

REPUBLIC OF YEMEN
MINISTRY OF AGRICULTURE AND IRRIGATION

IRRIGATION IMPROVEMENT PROJECT

(IDA Credit No. 3412 – YEM)

Main Technical Assistance Package for IIP

WORKING PAPER 13

Irrigation Management

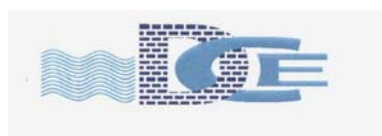
(First Mission Report)

February 2003

 **ARCADIS** EUROCONSULT

IN ASSOCIATION WITH





YEMENI ENGINEERING GROUP

Debriefing report Irrigation Management Specialist (Boissevain)

First input: January-February 2003-02-23

Introduction

This report summarizes the activities of the Irrigation Management Specialist (Mr. W. Boissevain) during his first input for the Yemen Irrigation Improvement Project (YIIP) from January 11 till February 25, 2003. At the end of the report a list of proposed tasks for the next input are given.

Work program

The tasks for the first mission of the Irrigation Management Specialist were determined in coordination with the TL as follows:

1. Assess the present O&M practices, activities and constraints in Wadi Tuban and Wadi Zabid.
2. Set-up a global field survey to inventory water management problems and issues in Wadi Tuban and Wadi Zabid (both at Wadi level and at the primary, secondary and field levels):
 - Spate flows (frequency and distribution)
 - Existing water rights and water distribution practices
 - Groundwater (availability of groundwater, number of wells)
 - Present maintenance activities by government and farmers
3. Start-up the estimation of O&M costs.
4. Define the approach and methodology for participatory designs.
5. Assist in the identification of logical units for organizing WUGs.

As this was his first input on the Project, the Irrigation Management Specialist also studied relevant background reports as well as the reports prepared in the first six months of Project implementation.

Based on the above tasks, the Irrigation Management Specialist prepared a work program covering the period 12 January till 24 February 2003 (see **Annex-1**). The implementation of the activities is shown in the itinerary (see **Annex-2**).

This mission of the Irrigation Management Specialist coincided with a mission of the Training Specialist. Therefore, the tasks were divided in a complementary way to enhance the efficiency and avoid duplication. The Training Specialist focused on starting-up the activities for organizing farmers, while the Irrigation Management Specialist worked more closely on irrigation issues with the local Water Management Specialists in Wadi Tuban and Wadi Zabid.

However, it would be advisable that following missions of the Irrigation Management Specialist and the Training Specialist till September 2003 are staggered in time, so that better continuity can be provided in guiding the process of establishing farmer organizations. Both the Training Specialist and the Irrigation Management Specialist have extensive experience in introducing participatory irrigation management (PIM) and in organizing farmers.

Inventory on water management issues

In order to obtain relevant information on water management, instructions and guidance was given to the Water Management Specialists in Wadi Tuban and Wadi Zabid. The specific data that will be collected includes the following:

Per diversion weir:

- Data on water rights, both formal and informal through observation, interviews with operation staff and study of existing reports.
- Data on operation rules for the head gates of the main canals.
- Data on who gives the formal/informal orders regarding gate operation.
- Data on spate frequency, magnitude and duration.
- Data on base flow volume, duration and utilization.
- Reported complaints and conflict of farmer interests.

Per irrigation scheme:

- What are the irrigation water sources?
- Describe the intake structure(s) on the Wadi?
- Availability (frequency, amount) of spate water?
- History of the irrigation scheme (age, rehabilitation, modernization)?
- Schematic layout of the irrigation system
- Inventory of canals and structures
- General functioning and condition of the canals and structures?
- Water distribution rules to the different parts of the scheme?
- Sanctions for non-adherence to water distribution rules?
- Areas irrigated by spate water, base flow and/or groundwater?
- Working areas and activities of Sheikh Al-Obar (Tuban) or Sheikh Al-Shareeg (Zabid)?
- Maintenance works carried out by government and by farmers themselves?
- Do farmers contribute financially towards maintenance works (if so, how much)?

Per tertiary unit (WUG):

- Crops and areas grown (cropping pattern)?
- Areas and crops irrigated with spate water, base flow and/or groundwater?
- Number and type of groundwater wells (hand-dug, borehole)?
- Depth of groundwater over the year and over the last 5 years?
- Problems with water availability or reliability?
- Problems concerning the functioning of irrigation facilities?
- Problems with neighbours over water rights?
- Sanctions for not respecting existing water rights?
- Occurrence (and frequency) of irrigation conflicts?
- Conflict resolution mechanisms?

It is anticipated that data collection will first start in the PIM pilot areas, and in the following months will expand to the other irrigation schemes in Wadi Tuban and Wadi Zabid. The Water Management Specialists will report their findings to the TA (Deputy) Team Leader. Verification and data analysis is expected to take place during next missions of the Irrigation Management Specialist.

Procedure for participatory design for canal rehabilitation works

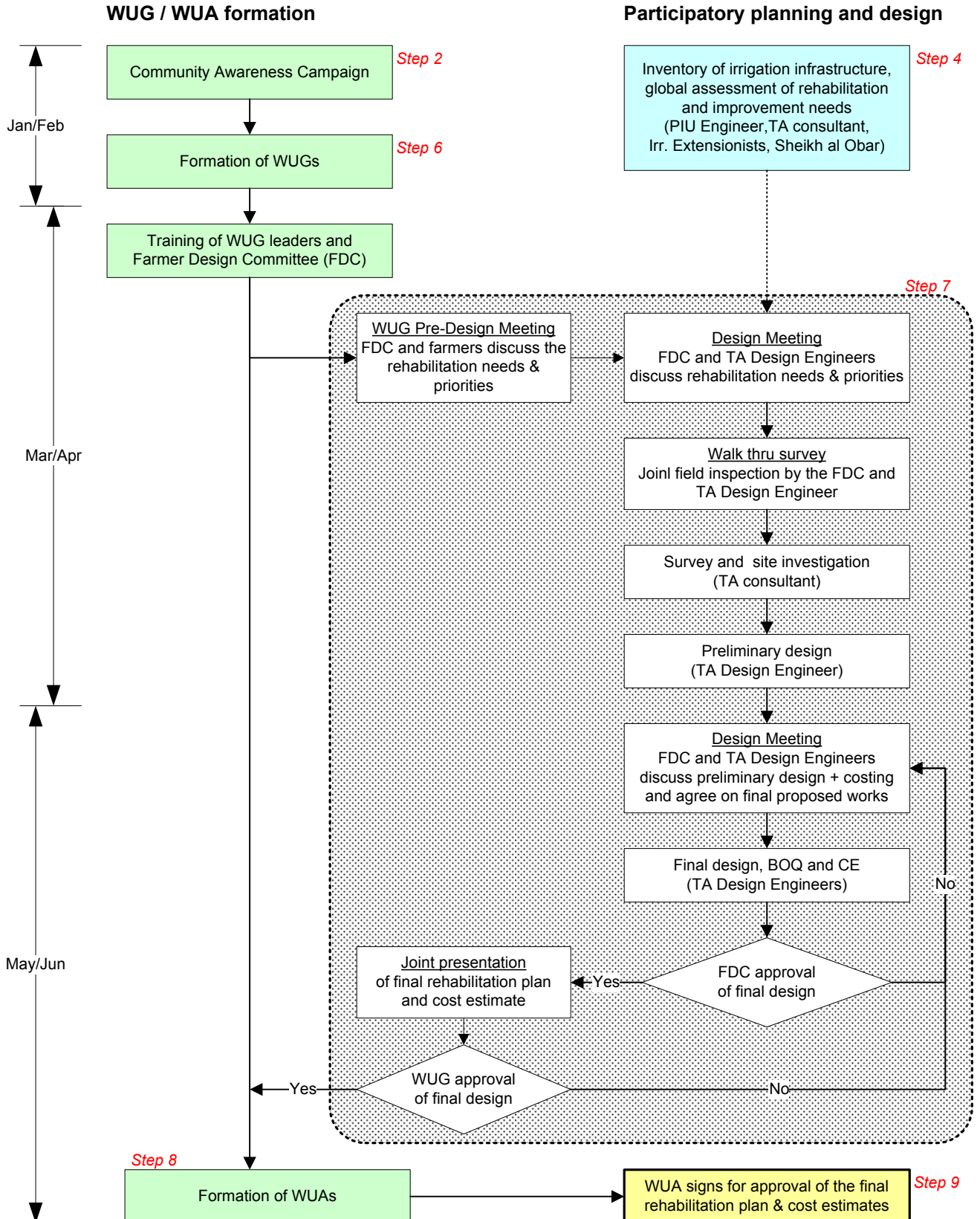
A flow chart with the proposed procedure for the participatory design of scheme rehabilitation works is shown in **Figure 1**.

The participatory design would start as soon as all WUGs in a particular irrigation scheme are formed. The leaders of the WUGs within the scheme would choose 5-6 representatives from among themselves who would form the 'Farmer Design Committee' (FDC). This committee will work with the Project's Design Engineer to ensure that the needs of the farmers are duly considered in the preparation of the design.

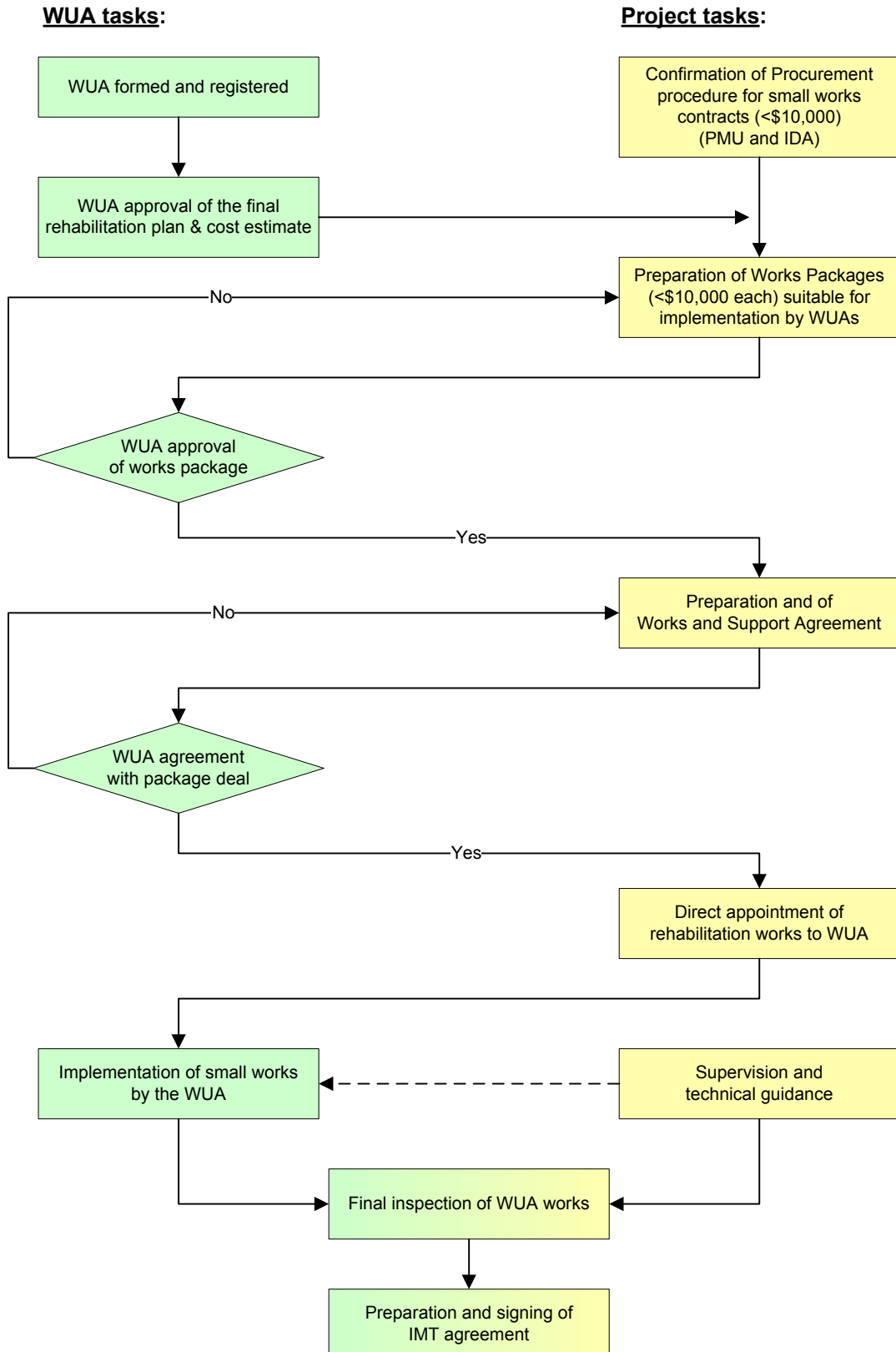
FIGURE 1

Participatory Planning & Design

Yemen IIP



Participatory Rehabilitation



The participatory design process would comprise the following steps:

1. The FDC meets with the WUGs to gather information about rehabilitation needs.
2. The FDC then meets with the TA Design Engineer to discuss the rehabilitation needs (scope of works) and priorities.
3. If necessary a field inspection is organized to verify the rehabilitation needs.
4. The TA Design Engineer then arranges the required field surveys and site investigation to collect data needed for preparing a preliminary design.
5. The TA Design Engineer prepares the preliminary design.
6. The preliminary design is discussed with the FDC.
7. The TA Design Engineer prepares the draft final design, bill of quantities and a cost estimate, incorporating FDC's comment on the preliminary design.
8. The draft final design is presented to the FDC for discussion and FDC approval.
9. When approved by the FDC, the FDC presents the draft final design and cost estimate to the different WUGs for discussion and WUGs' approval.
10. When approved by the WUGs, the final design and cost estimate needs formal approval by the WUA. This means that the farmers cannot formally approve the final design until the WUA is formed and registered. WUA approval is necessary, because the WUA (as legal entity) must sign the cost-sharing agreement.

This procedure enables parallel work on participatory planning and design and formation of the WUA, thus enabling the Project to avoid further delays in project implementation.

O&M cost estimation

Existing cost estimates for O&M are based on the operational costs of existing staff, earth moving machinery, etc. rather than on an inventory of canals and structures in the irrigation schemes. This method may be suitable for annual budgeting, but does not consider the actual O&M needs of the schemes, nor is it possible to distinguish between the maintenance needs of the different levels of the system (Wadi, primary, secondary canals).

To facilitate needs-based cost estimation for the various parts of an irrigation scheme, the scheme inventory must first be known. Therefore, forms were prepared for recording the dimensions of canals, embankments and structures (see **Annex-3**). The Water Management Specialists in Tuban and Zabid will collect these data. Unit costs and volumes of work (e.g. desiltation per m canal) will be estimated based on field observations and interviews during the next mission of the Irrigation Management Specialist. An estimate of the actual maintenance needs of the irrigation systems would provide useful information to farmers taking over O&M responsibility from the government.

Identification of logical units for WUGs

Schematic layout sketches were prepared of the irrigation schemes in Tuban by the PIM Extensionists under the supervision of the Water Management Specialist (see examples in **Annex-4**). The drawings are based on the identification farmers that depend for irrigation of their fields on a single tertiary outlet or ma'aqam. The principles were explained to the PIM Extensionist at the training workshop at the PIU office in Tuban on 25 January 2003. Results were partially checked by the Irrigation Management Specialist in February 2003, and will be completed by the Water Management Specialist.

The hand-drawn sketches will be converted into schematic drawings using Visio software. An example is shown in **Annex-5**. It is envisaged that the computer drawings will be completed during the next mission of the Irrigation Management Specialist.

The first results of this exercise indicate that a large number of tertiary outlets or ma'aqams serve only one farmer or just a small number of farmers. Lumping a number of such small units together would

not produce a meaningful WUG. Coherence among the farmers in such a WUG would be low, as they do not depend on each other for irrigation.

This raises the question of how farmers should best be organized. A possible solution may come from looking at the issue from the perspective of a (future) WUA. If the scheme is small in size and the number of farmers limited, the Assembly of the WUA may be made up of the individual members. However, for larger schemes the Assembly of the WUA would be more effective if it is comprised of delegates from the various parts of the scheme. The WUA should decide the desired number of delegates in the Assembly and then decide how to select the representative farmers who would make up the Assembly. A zoning system would be preferred, ensuring that farmers from the different parts of the scheme are represented in the WUA Assembly. WUGs represent one suitable method, but other grouping methods should also be considered. It is probably best to leave farmers room (flexibility) to make their own decision, and to suggest WUGs as one of the possible options.

Findings related to the introduction of PIM

A few unresolved issues were identified in the PIM Strategy Paper, in particular:

- Expected benefits for farmers to take over O&M responsibility
- Flexibility in the sequencing of activities (PIM steps)
- Lack of clarity on strategic options

Benefits for farmers to assume O&M responsibility

If farmers are to be motivated for taking over O&M responsibility of the irrigation schemes, the Project must be able to explain the costs and benefits for them in simple terms. Farmers know that maintaining the canals and structures requires significant effort and cost, which is so far provided by the government for free. Promises of rehabilitation/improvement works may be a partial incentive, but it is a one-time operation. It is equally important that farmers see long-term benefits for assuming responsibility for the O&M of the irrigation canals, or PIM will not be sustainable after the rehabilitation of the schemes.

Essential part in the farmers' decision to participate in PIM will be government's policy towards irrigation management. Government needs to decide between two options:

- a) To stop government O&M of primary, secondary and tertiary canals and structures, and encouraging farmers to organize themselves into WUGs and WUAs to fill the vacuum.
- b) To continue to do O&M of primary, secondary and tertiary canals and structures where farmers are not willing to organize themselves to take over this task. In this case the government should introduce irrigation service fees to recover the costs of O&M.

Flexibility in PIM procedures

The Strategy Paper for PIM was based on the assumption of the Project Appraisal Document, namely that the Project would start exclusively with setting-up the institutional arrangements, including:

- Completing the formation of WUGs and WUAs before the start of participatory planning and design of rehabilitation works, and
- Establishing the SWUF and Irrigation Council before the start of construction works

After discussions, more flexibility has been build in, making it possible to work in paralell on the formation of WUAs and preparing the participatory designs. Similarly, adjustment has been made to allow the implementation of construction works immediately after establishment of a WUA and the signing of the cost-sharing agreement.

Strategic options

Chapter 7 of the Strategy Paper for PIM lists a number of key issues that were discussed during the Orientation Workshop for PMU and PIU staff. Decisions on these issues should form the basis for the PIM strategy. However, a number of these issues were not yet decided, which leaves open ends. Therefore, part of the PIM strategy is still not clear. Specific issues, which need to be discussed and decided, are the following:

- Government policy on future O&M (consequences if farmers do not organize themselves for taking over irrigation O&M responsibility?).
- Method for collecting farmer contributions for rehabilitation works
- Criteria for acceptable funding levels for rehabilitation works
- Temporary procedure for WUA registration
- Meaningful role and responsibilities for the SWUF

To facilitate discussion and decision-making on these issues, the Irrigation Management Specialist has prepared an issue paper (Working Paper 12) in collaboration with the Training Specialist and the TA Team Leader. A workshop has been organized on 24 February 2003 to discuss the identified issues with the PMU and PIUs.

Proposed tasks during next mission(s)

Assuming that the next mission of the Irrigation Management Specialist will not completely overlap with input of the Training Specialist, the following list of tasks is proposed for the next input:

- Guidance and supervision to the process of organizing farmers in WUGs/WUAs
- Verification and data analysis of scheme water management issues
- Estimation of maintenance quantities and unit costs
- Finalizing schematic layout maps of irrigation schemes
- Updating the PIM Strategy Paper
- Preparation of a Working Paper on water management

Annex-1 Work Plan for Irrigation Management Specialist

Week	Planned Activities
11-17 Jan.	Travel Amsterdam-Sana'a-Aden Briefing with TL Introduction to PIU Tuban and field orientation Wadi Tuban Assist in the first Community Awareness Meetings
18-24 Jan.	Meeting with PMU-IIP in Sana'a Preparation of work plan and ToR Field visit to Wadi Tuban together with Training Specialist/Facilitator (Olaf Verheijen) <ul style="list-style-type: none"> - Assess present irrigation O&M practices and constraints - Set-up a global field survey to inventory water management issues/problems - Check progress of plotting tertiary canals and field numbers on map for Al-Arais - Assist in the identification of logical units for organizing WUGs
25-31 Jan.	Continuation of field visit to Wadi Tuban together with Training Specialist/Facilitator <ul style="list-style-type: none"> - Assist in trial-run of the water management field survey - Assess present irrigation O&M practices and constraints - Reporting on field visit Wadi Tuban
1-7 Feb.	Meeting with Water Institutions Specialist (Frank v. Steenbergen) Field visit to Wadi Zabid together with Training Specialist/Facilitator (Olaf Verheijen) <ul style="list-style-type: none"> - Assess present irrigation O&M practices and constraints - Set-up a global field survey to inventory water management issues/problems - Assist in the identification of logical units for organizing WUGs
8-14 Feb. <i>Eid-ul-Adha</i>	Continuation of field visit to Wadi Zabid <ul style="list-style-type: none"> - Assist in trial-run of the water management field survey - Assess present irrigation O&M practices and constraints - Reporting on field visit Wadi Zabid
15-21 Feb.	Estimation of O&M costs, based on review of available information (desk study) Define the approach and methodology for participatory designs Field visit to Wadi Tuban or Wadi Zabid <ul style="list-style-type: none"> - Review/evaluate the initial results of the global field survey
22-25 Feb.	Preparation of mission report Debriefing with PMU Director and TL Travel Sana'a-Amsterdam

Annex-2 Itinerary 1st mission to IIP Yemen (Boissevain)

Date	Location	Activity
Sat 11-01-2003		Travel Amsterdam-Sana'a
Sun 12-01-2003	Tuban	Travel Sana'a-Aden
Mon 13-01-2003	Tuban	Meeting with PIU staff Tuban + community awareness meeting
Tue 14-01-2003	Tuban	Field visit Al-Arais + community awareness meeting
Wed 15-01-2003	Sana'a	Travel Aden-Sana'a
Thu 16-01-2003	Sana'a	Team meeting (TL, DTL, IMS and TS)
Fri 17-01-2003	Sana'a	
Sat 18-01-2003	Sana'a	Meeting with PMU
Sun 19-01-2003	Sana'a	Preparation for field visit to Wadi Tuban
Mon 20-01-2003		Travel Sana'a-Aden
Tue 21-01-2003	Tuban	Discussion with Water Management Specialist
Wed 22-01-2003	Tuban	Preparation of work program for Water Management Specialist
Thu 23-01-2003	Tuban	Drafting of procedures for participatory design
Fri 24-01-2003	Tuban	
Sat 25-01-2003	Tuban	Training of PIM Extensionist
Sun 26-01-2003	Tuban	Checking of collected data Wadi Tuban
Mon 27-01-2003	Tuban	Preparation of irrigation inventory forms for O&M cost calculation
Tue 28-01-2003		Travel Aden-Sana'a
Wed 29-01-2003	Sana'a	Reporting
Thu 30-01-2003	Sana'a	Meeting with Water Institution Specialist
Fri 31-01-2003	Sana'a	
Sat 01-02-2003	Sana'a	Meeting with Water Institution Specialist
Sun 02-02-2003		Travel Sana'a-Zabid
Mon 03-02-2003	Zabid	Checking of collected data Wadi Zabid
Tue 04-02-2003	Zabid	Preparation of irrigation inventory forms
Wed 05-02-2003	Zabid	Field inspection priority works with PIU Director and PMU
Thu 06-02-2003		Travel Zabid-Sana'a
Fri 07-02-2003	Sana'a	
Sat 08-02-2003	Sana'a	Data processing Wadi Zabid
Sun 09-02-2003	Sana'a	Preparation of draft issues paper
Mon 10-02-2003	Sana'a	Team meeting (with TL, DTL, IMS, hydrologist, TS)
Tue 11-02-2003	Sana'a	Eid Al Adha
Wed 12-02-2003	Sana'a	Eid Al Adha
Thu 13-02-2003	Sana'a	Preparation of draft paper on water management
Fri 14-02-2003	Sana'a	Preparation of Issues Paper
Sat 15-02-2003	Sana'a	Preparation of Issues Paper
Sun 16-02-2003		Travel Sana'a-Aden
Mon 17-02-2003	Tuban	Checking of schematic layout maps Wadi Tuban
Tue 18-02-2003	Tuban	Checking of schematic layout maps Wadi Tuban
Wed 19-02-2003	Tuban	Checking of schematic layout maps Wadi Tuban
Thu 20-02-2003	Tuban	Reporting
Fri 21-02-2003	Zabid	Travel Aden to Zabid
Sat 22-02-2003	Zabid	Meeting with water management specialist
Sun 23-02-2003	Sana'a	Reporting
Mon 24-02-2003	Sana'a	Workshop on Issues Paper with PMU and PIUs
Tue 25-02-2003		Travel Sana'a-Amsterdam

Annex-3

Irrigation scheme O&M inventory

Irrigation inventory

Wadi TUBAN

Land & buildings

No.	Location	Type (land, building)	Area (m ²)	Used for?	Condition ¹⁾	Annual costs (YR)		
						Rent	Maintenance	Other ²⁾
1.								
2.								
3.								
4.								
5.								
6.								
7.								
8.								
9.								
10.								
11.								
12.								
13.								
14.								
15.								
16.								
17.								
18.								
19.								
20.								

¹⁾ Good, minor damages, major damages

²⁾ Taxes, electricity, phone etc.

Irrigation inventory

Wadi TUBAN

Office equipment Location: _____

No.	Type	Specifications	Age (year)	Condition ¹⁾	Purchase price (YR)	Annual costs (YR)	
						Repair	Other ²⁾
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							
9.							
10.							
11.							
12.							
13.							
14.							
15.							
16.							
17.							
18.							
19.							
20.							

¹⁾ Good, needs minor/major repair, not usable

²⁾ Toner, paper, etc.

Irrigation inventory

Wadi TUBAN

Transport equipment Location: _____

No.	Type	Specifications	Age (Year)	Condition ¹⁾	Used by?	Purchase price (YR)	Annual costs (YR)		
							Fuel and lubrication	Repair	Other ²⁾
1.									
2.									
3.									
4.									
5.									
6.									
7.									
8.									
9.									
10.									
11.									
12.									
13.									
14.									
15.									
16.									
17.									
18.									
19.									
20.									

¹⁾ Good, needs minor/major repair, not usable

²⁾ Annual tax, registration, etc.

Irrigation inventory

Wadi TUBAN

Machinery for O&M Location: _____

No.	Type	Specifications	Age (Year)	Condition ¹⁾	Used by?	Purchase price (YR)	Annual costs (YR)		
							Fuel and lubrication	Repair	Other ²⁾
1.	Buldozer								
2.									
3.									
4.									
5.									
6.									
7.									
8.									
9.									
10.									
11.									
12.									
13.									
14.									
15.									
16.									
17.									
18.									
19.									
20.									

¹⁾ Good, needs minor/major repair, not usable

²⁾ Annual tax, registration, etc.

Irrigation inventory

Wadi TUBAN

Permanent diversion weirs

No.	Location		Weir width (m)	Age	Gate Size		Condition ²⁾	Annual costs (YR)			
	Wadi	Scheme			Km ¹⁾	Left		Right	Earthworks	Weir	Gates
1.	Tuban	Al-Arais	9.0	200	1972						
2.		Ras Al Wadi	18.9	2 x 80	1958						
3.	Kabir	Faleg	27.1	130	1971						
4.		Fakih Lifiah	~30.0	136	1998						
5.		Mujahed	34.8	200	1971						
6.		Al-Waht	37.6	175	1962						
7.	Saghir	Beizag	25.7	90	1964						
8.		Al-Khadaram	31.6	95	1972						
9.		Bustan	35.2	75	1973						
10.		Bert Salem	38.2	-	?						
11.		Manasira	41.3	80	1988						
12.		Obar Riyadh	43.3	-	?						

¹⁾ Distance from Dukeim flow measuring station

²⁾ Good, minor damages, major damages

Irrigation inventory

Wadi TUBAN

Earthen diversion (Ogmas)

No.	Location			Annual earth movement (m ³)	Design flow (m ³ /s)	Command area (ha)	Condition ²⁾	Annual costs (YR)		
	Wadi	Scheme	L/R					Earthworks	Gates	
1.	Tuban	Dukeim	Right	4.9	4	10	Poor		-	
2.		Obar Shamia	Left	10.1	6	27	Reasonable	12,825	-	
3.		Geraib Al-Wadi	Right	13.3	4	16	Reasonable		-	
4.		Obar Shaka'a	Left	14.1	10	108	Reasonable	11,550	-	
5.		Obar Al-Sahloula	Left	17.0	6	31	Reasonable	8,630	-	
6.		Rod Al-Abab	Right	17.6	7	16	Reasonable	30,115	-	
7.	Kabir	Al-Mukharag	Right	21.5	16	30	Reasonable	37,200	-	
8.		Obar Al-Sadain	Right	25.1	17	71	Poor		-	
9.		Faleg Al-Nino	Left	-	12	172	Good	19,625	-	
10.		Obar Ba-Nagail	Left	-	8	38	Poor		-	
11.		Obar Al-Sada	Right	-	7	22	Reasonable		-	
12.		Ruwad	Right	-	6	20	Reasonable		-	
13.		Saghir	Lihsan	Right	22.1	11	231	Poor	17,770	-
14.			Ath Thalab	Left	28.5	15	280	Good	85,435	-
15.			Bert Salem	Right	38.2	15	250			-
16.			Obar Mansori	Left	38.7	10	60	Reasonable	32,145	-
17.	Oberali		Left	39.4	15	300	Reasonable	8,250	-	
18.	Al Bert		Right	39.8	8	80	Poor	10,950	-	
19.	Habeil		Right	39.8	10	100	Poor		-	
20.	Gadeid		Left	39.8	10	190	Reasonable	18,850	-	
21.	Mahagif		Right	40.2	10	60	Reasonable		-	
22.	Obar Heidara		Left	40.4	15	250	Reasonable		-	

¹⁾ Distance from Dukeim flow measuring station

²⁾ Good, minor damages, major damages

Irrigation inventory

Wadi TUBAN

Canals

No.	Canal		Q _{max} (m3/s)	Size (m)		Condition ' ₁	Desilting		Embankment		Annual costs (YR)	
	Scheme	Canal name		Length	Bed width		Depth (m)	Frequency	Volume (m3)	Quantity (m3/m)	Frequency	Volume (m3)
1	Al-Arais	Main canal	25	3,500	10							
2		Main canal	15									
3		Main canal	5									
4		P-2										
5		P-4										
6		P-6										
7		P-8										
8		P-10										
9		P-12										
10		P-14										
11		P-16										
12		P-18										
13		P-20										
14		P-22										
15		P-24										
16		P-26										
17		P-28										
		Total		37,370								
1	Obar Shamia	Main canal	6									
2												
3												
4												
5	Garaib Al Wadi	Main canal										
6												
7												
8	Obar Shaka'a	Main canal	10									
9												
10												
11	Obar Al Sahlula	Main canal	6									

Irrigation inventory

Wadi TUBAN

Canals

No.	Canal		Q _{max} (m3/s)	Size (m)		Condition ' ₁	Desilting		Embankment		Annual costs (YR)	
	Scheme	Canal name		Length	Bed width		Depth (m)	Frequency	Volume (m3)	Quantity (m3/m)	Frequency	Volume (m3)
12												
13												
14												
15	Rod Al Abab	Main canal	7									
16												
17												
18												
1	Ras Al-Wadi (right bank)	Main canal	25	10,000								
2		Main canal										
3		Main canal										
4		Main canal										
5		P-1	1	405								
6		P-2	3	1,850								
7		P-3	1	1,550								
8		P-4	7	6,280								
9		P-5	2	1,500								
10		P-6	10	7,420								
11		P-7	2	1,990								
12		P-8	8	3,900								
13		P-9	2	1,480								
14		P-10	6	4,480								
15		P-11	1	1,000								
16		P-12	3	1,200								
17		P-13	-	-								
18		P-14	2	1,330								
19		P-15	5	3,000								
		Total		47,385								

Irrigation inventory

Wadi TUBAN

Canals

No.	Canal			Size (m)		Condition ¹⁾	Desilting		Embankment		Annual costs (YR)		
	Scheme	Canal name	Q _{max} (m ³ /s)	Length	Bed width		Depth (m)	Frequency	Volume (m ³)	Quantity (m ³ /m)	Frequency	Volume (m ³)	Desilting
1	Ras Al-Wadi (center)	Main canal	10										
2													
3													
4													

¹⁾ Good, minor damages, major damages

Wadi KABIR

Irrigation inventory

Canals

No.	Scheme	Canal name	Q _{max} (m³/s)	Size (m) Length	Bed width	Condition	Depth (m)	Desilting Frequency	Volume (m³)	Quantity (m³/m)	Embankment Frequency	Volume (m³)	Annual costs (YR)	
													Disilting	Bank
1	Al Mukharag	Main canal	16											
2														
3														
4														
5														
6														
7														
8	Qhar Al Sadain	Main canal	17											
9														
10														
11														
12	Faleg Al Nino	Main canal	12	2,500										
13		Secondaries		4,500										
14														
15														
16														
17														
18	Faleg Ladh	Main canal	25	8,000										
19		Secondaries		31,000										
20														
21														
22														
23														
24														
25														
26	Qhar Ba-Nagail	Main canal	8											
27														
28														
29														
30	Qhar Al Sadra	Main canal	7											
31														
32														
33														
34	Ruwad	Main canal	6											
35														
36														
37														
38	Khabt	Main canal	5											
39														
40														
41														
42	Qhar Al Gladid	Main canal	8											
43														
44														
45														
46														
47														
48														
49														
50														
51														
52	Al Hidarim	Main canal												
53	(right)	Secondaries												
54														
55														
56														
57														
58														
59														
60														
61														
62														
63														
64														
65														
66														
67														
68														
69														
70														
71														
72														

) Good, minor damages, major damages

Irrigation inventory

Canals

No.	Scheme	Canal name	Qmax (m ³ /s)	Size (m) Length	Condition	Depth (m)	Destling Frequency	Volume (m ³)	Quantity (m ³ /m)	Embankment Frequency	Volume (m ³)	Annual costs (YR) Destling	Bank
1	Al-Azais	Main canal	25	9,000									
2		Secondaries		37,370									
3													
4													
5													
6													
7													
8	Obar Shake a	Main canal	10										
9													
10													
11													
12	Ras Al-Wadi	Main canal	25	10,000									
13	(right bank)	Secondaries		37,470									
14													
15													
16													
17													
18													
19													
20	Ras Al-Wadi	Main canal	10										
21	(center)												
22													
23													
24													
25	Lihan	Main canal	11										
26													
27													
28													
29	Beizag	Main canal		10,500									
30		Secondaries		23,680									
31													
32													
33													
34													
35													
36													
37	Al Thaleb	Main canal	15	4,500									
38													
39													
40													
41	Al Hadarem	Main canal	15										
42	(left)	Secondaries											
43													
44													
45													
46	Al Hadarem	Main canal											
47	(right)	Secondaries											
48													
49													
50													
51													
52													
53													
54													
55													
56													
57													
58													
59													
60													
61													
62													
63													
64													
65													
66													

} Good, minor damages, major damages

Irrigation inventory

Wadi TUBAN

Water Control Gates

(Sub)scheme: _____

No.	Location		Type	Dimensions	Condition	Annual costs (YR)	
	Canal	Km				Cleaning lubrication painting	Repair
1.			1)		2)		
2.							
3.							
4.							
5.							
6.							
7.							
8.							
9.							
10.							
11.							
12.							
13.							
14.							
15.							
16.							
17.							
18.							
19.							
20.							

1) Cross regulator, drop structure, intake structure, etc.

2) Good, minor damages, major damages

Irrigation staff inventory

Wadi TUBAN

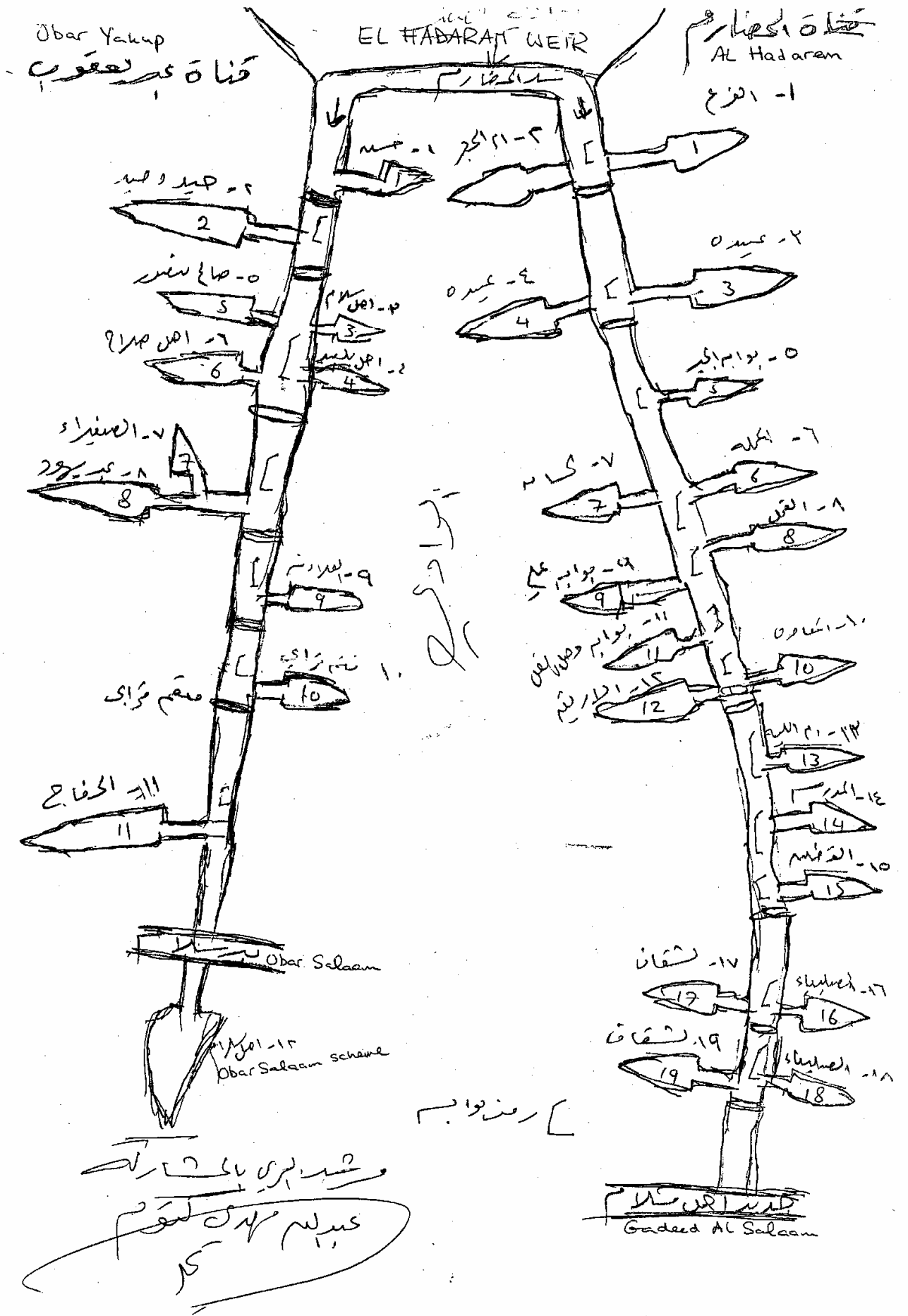
Irrigation Department

No.	Function	Location	Rank	Number	Unit cost (YR/month)	Annual costs (YR)		
						Salaries	Allowances	Other ¹⁾
	Operation							
1.	Director Lahaj	Office Lahaj		1				
2.	Director Tuban	Office Lahaj		1				
3.	Engineers	Office Lahaj		20				
4.	Weir keepers	Field		120				
5.	Gate operators	Field						
6.	Irrigation extensionists	Field		40				
7.	Workers	Office Lahaj		40				
8.								
9.								
10.	Maintenance							
11.	PIU Director							
12.								
13.								
14.								
15.								
16.								
17.								
18.								
19.								
20.								

¹⁾ Tax, health insurance, pension fund, etc.

Annex-4

Schematic layout sketches Wadi Tuban



Annex-5

Example of schematic layout (Al-Arais scheme)

Al-Arais irrigation scheme - schematic

Wadi TUBAN

Off-take	Area (ha)	Farmers
P-1	20.6	18
P-2	24.4	19
P-3	5.0	Military
P-3a	1.1	1
P-4	42.8	39
P-5	1.5	1
P-6	1.5	1
P-7	1.1	1
P-8	57.3	52
P-9	3.8	6
P-10	33.8	27
P-10-1	37.2	28
P-11	3.8	4
P-12	35.7	31
P-13	10.7	11
P-14	3.8	3
P-14-2	44.7	44
P-14-3	55.9	45
P-15	10.7	10
P-16	15.8	13
P-17	5.3	6
P-18	23.5	15
P-18-1	11.6	10
P-18-2	9.9	7
P-18-4	61.1	44
P-18-5	42.4	26
P-18-6	29.0	23
P-19	-	-
P-20	52.5	42
P-21	40.7	39
P-22	7.1	5
P-23	-	-
P-24-1	21.6	19
P-24-2	42.8	36
P-24-3	27.5	22
P-24-4	27.9	21
P-24-5	27.9	22
P-24-6	34.4	21
P-25-7	32.6	22
P-24-8	32.3	20
P-25	23.9	23
P-26	35.7	29
P-27	-	-
P-28	23.5	22
Total	996.5	800

