	2.0	73,800	1,000	32,000	41,800
Millet	38,500	0.8	61,600	700	33,100	28,500
Total	102,500		882,500		212,100	670,400
(C) Al Mahabisha						
Vegetables	900	16.0	72,000	5,000	11,700	60,300
Potaotes	500	16.0	32,000	5,000	5,700	26,300
Wheat & Barley	3,500	1.2	8,400	300	1,900	6,500
Millet	3,500	0.8	5,600	700	3,000	2,600
Legumes	5,800	1.4	48,700	2,200	17,600	31,100
Coffee	800	0.6	13,400	6,000	6,100	7,300
Grapes	800	6.3	60,500	19,500	21,700	38,800
Qut	5,500	2,200 bundles	847,000	4,000	106,700	740,300
Total	21,300		1,087,600		174,400	913,200

- to be continued -

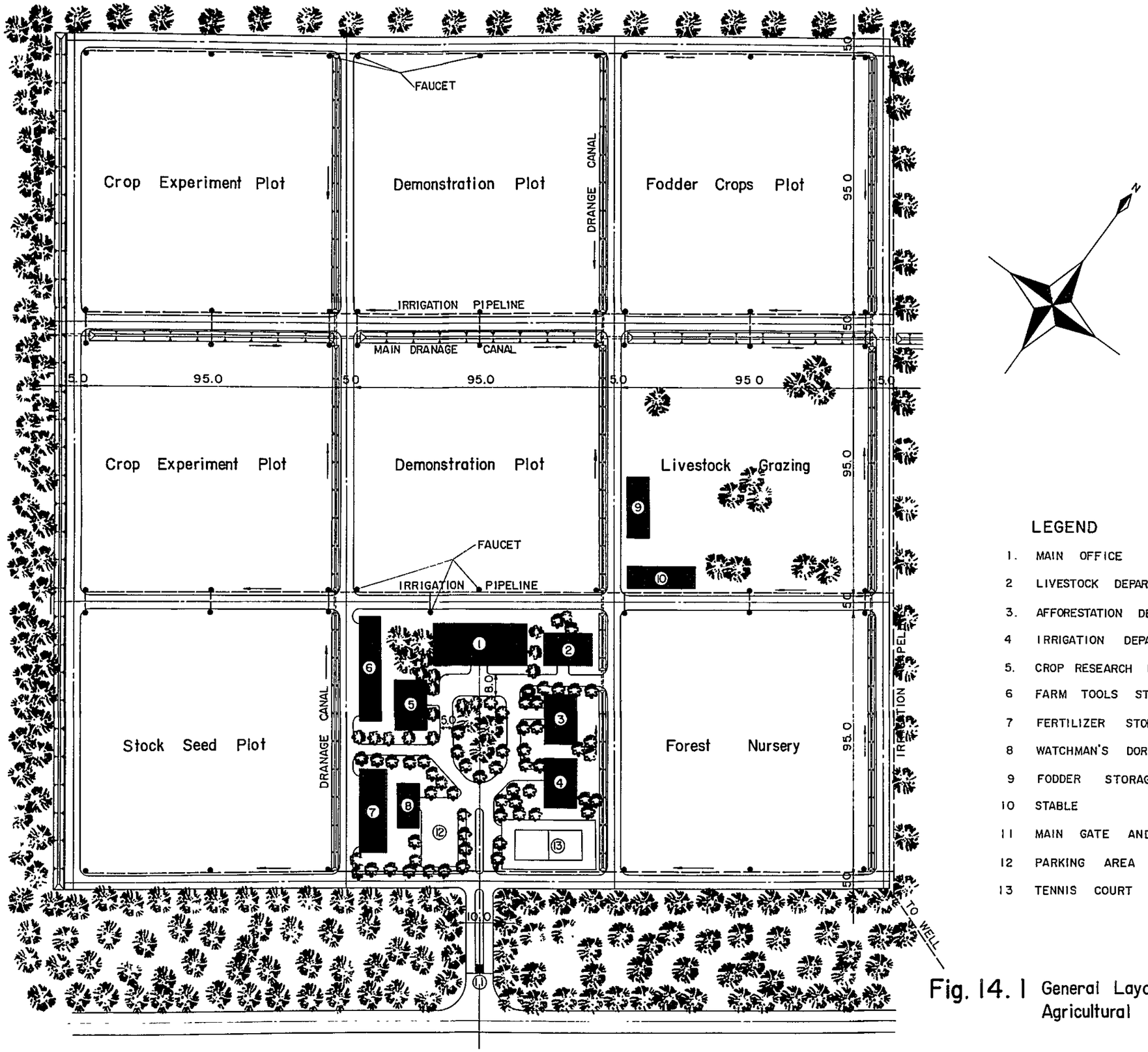
Quada/Crops	Cultivation area (ha)	Unit yield (tons/ha)	Gross production value ($\times 10^3$ YRs)	Unit production cost (YRs/ha)	Total production cost ($\times 10^3$ YRs)	Net production value ($\times 10^3$ YRs)
(D) Washha						
Vegetables	600	16.0	48,000	5,000	7,800	40,200
Potatoes	300	16.0	19,200	5,000	3,400	15,800
Sorghum	4,600	1.0	9,200	700	4,100	5,100
Maize	4,600	2.0	13,800	1,000	6,000	7,800
Millet	4,400	0.8	7,000	700	3,800	3,200
Fruits	500	12.0	36,000	21,000	14,100	21,900
Qut	200	2,200 bundles	30,800	4,000	3,900	26,900
Total	15,200		164,000		43,100	120,900
(E) Shahara						
Vegetables	600	16.0	48,000	5,000	7,800	40,200
Potatoes	300	16.0	19,200	5,000	3,400	15,800
Sorghum	5,400	1.0	10,800	700	4,900	5,900
Maize	5,400	2.0	16,200	1,000	7,000	9,200
Millet	2,400	0.8	3,800	700	2,100	1,700
Grapes	200	6.3	15,100	19,500	5,400	9,700
Qut	200	2,200 bundles	30,800	4,000	3,900	26,900
Total	14,500		143,900		34,500	109,400



LEGEND

1. MAIN OFFICE
2 LIVESTOCK DEPARTMENT
3. AFFORESTATION DEPARTMENT
4 IRRIGATION DEPARTMENT
5 CROP RESEARCH DEPARTMENT
6 FARM TOOLS STORAGE
7 FERTILIZER STORAGE
8. WATCHMAN'S DORMITORY
9 FODDER STORAGE
10 STABLE
11 MAIN GATE AND GUARD HOUSE
12 PARKING AREA
13 TENNIS COURT

4. 1 General Layout of Agricultural Research Station



LEGEND

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Fig. 14. 1 General Layout of Agricultural Research Station

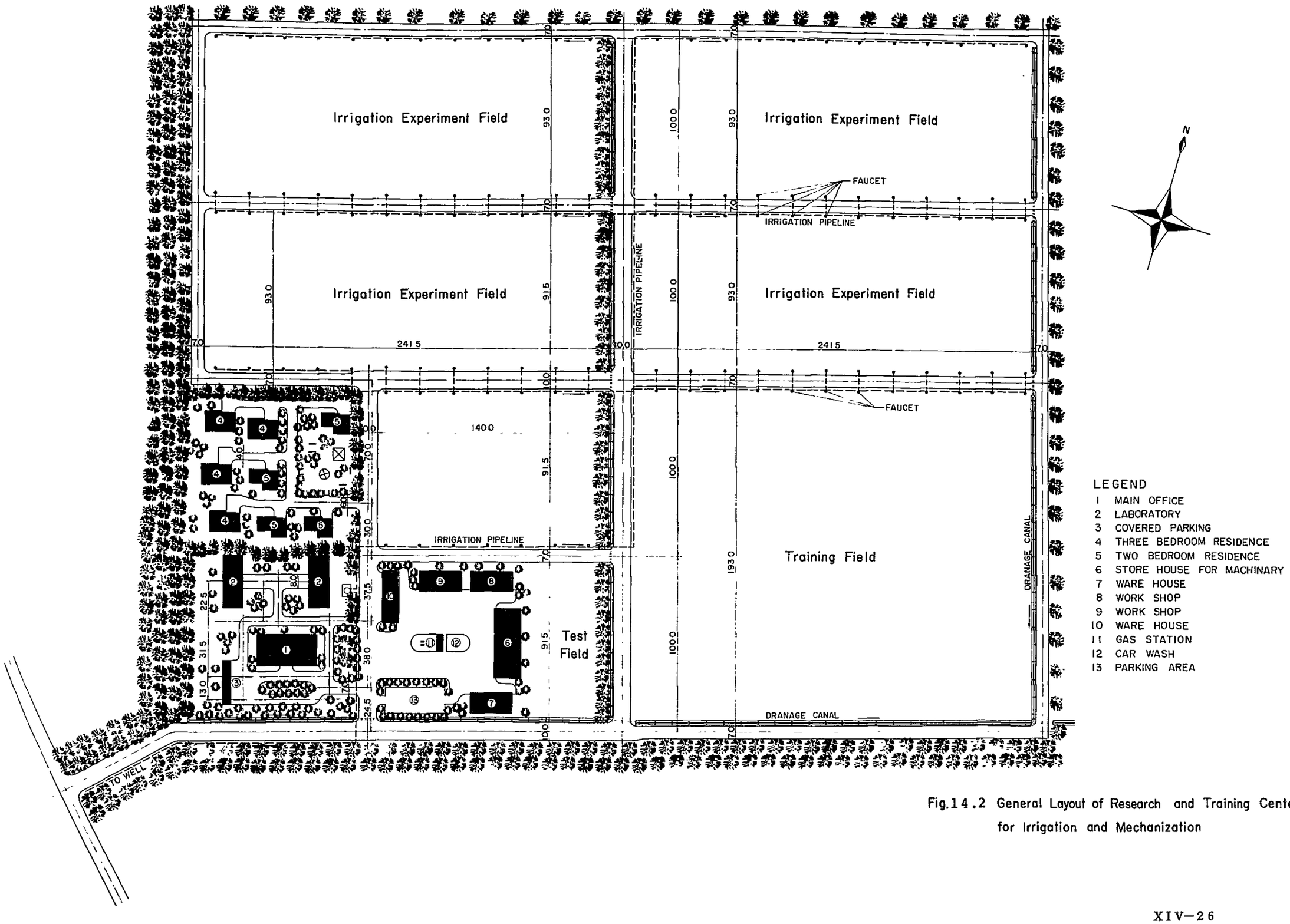


Fig.14.2 General Layout of Research and Training Center for Irrigation and Mechanization

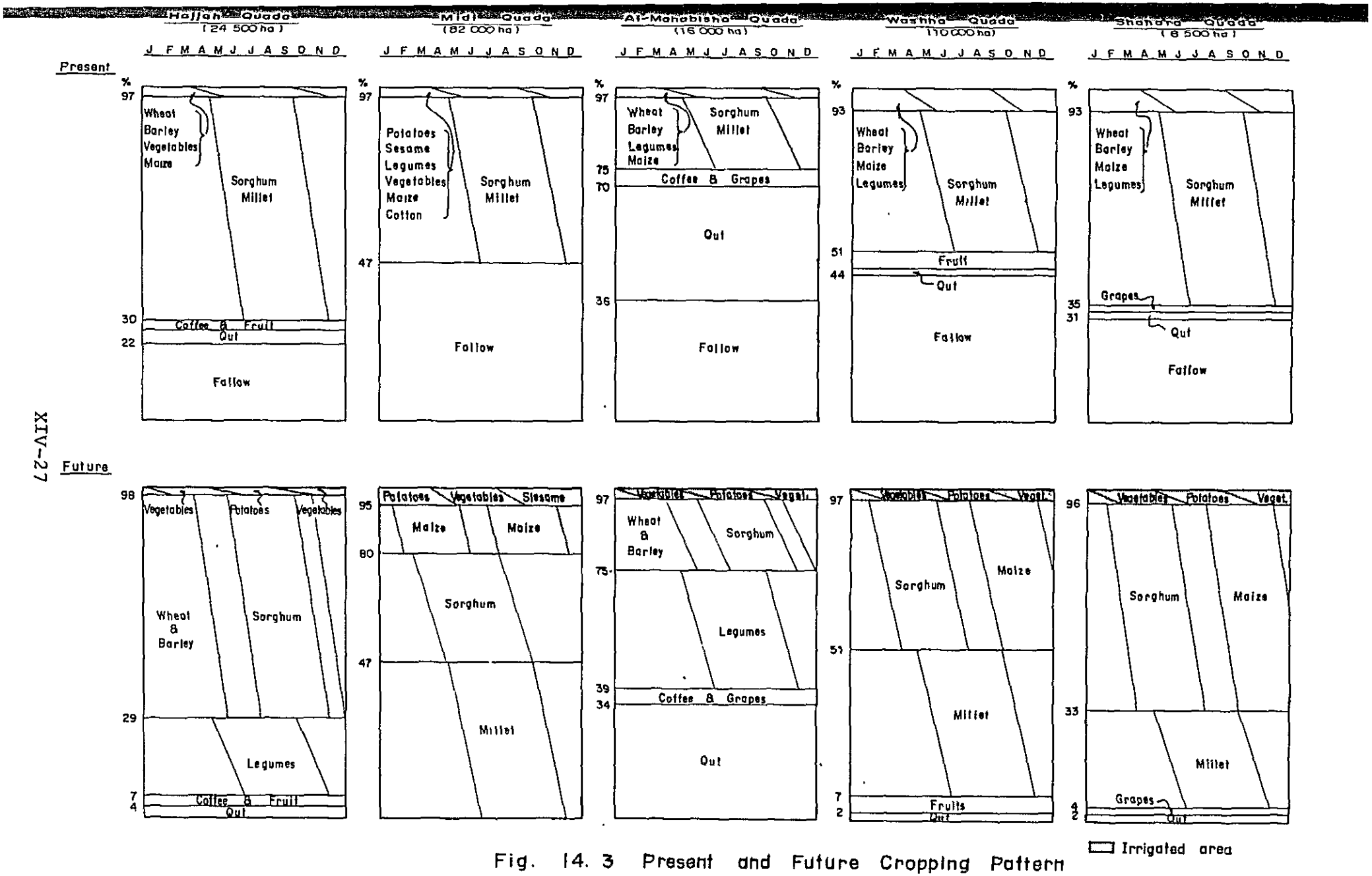


Fig. 14. 3 Present and Future Cropping Pattern

XV IRRIGATION IMPROVEMENT

1.	General	XV-1
2.	Irrigation Plan	XV-1
	Wadi-delta plains in lowland	XV-1
	Swampy lands around Al Mahabisha	XV-3
	Gentle-slopes along wadi courses	XV-3
3.	Field Trials on Irrigation Practices	XV-4

Table

15.1	Irrigation Improvement Plan for Wadi-Delta Plain	XV-5

Figure

15.1	Irrigable Areas in Lowland	XV-6

XV IRRIGATION IMPROVEMENT

(1) General

15.01 In the Hajjah Province, irrigated agriculture is limited due to the scarcity of water resources. The water resources for irrigation are ground water, very small perennial flow and seasonal floods coming down the wadi courses. Irrigation practices are still very limited in the mid and high-lands. Blessed with higher rainfall, rainfed farming prevails in these lands. Spate irrigation is common in the areas along wadis mainly in the coastal lowland. Ground water irrigation (shallow wells) by pumps is practised in some areas in the lowland, but the commandable areas are generally very small. The irrigation area totals only 16,000 ha, corresponding to about 11 % of the total crop land.

15.02 Irrigation possibility in the Province is not promising. Expansion of irrigation area is generally difficult because strictly limited additional water is available. The areas where irrigation is technically applicable, irrespective of economic feasibility, are as follows:

a. Wadi-delta plains in Tihama area by a combination of small dams and wells

b. Swampy lands around Al-Mahabisha by pumps

c. Gentle-slopes along the wadi courses by a combination of small dams and pumps

In each case, the commandable area is small and very high economic return will not be expected.

(2) Irrigation Plan

<u>Wadi-delta plains in lowland</u>

15.03 In the Tihama lowland, spate irrigation has been practised for centuries. The area under spate irrigation is about 12,000 ha, most of which extend along the wadi courses. The wadi water seems to be fully utilized for irrigation and other uses. Several dikes have been constructed across the wadi courses in order to divert the wadi spate water and keep the water in the fields for longer period. The dikes are of temporary nature and sometimes reconstructed by the farmers themselves using bulldozers.

15.04 In the rainy season, the wadi floods wash the wadi delta plains and disappear in a few days. The flood courses are generally capricious. The extent of the spate irrigation area depends on the flood courses and discharges, and therefore the irrigation area fluctuates largely year by year. The area where the dike was washed out by the first flood, would not be irrigated during the cropping season because reconstruction of the dike would not be possible in the short intervals of floods.

15.05 Since the additional water resources are quite limited, the basis for irrigation development will be improvement of irrigation water use. This includes improvement of irrigation water distribution, through construction of semi-permanent intake structures and canals and also land levelling, and re-use of seepaged water by shallow wells and pumps.

15.06 In the lowland, about 8,500 ha of the existing irrigated cropland will be possibly improved by constructing diversion works, supply canals and additional tubewells. The irrigated areas to be thus improved extend along the wadis as shown in Fig. 15.1. Since there is no reliable data on wadi water run-off and crop water

requirement, detailed plan or irrigation improvement is not possible to be prepared. However, a very rough estimate was tentatively made only for future reference and shown in Table 15.1.

Swampy lands around Al Mahabisha

15.07 There are three (3) scattered inter-mountain plains around the town of Al Mahabisha, totalling about 500 ha in area. They are:

a. Jaya area : 300 ha

b. Tahannen area : 100 ha

c. Sharhil area : 100 ha

15.08 In these areas, spring water is available and has partially been exploited for irrigation. The farmers grow rice under swampy condition. The soils of these lands are graded as Land Class 1, arable, being medium textured deep soils. If the irrigation water is effectively applied, crop production will be largely improved. In these areas, water is sufficient for irrigating all the arable lands of 500 ha. The areas are among others considered economically justifiable under present economic circumstances.

15.09 The irrigation plan includes full use of spring water and further exploitation of shallow groundwater. About 10 shallow wells will be made at the rate of one unit per 50 ha. The irrigation facilities will consist of 30 m shallow well, diesel driven pumps and pipes with 300 mm diameter. The irrigation plan will be discussed in Chapter XXI, "Priority Areas and Development Plan."

Gentle-slopes along the wadi courses

15.10 There exist scattered narrow strips along the wadis.

Although these lands have not been clearly identified yet, they occupy considerable areas. The estimated total area of these wadi lands are approximately 15,000 ha. These wadi lands include somewhat wide strips of about 50 - 100 m width. Irrigation will be feasible on these gently sloping wide wadi lands. The total area of such land is estimated at about 1,000 ha. Most of narrow strips are subject to seasonal flood damages and not suitable for modern irrigation practices.

15.11 Irrigation water will be taken directly from the wadis, by using diesel-driven pumps, and will be distributed to the field through pipe network. The commandable area will be generally small. Irrigation unit commanded by each intake facility will be about 10 - 30 ha.

(3) Field Trial on Irrigation Practices

15.12 The present irrigation practices show a remarkable degree of efficiency within the confines of traditional techniques. However, the water requirement will have to be re-studied through field experiment. If the water consumption could be saved, more areas of arable lands would be put under irrigation, resulting in the increase of total output. The water saving farm practices, including water application methods and field mulching, will also be studied for making the best possible use of the limited water.

15.13 The irrigation improvement plan will have to be modified after examination of these field trials and will require more accurate data on meteorology and hydrology. It is strongly recommended that observation gauge network be established within the Province as early as possible.

Table 15.1 Irrigation Improvement Plan for Wadi Delta Plain

Name of Wadi	Catchment Area (sq.km)	Average Annual Rainfall (mm)	Average Annual Discharge (1)×(2)×1/1000 ×0.054 1/ (m.c.m)	Design Drought Year Discharge (3)×0.7 2/ (m.c.m)	Net Irrigation Area (4)×100÷0.8 3/ (ha)	Gross Irrigation Area (5)÷0.6 4/ (ha)
(1) Harad	994.7	450	24.2	16.9	2,100	3,500
(2) Hayran	414.6	550	12.3	8.6	1,100	1,800
(3) Bawhal	249.8	600	8.1	5.7	700	1,200
(4) Al Qur	243.0	650	8.5	6.0	800	1,300
(5) Bani Nashir	126.7	650	4.4	3.1	400	700
Total					5,100	8,500

1/ Runoff coefficient

2/ Ratio of design drought year discharge to average annual discharge

3/ Irrigation water requirement (800mm=0.8m)

$$R = \frac{U-P}{R}$$

where, R; irrigation water requirement

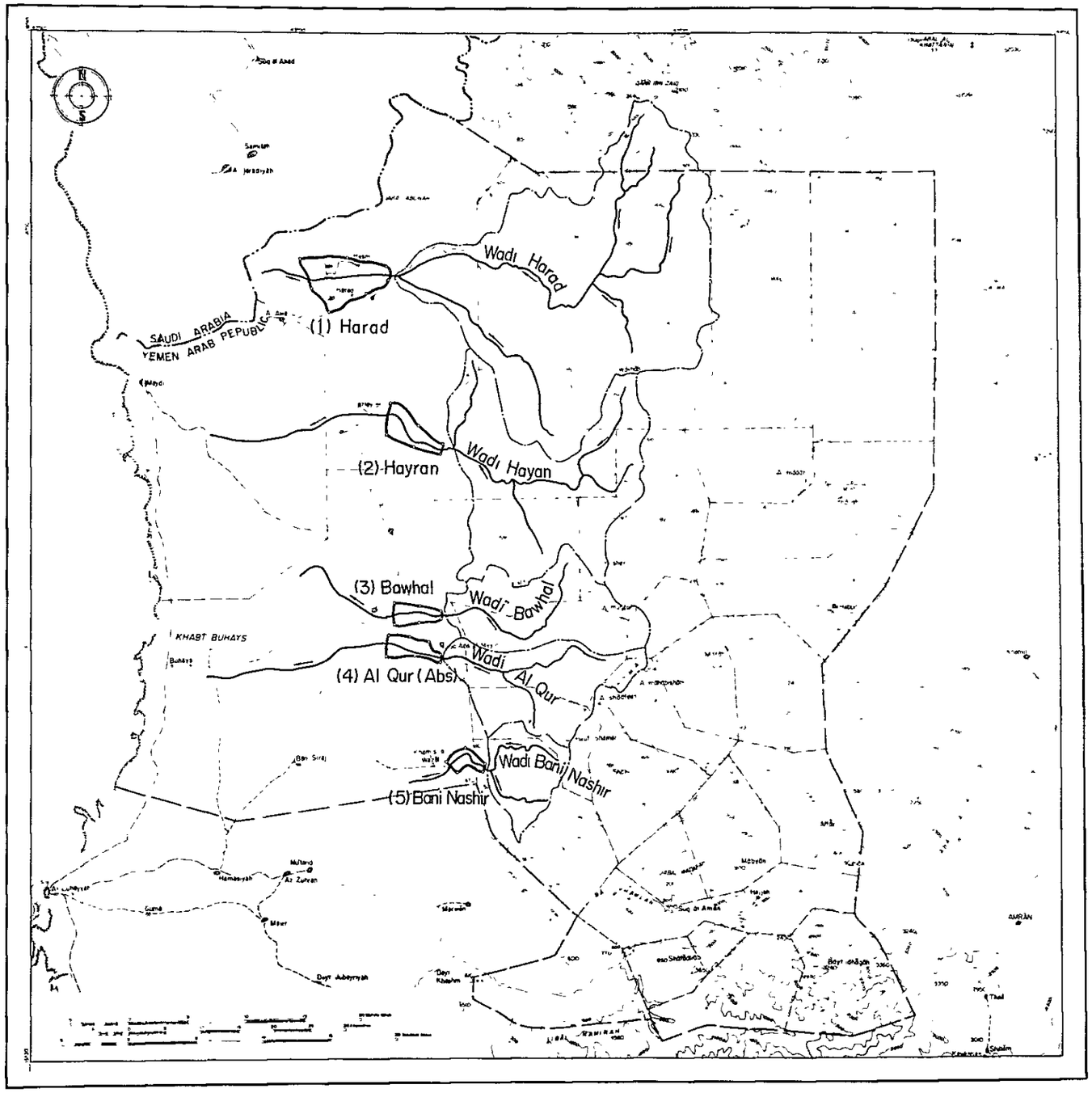
U; consumptive use requirement, 500-900mm

P; effective precipitation, 100-200mm

U-P; water requirement at crop, 500mm

E; system efficiency, 60%

4/ Ratio of net irrigation area to gross irrigation area



Irrigable Area in Lowland

Name of Wadi	Catchment Area (sq km)	Irrigable Area (ha)
(1) Harad	994 7	3,500
(2) Hayran	414 6	1,800
(3) Bawhal	249.8	1,200
(4) Al Qur	243.0	1,300
(5) Bani Nashir	126.7	700

Legend

- Wadi
- Catchment Area
- Irrigable Area

Fig. 15 1 Irrigable Area in Lowland

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XVI AFFORESTATION

1.	General	XVI-1
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3.	Basic Concept for Afforestation	XVI-3
4.	Development Plan	XVI-4
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	Range Land on Rocky Slopes	XVI-6
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	Gullied Areas and Severe Erosion Area	XVI-7
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Figure

16.1	Vegetation Map	XVI-9

XVI AFFORESTATION

(1) General

16.01 The forestry resources of the Hajjah Province are sparse and being depleted rapidly. The rural inhabitants are facing acute shortage of fire woods and the market prices are increasing to a very high level of YR 40 for a 65 kg stack of woods.

16.02 Not much effort has been done for afforestation in the province. In some areas, however, Tamarix is planted as windbreaks and Eucalyptus as woodlots in the high rainfall areas. The high market prices of woods have encouraged local farmers to plant trees. This tendency will have to be sustained as there is much scope for large scale additional afforestation which will have a number of important benefits such as soil retension, watershed protection, windbreaks and feeds to the grazed animals.

(2) Present Vegetation

16.03 The Province has no forest in the strict sense. However, large areas are covered by some woody vegetation (see attached vegetation map). These lands are mainly used for grazing domestic animals. Even in these woody lands, trees are normally scattered and used mainly for poles and fuel. These woodlands may be grouped into four types as follows:

a. mangroves of coastal belts

b. savannah-type woodlands running close to the foothills with acacia species dominant which grow on gravelly or sandy sediments

c. acacia scrub woodlands of midlands and highlands extending over large areas on the central and

northern rocky slopes of the province

d. wadi bottom woods which include tamarix and ficus species

16.04 Most of Tihama lowland are mainly dwarf grassland with some scattered acacia species scrub. Grazing is very important in the rural economy. The animal population in this region amounts to about 60 - 70 % of the total livestock in the Province. Shortage of animal feeds is very serious. The Tihama lowland has another problem of sand dune encroachment on the agricultural croplands. This is caused by seasonal strong winds blowing from sothwest to northeast. Under such circumstances, development of pasture and protection of sand drift should go with afforestation programme.

16.05 The system of land use prevailing in the mountain areas is that the terraced lands are for crops production, while rocky slopes are for grazing. In recent years, marginal terraced lands are being abandoned. The chief causes for this trend is shortage of workers due to frequent labour turnover in response to attractive pay in big cities. Once these terraces have been allowed to become eroded with the rock-wall collapsing, rebuilding would not be feasible under present economic situation. It is therefore a matter of some urgency that tree plantation on these marginal terraces be enhanced to prevent their further rapid deterioration. The rocky slopes that occupy about 65 % of the total land area cannot be neglected for well-balanced rural development. Both agricultural terraces and rocky slopes will have to be developed. When the rocky slopes get a perennial vegetation cover that provides firewood and nutritious browse for livestock and at the same time prevents soil erosion and regulates stream-flow, the rural inhabitants will receive a lot of benefits.

16.06 The Province has some woody vegetation cover. However, scarce timber resources are being depleted through excessive wood cutting and most of range lands suffer from over-grazing.

(3) Basic Concept for Afforestation

16.07 The present denudation and depletion of woodlands, which resulted from the quest for quick return and lack of integrated development strategies, have brought about very serious repercussions. For instance, dangerous floods and torrents (and ironically shortage of water), soil erosion, exposure of soils to dry climate and desertification, shortage of essential wood products and soaring prices are giving many hardship to rural inhabitants.

16.08 The benefits of afforestation are manifold, and the rural inhabitants will have to rely on woodlands for various essential requirements. Fuel wood may be the only available source of energy, as alternative sources such as petroleum and/or electricity are either lacking or too expensive. The fire wood is needed not only for cooking, but also for many cottage industries. Wood products like pole lumbers and sawnwood are also needed for housing, fencing, furniture, and handles of agricultural tools. Wood lands are also a source of fodder for livestock. The green belts and windbreaks close to settlements and shade trees along roads and in between and within houses, will enhance the quality of rural life through improvement of climate protection and provision of recreational outlets. Windbreaks around croplands also protect crops against adverse climatic conditions and induce higher productivity. Forestry benefits to rural inhabitants also take the form of soil and water conservation. With this in view, afforestation will have to be considered as one of important projects under the integrated rural development programme.

16.09 The steady decline of forestry is so serious at present and cannot be reversed except over the very long run. Factors which impede afforestation in the rural development include uncontrolled over-grazing, indiscriminate cutting for fire wood and lack of tree protection and replacement. Individual farmers pay little attention to overall resources limitation. Another problems in this connection are lack of sufficient fund for afforestation and shortage of trained forestry manpower coupled with lack of institutional support. This situation is further accentuated by the difficult question of land tenure, as most of the lands are privately owned, and suitable afforestation sites for community use are difficult to select in the Province.

16.10 The forestry work for rural development will have to be carried out by the rural inhabitants who will also receive most of benefits. This must be the principle of forestry development in the rural area. Considering all these facts, it is suggested that the rural inhabitants be given a demonstration to show forest or trees on their lands are beneficial. In order to strengthen the demonstration work, agricultural extension should include forestry work and forest nursery be established at a suitable site for propagation of technical know-how coupled with distribution of tree seedlings.

(4) Development Plan

16.11 Since no forests in the strict sense are found and some woody vegetation has been depleted by misuse, new woodlands will have to be created to satisfy present and future needs. The rural community needs fire-wood and building poles. It also needs animal feeds, but heavy grazing has reduced pasture to bareland in the mountain slopes and to moving sand dunes in the lowland. Both zones

need care of perennial vegetation cover preferably fodder trees. These would contribute toward soil retension and watershed protection.

16.12 The development plan will cover the following four typical areas:

a. Tihama lowland

b. Range lands on rocky slopes

c. Marginal terraced lands

d. Gurried areas and severe erosion sites

Tihama lowland

16.13 The immediate requirements of the inhabitants in this region are (a) protection of cropland from sand dune encroachment, (b) fodder for their livestock, and (c) fuel woods and building poles. Some indigenous species like Suaeda monoica, Tamarix nilolica and Panicum turgidum can be utilized in fixing sand dune movement. However, Acacia albida, Cassia sturtii and Prosopis chilensis may be more effective in this area. These tree species have important characteristics of resisting drought and their vegetable parts or pods can be fed to animals. The few trees in the experimental farm of the Wadi Zabid Development Project indicate the high potential of Tihama lowland for production of industrial timber under irrigated condition. These are various eucalyptus including Eucalyptus microtheca and Eucalyptus salmonophloia.

16.14 The farmers would thus be protected from sand dune encroachment by establishing shelter belts of promising tree species that would produce excellent feeds for their livestock. The extensive flats in the Tihama lowland have a good potential for industrial plantation of timber trees.

For accomplishment of these development targets, the rural inhabitants will have to be convinced to include promising tree species among their cash crops. This can be led by demonstration.

16.15 At least two demonstration sites will be needed to lead this type of work in extensive area of Tihama lowland. The areas selected for demonstration will be located around Abs and Harad. The sites will cover about 10 ha each and be provided with irrigation facilities.

16.16 The demonstration work will, however, necessitate research on species trials and watering regimes. Such trials would require several years to identify the most suitable trees for different ecological zones in the Tihama lowland. Such research work will not be included in the development plan. The research activities will be continued by Tihama Development Authority. The demonstration work will, therefore, have to be delayed until the research work will progress into final stage.

Range land on rocky slopes

16.17 These lands are being cased for grazing. The total land area is about 622,000 ha or 65 % of the Hajjah Province. The area is mainly dwarf grassland with sparse scrub. The natural vegetation is very poor. Existing woody lands are continuously dwindling because of over-grazing and uncontrolled cutting for fire-wood and building poles without protection and replacement. This area will have to need the care of perennial vegetation preferably fodder trees. This would greatly contribute to watershed protection and soil conservation. The rural inhabitants could be led by demonstration to promote the afforestation in this area.

16.18 The demonstration will be carried out in two areas. One will be located in the 400 - 600 mm rainfall zone and the other in the above 600 mm rainfall area. The sites selected is located around Shahara representing for less rainfall area and around Mahabisha for higher rainfall area. The size of demonstration afforestation site will be 200 ha each under rainfed conditions. The recommendable fodder tree species are Acacia mellifera, Ziziphus spina, Prospis chilensis, etc. Many other species are being studied by on-going forest nurseries in Sana'a and Ibb. Seedlings of promising tree species will be obtainable from these nurseries.

Marginal terraced land

16.19 The tree plantation on these lands is rather urgent as described before. In these lands, it is recommended that tree species suitable for building poles and timber for agricultural implements be planted because these species may not be produced in good quantity on other mountain slopes due to the poor soil condition, grazing pressure and the absence of motorable roads. The seedlings of promising species like Eucalyptus camaldulensis, Casuarina equisetifolia, etc. are readily obtainable from the said on-going forest nurseries. The demonstration work will be difficult for these areas because most of lands are privately owned. Extension services will, therefore, be highly required for this type of work. The serious areas where marginal lands are continuously abandoned, are Hajjah, Mabyan and Shahara. The extension services and provision of tree seedlings will first be concentrated to these areas.

Gullied areas and severe erosion sites

16.20 These lands can also be reclaimed by planting tree

species such as Acacia farnesiana, Leucaena glauca and Cassia auriculata. These species are quick-growing and regenerate themselves under severe conditions. This type of land reclamation is under progress in the southern parts of YAR. It is very important to involve the rural inhabitants in this type of works and to demonstrate that the lack of vegetation cover resulted in gullies and advanced soil erosion sites. The lands that require soil and water conservation, extend over the Province. The demonstration or pilot afforestation on such lands will gradually be carried out after some progress will be observed on range land on rocky slopes and marginal terraced land.

(5) Recommendation

16.21 It is recommended that a forest nursery be established within the Hajjah Province. Although there are some on-going forest nurseries in other Provinces, the Hajjah Province needs its own nursery for effective distribution of seedlings and training of local staff. Field work in nursery and demonstration sites will provide the best opportunity for in-service training.

16.22 For effective execution of afforestation programme, a field office will be needed in the Province. The functions required for the field office will be:

a. operation of forest nursery,

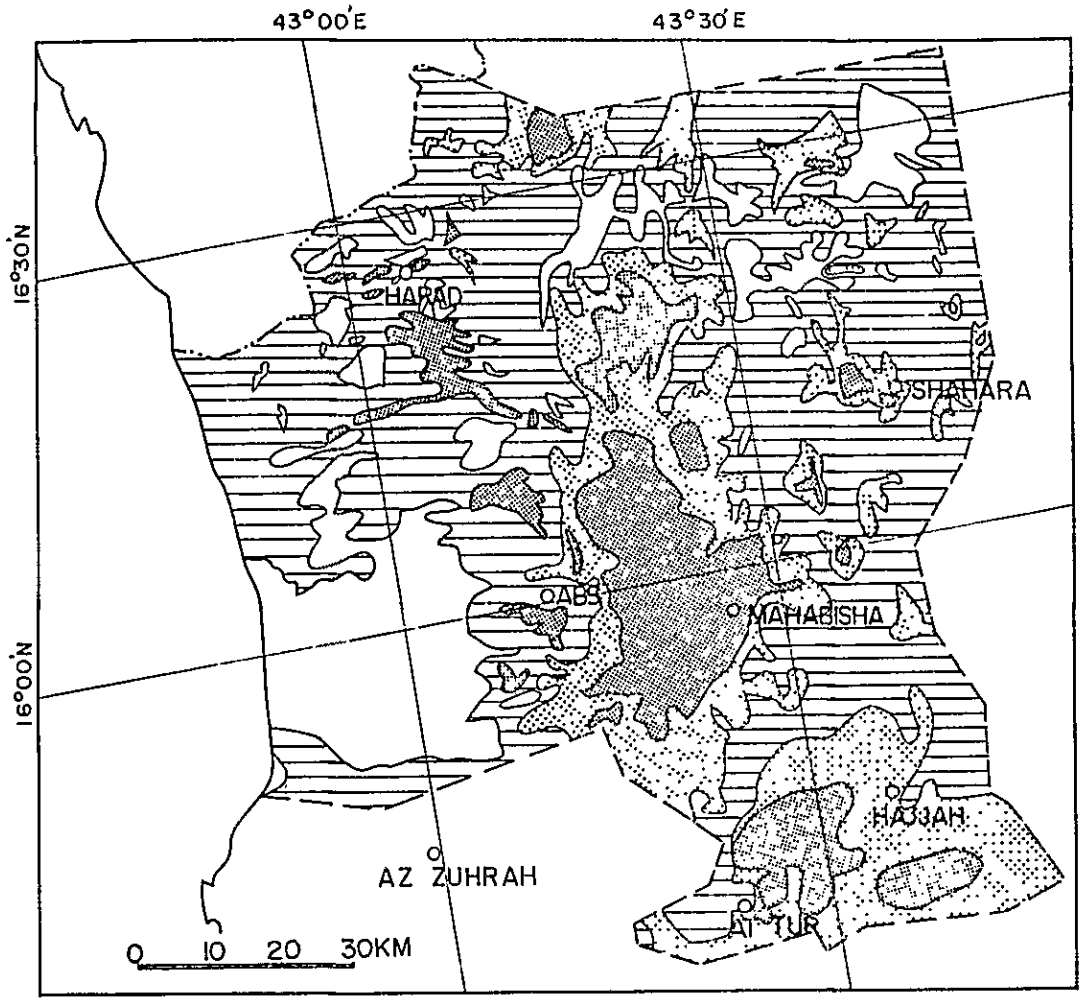
b. training of local staff

c. selection of demonstration sites,

d. management of pilot afforestation field (demonstration field),

e. forestry extension services,

f. coordination with on-going forestry projects for selection of suitable species and staff training.



Dense Vegetation Cover / Mainly Croplands

Scrub and Trees / Acacia and Eucalyptus Species

Sparse Scrub on Rocky Slopes Mainly Acacia Species / or Grassland with Scrub

Grassland with Sparse Scrub

Fig. 16.1 Vegetation Map

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XVII FISHERY DEVELOPMENT

1.	Present Situation	XVII-1
2.	Basic Concept for Fishery Development	XVII-2

XVII FISHERY DEVELOPMENT

(1) Present Situation

17.01 Most fishing operations are carried out within 10 - 15 km from the coast. In the Hajjah Province, the coast extends on the Red Sea over about 70 km. The coast is generally flat, with small sand spits oritented northwards. It is characterized by shallow waters with sand bars which makes navigation difficult. There is no natural shelter for fishing boats. The seasonal winds bring about strong surfs beating the coast. These make difficult the establishment and maintenance of fishery port.

17.02 In spite of these adverse condition, fishery is the mainstay for the people living along the coast. About 200 full-time fishermen contrive to land about 400 - 500 tons of fish annually. The catch includes mainly king mackerels, barracudas, sharks and various species of tunas. All this catch is taken within a narrow coastal band by traditional fishing methods.

17.03 Population density of the coastal area is generally low. Major town is Midi. The total population in and around Midi is about 9,000. They are partly engaged in farming and partly in fishing. There are no big towns except Midi along the coast. Some small settlements less than 100 inhabitants are observed along the coastal roads. They are living on income from traditional fishing.

17.04 Fishing craft is of canoe type. They are mostly planked boats built locally with imported woods for planking and local woods for the frames. The length of these canoes varies from 4 to 6 meters. The total number of canoes used in the Province is estimated around 50. The larger vessels called sambuks, vary in length from 8 m to 14 m with a 2 -

3.5 m beam. They are made of carefully assembled planking over naturally bent frames and are equipped with 15 - 25 PS class engines. There might be a total of 8 sambuks in the Province.

17.05 There are no landing facilities. The fishing vessels are run to the beach. No ice is carried on board and cold storage is inexistent. Because of this situation, the catch is easily deteriorated by the time it is sold. Most of the catch is sold in raw without any processing. The raw fish is transported to inland towns like Harad and Abs and is sold in street market. About one-third of the marketed fish is sold to merchants from Saudi Arabia. The prices fluctuate considerably according to the type of fish and the amount marketed. The local fish demand has not been exploited yet. Fishermen's net incomes are very low.

(2) Basic Concept for Fishery Development

17.06 The present stage of fishery in the Province is too primitive. Although fish resources are considerable, local fish demand is not big enough for further development. Investment on fishery development may not be feasible at present. The magnification of domestic fish demand will be pre-condition for further development.

17.07 Hodeidah and Kamran, famous fishery ports, are located near to the Hajjah Province. Several projects concerning industrial fishery are planned and some of them have been executed in these areas. Even if fish consumption increases in the Hajjah Province, most of fresh fish will come from these areas where all necessary facilities are already installed and a large quantity of fresh fish can be supplied to the markets. With this in view, the Hajjah coast would have only supplementary function for fresh fish

supply. A large scale fishery development will not be feasible under present economic circumstances.

17.08 It is expected that ongoing fishery projects will exploit the latent domestic demand for fish and gradual changes in fish consumption will extends over the country as well as the Hajjah province. There are good opportunities to develop the domestic markets, as farm interview conducted by the present team has indicated that fresh fish, if in good state of preservation, is readily accepted by the rural inhabitants and also that the demand increases when good quality of fish is offered at reasonable prices.

17.09 The fishery development along the Hajjah coast is not promising as stated before. Although drastic investment is not feasible, gradual improvement will have to be continued for better profits from fishery operations. Among others, small landing facilities, ice-making plant and cold storage will be essential needs for improvement of present fishery. Investment will have to be made gradually within the amounts the rural inhabitants can share. It is recommended that these investments be supported by credit facilities.

17.10 Considering all these, the fishery development is not of urgent nature. For effective use of limited fund, the fishery development will have to be delayed until other sectors will be started along right lines. In the master plan, any fishery development will not be taken into consideration.