CHAPTER 5 COMPREHENSIVE WATER RESOURCES MANAGEMENT AND DEVELOPMENT

5.1 Development Plan in Palestine

5.1.1 Medium Term Development Plan

The Palestinian National Authority (PNA) intends to achieve: (i) economic growth and poverty alleviation; (ii) development of social and human resources; (iii) improvement of physical infrastructure network; and (iv) realization of good governance under the above mentioned situation as well as Israeli occupation. To achieve the target, PNA compiled a three years' development plan namely the "Medium Term Development Plan (MTDP) 2005-2007" and is finalizing the compilation of MTDP 2008-2010. MTDP 2005-2007 states overarching goals, national programs and program components (named as program areas) as follows:

Overarching Goals

1) To address poverty in a sustainable way, by providing a framework to shift PNA and donor assistance from emergency relief to job creation, recovery and social and economic development, particularly focusing to engage women in this process;
2) To improve the effectiveness of PNA governance by building institutional capacity and accelerating reform; and
3) To enhance PNA accountability by providing clear and gender-sensitive development objectives, which are monitored throughout the period of implementation.

▲

National Programs

1) Establishment of an independent democratic Palestinian state;
2) Establishment of a modern economy, working with human capital as the highest priority resource;
3) Provision of social care and protection for all citizens; and
4) Protection and development of natural resources, including land, water, the environment and energy sources.

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Program Areas		Required Budget (USD 1,000)
1)	Budget support	1,925,000
2)	Social safety net	490,000
3)	Ensure social protection	587,856
a) Food and cash aid, b) Job creation and emergency municipal support, c) Emergency education, health and social affair, d) Rehabilitation of ex-detainees, e) Educational and cultural human development, f) Health resources development, and g) Support vulnerable groups and improve targeting assistance		

Program Areas	Required Budget (USD 1,000)
4) Invest in physical capital	1,618,294
a) Education facilities, b) Health equipment, c) Transportation, d) Energy, e) Water, wastewater and solid waste, f) PNA and local public building, g) Antiques, cultural heritage and land administration, h) Integration of settlements, i) Industrial zone, j) Gaza sea port, k) Airport, l) Entry points, m) strategic and national infrastructure projects, n) Desalinization plants, o) Rehabilitation of public buildings, and p) Rehabilitation of roads	
5) Invest in institutions of good governance	301,280
a) PNA good governance, b) Institutional building, and c) Supply of materials and equipment	
6) Create an environment for private sector growth	709,664
a) Loans and grants, b) Internal industrial areas, c) Private sector development and capacity building, d) Rehabilitation of private building, e) Rehabilitation of private agriculture land, and f) Rehabilitation of non-building assets of private sector	

This Study result is expected to accelerate the activities categorized in *4) Invest in physical capital* of the program areas of MTDP.

5.1.2 National Water Policy and Strategy

Most development plans by sector are similar to and defined under MTDP, while some sector development plans or strategies have been additionally formulated.

PWA has a plan to finalize the National Water Policy and Strategy.

Present Condition of Water Resources		
1)	Water Resources to be Available in West Bank	982,000,000 m^3/year
	- Renewable fresh water of the mountainous aquifer:	650,000,000
	- Surface runoff in wadis:	70,000,000
	- Palestinian's annual to be shared from the Jordan River:	262,000,000
2)	Present Water Consumption in West Bank	120,000,000 m^3/year
	- Irrigation from ground water:	86,000,000
	- Domestic and industrial use from groundwater:	34,000,000
3)	Increment of Future Demand	
	- Target rates for domestic water demand:	Increase water supply up to 150 liter/capita/day
	- Projected potential agricultural demand:	200,000,000 m^3/year including Gaza Strip
	- Commercial and industrial water demand:	9% increase compared with present situation
4)	Other Important Issues	
	- Deterioration of groundwater quality	
	- Lack of awareness that water has a high social, environmental and economic value	
	- Not well-functioning Joint Water Committee (JWC)	
	- Not well-functioning PWA	

National Water Policy	
1)	Basic concept
	Palestine must develop and manage its water resources efficiently in order to meet present and future water needs in an environmentally sustainable way.
2)	Main Principles of Sustainable Water Resources Management
	- All sources of water to be public property
	- Compatible water supply for domestic, industrial and agricultural use
	- Polluter-pays principle
	- Coordination by national level; implementation by local level
	- Public participation
	- Integrated water quality and quantity management, including wastewater management
	- Protection and pollution control, etc.

National Water Policy
3) Key Elements of the Water Management Strategy
- Secure Palestinian water rights - Strengthen national policies and regulations - Build institutional capacity and development of human resources - Improve information services and assessment of water resources - Regulate and coordinate integrated water and wastewater investments and operation - Enforce water pollution control and production of water resources - Build public awareness and participation - Promote regional and international cooperation

5.1.3 Agricultural Medium Term Development Plan 2006-2008

MoA has drafted a sector-specific MTDP as the Agricultural Medium Term Development Plan 2006-2008 in December 2005. The outline of the Agricultural MTDP is summarized as follows:

Background
1) Sector Constraints (particular in rural areas)
- Food insecure - Lack of income opportunities - Lack of employment opportunities
2) Main Reasons for the Constraints
- Limitation of any types of movement; access to land resources, internal/international market and agricultural inputs caused by movement restrictions on people - Limitation of access to water for irrigation - Physical losses of damaged crop, destruction of agricultural infrastructures and bulldozing land
3) Advantages of Palestinian Agriculture
- Climate in winter are mild and favorable for agricultural activities - Technical knowledge regarding modern agricultural systems and produce - High potential and strong demand for food supply to Israel, Europe and some Gulf countries - Favorable trade conditions offered by EU - Strong network of community; NGOs, village councils, women's groups, associations and cooperatives - Motivated staff in directorates of agriculture - Relatively high level of education - Additional or underused water pockets available for further use

Agricultural Development Plan
1) Goal
Increasing income and job opportunities through increase of agricultural productions and enhancement of agricultural activities
2) Targeted Programs
- Improve rural livelihoods (food security, poverty alleviation, creation of rural employment and raising income) through maintaining and agricultural activities - Undergo institutional reform and capacity building - Develop natural resource - Support and provide technical assistance to farmers - Support development of marketing and agricultural trade - Preserve green areas and wildlife, etc.

3) Key Elements of the Water Management Strategy
- Secure Palestinian water rights - Strengthen national policies and regulations - Build institutional capacity and human resources development - Improve information services and assessment of water resources - Regulate and coordinate integrated water and wastewater investments and operation - Enforce water pollution control and production of water resources - Build public awareness and participation - Promote regional and international cooperation

5.1.4 Oslo II Accords

Under the Oslo II Accords on 28 September 1995, both Palestine and Israel recognized the need to protect the environment and utilize natural resources on a sustainable and environmentally sound basis, and to cooperate in sewage, solid waste and water issues. The agreement explicitly states that Israel recognizes Palestinian water rights, to be negotiated in the final talks without further elaboration on the nature of these rights, and the principles governing the rights and obligations of both parties. Article 12 expressly recognizes water as a natural resource.

Article 40, Annex III, Appendix 1 of the Accords deals with water allocation, referring to the immediate needs of the Palestinians. Water of 70-80 MCM/year has been allocated for the Palestinians, with 28.6 MCM/year from the eastern aquifer for immediate needs. The parties agreed to establish a Joint Water Committee (JWC) to serve as an institutional mechanism for the interim period, mainly to oversee the implementation of Article 40. The following table presents the recognized water allocation under the Oslo II Accords.

Table 5.1.1 Water Allocation Recognized under Oslo II Accords

Aquifer	Potential (MCM/yr)	Used by Israel (MCM /yr)	Used by Palestine (MCM /yr)	Remaining Quantities (MCM /yr)
Eastern	172	40	54	70~80
Western	362	340	22	-
Northeastern	145	103	42	-
TOTAL	679	483	118	70~80
% of share	100%	71.1%	17.4%	11.5%

Source: Document of Oslo II Accords, 28 September 1995

Future development of groundwater resources will be made under the Accords.

5.1.5 Organization of Water Resources Development in Palestine

(1) Palestinian Water Authority (PWA)

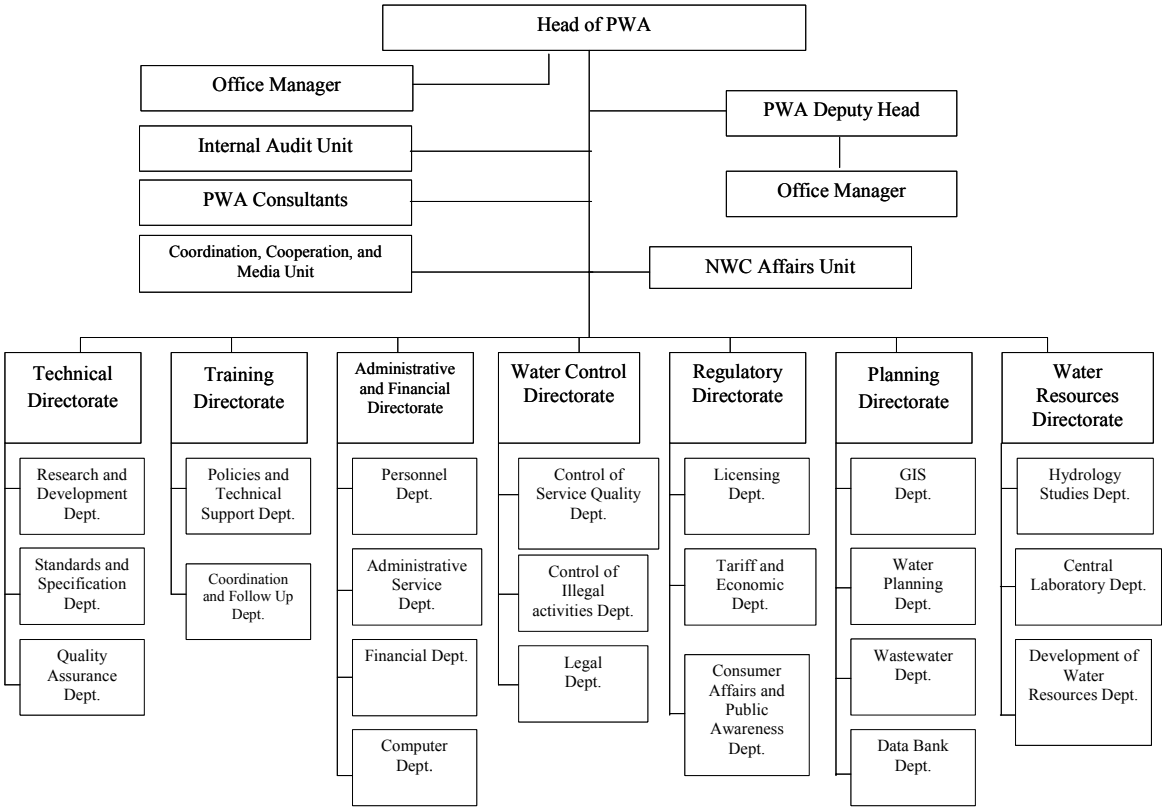
PWA is the responsible organization for water resources management. The present organizational chart of PWA is shown in Figure 5.1.1. In the figure, the Water Control Directorate has the responsibility for the regulation of water resources management.

However, the water sector in Palestine has been scattered and unclear on how to accommodate the various needs in water resources management. Thus, PWA decided to restructure the water sector separating the existing organizations to clarify their roles into decision making, regulatory and service delivery levels. The overall existing and future institutional framework of the water sector is described in Table 5.1.2.

Table 5.1.2 Existing and Future Institutional Framework of the Water Sector

	Current Framework	Future Framework	Level
1	Cabinet of Ministers	Cabinet of Ministers	Decision Making Level
2	National Water Council	National Water Council	
3	Palestinian Water Authority	Palestinian Water Authority	Regulatory Level
4	West Bank Water Department	Bulk Water Utilities	Service Delivery Level
5	Water & Wastewater Sub-utilities Municipal Water Department Village Councils Water Departments Joint Services Councils	Regional Water Utilities	
6	Well Owners and Farmers Spring Users	Water Users' Associations	

Source: "Institutional Reforms in the Water Sector and the Future Water Institutions in Palestine"



Source: PWA

Figure 5.1.1 Organizational Structure of PWA

(2) Ministry of Agriculture (MoA)

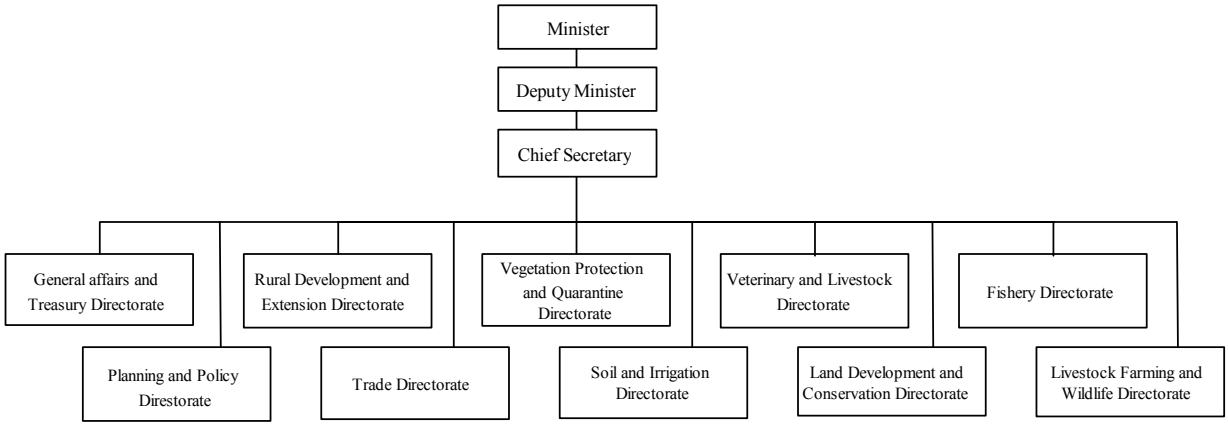
MoA has responsibilities on food security and poverty alleviation through sustainable agricultural development. Therefore, MoA is one of the key organizations and positioned to take into consideration the farmers' side in water resources management. The organizational chart of MoA is summarized in Figure 5.1.2.

In the figure, the Planning and Policy Directorate and the Soil and Irrigation Directorate are the main directorates related to water resources management projects.

The Planning and Policy Directorate is in charge of data and information management,

policy and plan preparation and evaluation, international project coordination, and supporting farmers' associations.

On the other hand, there are four departments under the Soil and Irrigation Directorate: i) Laboratory Department, ii) Water Department from the water supply side, iii) Irrigation Department from the water demand side, and iv) Soil Department.



Source: MoA

Figure 5.1.2 Organizational Structure of MoA

5.2 Water Resources in the Study Area

5.2.1 Present Water Resources

The major present water resource in the Study Area is groundwater, which includes springs and wells. Moreover, due to the shortage of water, Mekorot (Israel National Water Company) water is also purchased and utilized for agricultural and domestic consumption.

The present water resources in the four sub-regions are estimated on the basis of available data in 2005 as summarized in the following table.

Table 5.2.1 Present Water Resources in 2005

Sub-region	Spring (MCM/yr)	Well (MCM/yr)	Mekorot* (MCM/yr)	Total (MCM/yr)
Jericho/Al 'Auja	22.22	3.83	1.09	27.14
Lower Al Far'a	1.50	4.20	0.17	5.87
West Tubas	8.38	2.88	0.02	11.28
North Tubas	0.00	0.38	4.10	4.48
Total	**32.10**	**11.29**	**5.38**	**48.77**

Note: Excluding assumed losses.
**: purchse from Mekorot (Israel water company)*
Source: PWA database (2005)

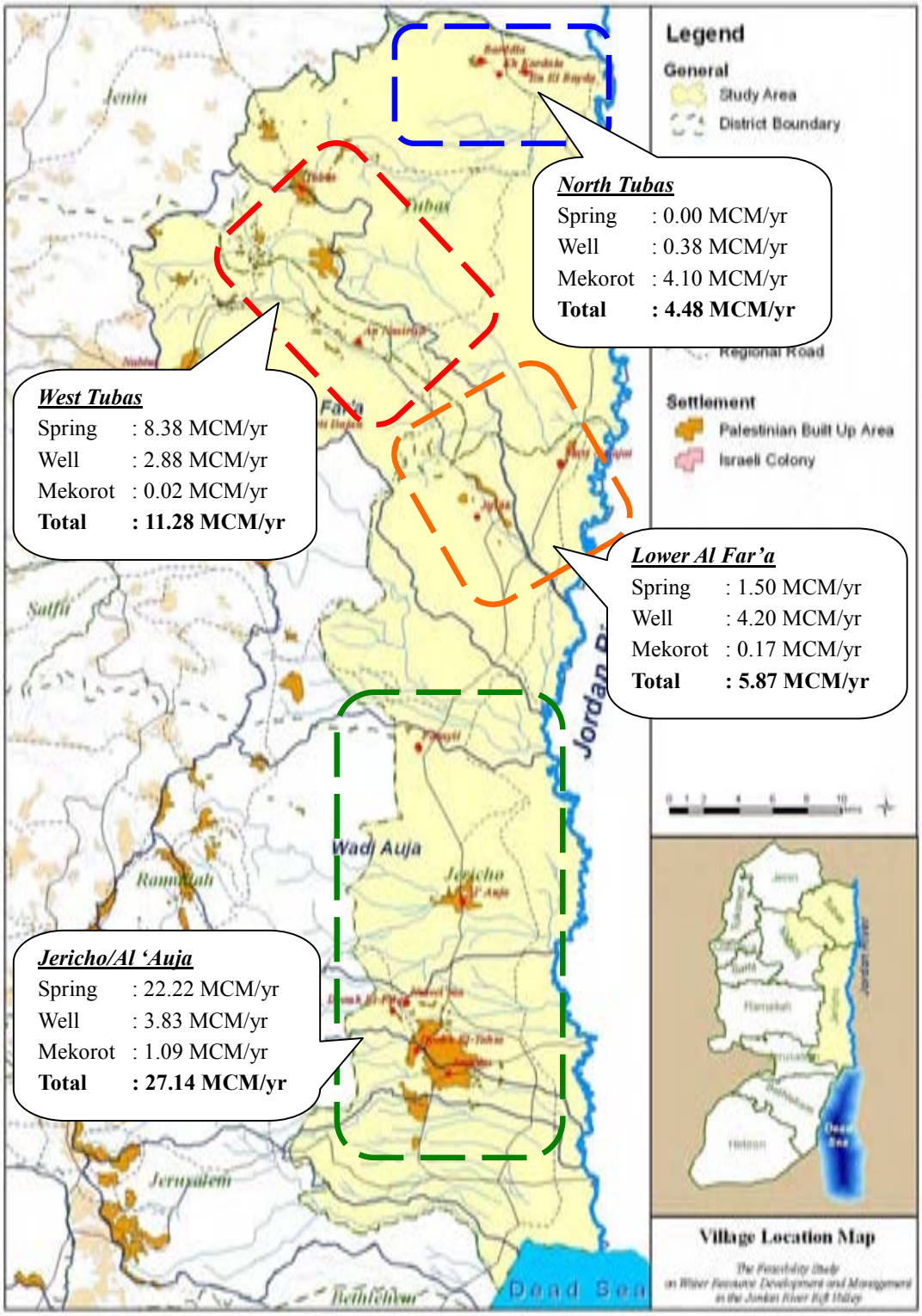


Figure 5.2.1 Present Water Resources in each Sub-region

5.2.2 Present Water Demand

(1) Agricultural Water Demand

Water resources in the Study Area are mainly allocated for agricultural use and domestic use (including industries). It is reported that agricultural use reaches about 95% of the water resources in the Study Area. By applying water efficiency of 75% (considered to be optimum water use under the present conditions), water demand for the agricultural use in the Study Area is estimated on the basis of the agricultural statistics 2004/2005, which is summarized in the following table.

Table 5.2.2 Present Agricultural Water Demand in 2004/2005

Sub-region	Irrigated Area (Dunum)	Agricultural Water Demand (MCM/yr)				
		Field Crop	Protected Plants	Open Field Vegetable	Fruit	Total
Jericho/Al 'Auja	26,079	0.88	0.60	12.66	15.03	29.17
Lower Al Far'a	20,289	2.05	0.61	9.76	2.84	15.26
West Tubas	5,837	0.53	0.66	0.82	2.13	4.14
North Tubas	8,772	0.17	2.93	2.72	0.23	6.05
Total	**60,977**	**3.63**	**4.80**	**25.96**	**20.23**	**54.62**

Source: Agricultural Statistics, PCBS, 2004/05, Water resources and Irrigated Agriculture, Applied Research Institute, March 1998, and JICA Study Team estimate

(2) Domestic Water Demand

Water demand for domestic, industrial, tourism and livestock uses, which is called the municipal and industrial (M&I) demand, is calculated on the basis of population and the target water supply level set by PWA as shown in the following table.

Table 5.2.3 Present Municipal and Industrial Water Demand in 2005

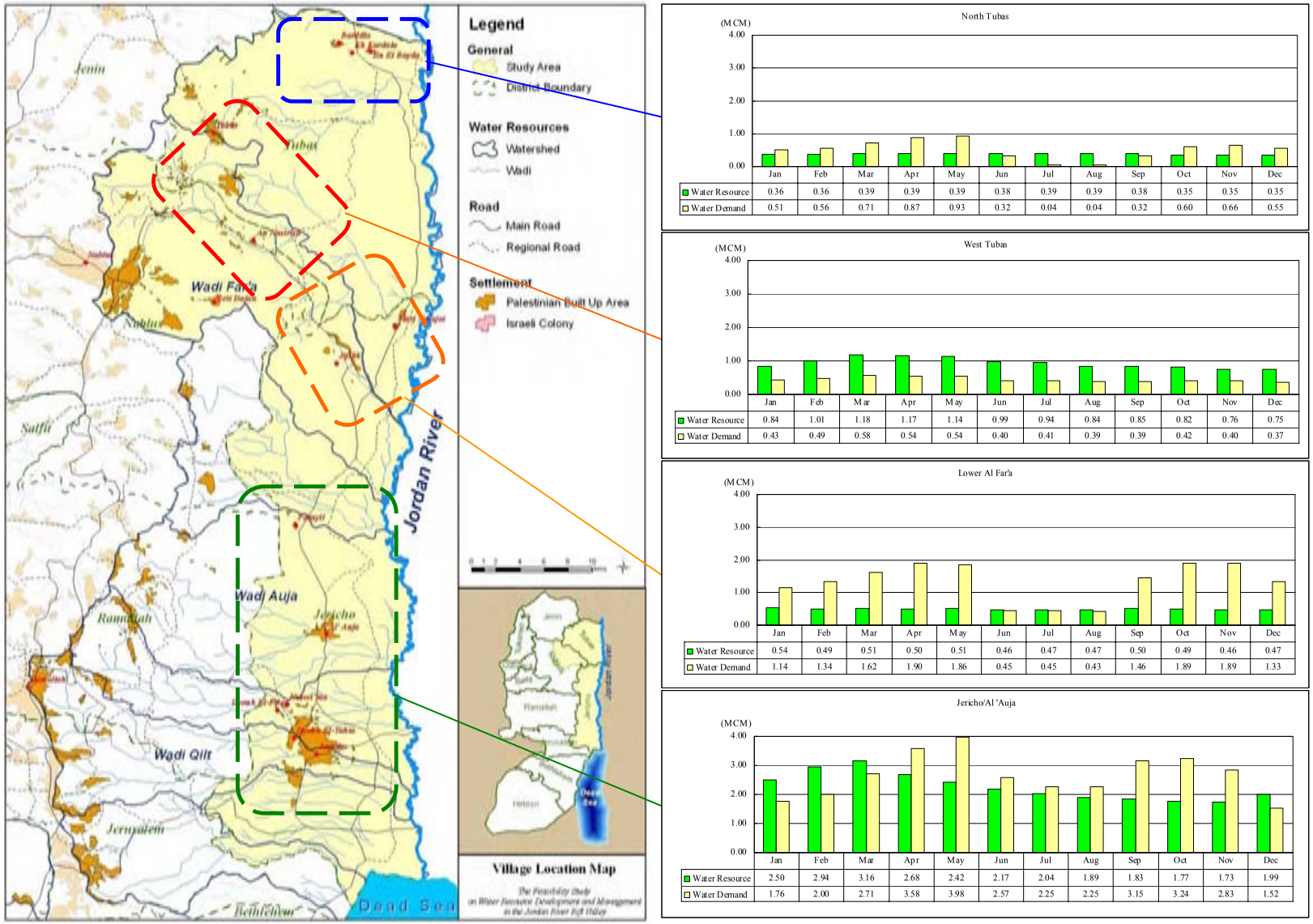
Sub-region	Population	Municipal & Industrial Demand (MCM/yr)					
		Dom.	Tour	Public	Livstck	Indst.	Total
			200 lpc	*3%*	*10%*	*15%*	
2005							
Jericho/Al ‘Auja	35,514	1.72	0.20	0.08	0.27	0.40	2.67
Lower Al Far’a	7,982	0.35	0.00	0.01	0.05	0.07	0.48
West Tubas	50,023	0.88	0.00	0.04	0.12	0.18	1.22
North Tubas	3,143	0.06	0.00	0.00	0.01	0.01	0.08
Others	711	0.01	0.00	0.00	0.00	0.00	0.02
Total	**97,373**	**3.02**	**0.20**	**0.13**	**0.45**	**0.66**	**4.47**

Note: - It is assumed that the number of tourists will be 400,000 in a year and each tourist will stay for 2.5 nights in only the Jericho/Al ‘Auja area.
- Public water demand is assumed to be 3% of M&I demand.
- Livestock water demand is assumed to be 10% of M&I demand.
- Industrial water demand is assumed to be 15% of M&I demand.
- Domestic water demand is assumed under the target water supply level set by PWA.

Source: JICA Study Team estimate

5.2.3 Present Water Balance

Based on the water resources and demands, the present water balance in each sub-region is illustrated in the following figure.



Source: JICA Study Team estimate

Figure 5.2.2 Present Water Balance in each Sub-region

(1) Jericho/Al ‘Auja sub-region (Greater Jericho area)

Water resources in this sub-region, particularly spring discharge, are relatively abundant, although water demands are also very high. The water demands have exceeded the water resources from April to November.

(2) Lower Al Far’a sub-region (Wadi Far’a and Al Jiftlik area)

The water resources in this sub-region are quite limited, but the water demand for agricultural use is high. Water resources are lacking for the water demands throughout the year.

(3) West Tubas sub-region

Water resources exceed the water demands throughout the year. Agricultural water demand in this area is relatively low, because rainfed agriculture is more widely practiced as compared to other sub-regions.

(4) North Tubas sub-region (Bardala/Kardala and Wadi Malih area)

Although the pumping potential from wells is relatively high as described in Section 4.3, the water demands in this area mainly rely on water supply from Mekorot. Most wells are not operated due to deterioration over the years.

The water balance characteristics of each sub-region in the Study Area are summarized in the following table.

Table 5.2.4 Characteristics of Sub-regions in the Study Area

Sub-region	Population	Water Resource (MCM/yr)	Water Resources	Water Demands
Jericho/ Al’ Auja	35,589	27.14	• Spring water is abundant. • Spring has a seasonal fluctuation. • Wells water is brackish. • Precipitation is very low.	• Growth rate of population is relatively high. • Agricultural water use is high. • Irrigated area is widely spread. • Rainfed agriculture is not practiced.
Lower Al Far’a	7,982	5.87	• Wells water is brackish. • There are wells, which are not operated. • Precipitation is very low.	• Irrigated area is widely spread. • Rainfed agriculture is not practiced.
West Tubas	50,659	11.28	• Spring water is abundant • There are some wells. • Precipitation is relatively high.	• Rainfed agriculture is practiced.
North Tubas	3,143	4.48	• Pumping potential from wells is relatively high. • There are wells which are not operated. • Water is supplied from Mekorot.	• All the area lies in Area C.

Source: JICA Study Team

5.2.4 New Water Resources in the Study Area

In the Study Area, two new water resources would be made available. They are:

(i) Floodwater in wadi basins; and
(ii) Recycled water from wastewater treatments plants in major cities/towns.

Floodwater in wadis in the Jordan River Rift Valley is considered the most probable new water resource in the future. PWA estimates that its development potential would reach 28.5 MCM on an annual average, which could be developed by means of conventional technologies. The stored floodwater could be recharged into the groundwater aquifer so that additional wells could be developed without additional extraction from the aquifer. It is also possible to have surface reservoirs with dams on wadis, although it would be dependent on the geological conditions at the potential sites of dams and reservoirs.

Water recycling from wastewater will be another water resource for irrigation purposes. Wastewater from major cities in the central highlands in the West Bank, such as Nablus, Ramallah, and East Jerusalem would flow down to the Jordan River basin. The availability of recycled water depends on the development of the sewerage network and treatment systems in such major cities.

5.2.5 Constraints on Water Resources Development and Management

The following constraints on the water resources development and management in the Study Area are pointed out:

(i) Limited Water Resource;
(ii) Inefficient Water Utilization due to Deteriorated Conveyance System;
(iii) Existence of Non-functioning Wells;
(iv) Ineffective Use of Storm Water Resource; and
(v) Political Issues to be settled for the water resources development and management (e.g. delay issue of permits from Israeli side).

5.2.6 Strategies for Water Resources Development and Management

Under these situations, the following development frames have been recommended for water resources development and management in the Study Area, which have been set in the Jericho Regional Development Study:

(i) The first priority should be accorded to domestic water supply in water allocation. The target supply level in 2020 is 150 liters/capita/day, which is equivalent to the WHO and PWA standards;

(ii) Promotion of water-saving agriculture should be the first step for water management, which could make it possible to allocate more water for domestic purposes;

(iii) Activities on reduction of water conveyance losses and rehabilitation of the existing water extraction facilities should be implemented as quickly as possible. At the same time, it is necessary to reform the water users committee to maintain the facilities and to manage water as a common asset of the Palestinian people; and

(iv) Practical water resource development, including floodwater capture along wadis and water recycling through development of sewerage networks will be programmed for mid-term implementation. Technical feasibility, however, should be assessed as quickly as possible to implement such projects.

The following measures are proposed for water resources development and management in the Study Area as the first step:

(i) Improvement of Spring Water Conveyance Systems;

(ii) Rehabilitation and Integrated Management of Agricultural Wells;

(iii) Development of Storm Water Harvesting; and

(iv) Formulation of Management System.

Responding to the present water balance in the Study Area, strategies are recommended for water resources development and management in each sub-region as follows:

Table 5.2.5 Strategies for Water Resources Development and Management of Sub-regions in the Study Area

Sub-region	Spring Canal Improvement	Well Rehabilitation	New Well Development	Storm Water Harvesting	Waste Water Reuse
Jericho/ Al 'Auja	*	***	***	**	*
Lower Al Far'a	*	***	***	**	***
West Tubas	*	**	**	**	*
North Tubas	***	*	**	***	**

*Note: *1st priority, **2nd priority, ***3rd priority*
Source: JICA Study Team

5.3 Future Potential of Water Resources in the Study Area

5.3.1 Future Potential of Water Resources

The future potential of water resources is estimated based on the concept of the above described sections and the previous study, namely the Jericho Regional Development Study in 2006.

(1) Improvement of Spring Water Conveyance System

It is planned that 30% of the water losses of spring water conveyance systems will be improved to 5%, and the volume of available water will increase as estimated below.

Table 5.3.1 Future Increased Volume through Improvement of the Spring Water Conveyance System

Sub-region	Discharge	Assumed Loss		Existing (2005)	Pilot Term 2007-2009 (3 years)	Short Term 2010-2012 (3 years)	Mid Term 2013-2015 (3 years)	Long Term (After 2016)
	(MCM/yr)	(%)	(MCM/yr)	(MCM/yr)	(MCM/yr)	(MCM/yr)	(MCM/yr)	(MCM/yr)
Jericho/Al 'Auja	31.74	30%	9.52	22.22	0	2.39	1.87	3.68
Lower Al Far'a	2.14	30%	0.64	1.50	0	0	0	0.54
West Tubas	11.97	30%	3.59	8.38	0	0	0	2.99
North Tubas	0	30%	0	0	0	0	0	0
Total	**45.85**		**13.75**	**32.10**	**0**	**2.39**	**1.87**	**7.21**
Accumulated Volume to be increased				**32.10**	**0**	**2.39**	**4.26**	**11.47**

Source: JICA Study Team estimate

(2) Rehabilitation of Existing Wells

Water volume to be made available by rehabilitation of existing wells is estimated as summarized in the following table.

Table 5.3.2 Future Increased Volume through Rehabilitation of Existing Wells

Sub-region	Pilot Term 2007-2009 (3 years)	Short Term 2010-2012 (3 years)	Mid Term 2013-2015 (3 years)	Long Term (After 2016)
	(MCM/yr)	(MCM/yr)	(MCM/yr)	(MCM/yr)
Jericho/Al 'Auja	0.08	0.82	0.33	1.24
Lower Al Far'a	0.39	1.76	0.77	2.32
West Tubas	-	0.19	1.59	-
North Tubas	-	0.11	0.65	-
Total	**0.47**	**2.88**	**3.34**	**3.56**
Accumulated Volume to be increased	**0.47**	**3.35**	**6.69**	**10.25**

Note: Excluding assumed loss of 5%.
Source: JICA Study Team estimate

(3) Development New Wells Already Approved by the JWC

The PWA has drilled a new well in Tammun town in Tubas. This new well is a new water source. It would produce 0.80 MCM/yr of water according to the analysis by the PWA. The available water volume will be 0.76 MCM/yr excluding the loss of 5 % in the short term.

(4) Storm Water Harvesting

The floodwater of wadis in the rainy season has the potential for a new water resource. However, required data, especially on the discharge of floodwater, is still limited. This data should be continuously collected throughout the long-term period. Therefore, the large scale of the storm water harvesting project will be implemented as a long term plan since accumulation of relevant data is still required for the preparation of the plan. The small-scale pilot projects for the storm water harvesting will be programmed during the short- and medium-term in order to verify the sustainability and effectiveness of the future plans.

(5) Water Recycling

The potential water volume to be made available by water recycling is estimated on the basis of the following assumptions:

- 80% of domestic water used will be collected in the areas in which piped collection systems will be introduced.
- 5% of domestic water used will be collected in areas where tanker collection systems will be introduced.
- 70% of collected wastewater will be treated and reused.

The total water volume to be made available by the recycling system is summarized in the following table.

Table 5.3.3 Future Volume to be Increased by Water Recycling System

Sub-region	Pilot Term 2007-2009 (3 years)	Short Term 2010-2012 (3 years)	Mid Term 2013-2015 (3 years)	Long Term (After 2016)
	(MCM/yr)	(MCM/yr)	(MCM/yr)	(MCM/yr)
Jericho/Al 'Auja	0.63	0.94	1.17	1.45
Lower Al Far'a	0.00	0.00	0.00	0.37
West Tubas	0.00	0.39	0.96	2.09
North Tubas	0.00	0.00	0.00	0.14
Other Governorates				8.45
Accumulated Volume to be increased	**0.63**	**1.33**	**2.13**	**12.50**

Note: Excluding assumed loss of 5%.
Source: PWA Database, JICA Study Team estimate

(6) Total Potential Water Volume in Future

The total potential water volume in the Study Area in the future is thus estimated as summarized in the following table.

Table 5.3.4 Future Potential Water Volume in the Study Area

Water Resource	Available Water Volume				
	Existing (2005)	Pilot Term 2007-2009 (3 years)	Short Term 2010-2012 (3 years)	Mid Term 2013-2015 (3 years)	Long Term (After 2016)
	(MCM/yr)	(MCM/yr)	(MCM/yr)	(MCM/yr)	(MCM/yr)
(1) Existing Water Resources					
· Existing Springs	32.10	32.10	32.10	32.10	32.10
· Existing Wells	11.29	11.29	11.29	11.29	11.29
· Mekorot *	5.38	5.38	5.38	5.38	5.38
Sub-total (1)	***48.77***	***48.77***	***48.77***	***48.77***	***48.77***
(2) Future Potential Water Resources					
· Spring Canal Improvement			2.39	4.26	11.47
· Well Rehabilitation		0.47	3.35	6.69	10.25
· New Well Development		0.76	0.76	0.76	0.76
· Storm Water Harvesting**			0.50	0.50	10.00
· Wastewater Reuse		0.63	1.33	2.13	12.50
Sub-total (2)		***1.86*** *(+1.86)*	***8.33*** *(+6.47)*	***14.34*** *(+6.00)*	***44.98*** *(+30.64)*

Water Resource	Available Water Volume				
	Existing (2005)	Pilot Term 2007-2009 (3 years)	Short Term 2010-2012 (3 years)	Mid Term 2013-2015 (3 years)	Long Term (After 2016)
	(MCM/yr)	(MCM/yr)	(MCM/yr)	(MCM/yr)	(MCM/yr)
(3) Palestinian Historical Water Rights***					
・ Fashkha Springs Group		20.00	30.00	40.00	70.00
・ Jordan River ****		-	-	250.00	250.00
Sub-total (3)		***20.00***	***30.00***	***290.00***	***320.00***
Grand-total (1)+(2) (excluding (3))	***48.77***	***50.63***	***57.10***	***63.11***	***93.75***

Source: PWA Database, JICA Study Team estimate
*Note: *: Management will be transferred to Palestinian institution depending on peace process*
***: Further studies on storm water harvesting are required after collecting sufficient data for analysis.*
****: Quantity of water volume should be estimated as a result of the peace process.*
*****: Based on Johnston Plan*

5.3.2 Future Water Balance

Since the highest priority for water allocation is given to domestic and industrial use, the water available for agriculture in the future will be the remaining water. In this context, water allocation for domestic, industrial, tourism and livestock uses is to be taken into account first. Water demands for these purposes are called the municipal and industrial (M&I) demand and calculated in the following table.

Table 5.3.5 Future Municipal and Industrial Water Demand

Sub-region	Population	Municipal & Industrial Demand (MCM/yr)					
		Dom.	Tour	Public	Livestock	Indst.	Total
			200lpc	3%	10%	15%	
Pilot Term (2007-2009)							
Jericho/Al 'Auja	39,910	2.01	0.20	0.09	0.31	0.46	3.07
Lower Al Far'a	8,964	0.42	0.00	0.02	0.06	0.09	0.58
West Tubas	56,171	1.54	0.00	0.06	0.21	0.32	2.14
North Tubas	3,531	0.10	0.00	0.00	0.01	0.02	0.13
Others	797	0.02	0.00	0.00	0.00	0.00	0.03
Total	109,373	4.09	0.20	0.17	0.59	0.89	5.95
Short Term (2010-2012)							
Jericho/Al 'Auja	43,144	2.22	0.20	0.10	0.34	0.50	3.36
Lower Al Far'a	9,690	0.47	0.00	0.02	0.07	0.10	0.66
West Tubas	60,722	2.11	0.00	0.09	0.29	0.44	2.92
North Tubas	3,817	0.13	0.00	0.01	0.02	0.03	0.18
Others	862	0.03	0.00	0.00	0.00	0.01	0.04
Total	118,235	4.96	0.20	0.22	0.72	1.08	7.16
Medium Term (2013-2015)							
Jericho/Al 'Auja	46,430	2.44	0.20	0.11	0.37	0.55	3.67
Lower Al Far'a	10,429	0.53	0.00	0.02	0.07	0.11	0.74
West Tubas	65,347	2.77	0.00	0.12	0.38	0.58	3.84
North Tubas	4,108	0.17	0.00	0.01	0.02	0.04	0.24
Others	927	0.04	0.00	0.00	0.01	0.01	0.06
Total	127,240	5.95	0.20	0.26	0.85	1.29	8.55

Note: - It is assumed that the number of tourists will be 400,000 in a year and each tourist will stay for 2.5 nights in only the Jericho/Al 'Auja area.
- Public water demand is assumed to be 3% of M&I demand.
- Livestock water demand is assumed to be 10% of M&I demand.
- Industrial water demand is assumed to be 15% of M&I demand.
- Domestic water demand is assumed under the target water supply level set by PWA

Based on the above estimate of the M&I water demand, water available for future agriculture is estimated as summarized in the following table and figure.

Table 5.3.6 Future M&I Water Demands and Water Available for Agriculture

Sub-region	Population	2005 Current Volume (MCM/yr)			Potential Resources (MCM/yr)	M&I Demand (MCM/yr)	Available for Agriculture (MCM/yr)
		Dom.	Agri.	Total			
Pilot Term: 2007-2009 (3 years)							
Jericho/Al 'Auja	39,910	2.67	29.17	31.84	27.85	3.07	24.78
Lower Al Far'a	8,964	0.48	15.26	15.74	6.26	0.58	5.68
West Tubas	56,171	1.22	4.14	5.36	12.04	2.14	9.90
North Tubas	3,531	0.08	6.05	6.13	4.48	0.13	4.32
Others	797	0.02	0.00	0.02		0.03	
Total	**109,373**	**4.47**	**54.62**	**59.09**	**50.63**	**5.95**	**44.68**
Short Term: 2010-2012 (3 years)							
Jericho/Al 'Auja	43,144	2.67	29.17	31.84	31.87	3.36	28.51
Lower Al Far'a	9,690	0.48	15.26	15.74	8.02	0.66	7.36
West Tubas	60,722	1.22	4.14	5.36	12.62	2.92	9.70
North Tubas	3,817	0.08	6.05	6.13	4.59	0.18	4.37
Others	862	0.02	0.00	0.02		0.04	
Total	**118,235**	**4.47**	**54.62**	**59.09**	**57.10**	**7.16**	**49.94**
Medium Term: 2012-2015 (3 years)							
Jericho/Al 'Auja	46,430	2.67	29.17	31.84	34.30	3.67	30.63
Lower Al Far'a	10,429	0.48	15.26	15.74	8.79	0.74	8.05
West Tubas	65,347	1.22	4.14	5.36	14.78	3.84	10.94
North Tubas	4,108	0.08	6.05	6.13	5.24	0.24	4.94
Others	927	0.02	0.00	0.02		0.06	
Total	**127,240**	**4.47**	**54.62**	**59.09**	**63.11**	**8.55**	**54.56**

Source: JICA Study Team estimate

CHAPTER 6 BASIC PLAN FOR WATER RESOURCES DEVELOPMENT AND MANAGEMENT

6.1 Baseline Survey and Inventory Survey

In order to grasp the present status of water resources development in the Study Area, the existing conditions of rural society and water resources were surveyed through the baseline and inventory surveys.

6.1.1 Baseline Survey

Questionnaires were prepared by the experts-in-charge in the Study Team and the JICA Technical Cooperation Project and were also examined by PWA and MoA. The questionnaires consist of following items:

(i) Family structure: member, age, sex, labor force;
(ii) Agriculture and water use: cultivated area, crop production, irrigation practice, water source, ownership of land and water, quality and quantity of water; and
(iii) Living standard level: income and expenditure.

(1) Sampling Size

Considering the expected sampling errors, 400 households were planned to be covered. The actual sampling size, however, was higher at 405 households in total, consisting of 207 households covered by the Study Team and 198 households by the JICA Technical Cooperation Project. Target villages and number of samples are shown in Table 6.1.1.

Table 6.1.1 Sample Distribution

Name of village/city	No. of samples
'Ein el Beida	29
Ad Duyuk	31
Al ‘Auja	32
Al Badhan	19
Al Jiftlik	34
An Nassariya	29
An Nwai’mah	23
Az Zubeidat	22
Bardala	41
Fasayil	12
Furush Beit Dajan	19
Jericho City	47
Kardala	14
Marj Na’ja	20
Marj al Ghazal	18
Ain Shbli	6
Aqrabania	3
Beit Hasan	6
Total	405

Source: Baseline survey by JICA Study Team and JICA Technical Cooperation Project

(2) Results of Questionnaire Survey

Basic information

Table 6.1.2 shows basic information of surveyed households. Average number of family members of the surveyed households is 8.1. The number of female members, 3.8 persons, is fewer than that of male members, 4.3 persons. On the average, 3.0 persons of the family members are involved in farming activity permanently, and 1.7 persons are only temporarily involved.

Table 6.1.2 Basic Information of Surveyed Households

		No.	Mean	Median	Minimum	Maximum	Standard Deviation
Family member		405	8.1	7.00	1	38	4.546
Male		405	4.3	4.00	0	25	2.650
Female		405	3.8	3.00	0	16	2.332
Age 15 and above		405	5.0	4.00	1	18	2.905
Age under 15		405	3.1	3.00	0	22	2.753
Male age 15 and above		405	2.7	2.00	0	10	1.795
Male age under 15		405	1.6	1.00	0	15	1.688
Female age 15 and above		405	2.3	2.00	0	10	1.534
Female age under 15		405	1.5	1.00	0	9	1.580
Number of family members involving in farm activity	Permanent	405	3.0	2.00	0	15	2.327
	Temporary	405	1.7	1.00	0	12	1.843

Source: Baseline survey by JICA Study Team and JICA Technical Cooperation Project

Land tenure

Table 6.1.3 shows the average ownership of agricultural land and land use. Average cultivated area per family is 48.5 dunum, of which, an average 17.1 dunum are owned by the family, and 31.4 dunum are rented from farm land owners. Total irrigated area is 38.6 dunum (80%), and rainfed cultivated land is 9.0 dunum (19%). With regard to irrigation practice, only 4% of cultivated area adopts greenhouse, while 75% is utilized for open-field irrigation. As shown in Figure 6.1.1, almost half of the families cultivate land areas ranging only between 10 dunum and 30 dunum, although the average cultivated area is 48.5 dunum.

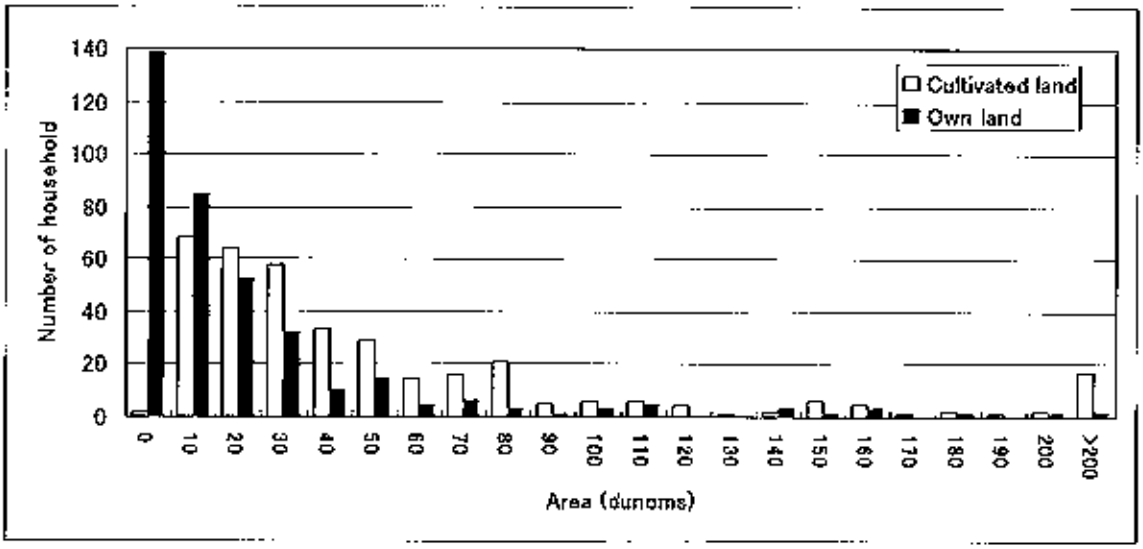
Table 6.1.3 Average Agricultural Land Area Used and Owned by the Family

Unit: dunum

	Mean	Median	Minimum	Maximum
Total cultivated area	48.5	25.0	0.0	500.0
Open field irrigation	36.7	22.0	0.0	500.0
Green house irrigation	1.9	0.0	0.0	32.0
Rainfed	9.0	0.0	0.0	300.0
Grazing land	0.9	0.0	0.0	150.0
Total own area	17.1	5.0	0.0	253.0
Open field irrigation	12.1	2.0	0.0	200.0
Green house irrigation	1.0	0.0	0.0	20.0

	Mean	Median	Minimum	Maximum
Rainfed	3.6	0.0	0.0	150.0
Grazing land	0.4	0.0	0.0	100.0

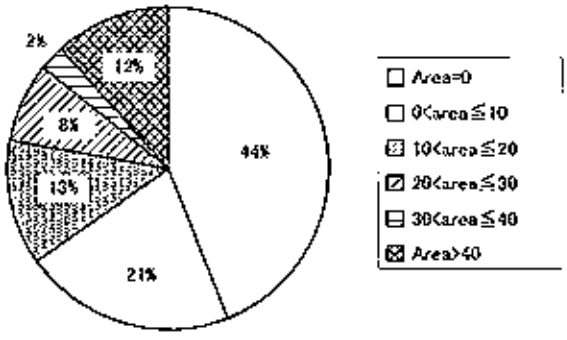
Source: Baseline survey by JICA Study Team and JICA Technical Cooperation Project



Source: Baseline survey by JICA Study Team and JICA Technical Cooperation Project
Valid response: 364 households

Figure 6.1.1 Cultivated Area and Own Land

Figure 6.1.2 shows the percentage of families based on the area of land owned by the household. 44% of families are landless. Families owning 10 dunum or below reach 21% of total. Overall, these two categories comprise 65% of the total landowner families.

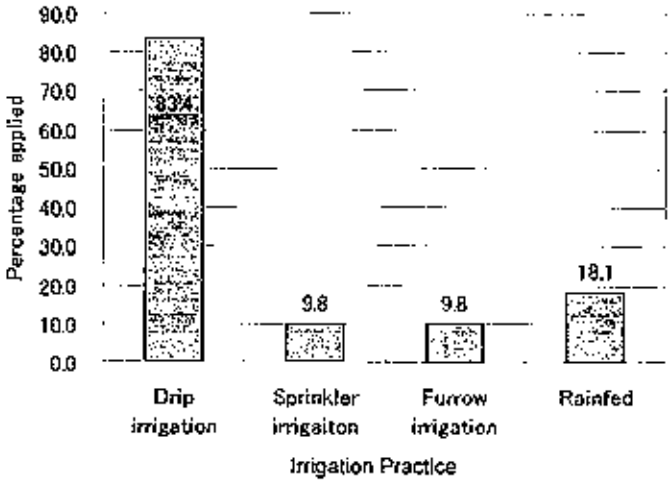


Source: Baseline survey by JICA Study Team and JICA Technical Cooperation Project

Figure 6.1.2 Land Owned by Family

Irrigation practice

Irrigation types practiced in the survey area are shown in Figure 6.1.3. Drip irrigation is widely used in 93.2% of the Study Area, because vegetable is the main crop in the surveyed area. Sprinkler and furrow irrigation are also partially practiced.

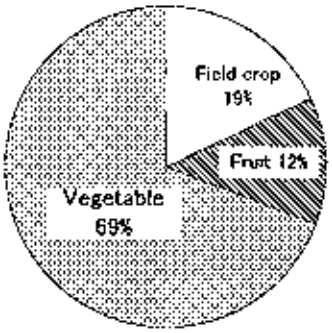


Source: Baseline survey by JICA Study Team and JICA Technical Cooperation Project

Figure 6.1 3 Irrigation Practice

Crops

On the average, 69% of the cultivated area is used for vegetable cultivation (Figure 6.1.4). Field crops and fruits are cultivated in 19% and 12% of the total cultivated area, respectively.



Source: Baseline survey by JICA Study Team and JICA Technical Cooperation Project

Figure 6.1.4 Cultivated Area by Crop

Table 6.1.4, 6.1.5 and 6.1.6 show cultivated area by type of crops. Wheat is cultivated largely as a field crop in 13.1% of the total cultivation area. Fruits, such as banana, citrus, dates, olives and grapes, are cultivated, although banana has largest cultivated area among fruits as 5.6% of total cultivated area. There are various vegetables cultivated in the surveyed area, with squash as the most popular, which is cultivated in 17.6% of the total cultivated area. Eggplant, tomato and corn, respectively, are the next largely cultivated vegetables.

Table 6.1.4 Average Cultivated Area per Family (Field Crops)

Unit: dunum

	Wheat	Barley	Green forage	Groundnut	Other grains
Mean	6.34	1.92	0.50	0.49	0.42
Median	0.00	0.00	0.00	0.00	0.00
Sum	2,560	776	204	102	87
Minimum	0	0	0	0	0
Maximum	180	120	100	100	65

Source: Baseline survey by JICA Study Team and JICA Technical Cooperation Project

Table 6.1.5 Average Cultivated Area per Family (Fruits)

Unit: dunum

	Citrus	Banana	Dates	Olive	Grape	Loquat	Other fruits
Mean	1.28	2.46	1.00	0.71	0.36	0.00	0.10
Median	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sum	516	994	403	288	145	0	42
Minimum	0	0	0	0	0	0	0
Maximum	100	120	175	60	40	0	15

Source: Baseline survey by JICA Study Team and JICA Technical Cooperation Project

Table 6.1.6 Average Cultivated Area per Family (Vegetables)

Unit: dunum

	Squash	Tomato	Watermelon	Green bean	Eggplant	Chili pepper	Sweet melon	Cucumber
Mean	8.70	3.73	0.15	1.09	4.29	1.18	0.28	2.68
Median	5.00	2.00	0.00	0.00	3.00	0.00	0.00	0.00
Sum	3,514	1,510	32	440	1,737	480	57	1,084
Minimum	0	0	0	0	0	0	0	0
Maximum	80	28	8	30	60	25	8	100

	Pumpkin	Sweet pepper	Yellow bean	Potato	Cauliflo wer	Corn	Jew's mallow	Dry onion
Mean	0.15	0.58	0.59	1.21	1.49	3.52	1.14	1.08
Median	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sum	61	234	240	487	605	1,426	463	394
Minimum	0	0	0	0	0	0	0	0
Maximum	10	20	20	100	60	100	28	70

	Cabbage	Green onion	Carrot	Spinach	Snake cucumber	Cowpea	Onion set	Other vegetables
Mean	0.47	0.10	0.06	0.16	1.10	0.13	0.46	0.05
Median	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sum	173	22	12	33	227	52	96	11
Minimum	0	0	0	0	0	0	0	0
Maximum	12	10	10	6	20	5	60	5

Source: Baseline survey by JICA Study Team and JICA Technical Cooperation Project

Livestock

56% of 207 surveyed families raise livestock (Table 6.1.7). Families raising goat/sheep account for 37.7% and 18.4% for chicken. On average, families have 26 heads of goats/sheep and 27 chickens, respectively. 12 families (5.8%) raise cattle with an average 11 heads. A small number of other livestock, such as donkey, horse, and camel, are also raised.

Table 6.1.7 Livestock Owned by Family

	Cattle	Goat/sheep	Donkey	Horse	Camel	Chicken	None
Number of family	12	78	10	7	3	38	116
(percentage)	5.8%	37.7%	4.8%	3.4%	1.4%	18.4%	56.0%
Total heads	55	2,066	13	9	3	1,020	-
Average heads per family	11	26	1	1	1	27	-

Source: Baseline survey by JICA Study Team

Agricultural facility and equipment

About 50% of the farm households own wheel tractor (Table 6.1.8). Only 2.0% of the farmers have a harvester. Considering that vegetables and fruits are the dominant crops in the surveyed area, this is understandable since it is difficult to harvest by machinery. The ownership ratio for a storage facility is quite low at 9.2%. This means that the farmers have to sell their produce as soon as these are harvested.

Table 6.1.8 Percentage of Respondents Owning Agricultural Equipment and Facilities

Equipment	Wheel tractor	Manual sprayer	Motor sprayer	Irrigation pump	Trailer	Harvester	Storage
No. of HH	206	167	302	81	135	8	37
Percentage	51.0%	41.3%	74.8%	20.0%	33.4%	2.0%	9.2%

Source: Baseline survey by JICA Study Team

Income and expenditure

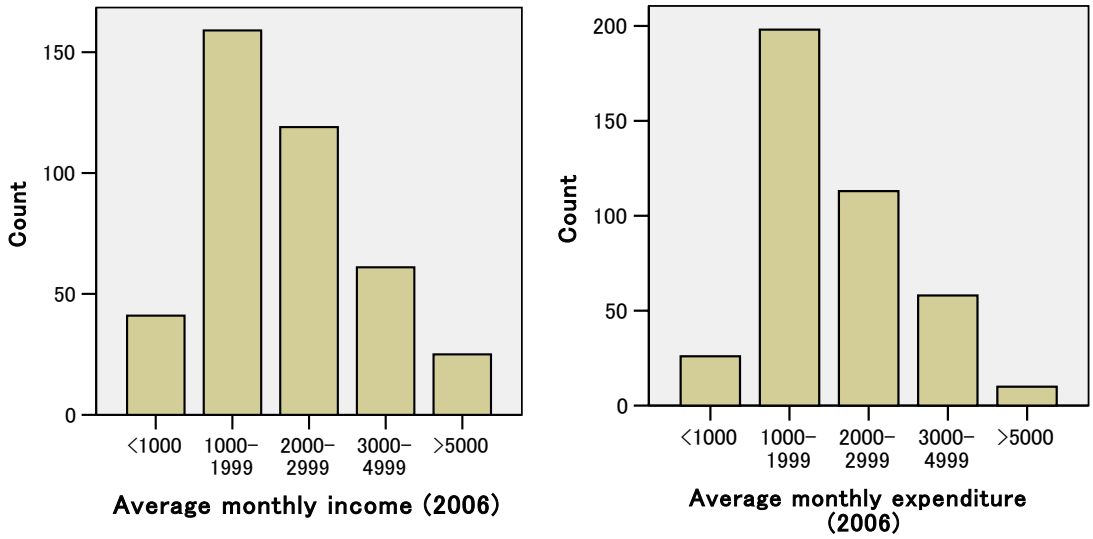
Table 6.1.9 shows the income source and dependence of the families. About 92% of total surveyed families mainly depend on crop and livestock sales. Therefore, the ratio for full-time farm household is very high in the surveyed area.

Table 6.1.9 Income Source and Dependence

Income Source	Main	Subsidiary	Minor	None
Crop sales (including by-products)	88.9%	6.3%	4.3%	0.5%
Livestock sales (including by-products)	2.9%	13.0%	18.8%	65.2%
Salaries/wages	6.8%	0.5%	0.5%	92.3%
Commodity sales	0.5%	3.9%	3.9%	91.8%
Business/Merchandise	0.5%	0.5%	0%	99.0%
Leasing land	0.5%	1.0%	0%	98.6%
Remittance from family members/relatives	0.5%	0%	0%	99.5%

Source: Baseline survey by JICA Study Team

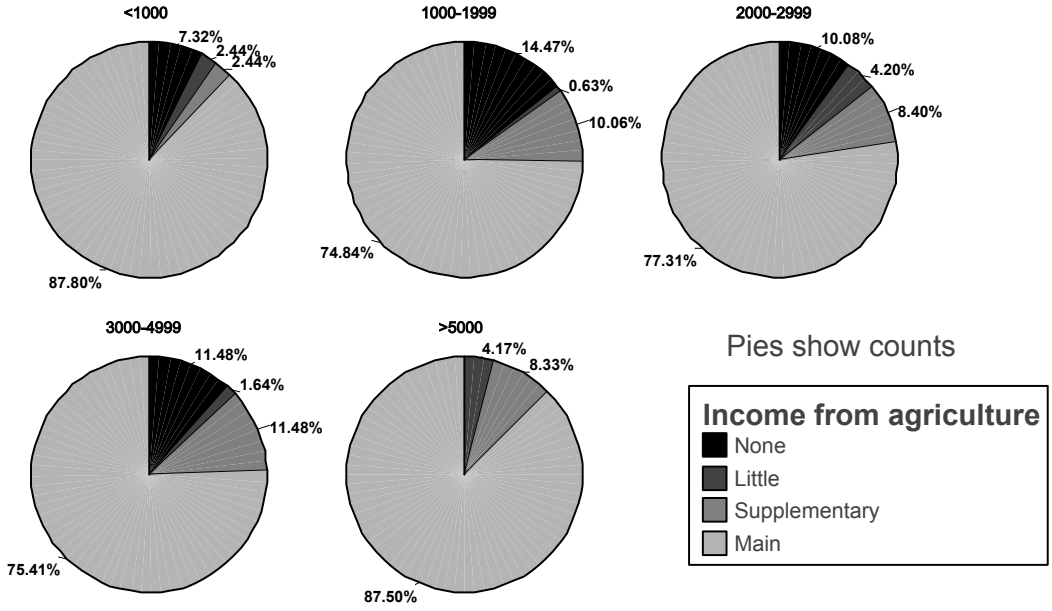
Figure 6.1.5 shows the distribution of monthly income and expenditure at the household level in 2006. Both income and expenditure are concentrated in the range between 1,000 NIS and 3,000 NIS.



Source: Baseline survey by JICA Study Team

Figure 6.1.5 Average Monthly Income and Expenditure (2006)

Dependence on agriculture as income source is shown in Figure 6.1.6. For all the income levels, agriculture is the main income source.

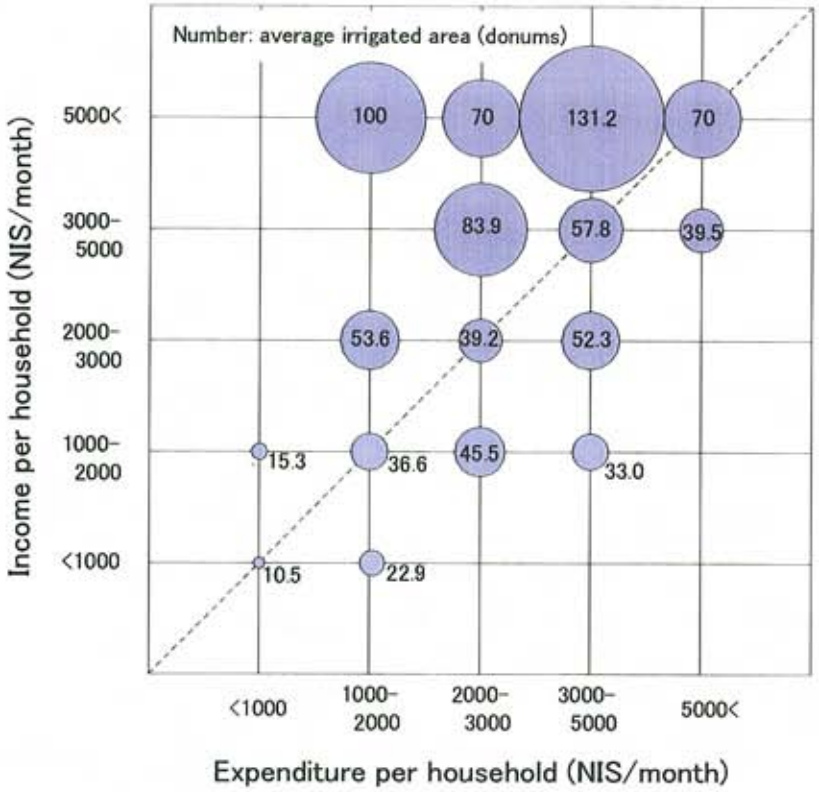


Numbers above pie chart are average monthly income in NIS.

Source: Baseline survey by JICA Study Team

Figure 6.1.6 Degree of Income Dependence on Agriculture by Income Level

The relationship between income and expenditure levels and the irrigated area is shown in Figure 6.1.7. Farmers who have larger irrigated areas tend to earn higher income. It is observed that the expenditures of farmers who have more than 70 dunum of irrigated area do not exceed their income.



Source: Baseline survey by JICA Study Team

Figure 6.1.7 Distribution of Income and Expenditure of Household with Irrigated Area

Living conditions

95.2% of families answered "worse" or "very worse" on living condition in last 5 years. However, with regard to their present living condition, 61.7% of families responded "average" or "more than average". This indicates that although their income level has decreased and life has become more difficult in the last 5 years, some families still think that they are within the average living condition.

Table 6.1.10 Evaluation of Monthly Income in Last 5 years

Decrease very much, and life is very much harder than before	Decreased, and life is getting worse than before	Almost the same, nothing changed
58.50%	36.70%	4.80%

Source: Baseline survey by JICA Study Team

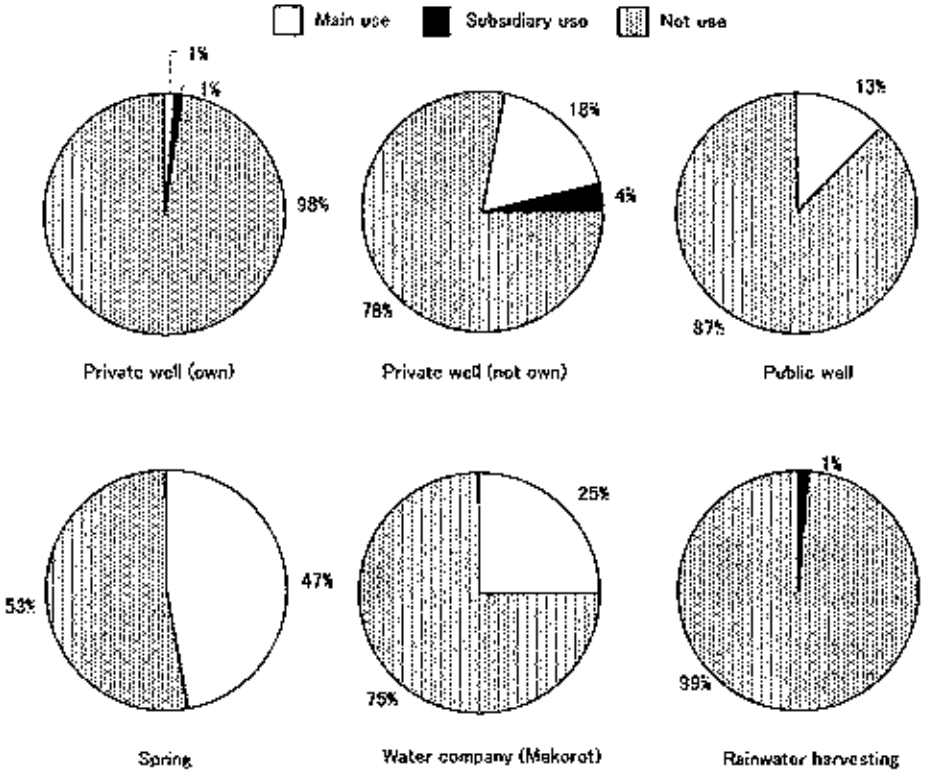
Table 6.1.11 Self Evaluation of Living Standard

Better than average	Average	Less than average
7.30%	54.40%	38.30%

Source: Baseline survey by JICA Study Team

Water source for agriculture

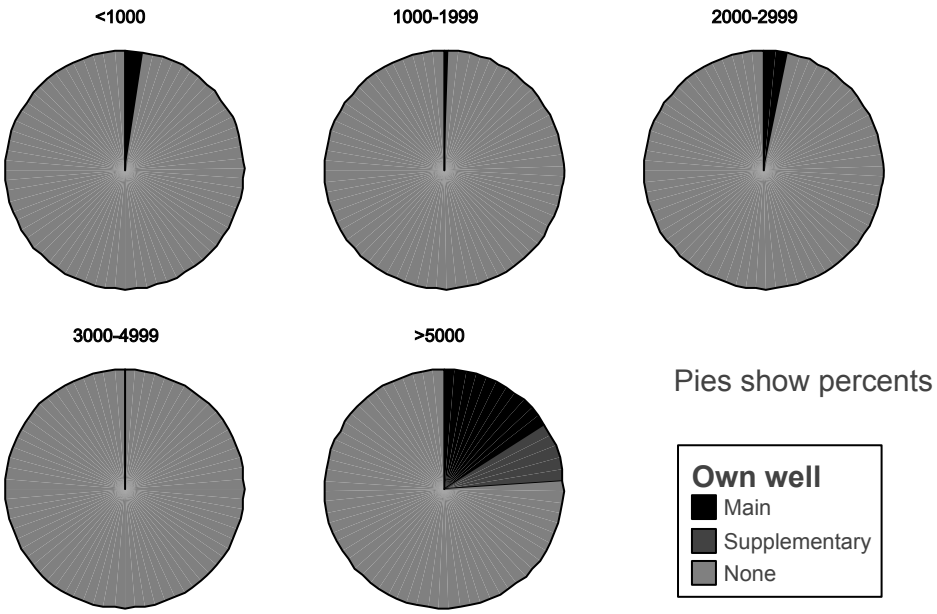
Figure 6.1.8 shows the main water sources for agriculture in the surveyed area. It is observed that farmers rely on more than one water sources. Nearly half of the farmers use spring water as main water source for agriculture. Farmers who use their own wells are only 1%, while 31% rely on other wells, such as public wells and private wells (not owned). Besides these sources, 25% of farmers are dependent on water supply from Mekorot. Rainwater is hardly utilized for agriculture use.



Source: Baseline survey by JICA Study Team

Figure 6.1.8 Main Water Sources for Agriculture

Ownership of wells by income level group is shown in Figure 6.1.9. About a quarter of the farmers in the highest income level (more than 5,000 NIS/month) use their agriculture wells as main or supplemental water source, while only a few well owners in the other income level groups use their wells.

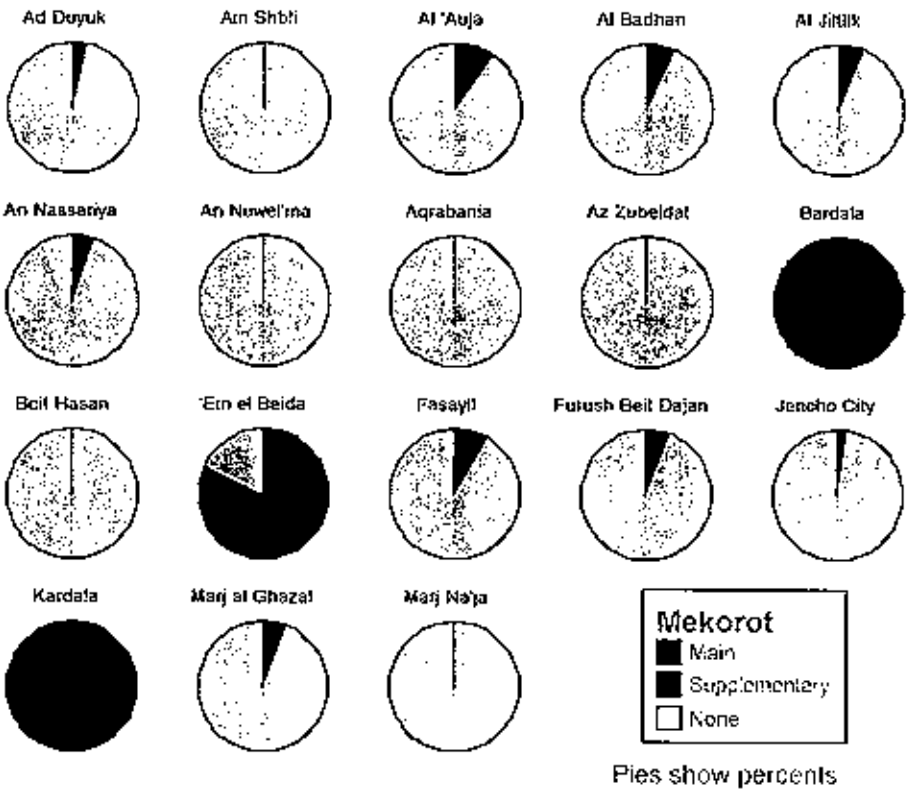


Numbers above pie chart are average monthly income in NIS.

Source: Baseline survey by JICA Study Team

Figure 6.1.9 Usage of Own Well for Agriculture by Income Level

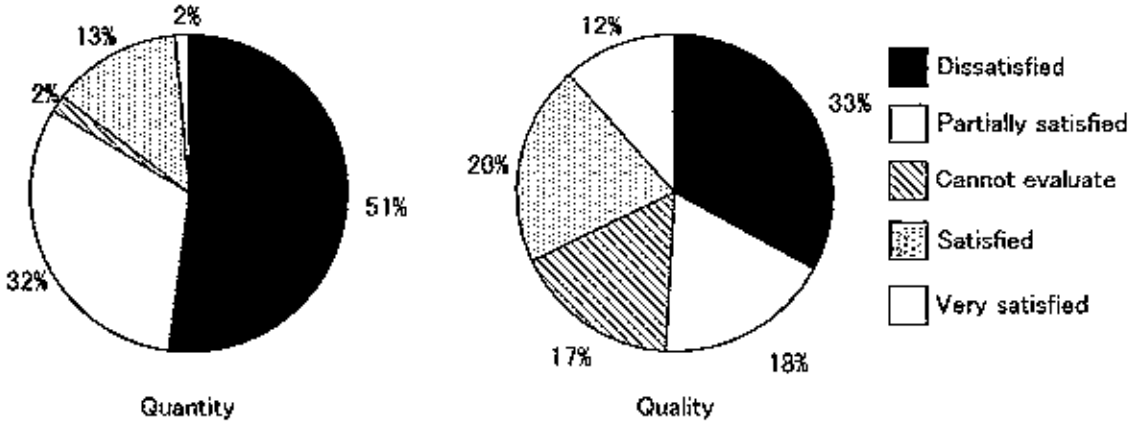
The following Figure 6.1.10 shows the level of Mekorot water use for agriculture by village. Three villages in the northern part of Jordan Valley, namely Baldara, Kaldara and Ein el Beida, substantially rely on Mekorot water. Since the number of samples is limited in each village, it is deemed not accurate to compare the statistical figures among the villages.



Source: Baseline survey by JICA Study Team

Figure 6.1.10 Agricultural Water from Mekorot by Village

More than 50% of the surveyed families responded "dissatisfied" with the volume of supplied irrigation water, while 15% answered "very satisfied" and "satisfied" (See Figure 6.1.11). For water quality, families with "dissatisfied" and "very satisfied"/ "satisfied" answers are almost in the same ratio at 32-33%.

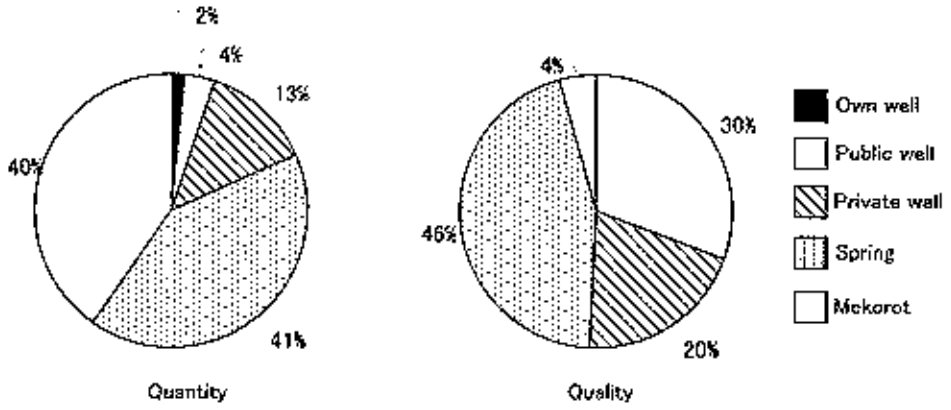


Source: Baseline survey by JICA Study Team

Figure 6.1.11 Quantity and Quality of Water Sources for Agriculture

The percentage of farmers who are "dissatisfied" on the quantity and quality of each irrigation water source are shown in Figure 6.1.12. For both quantity and quality, dissatisfaction on spring water is high, mainly due to the large number of spring water

users. On the other hand, there is higher dissatisfaction on quantity than on quality of water supply from Mekorot. Dissatisfaction on well water quality is also high at 50%.



Source: Baseline survey by JICA Study Team

Figure 6.1.12 Dissatisfaction on Quantity and Quality by Water Source

Problems and constraints on agriculture

Table 6.1.12 shows the ranking of problems. The first four top-ranked problems concerned farm economy and marketing. The 5th and 6th problems are related to irrigation water and facilities. In order to improve farmers' economic situation, it is necessary to improve the marketing system and access to credit as well as water supply.

Table 6.1.12 Ranking of Problems and Respondents

	Problems	Percentage of respondents
1	Difficulty from expensive farm inputs	95.6%
2	Difficulty from lack of capital and available credit source	95.6%
3	Difficulty from low selling price of products	90.8%
4	Difficulty in grasping and following market demand	87.9%
5	Difficulty from shortage of irrigation water	85.0%
6	Difficulty from poor condition of irrigation facilities	74.3%
7	Difficulty from lack of market-related facilities	73.8%
8	Difficulty from shortage of machinery	72.8%
9	Difficulty from lack of proper farming practice and technique	69.9%
10	Difficulty from pests and diseases	68.5%
11	Difficulty in obtaining quality seeds and seedlings	68.4%
12	Difficulty from low quality of crops	66.5%
13	Difficulty from low yield of crops	64.6%
14	Difficulty from poor soil fertility	58.3%
15	Difficulty in purchasing fertilizer	56.8%
16	Difficulty in purchasing agro-chemical material	51.9%
17	Difficulty from weed damage	49.5%
18	Difficulty from shortage of water for crops	43.7%
19	Difficulty from wild animals	40.8%
20	Difficulty from labor shortage	40.3%
21	Difficulty from shortage of animal feed	26.2%
22	Difficulty from animal diseases	13.1%

Source: Baseline survey by JICA Study Team

6.1.2 Inventory Survey on Agricultural Wells and Springs

The inventory survey for agricultural wells and springs, including their facilities and equipment were conducted for the purposes of: i) obtaining the current condition and situation on water resources, water conveyance and distribution facilities, and water utilization; ii) preparation of the inventory of each well and spring; and iii) identification of the improvement needs of the facilities.

There are 184 wells from pumping, abandoned and non-pumping wells in the Study Area of the Jordan River Rift Valley in West Bank. Most of these wells were drilled before 1967 and need rehabilitation. Based on the urgent rehabilitation needs of PWA and MoA, 29 wells were selected for the inventory survey. The selection procedure for the wells inventory is discussed in Subsection 6.2.3.

There are 24 springs in the Study Area, but the number of target springs was set to be only 19, to exclude the Abu Saleh located in Al' Aqrabaniya, Al Fawwar, Al Far'a, Al Jummaizah and Al Ru'yan located in Jerusalem, due to the following reasons:

(i) The spring is completely dried up; and
(ii) The spring is located in or near an Israeli settlement and not used for any purpose.

The components of the survey works are listed below.

(1) Preparation of the Work
   1) Collection of basic data
   2) Preparation of detailed schedule
   3) Arrangement of field works

(2) Site Survey on the Current Condition of Existing Facilities and Equipment
   1) Survey on the existing facilities and equipment
   2) Survey on the current natural and environmental condition
   3) Measurement of the water flow at the water source, branch and distribution point for spring system

(3) Interview Survey on the Current Water Utilization and Operation and Maintenance Activities
   1) Survey on the current situation of Operation and Maintenance (O&M) for facilities and equipment
   2) Survey on current situation of water utilization for agriculture

(4) Analysis of Issues on Current Condition and Needs of Improvement of Facilities and Equipments
   1) Identification of current water allocation for domestic and agricultural uses
   2) Identification of the characteristics of each well and spring
   3) Identification of issues on condition of springs, existing facilities, equipments and system and organization for operation and maintenance and water utilization
   4) Identification of rehabilitation and improvement needs for the well and spring facilities and equipments

The surveys were conducted from the 29th of May to the 7th of July 2007. The summary of the inventory is shown in Table 6.1.13 and Table 6.1.14. The Basic Plan explained in the succeeding sections is prepared based on the surveys.

Table 6.1.13 Summary of Inventory for Agricultural Wells

No.	Code	Point Name	Location	Area A/B/C	Discharge (m^3/hr)	Agricultural Area (Dunum)		Present Status
						Irrgable	Irrigated	
1	19-14/064	Arab Project No.1	Jericho	A	55	4,000		Not pumping
2	19-14/080	Arab Project No.19	Jericho	C	15	4,000		Not pumping
3	19-17/034	Rajy Al Skakah	Frush bet dajan	C	60	300	300	Bad
4	19-14/069	Arab Project	Jericho	A		4,000		Not pumping
5	19-17/047	Hasan 'Abed Al Jaleel	frush bet dajan	C	40	85	85	Bad
6	19-15/008	'Abed Al Kareem Njum	Auja	A		1,000	200	Not pumping
7	19-17/023	Burhan Al Damin	Jiftlik	C	120	1,000	1,000	Bad
8	19-19/005A	Rafeeq Al Zua'bi	Ein Al Bahda	C	132	1,000	400	Bad
9	19-15/019	Yusef Mahmood Al Nojoom	Auja	C		1,000		Not pumping
10	19-17/033	Deya' Saleh 'Abdu	Jiftlik	C		250		Not pumping
11	19-17/055	Jawad Al Masri	Jiftlik	C	72	1,000	635	Bad
12	18-18/027A	Ibrahem Dyab	Fara	B		40		Not pumping
13	19-20/001A	Khursheed Mbaslat	Bardalla	C		250		Not pumping
14	18-18/036	Khaleel 'Abed Al Hadi	Fara	B	80-100	500	450	Bad
15	20-17/022	Sulayman Saleh	Marji Naja	C	120	500		Not pumping
16	19-17/027	Hasan Al Sumadi	Jiftlik	C	75	575	500	Bad
17	18-18/016	Mustafa Abu Khayzaran	Fara	A	80	1,200	1,200	Bad
18	19-14/062	Sa'eed 'Ala' Al Deen	Jericho	A	75	1,500	965	Fair
19	19-17/054	Ma'rouf Abu Samrah	Jiftlik	C	72	500	300	Bad
20	18-18/019	Abdul Kareem Salem	Fara	B	80	132	132	Bad
21	19-17/012	Marj Na'ja C5	Marji Ghazal	C		97	97	Not pumping
22	19-16/005	'Abed Al'azeez Lubbad Sarrees	Jiftlik	C	68	400	200	Bad
23	19-15/028A	Al 'Auja	Auja	A				Not pumping
24	19-14/058B	Yunes 'Abdu	Jericho	A		150	150	Not pumping
25	18-18/025A	Mohammad Ali Abdullah	Fara	A	228	1,900	1,400	Fair
26	19-17/056	Mohammad Al Damin	Jiftlik	C	90	520	520	Fair
27	19-17/010	Husain Drai'i	Jiftlik	C	36	500	200	Fair
28	19-17/009	Rafeeq Qamhawi	Jiftlik	C	60	136	136	Fair
29	20-17/019	Jameel Khamees	Marji Ghazal	C	35	45	45	Fair

Source: Inventory survey conducted by JICA Study Team

Table 6.1.14 Summary of Inventory for Springs

No.	Name	Code	Description	Area A/B/C	Main Distribution System		Total Irrig. Area (Dunum)	Total Agri. Area (Dunum)	Discharge (m3/hr)	Present Status	
					Type	Total Length				Intake	Distribution System
1	Fasayil	AC/054	Domestic & Agriculture	C	Steel Pipe Line (6")	3.5	630	3,700	165	Bad	Bad
2	Al Dyuk	AC/060	Domestic & Agriculture	A	Concrete Canal	9	3,300	6,000	804	Good	Fair
3	Al Nwai'mah	AC/060A	Domestic & Agriculture	A	Concrete Canal, Steel Pipe Line (8")	10	1,400	4,000	423	Good	Bad
4	Al Shusah	AC/060B	Agriculture	A	Concrete Canal, Steel Pipe Line (8")	0.4	380	380	117		Bad
5	Al Sultan	AC/061	Domestic & Agriculture	A	Steel Pipe Line	20	4,000	10,000	909	Good	Good
6	Shibli	AQ/022	Domestic & Agriculture	C	Concrete Canal,Steel Pipe Line (2", 4",	21	11,000	20,000	189	Good	Good
7	Abu Saleh	AQ/024	Dry								
8	Meskah	AQ/025	Agriculture	C	Concrete Canal	0.7	60	60	390	Good	Bad
9	Al Far'ah	AQ/030	Domestic & Agriculture	A	Concrete Canal, Open Earth	3	510	2,000	2,076	Bad	Bad
10	Al Dlaib	AQ/032	Agriculture	A	Concrete Canal	1.5			2,639	Bad	Bad
11	Sedrah	AQ/036	Agriculture	B	Concrete Canal, Open Earth	0.02	2,570	5,200	2,004	Bad	Bad
12	Hamad & Baidah	AQ/037A	Domestic & Agriculture	B	Concret Canal	2			445	Fair	Fair
13	Qdairah	AQ/037B	Domestic & Agriculture	B	Concret Canal	1.5			469	Fair	Fair
14	Jeser	AQ/038	Agriculture	B	Discharge directly from the spring source to the wadi				40	Bad	
15	Tabban	AQ/039	Domestic & Agriculture	B	Concrete Canal, Steel pipe				230	Good	Fair
16	Al Subyan	AQ/040	Agriculture	B	PVC Pipe				62	Bad	Bad
17	Balata	AQ/043	Domestic	A			0	0	137	Fair	
18	Dafna	AQ/044	Domestic	A			0	0	150	Fair	
19	Al 'Auja	AR/020	Agriculture	C	Open Concret Canal	8	5,000	50,000	2,904	Fair	Bad
20	Al Qilt & Al Fawwa	AS/020	Domestic & Agriculture	C	Open Concret Canal	15	2,000	5,000	13,625	Fair	Fair
21	Al Fawwar	AS/021	Including No.20								
22	Fara	AS/022	No used								
23	Al Jummaizah	AS/022A	No used								
24	Al Ru'yan	AS/022B	No used								

Source: Inventory survey conducted by JICA Study Team

6.2 Basic Plan for Rehabilitation and Integrated Management of Agricultural Wells

There are 88 working wells in the Study Area. Most of these wells were drilled before 1967 and their conditions became worse due to electro-mechanical and/or hydro-geological reasons. The total volume of wells extraction is around 9.4 MCM in 2004, while its extraction in 2000 is more than 12.0 MCM. This means a dramatic decrease in the volume of wells extraction within only four years. There are 96 non-pumping and abandoned wells in the Jordan River Rift Valley due to hydro-geological, electro-mechanical and/or economic reasons as well. The Basic Plan for the rehabilitation of all the above agricultural wells was targeted in this study.

6.2.1 Basic Consideration for the Rehabilitation of Private Wells as a Public Project

As mentioned in Subsection 3.5.2, most of the wells are managed by private owners. However, the water abstracted from the wells is a precious resource for farmers. Under this situation, the following points have been considered in the preparation of the Basic Plan for the rehabilitation and integrated management of private agricultural wells as a public project.

(1) Limited Access to Public Water Sources for Farmers

Based on the result of the questionnaire survey, only 1% of farmers use their own well for agriculture. The other farmers have to rely on private wells and springs owned by others as well as public ones. However, the quantity of water from public wells and springs is limited in volume and distribution. To improve the water availability for farmers in the Study Area, the private wells, as the main water source, are considered to be public in nature and thus targeted for rehabilitation and improvement.

(2) Participation in National Level Water Management

Optimum water utilization is not the only issue for a well, but it reflects on the issue of the national level water utilization. All water resources should be monitored and controlled by PWA for better water resources management at the national level, thus all water service providers, such as regional water utilities and Water Users Associations (WUAs) as water management groups at the field level, have to be established and registered with PWA.

(3) Establishment of Management System by Water Users Association

The purpose of establishment of a WUA, as the water service provider, is to operate and maintain the rehabilitated well efficiently. It is essential, therefore, that the limited water resources are effectively utilized through rehabilitation works.

6.2.2 Concept of the Basic Plan for Rehabilitation of Agricultural Wells

Water from wells and springs are the main and limited water resources for Palestinian agriculture in the Study Area. Therefore, these water resources are required to be used with efficiency, effectiveness, equity and sustainability through rehabilitation of the agricultural wells and improvement of the spring water conveyance system. In the formulation of the Basic Plan for the rehabilitation of the agricultural wells, the following

points were mainly considered as the basic concept in the Study.

(1) Process of JWC Approval

All water development and management projects need JWC approval. Past experiences of PWA showed that issuance of the approval takes a long time. Additionally, the issue of the approval was uncertain since the Israeli side would have a different development policy for the West Bank. Considering this situation, first priority was given to the wells which were already in the process of getting JWC approval or would be in process soon.

(2) Sustainability of Groundwater Resources

The discharge of springs is determined by the groundwater level and recharge capacity of each aquifer. Therefore, the discharges cannot be controlled without the setting of artificial stoppers to their outlets. On the other hand, however, the volume of wells' extraction can easily be controlled by daily human activities.

Considering the result of the groundwater analysis in Chapter 4, the downward tendency of the groundwater level alerted the Study Team to the depletion of groundwater resources especially in the southeastern part of the Study Area, including Jericho, Al 'Auja and the surrounding areas. Water quality of the wells in these areas has deteriorated as well. On the other hand, the northern part of the Study Area was assumed to have more capacity to supply the water than the present volume of extraction.

(3) Licensed Volume of Extraction

Most wells are registered in PWA database with a licensed volume of extraction, which was decided under the agreement between Israel and Palestine for the sustainable use of groundwater resources. However, the present volume of extraction in some wells might be larger than the licensed volume.

In the Study, the licensed volume was regarded as the maximum volume of extraction.

(4) Combination of Hardware Component and Software Component

To achieve integrated water resources management in the Study Area, a combination of the hardware component (wells' rehabilitation including installation of pumping equipment) and software component (O&M of rehabilitated wells by WUA and water saving irrigation system applied in the field level) are required. Therefore, the present physical and socio-economic conditions in the Study Area are taken into consideration for the Basic Plan formulation.

6.2.3 Selection of the First Priority Agricultural Wells for Rehabilitation

Out of the 184 existing wells, including non-pumping and abandoned ones, the first priority agricultural wells for rehabilitation were selected through the following steps:

Step 1: Selection by PWA and MoA

At the beginning of this JICA Study, PWA and MoA prepared a list of 45 agricultural wells to be rehabilitated urgently, and these wells had been highly prioritized for JWC

approval. Taking into consideration the time required for the approval process by JWC, the wells were given priority to be included for the next step. Table 6.2.1 shows the list of wells recommended by PWA and MoA.

Step 2: Clarification of other financial sources for rehabilitation

The possibility of rehabilitation through other financial sources was clarified as the second step for the screening of the selected 45 wells. Among the 45 wells, 29 wells were chosen as the top priority projects for the inventory survey, since the remaining 16 wells are planned to be rehabilitated using funds from other donors as shown in Table 6.2.1.

Step 3: Inventory survey

The selected 29 wells were included in the inventory survey as mentioned in Section 6.1. Based on the inventory survey, four wells were found to be newly rehabilitated by FAO and Arab Fund. In addition, another four wells were dropped because of the following reasons:

- Two wells were in proper working order or required very minimal rehabilitation;
- A substitute well was operated instead of a well to be rehabilitated; and
- A well was observed and assumed to have low extraction capacity even after being rehabilitated.

Through the above steps, 21 wells were selected as first priority wells to be rehabilitated. However, in a course of the Study, two wells were again dropped because their rehabilitation was suddenly taken on by others. Finally, the list of the 19 wells as first priority for rehabilitation was prepared as presented in Figure 6.2.1, while the location map of the wells is shown in Figure 6.2.2.

Table 6.2.1 List of High Priority Wells Selected by PWA and MoA

	Code	Locality	Funded by			JICA Study		Remarks
			FAO	Arab Fund	Others	Inventory survey	High priority	
1	18-18/016	Wadi Al Far'a				*	*	
2	18-18/019	Wadi Al Far'a				*	*	
3	18-18/025A	Wadi Al Far'a				*		No need to be rehabilitated according to the inventory survey
4	18-18/027A	Wadi Al Far'a				*	*	
5	18-18/036	Wadi Al Far'a				*	*	
6	19-13/021	Jericho	*					Under preparation of rehabilitation
7	19-13/050	Jericho	*					Under preparation of rehabilitation
8	19-14/017	Jericho	*					Under preparation of rehabilitation
9	19-14/037	Jericho	*	*				Under preparation of rehabilitation
10	19-14/049	Jericho		*				Under preparation of rehabilitation
11	19-14/058B	Jericho				*	*	
12	19-14/062	Jericho				*	*	
13	19-14/064	Jericho		*		*		Preparation started after inventory survey
14	19-14/069	Jericho				*		Well owner started using substitute well.
15	19-14/080	Jericho				*		Very low capacity of water extraction
16	19-14/081	Jericho	*					Under preparation of rehabilitation
17	19-15/005	Al 'Auja	*					Under preparation of rehabilitation
18	19-15/007	Al 'Auja	*					Under preparation of rehabilitation
19	19-15/008	Al 'Auja				*	*	
20	19-15/019	Al 'Auja	*			*		Preparation started after inventory survey
21	19-15/028A	Al 'Auja				*	*	
22	19-16/001	Al Jiftlik	*					Under preparation of rehabilitation
23	19-16/005	Al Jiftlik				*	*	
24	19-16/006	Fasayil		*				Under preparation of rehabilitation
25	19-17/007	Al Jiftlik		*				Under preparation of rehabilitation
26	19-17/008	Al Jiftlik	*	*				Under preparation of rehabilitation
27	19-17/009	Al Jiftlik		*		*		Preparation started after inventory survey
28	19-17/010	Al Jiftlik		*		*		Preparation started after inventory survey
29	19-17/012	Marj Na'ja				*	*	
30	19-17/023	Al Jiftlik	*			*		Preparation started after inventory survey
31	19-17/027	Al Jiftlik				*	*	
32	19-17/031	Al Jiftlik	*	*				Under preparation of rehabilitation
33	19-17/033	Al Jiftlik				*	*	
34	19-17/034	Furush Beit Dajan				*	*	
35	19-17/047	Furush Beit Dajan				*	*	
36	19-17/054	Al Jiftlik				*	*	
37	19-17/055	Al Jiftlik				*	*	
38	19-17/056	Al Jiftlik				*		Rehabilitation cost is too small.
39	19-19/005A	Bardala				*	*	
40	19-20/001A	Bardala				*	*	
41	20-17/009	Marj Na'ja		*				Under preparation of rehabilitation
42	20-17/016	Marj Na'ja	*					Under preparation of rehabilitation
43	20-17/019	Marj Na'ja		*		*		Preparation started after inventory survey
44	20-17/022	Marj Na'ja				*	*	
45	20-17/023	Marj Na'ja		*				Under preparation of rehabilitation

Source: Interview survey of PWA and MoA

No.	Code	Name	Location	Area	Status	Needs and Remarks
1	18-18/016	Mustafa Abu Khayzaran	Far'a	A	Bad condition	Submersible pump
2	18-18/019	Abdul Kareem Salem	Far'a	B	Bad condition	Motor
3	18-18/027A	Ibrahem Dyab	Far'a	B	Not pumping	Deepening up to 100 m, motor, assessment, testing after deepening
4	18-18/036	Khaleel 'Abed Al Hadi	Far'a	B	Bad condition	Motor, rehabilitation of turbine, shaft, gear head
5	19-14/058B	Yunes 'Abdu	Jericho	A	Not pumping	Deepening up to 120 m, submersible pump, 90 m cable and pipe
6	19-14/062	Sa'eed 'Ala' Al Deen	Jericho	A	Fair condition	Two pipes with shafts and lagers
7	19-15/008	'Abed Al Kareem Njum	Auja	A	Not pumping	Cleaning up to 58 m, generator, generator, submersible pump, 48 m and cable and pipe
8	19-15/028A	Al 'Auja	Auja	A	Not pumping	Substitute well, generator, submersible pump
9	19-16/005	'Abed Al'azeez Lubbad Sarrees	Jiftlik	C	Bad condition	Motor
10	19-17/012	Marj Na'ja C5	Marji Ghazal	C	Not pumping	Motor
11	19-17/027	Hasan Al Sumadi	Jiftlik	C	Bad condition	Motor
12	19-17/033	Deya' Saleh 'Abdu	Jiftlik	C	Not pumping	Deepening up to 70 m, casing, motor, vertical pump, gear head, assessment, testing after deepening
13	19-17/034	Rajy Al Skakah	Frush bet dajan	C	Bad condition	Pump rising, logging, acidization, assessment, testing after development
14	19-17/047	Hasan 'Abed Al Jaleel	Frush bet dajan	C	Bad condition	Deepening more than 20 m, acidization, motor, assessment, testing after deepening
15	19-17/054	Ma'rouf Abu Samrah	Jiftlik	C	Bad condition	Submersible pump, electric panel
16	19-17/055	Jawad Al Masri	Jiftlik	C	Bad condition	Motor, vertical pump, gear head
17	19-19/005A	Rafeeq Al Zua'bi	Ein Al Byhda	C	Bad condition	Transformer, registration, electric drive motor and maintenance
18	19-20/001A	Khursheed Mbaslat	Bardalla	C	Not pumping	Motor and gear head
19	20-17/022	Sulayman Saleh	Marji Naja	C	Not pumping	Motor, vertical pump and gear head

Source: JICA Study Team

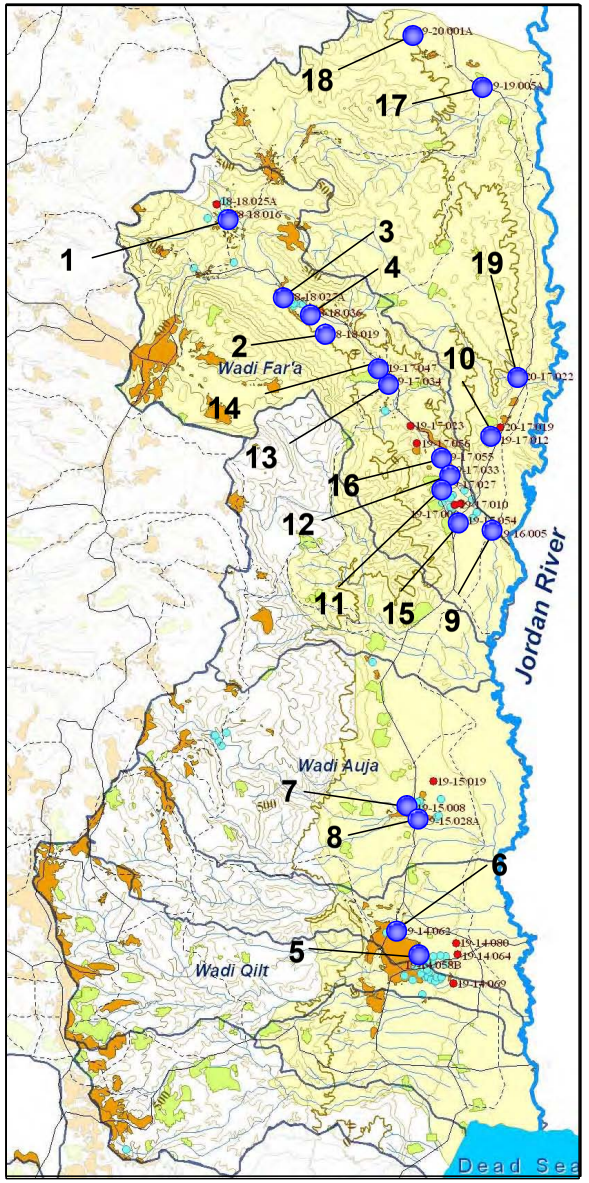


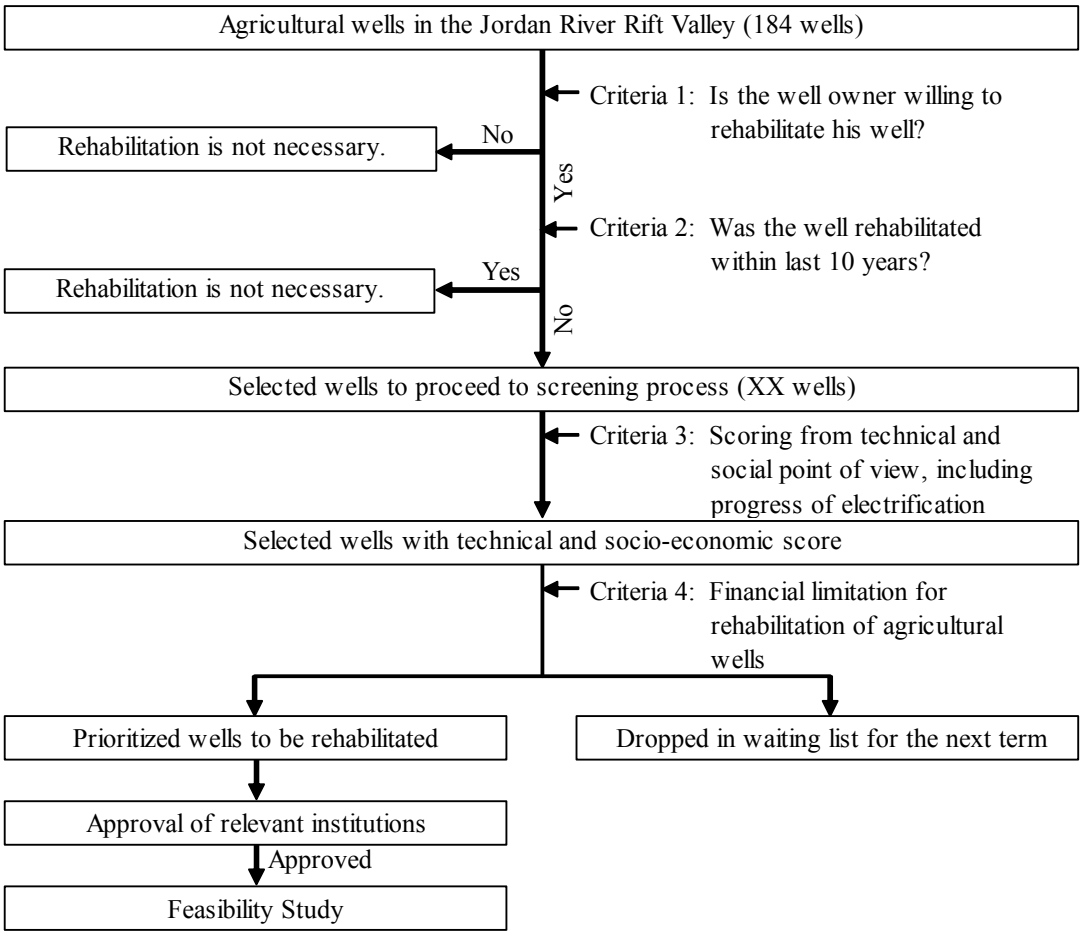
Figure 6.2.1 First Priority Agricultural Wells for Rehabilitation

6.2.4 Recommendation for Further Rehabilitation of Remaining Agricultural Wells

(1) Importance of Prioritization Process for Rehabilitation of Agricultural Wells

Through the process outlined in Subsection 6.2.3 above, the first priority agricultural wells for rehabilitation were selected. These wells were positioned as the target wells for Feasibility Study and the pilot project in the Study.

However, taking into consideration: i) the existence of 188 agricultural wells in the Study Area; ii) that most of all wells are in bad condition or not operational; iii) that agriculture is the main industry; and iv) that farmers are struggling due to the scarce water supply condition, the agricultural wells need to be rehabilitated continuously. On the other hand, governmental budget is limited for the rehabilitation. Given this situation, a fair and transparent prioritization process for the rehabilitation should be established. The recommended process for the prioritization is illustrated in the following figure.



Source: JICA Study Team

Figure 6.2.2 Recommended Process to Prioritize Agricultural Wells for Rehabilitation

Unfortunately, because of the lack of budget and difficulty of physical access to the wells, periodical monitoring to be conducted by PWA has not been undertaken appropriately. In addition, some important information was not included in the periodical survey questionnaire, such as number of beneficiaries, irrigated and irrigable areas after rehabilitation, etc. Therefore, it is strongly recommended to periodically monitor the

necessary information for the prioritization under the financial and administrative support of donor agencies.

(2) Recommended Technical and Social Criteria for the Prioritization

The criteria to be used for the prioritization process are shown in Table 6.2.2. In fact, through discussions with PWA and MoA, these criteria were formulated and applied in the selection process of the pilot project of rehabilitation of agricultural wells.

Table 6.2.2 Recommended Criteria for the Prioritization of Agricultural Wells

Criteria		Description
Technical	Extraction license	When the licensed volume of extraction exceeds the actual volume of extraction in a well, the well should be given the higher priority.
	Water quality	Higher priority should be given to better quality of water for agriculture. If the water quality data is not available, the northern and western area of the Jordan River Rift Valley should be given higher priority because the southeastern area shows tendency of deteriorating water quality.
	Status of pumping equipment	Higher priority should be given to the worse status of pumping equipment. In case of a non-pumping well, mechanical or economical reasons why pumping stopped should be accorded more priority over hydro-geological reasons such as bad water quality and low groundwater table.
	Needs for rehabilitation	In case of hydro-geological reasons for pumping stoppage, the highest priority should be given to the wells which need to be developed, excluding deepening. The second highest priority should be given to the wells which require both development and deepening. The substitute wells should be given lower priority since necessity of rehabilitation is lesser. In case of electromechanical reason, installation of motors and pumps should be given higher priority than the maintenance of existing pumping equipment in terms of the necessity for governmental support. Electrification of power source has advantage in the rehabilitation. The lowest priority should be given to the economical reason in terms of the necessity of governmental support as well.
Socio-economic	Availability of alternative water source	Some of the wells have alternative water source, such as spring water channel near the cultivated area. Priority of these wells should be lower than the others.
	Irrigated area	The technical criteria are limited to a bore hole and pumping equipment. Therefore, the water distribution system is not included. Even though the well would be rehabilitated, sometimes expansion of cultivation area can not be expected due to the farmers' difficult economic condition. Since a wider cultivation area is assumed to show more cost-benefit performance, a well, which serves a wider irrigated area, should be given higher priority.
	Irrigable area	A well, which serves more irrigable land as compared to the actual irrigated area, is expected to possibly expand its irrigation network in future. Such wells should be given higher priority than others.
	Water users	The criterion on the water user has two levels. One is the combination of water users, such as an absent landowner, owner farmer and tenant farmer. Another level is the number of total water users. To avoid limiting the benefits of rehabilitation to the land and well owners and their families only, a well, of which the water users are just the owner and his family, should be given the lowest priority. In terms of O&M, the owners obviously have an important role, and they should be actively involved in this aspect. Consequently, a well, which is utilized by both owner farmers and tenant farmers, should be given the highest priority. Meanwhile, a well, which is used only by tenant farmers, should be the second priority. Furthermore, the number of total water users should be taken into consideration for the prioritization. A larger number of total water users (beneficiaries) should be given higher priority.

Source: JICA Study Team

The information required for the above criteria can be collected through periodical monitoring conducted by PWA and some additional interview surveys can be done involving well owners and farmers. For the preliminary selection of agricultural wells to be rehabilitated, the information is required to be collected by organizations concerned such as PWA and MoA. The following table shows the recommended agricultural wells for rehabilitation from PWA and MoA based on the field investigation undertaken by PWA surveyors. This list is helpful for organizations which are interested in the rehabilitation, and can be applied in the selection in case urgent decisions are required to be made. However, it must be noted that these wells were designated from the technical point of view. It is recommended that the selected wells are also to be reviewed and prioritized again utilizing the criteria as mentioned above.

Table 6.2.3 Next Priority Wells Recommended by PWA and MoA

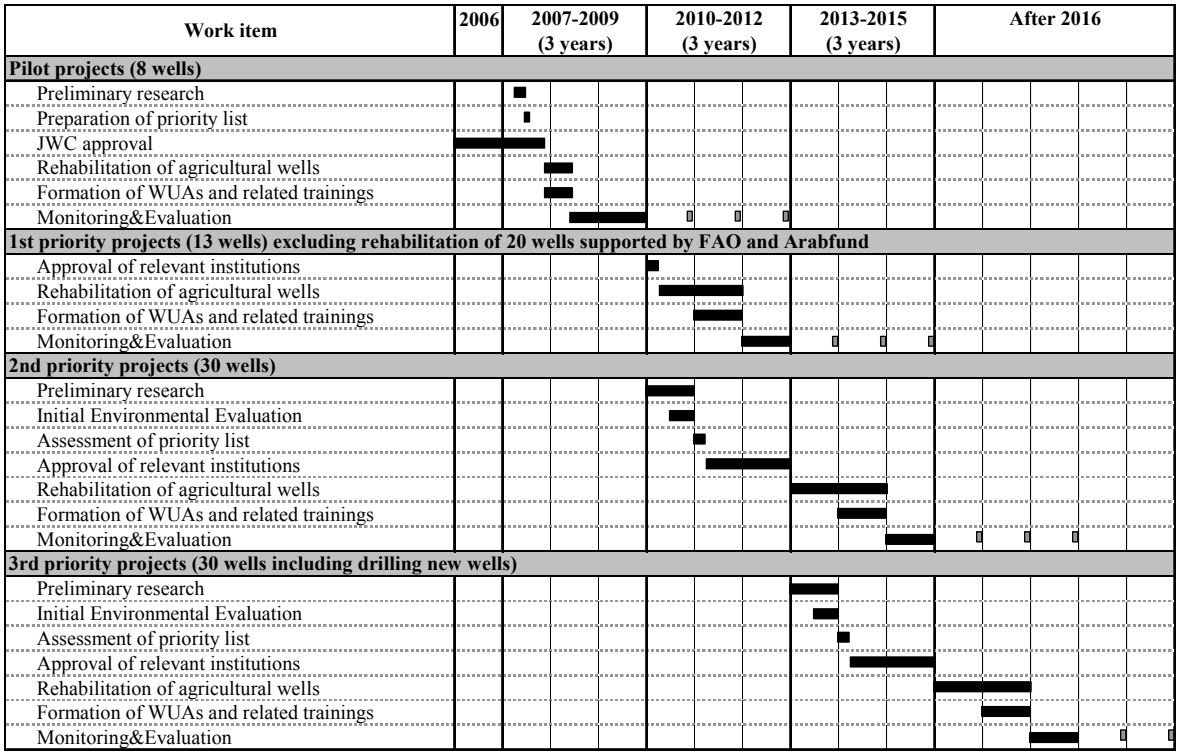
NO.	ID	Name of well	Locality Name
1	18-18/014	Sukaynah 'Abed Al Hadi	Wadi Al Far'a
2	18-18/023	'Azmi 'Abed Al Majeed	Wadi Al Far'a
3	18-18/025 A	Mohammad Ali Abdullah	Wadi Al Far'a
4	18-18/031	Nader 'Abed Al Hadi	Wadi Al Far'a
5	19-13/005	Kamel I'raiqat No.2	Jericho (Ariha)
6	19-13/015	Fahed Hishmah	Jericho (Ariha)
7	19-13/022	Basel Husaini	Jericho (Ariha)
8	19-13/024	Al Awqaf Well No.1	Jericho (Ariha)
9	19-13/048	Fahmi Al Nahhas	Jericho (Ariha)
10	19-13/052	Zuhdi Hashwah	Jericho (Ariha)
11	19-13/055	Sulayman Abu Jebnah	Jericho (Ariha)
12	19-14/003	'Othman Hlailah	Jericho (Ariha)
13	19-14/019	Jawdat Sha'sha'ah	Jericho (Ariha)
14	19-14/023	Musa Nassar Hater	Jericho (Ariha)
15	19-14/037	'Awni Hjazi	Jericho (Ariha)
16	19-14/052	'Awni Hjazi	Jericho (Ariha)
17	19-14/067	Arab Project	Jericho (Ariha)
18	19-14/081	Arab Project No.23	Jericho (Ariha)
19	19-15/005	Jawad Dawudi	Al 'Auja
20	19-15/023	Sulayman Mkarkar	Al 'Auja
21	19-16/001	'Ali 'Abdallah Damen	Al Jiftlik
22	19-16/003	Ahmad Hashem Al Zghayyer	Al Jiftlik
23	19-16/004	Ahmad Hashem Al Zghayyer	Al Jiftlik
24	19-16/006	Sumsam Nemer	Fasayil
25	19-16/009	Nawwaf Al Damen	Al Jiftlik
26	19-17/002	Waheed Al Masri	Al Jiftlik
27	19-17/007	Fathalla Al Masri	Al Jiftlik
28	19-17/008	'Allan Al Damen & Partners	Al Jiftlik
29	19-17/010	Husain Drai'i	Al Jiftlik
30	19-17/023	Burhan Al Damen	Al Jiftlik
31	19-17/031	'Abed Al Lateef Haydar	Al Jiftlik
32	19-17/044	Muhammad Yusef Shaheen	Furush Beit Dajan
33	19-17/050	Muhammad Ahmad 'Abed Al Jabbar	Furush Beit Dajan
34	20-17/016	Sulayman Saleh	Marj Na'ja
35	20-17/018	Muhammad 'Ali Salmi & Partners	Marj Na'ja
36	20-17/019	Jameel Khamees	Marj Na'ja
37	20-17/022	Sulayman Saleh	Marj Na'ja

Source: JICA Study Team

(3) Implementation Schedule for Rehabilitation of Agricultural Wells

The rehabilitation of agricultural wells should be implemented by stages since its progress would be limited by the progress of JWC's and Civil Administration's approval, and the availability of PWA and MoA budget. Based on the past experiences of PWA and MoA, as well as the experience of pilot projects for rehabilitation of agricultural wells mentioned in Chapter 7, the number of wells to be rehabilitated and the implementation schedule were tentatively set as shown in the Figure 6.2.3.

As a result of the rehabilitation activities, 71 out of the existing 184 wells will be rehabilitated by 2015.



Source: JICA Study Team

Figure 6.2.3 Tentative Implementation Schedule for Rehabilitation of Agricultural Wells

6.2.5 Basic Plan for Integrated Management of Wells

(1) Basic Conditions for Rehabilitation

For the rehabilitation of the wells, the following basic conditions should be met prior to the rehabilitation. All well owners and beneficiaries have to agree on these conditions before rehabilitation of their wells.

1) Official license and registration
A well, which is planned to be rehabilitated by public assistance, has to be officially registered and has its abstraction license renewed at the time of rehabilitation.

2) Cooperation on water management at regional and national levels
Owners and users of a well, which is rehabilitated by public assistance, have to cooperate on regional and national water management for sustainable and efficient water use with the National Water Council and PWA.

3) Contribution to the rehabilitation in cash or in kind (if a donor requests)

4) Establishment of Water Users' Association (WUA)
In order to ensure transparency in the well management, a Water Users' Association, which is a voluntary group consisting of stakeholders, has to be established, with the stakeholders participating in the management of the well.

5) Establishment of a tariff system (water fee for water users)
In accordance with the tariff regulation and guideline issued by PWA, tariff for each well has to be set by the WUA.

6) Long term contract between owners and existing water users
In order to guarantee the right of tenant farmers, the owners of a well cannot cancel the contract for farm land leasing and water supply in a unilateral way during the entire depreciation period of the support equipment. If a farmer wants to leave the farm during this period, he can transfer the right of priority rent or lease of the land and water use to another farmer.

7) Disclosure of information on management
In any case, information on the management of a well, especially the O&M cost, water distribution records, and water fee collection, has to be recorded and should be disclosed upon demand of the stakeholders and authorities concerned.

(2) Establishment of Water Users' Association

Necessity of Joint Management of Agriculture Well

Joint management of agriculture well is that well owners and water users jointly manage the well aiming to effective and efficient water management. This joint management is never fraught with any change of ownership of the well and the water right.

Present condition and problems

Sharecropping system is dominant in the Study Area. In this system, the well owner pays all the expenses of agriculture inputs for tenants on temporary basis. Then, after produces are collectively sold, the well owner deducts expenses he paid from the sales, and pays only shared profit to tenants. So, tenants never directly pay the water cost as well as other agriculture input cost. This causes low awareness on water cost among tenants, as they often say "water is free" or "I don't need to pay for water". Therefore, an incentive to decrease water cost among tenants tends to be kept at low level. This situation also makes farm economy in difficult situation.

Water fee for the well, in general, must consist of operation cost, maintenance cost, labor cost (if operators is hired), owners' profit, other cost (renewal fee of license, stationeries, etc.), and depreciation cost of equipment. Among these cost depreciation cost has never been considered as the cost of water. As a result, owners cannot replace their equipment at the time of renewal. Tariff system introduced in joint management basically includes depreciation cost. In addition, water supply equipment is owned by owners, and currently farmers are not involved in O&M of the facility. This also causes carelessness of farmers on water management.

Necessity of joint management system of agriculture well

In order to improve the present situation, it is necessary to introduce the system, which both owners and water users participate in water management. The system introduces equitable water tariff depending on the volume of water use. Furthermore, water fee has to be calculated based on clear grounds. Calculation methodology, which includes all the cost, is also reasonable and equitable for water users. And transparency of above information has to be secured in the system. Both owners and users participate in the process to establish the management system by themselves through discussions. The process promotes interest of both owners and users on water management. In the pilot project, a group, which tries to realize the joint management of agricultural well, is called "Water Users Association (WUA)". In Water Law, Palestinian Authority establishes National Water Council, consisting of stakeholders from both public and private sector, and aims to comprehensive water management at national and regional level. For agricultural well, Water Users Association as water service provider is encouraged to participate in this council.

As one of the conditions for the rehabilitation of an agricultural well, stakeholders have to establish a management body, which will be in charge of operation and maintenance, called the Water Users Association (WUA). The WUA consists of the well owners, water users, and other concerned persons.

The WUA is identified in the Water Law as follows:

Water Law #3 - 2002– Chapter 7 Article 25 &26 acknowledge that the WUAs as legitimate bodies that contribute to the establishment of Regional Water Utilities, managing water and setting tariffs.

The WUA has to have at least the following functions:

i) Planning and operation of water distribution for members based on their needs;
ii) Maintenance of water supply facility and equipment (on-farm facility is not included);
iii) Water tariff setting and fee collection;
iv) Record-keeping of O&M and water fee collection, and corresponding disclosure of the records; and
v) Dispute resolution within the WUA.

Since details on the WUA as an authorized entity have not yet been developed, PWA, in cooperation with MoA, has to formulate guidelines that show basic information such as legal rights, functions, roles, and responsibilities of the WUA. Monitoring and evaluation results of the Pilot Project can be utilized for the development and improvement of the WUA guidelines.

(3) Type of Ownership of Support Equipment and responsibility

Ownership of support equipment should ideally belong to a body, which is in charge of O&M, or a group of beneficiaries. Most agricultural wells in the Study Area, however, are private wells. Therefore, ownership of equipment is carefully considered from the

technical and management points of view. The following three alternatives are envisioned. In any cases, the water pumping right remains in the well owners' hand, and the WUA has the responsibility in the O&M.

Alternative 1: PWA

Generally, the ownership of equipment and/or facility supported or granted by donors is transferred to a public institution, such as the executing organization, after project implementation. From this viewpoint, it is reasonable to assume that PWA has ownership of the support equipment. It is also considered that there is a possibility to transfer the ownership to other parties (WUA or well owner) after a certain period, such as the depreciation period of the equipment. Transfer of ownership needs consultation with the donor.

Alternative 2: Well owner

In the UNDP project (Land Development Program), ownership of support equipment is transferred to a well owner after a certain period, with some conditions. The owner has to contribute more than 15% of the rehabilitation cost prior to the start of rehabilitation. The remaining share of the cost, but not more than USD 60,000, is covered by the project. After the rehabilitation, the owner has to reduce his profit from the water fee. When the accumulated amount of reduction totals the cost covered by the project, ownership of the equipment is transferred from the project to the well owner. In this case, the water users can enjoy lower water fees until the ownership is transferred, and the owner can rehabilitate his well without spending for the big initial investment cost. The period and amount of reduction is discussed between the owners and users.

Alternative 3: Water Users' Association (WUA)

If the WUA has ownership of the equipment, it is expected to enhance a sense of ownership of the project. Furthermore, it can also be expected to encourage interest among water users on water management at the regional level. On the other hand, the WUA is a voluntary group, and it cannot be guaranteed to exist permanently in the future.

(4) Capacity Building on Operation and Maintenance

In the target area, sharecropping is dominant as the farming system. Presently, a well owner as a leader-farmer, or sometimes a big farmer, who has a direct contract with a well owner, manages the well physically and financially, both for water supply and management of farmland and farm input. Once a well is rehabilitated, the WUA will be in charge of O&M. Well owners and big farmer are included in members of WUA, and they are expected to lead other members on the initial stage of WUA activities. It is impossible for PWA to directly operate and maintain the rehabilitated well on site, although it has the responsibility to monitor the condition of the rehabilitated well periodically from the technical and management viewpoints. If any problems are identified, PWA has to give advice to the WUA. MoA has the responsibility to monitor on-farm water management from a technical point of view through their extension services.

(5) Introduction of Tariff System

In order to achieve a fair water pricing system, the price of water supplied from a rehabilitated well to the farm has to be determined on the basis of unit volume or unit time, and water fee is collected from all users in accordance with this tariff system. According to the Draft Tariff Regulation & Guideline (PWA, May 2003), full cost recovery has to be achieved in the following 3 stages:

Stage 1: Revenues cover Operation and Maintenance (O&M) costs;

Stage 2: Revenues cover O&M costs and depreciation cost based on revalued asset; and

Stage 3: Revenues cover O&M costs, depreciation cost based on revalued asset, and interest charges on loans (if any).

In order to achieve a full cost recovery, and to realize a renewal of equipment by WUA in future, Stage 2, which includes depreciation cost, has to be applied for the water fee computation. Results of the pilot project showed that the depreciation cost per cubic meter varies from 0.05 NIS to 0.60 NIS[1]. The tariff system has to be discussed among WUA members in consideration of both the farmer's affordability and the necessary cost, such as O&M cost, depreciation cost, managerial cost, labor cost, and profit of well owners.

Various water distribution methods are practiced on the field level. Direct water distribution, in which pumped water directly supplied to the farm through the piping system and indirect distribution system, in which pumped water is supplied through a pond or existing canal system are observed. And combinations of above direct and indirect systems are currently applied in the Study Area. Therefore, it is very complicated to decided tariff in each well. The basic concept for tariff calculation is covering the necessary cost by water fee from water users. Tariff in each well, therefore, needs to be modified building the consensus of WUA members.

[1] See details in the results of the Pilot Project (Chapter 7)

6.3 Basic Plan for Improvement of Spring Water Conveyance System

6.3.1 Basic Consideration for Improvement of Spring Water Conveyance System

The spring is main water source in the Study Area and mainly used for agriculture. On the other hand, spring water contributes to even domestic uses, accounting for 68% of the total volume for domestic users in the Study Area, followed by 24% from the Mekorot wells and 7% from wells including agricultural wells, due to high discharge volume and good water quality for drinking. Taking this fact into account, it is very important to consider the optimum water allocation of spring water under the comprehensive water resources management. In other words, the overall goal of the Basic Plan is to achieve of the following: i) Establishment and strengthening of governmental institutions for water management; ii) Reformation of private ownership of spring water for public use; iii) Establishment of a joint organization for management of multiple water use; iv) Realization of optimum water allocation, both for domestic and agricultural purposes; and v) Increase in agricultural productivity. The Basic Plan is set up for the improvement of agricultural water utilization taking into consideration the above-mentioned overall goal. The Basic Plan does not include any development plans for domestic water, however, it should take into account domestic water supply, including Bedouin use.

Based on the inventory survey of the existing situation of spring water supply and use, the following constraints in the current situation are also considered in the basic planning:

(1) Constraints in the supply situation

(i) Due to leakages and seepage from the main conveyance systems consisting of open canals, there are water losses in between the sources and the irrigated lands;

(ii) Canals are expected to overflow because of insufficient capacities of the main conveyance systems and the big seasonal fluctuation of spring discharge;

(iii) Water resources are insufficient if compared with land availability;

(iv) Spring water is contaminated by untreated wastewater and algae while flowing in the main open canals or natural wadis; and

(v) Operation and maintenance works for the facilities are not efficient and it is unclear who should have responsibilities for them.

(2) Constraints in the water use

(i) Water distribution for irrigation is made in the manner of a traditional water right system, and this situation is making it difficult to promote water resources management for the water providers or government organizations;

(ii) The conveyance and distribution lines do not have any system to control and monitor water volume discharging from sources, flowing into the irrigation system and utilized for irrigation; and

(iii) There are some private springs that prevent the public from using water in proper volume and allocation;

6.3.2 Concept of the Basic Plan for Improvement of Spring Water Conveyance System

(1) Basic Component of Project for Improvement of Spring Water Conveyance System

Taking into consideration the overall goal and current constraints mentioned above and in order to establish and enhance the spring water management system, the concept of the Basic Plan for improvement of spring water conveyance systems for agriculture is set up generally as follows:

1) Improvement of conveyance and distribution system

(i) Reduction of physical losses
(ii) Prevention of water contamination
(iii) Introduction of fair water distribution under a water rights system
(iv) Introduction of a water distribution monitoring system

2) Improvement of water use and O&M systems and activities

(i) Establishment and strengthening of O&M organization
(ii) Training on on-farm water management

(2) Concept of Regional Strategy for Improvement of Spring Water Conveyance System

In accordance with the above concept, the Basic Plan for improvement of spring water conveyance system is prepared under the following regional-wise development:

1) Wadi Far'a Area (Badhan, Al Far'a and Ain Shibli Spring Groups)

There are 3 spring groups along Wadi Far'a, i.e., Badhan, Al Far'a and Shibli spring groups. In the upper area, spring water is not consumed much. In the end, much spring water is flowing into wadi, to the downstream areas. It is therefore very important to consider the water allocation to areas such as Aqurabaniya, Nassariya, Frush Beit Dajan and Jiftlik. These areas are experiencing scarcity of domestic water. The Basic Plan should take into account some water allocation for domestic uses in these areas. However, since water quality is contaminated by untreated wastewater, the water should be protected from contamination to convey good quality water to the downstream.

There is an existing steel pipeline with a diameter of 24 inch and length of around 11,000m from the Shibli Village to the Jiftlik Village, owned by the Al Far'a Irrigation Project. The capacity of the pipeline to convey water from the start of pipe at settling basin site with the elevation of -50m to the Jiftlik area where the elevation is around -150m is calculated to be more than 2,000m^3/hr. This capacity is considered to be enough for the water demand at the downstream areas including for domestic use. Therefore, this existing pipeline can be used as a conveyance line.

In conclusion, the following components are proposed for the spring conveyance improvement for the Wadi Far'a area.

(i) Rehabilitation of the intake facilities of Al Dlaib, Hammad & Beidha, Qudairah, Sedrah, Jeser, Subyn and Meskeh springs;
(ii) Development of a pipeline system for main and secondary conveyance lines of Al Far'a, Al Dlaib, Hammad & Baidah, Qudairah, Tabban, Sedrah, Jeser, Subyan and Meskeh springs;

(iii) Development of trunk pipelines to convey water from Al Badhan and Al Far'a Spring Groups to the downstream villages, connecting to the Al Far'a Irrigation Project;

(iv) Development of secondary pipelines to convey water to the downstream areas such as An Nassariya, Al' Aqrabaniya, Frush Beit Dajan and Al Jiftlik;

(v) Establishment of O&M bodies including a coordination committee;

(vi) Strengthening of O&M bodies and coordination committee; and

(vii) Awareness promotion for effective water use for irrigation.

The new system for this area will contribute to farmers and communities in multiple localities for both domestic and agricultural water uses. Expectedly, some friction over their water rights may arise among the users. Currently, water rights in Al Far'a Irrigation Project belong to Al Far'a Irrigation Project Committee. The related village councils, together with MoA and PWA, should discuss and agree on the water rights and water allocation method. Moreover, organization for operation and maintenance should be carried out in a unified manner, covering all the facilities.

It is highly recommended to commence construction of a wastewater treatment system for the Nablus City and its surrounding areas. The treated water will supplement the fresh spring water and thus, available water for agriculture in the downstream areas will be increased.

2) Al 'Auja Area (Al 'Auja Spring)

Al 'Auja Spring has the highest discharge in the Study Area. However, the spring water is not used effectively due to much physical losses and insufficient capacity of the conveyance facilities. It is expected that improvement of the main canal will result to higher efficiency and consequently, increase the available water for the downstream areas.

A section between the spring source and the intake weir is part of a natural reserve area, and is considered an important place for tourism, thus, there will be some restrictions on the plan. In order to make the intake effective, therefore, only excavation works to remove stones or rocks at the intake weir is included in the plan.

The proposed main components of the Basic Plan are as follows:

(i) Rehabilitation of existing intake weir;

(ii) Development of pipeline system for main and secondary conveyance lines;

(iii) Establishment and enhancement of O&M body; and

(iv) Awareness promotion for effective water use for irrigation.

The main characteristic of this spring is that its discharge rate sharply fluctuates. The design for improvement of the conveyance system should therefore be formulated in consideration of this characteristic.

It is thus recommended to continue supply of domestic water from the Mekorot because the unstable flow of the spring discharge is not reliable for domestic use.

3) Jericho Area (Al Sultan and Al Dyuk Spring Groups)

The system for Al Sultan Spring was already improved through the IFAD Fund. The targets for development in this area are the second springs, i.e. Al Dyuk and Al Nwai'mah.

The water demand for domestic purposes is very high in this area, especially

Jericho City and its surrounding refugee camps. The overall goal of the Basic Plan is to set up the spring water to be allocated also for domestic use in order to meet future demand. As a first step, improvement of the agricultural water conveyance and distribution system should be prioritized. In order to increase the efficiency of water conveyance and agricultural water use, the following works should be carried out for Al Dyuk and Al Nwai'mah Spring facilities:

(i) Development of pipeline system for main and secondary conveyance lines;
(ii) Rehabilitation of existing open canals for main and sub-mail conveyance lines;
(iii) Establishment and enhancement of O&M body; and
(iv) Awareness promotion for effective water use for irrigation.

The intakes of the two springs were already rehabilitated through the ICRC fund. The rehabilitation works for the intake facilities, therefore, are not included in the plan.

There is a private spring in this area called Shusah Spring. In the future, public use of this spring will also be taken into account for the comprehensive water management system after the effort is made to change its private ownership and management.

6.3.3 Prioritization of Improvement of Spring Water Conveyance System

There are 24 springs in the Study Area. Among them, the technical survey for 19 springs was conducted, except Abu Saleh Spring, which has completely dried-up, and Far'a, Al Jummaizah and Al Ru'yan, which are difficult to access. The results of the survey are summarized in the following table.

Table 6.3.1 Result of Spring Inventory Survey

No.	Name	Avr. Discharge (Mcm/yr)		Use	Owner	Users	Rehabilitation Needs
1	Fasayil	0.66		Agri&Dom	Private	Fasayil	Main canal, secondary canal
2	Al Dyuk	4.86		Agri&Dom	Public	Dyuk	Main canal, secondary canal
3	Al Nuwai'mah	2.60		Agri&Dom	Public	Nuwai'mah	Main canal, secondary canal
4	Al Shusah	0.61		Agri&Dom	Private	Nuwai'mah	Main canal, secondary canal
5	Al Sultan	5.54		Agri&Dom	Public	Jericho	No (Already rehabilitated)
6	Shibli	0.85		Agri&Dom	Public	Shibli, Frush Beit Dajan, Jiftlik	Main canal, secondary canal
7	Meskah	1.29	No water in Jun.2007	Agri&Dom	Public	Al Badhan, Nassariya, Aqrabaniya, Shibli, Frush Beit Dajan, Jiftlik	Main canal, secondary canal
8	Al Far'a	5.31		Agri&Dom	Public	Ras Al Far'a	Main canal, secondary canal
9	Al Dlaib	1.20	No water in Jun.2007	Agri&Dom	Public	Ras Al Far'a	Main canal, secondary canal
10	Sedrah	1.46	No water in Jun.2007	Agri&Dom	Public	Al Badhan, Nassariya, Aqrabaniya, Shibli, Frush Beit Dajan, Jiftlik	Main canal, secondary canal

No.	Name	Avr. Discharge (Mcm/yr)		Use	Owner	Users	Rehabilitation Needs
11	Hamad & Baidah	0.88		Agri&Dom	Public	Al Badhan, Nassariya, Aqrabaniya, Shibli, Frush Beit Dajan, Jiftlik	Main canal, secondary canal
12	Qdairah	1.19		Agri&Dom	Public	Al Badhan, Nassariya, Aqrabaniya, Shibli, Frush Beit Dajan, Jiftlik	Main canal, secondary canal
13	Jeser	0.14		Agri&Dom	Public	Al Badhan, Nassariya, Aqrabaniya, Shibli, Frush Beit Dajan, Jiftlik	Main canal, secondary canal
14	Tabban	1.29		Agri&Dom	Public	Al Badhan, Nassariya, Aqrabaniya, Shibli, Frush Beit Dajan, Jiftlik	Main canal, secondary canal
15	Al Subyan	0.19		Agri&Dom	Public	Al Badhan, Nassariya, Aqrabaniya, Shibli, Frush Beit Dajan, Jiftlik	Main canal, secondary canal
16	Balata	0.18		Only Dom.	Public	Nablus	None
17	Dafna	0.13		Only Dom.	Public	Nablus	None
18	Al 'Auja	9.55		Agri&Dom	Public	Al 'Auja	Main canal, secondary canal
19	Al Qilt & Al Fawwar	6.55		Agri&Dom	Private	Jericho	Main canal, secondary canal

Source: JICA Study Team

The priority schemes for the Improvement of Spring Water Conveyance System are selected from these springs.

(1) Shortlist of Priority Schemes

The criteria for selection of priority schemes was set as shown in the following lists from the viewpoint of the characteristics of water sources and water use situation and the necessary improvement based on the Basic Plan concept.

(i) The spring should have continuous discharge throughout the years, which means that any dried up spring or seasonal spring should be dropped from the shortlist;
(ii) The spring water should be used for agricultural purposes;
(iii) The spring should be used for public benefit, which means that the spring water and facilities should not be owned and used only by a particular family;
(iv) The spring should be used only in a particular locality, which means that a spring having users and stakeholders in various localities should be dropped from the shortlist because it will need to take much time to reallocate water rights in several conveyance systems; and
(v) The rehabilitation needs identified for the spring should include rehabilitation of its mainline to match the concept of the Basic Plan.

Each spring was evaluated based on the above criteria, the results of which are presented in the following table.

Table 6.3.2 First Evaluation for Shortlist of Priority Scheme

No.	Name	Code	Water Discharging	Agri. Use	Public Use	Used for Single Village	Rehabili. Needs in Mainline
1	Fasayil	AC/054	Yes	Yes	No	-	-
2	Al Dyuk	AC/060	Yes	Yes	Yes	Yes	Yes
3	Al Nuwai'mah	AC/060A	Yes	Yes	Yes	Yes	Yes
4	Al Shusah	AC/060B	Yes	Yes	No	-	-
5	Al Sultan	AC/061	Yes	Yes	Yes	Yes	No
6	Shibli	AQ/022	Yes	Yes	Yes	No	-
7	Meskah	AQ/025	No	-	-	-	-
8	Al Far'ah	AQ/030	Yes	Yes	Yes	Yes	Yes
9	Al Dlaib	AQ/032	No	-	-	-	-
10	Sedrah	AQ/036	No	-	-	-	-
11	Hamad & Baidah	AQ/037A	Yes	Yes	Yes	No	-
12	Qdairah	AQ/037B	Yes	Yes	Yes	No	-
13	Jeser	AQ/038	Yes	Yes	Yes	No	-
14	Tabban	AQ/039	Yes	Yes	Yes	No	-
15	Al Subyan	AQ/040	Yes	Yes	Yes	No	-
16	Balata	AQ/043	Yes	No	-	-	-
17	Dafna	AQ/044	Yes	No	-	-	-
18	Al 'Auja	AR/020	Yes	Yes	Yes	Yes	Yes
19	Al Qilt & Al Fawwar	AS/020	Yes	Yes	No	-	-

Source: JICA Study Team

The shortlisted sites are listed below:

(i) Al Dyuk Spring;
(ii) Al Nwai'mah Spring;
(iii) Al Far'a Spring; and
(iv) Al 'Auja Spring.

(2) Selection of Priority Schemes

Final selection of the priority schemes was made based on availability of alternative water sources for agriculture. In the localities where the shortlisted springs are situated, availability of groundwater resources from wells is shown in the following table with the annual average abstraction volume from 2002 to 2004.

Table 6.3.3 Water Resources Availability for Shortlisted Site

Locality	Availability of Spring		Availability of Well	
	Spring Name	Volume (Mcm/year)	No. of Wells	Volume (Mcm/year)
Al Dyuk	Al Dyuk Spring	4.86	0	0
Al Nwai'mah	Al Nwai'mah Spring	2.60	0	0
Wadi Far'a	Al Far'a Spring	5.31	16	1.56
Al 'Auja	Al 'Auja Spring	9.55	7	0.54

Source: PWA

The Wadi Far'a village has much water from wells for agriculture. In addition, it is possible to practice rainfed cultivation in this area. The improvement of Al Far'a Spring conveyance system therefore, is not a priority. The location of priority schemes is presented in the following figure.

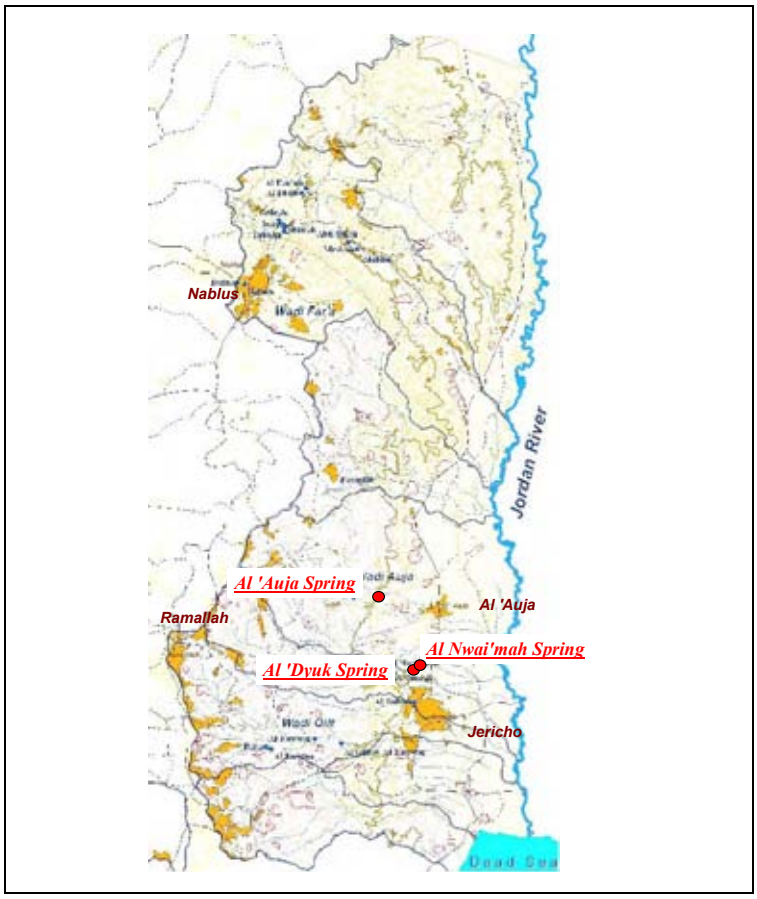


Figure 6.3.1 Location Map of Priority Schemes (Spring)

It is expected that efficiency of improvement for Al ‘Auja Spring conveyance system will be high in terms of minimizing water losses in the main canal. As estimated by the detailed survey on agricultural water use carried out by JICA Study Team, water losses in the conveyance system are shown in the following table.

Table 6.3.4 Estimated Water Loss in Conveyance System

Spring Name	Estimated Water Loss	
	(%)	(Mcm/year)
Al Dyuk	48%	2.33
Al Nwai’mah	34%	0.90
Al 'Auja	44%	4.20

Note: The water losses in percentage were estimated by means of flow measurement in the main canals carried out in the Detailed Survey on Agricultural Water Use conducted by JICA Study Team.

The water losses in amount were calculated from the above-mentioned estimated results and annual average of spring water discharge obtained from PWA database.

In conclusion, Al ‘Auja Spring is considered as the highest prioritized site.

(3) Improvement Plan for Other Springs

For the other sites in the Study Area, the following springs are not included in the Basic Plan.

1) Spring with no rehabilitation needs (or already rehabilitated) : Al Sultan Spring
2) Spring for domestic purposes : Balata Spring, Dafna Spring

Before starting the improvement works for non-prioritized spring facilities, the following surveys, studies or assessments should be carried out to clarify existing conditions and potential development in the future.

(i) Survey on current water use situation and farmers activities including water right systems,
(ii) Survey on layout and condition of existing conveyance facilities,
(iii) Assessment of social environment for coordination of water resources sharing with plural localities, and
(iv) Assessment of possibility to change the private springs to public properties or properties for regional social and economic development.

For the private springs such as the Fasayil, Al Shusah and Al Qilt Springs, it is very important to reach a consensus among owner families on public utilization of their spring sources and conveyance facilities. For the springs situated along the Wadi Far'a such as Shibli, Hamad & Baidah, Qdairah, Jeser, Tabban, Al Subyan, the Study, comprising of the abovementioned surveys and assessments, will be required to be coordinated with the related localities and private users for allocation of the spring water resources. This study should include a survey on dried-up springs such as Meskah, Al Dlaib and Sedrah to avoid any water rights issues in the future, in years when high water discharge may be experienced.

After the preliminary study on the above-mentioned issues, the feasibility study and design can be formulated to implement the works for improvement of the springs.

6.3.4 Implementation Plan for the Improvement of Spring Water Conveyance System

(1) Necessary Steps for Implementation of Priority Scheme

For the implementation of the priority scheme for the improvement of spring conveyance system, it is necessary to follow the following steps:

(i) Approval by the relevant institutions;
(ii) Basic design study;
(iii) Detailed design study; and
(iv) Construction works and software component program (capacity strengthening for O&M)

Details of the proposed works and the estimated cost for priority schemes are presented in Chapter 8.

(2) Necessary Steps for Future Prioritized Scheme

In order to prioritize future schemes and commence implementation, (except the schemes for Al 'Auja, Al Dyuk and Al Nwai'mah Springs) the following steps should be carried out:

(i) Preliminary study and feasibility study;
(ii) Approval by the relevant institutions;
(iii) Basic and detailed design study; and
(iv) Construction works and software component works (capacity strengthening of O&M organizations and farmers).

Prior to commencing the design works, it is necessary to conduct some studies to identify: i) detailed water right system; ii) detailed water use situation for domestic and agricultural purposes; iii) feasibility for reallocation of water rights and the establishment of a coordination committee with O&M organizations in cooperation with concerned villages; iv) feasibility of changing the water distribution or water rights method, i.e., from private to public basis; v) identification of necessary works for improvement of the conveyance system; and vi) technical and financial feasibility for implementation of projects.

(3) Provisional Implementation Works for Future Prioritized Schemes

In the long-term, the following projects for implementation are proposed under the conditions of water right allocation system to be clear and to be agreed among the stakeholders:

Table 6.3.5 Proposed Long-term Project

Project	Target Springs
Project for Improvement of Conveyance System for Al Fa'ra Area Springs	Shibli, Meskeh, Al Far'a, Al Dlaib, Sedrah, Hamad & Baidah, Qdairah, Jeser, Tabban, Al Subyan
Project for Improvement of Conveyance System for Private Springs	Fasayil, Al Shusah, Al Qilt & Fawwar

Source: JICA Study Team.

Based on the result of inventory survey conducted by JICA Study Team, the work items and for the implementation of the projects above are provisionally provided as shown in the following table.

Table 6.3.6 Proposed Work Item for the Future Project

Item		Unit	Quantity
Improvement of Conveyance System for Al-Far'ah Area Springs			
1) Rehabilitation & Construction of Intake Facilities		L.S.	1
2) Pipe Installation for Main Conveyance in Each Spring Site		m	11,600
3) Pipe Installation for Trunk Line-1 (Badan-Malaqi Jct.-Shibli)		m	10,000
4) Pipe Installation for Trunk Line-2 (Far'ah-Malaqi Jct.)		m	3,000
5) Pipe Installation for Sub-main Conveyance (An Nassariya, Al' Aqrabaniya, Frush Beit Dajan, Al Jiftlik)		m	19,000
Improvement of Conveyance System for Private Springs			
1) Fasayil Spring	Intake Rehabilitation	L.S.	1
	Pipe Installation for Main Conveyance	m	2,000
2) Shusah Spring	Intake Rehabilitation	L.S.	0
	Pipe Installation for Main Conveyance	m	1,000
3) Al Qilt & Fawwar Spring	Intake Rehabilitation	L.S.	0
	Main Canal Rehabilitation	m	5,000

Source: JICA Study Team.

(4) Provisional Cost Estimate for Implementation of Basic Plan

The implementation costs for the both prioritized projects and future projects are provisionally estimated as summarized in the following table.

Table 6.3.7 Provisional Cost Estimate for Priority Scheme

Item	Total Amount (US$)
[Al 'Auja Spring]	
1. Construction Cost	**5,734,900**
(1) Direct Construction Cost	5,213,500
(2) Administrative Cost	521,400
2. Engineering Cost	**860,200**
3. Software Component Program	**533,500**
SubTotal	**7,128,600**
Contingency	1,425,700
Total	**8,554,300**
[Al Dyuk & Nwai'mah Spring]	
1. Construction Cost	**4,343,200**
(1) Direct Construction Cost	3,948,400
Nwai'mah	1,246,100
Dyuk	2,702,300
(2) Administrative Cost	394,800
2. Engineering Cost	**592,300**
3. Software Component Program	**541,100**
SubTotal	**5,476,600**
Contingency	1,095,300
Total	**6,571,900**

Source: JICA Study Team.

Note: - The details of work items will be explained in Chapter 8.
- Before implementation, the basic design study is required, but the cost for the Study is not included in the table above.

Table 6.3.8 Provisional Cost Estimate for Future Project

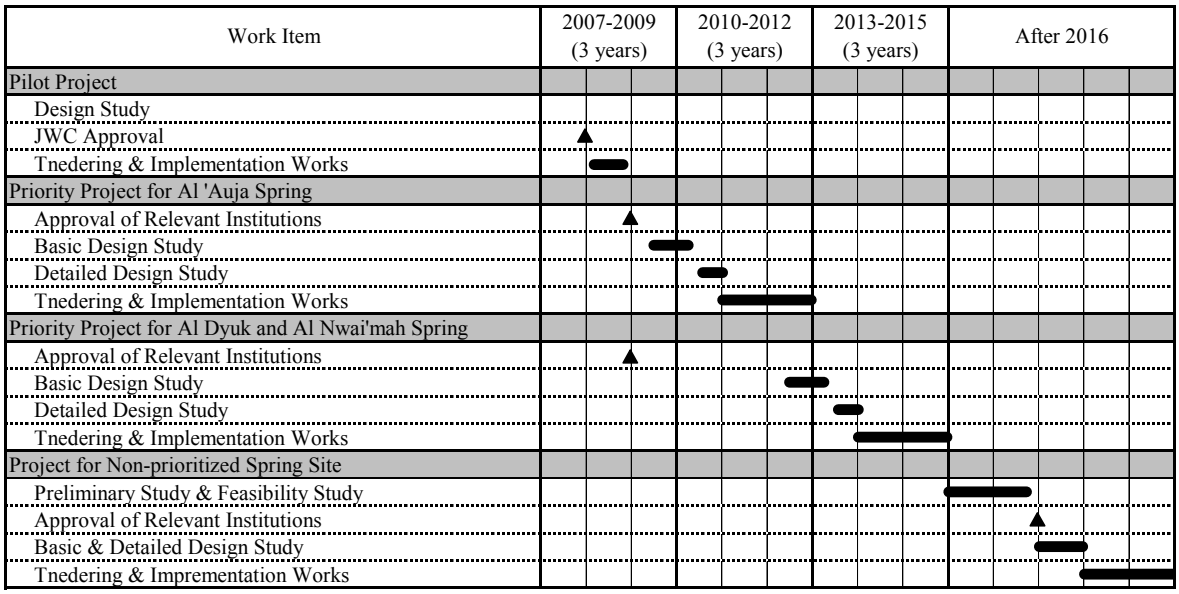
Item		Cost (USD)
Improvement of Conveyance System for Al-Far'ah Area Springs		
1. Construction Cost		**12,674,200**
(1) Direct Cost		11,522,000
(2) Administration Cost	*10% of Direct Cost*	1,152,200
2. Engineering Cost	***15% of Direct Cost***	**1,728,300**
Subtotal		**14,402,500**
Contingency	*20% of Subtotal*	2,880,500
Total		**17,283,000**
Improvement of Conveyance System for Private Springs		
1. Construction Cost		**1,653,410**
(1) Direct Cost		1,503,100
(2) Administration Cost	*10% of Direct Cost*	150,310
2. Engineering Cost	***15% of Direct Cost***	**225,465**
Subtotal		**1,878,875**
Contingency	*20% of Subtotal*	375,775
Total		**2,254,650**

Source: JICA Study Team.

Note: The cost for software component for the future projects is not estimated because the detailed survey will be required to identify its work items

(5) Tentative Implementation Schedule for Improvement of Spring Conveyance System

The following schedule for implementation is tentatively proposed.



Source: JICA Study Team

Figure 6.3.2 Proposed Implementation Schedule of Basic Plan for Improvement of Spring Water Conveyance System

The bar schedule for each priority project will be varied in terms of detailed work components which shall be identified as result of each Feasibility Study to be conducted.

6.3.5 Basic Plan for Integrated Management of Spring Water Conveyance System

(1) Basic Conditions for Rehabilitation

The following basic conditions must be agreed among stakeholders before rehabilitation.

- Establishment of a coordination committee or a similar body, which manages the spring water conveyance system at local government level.
- Contribution of a rehabilitation counterpart cost (if a donor requires)
- Compliance to a tariff system, which is set by the coordination committee

If there are informal water users, such as Bedouins who traditionally take water from canals, their continuous water use after the rehabilitation has to be taken into consideration in the design and water distribution planning.

(2) Ownership of Facility

The rehabilitated facility is a public facility, which provides water supply service for domestic, agriculture and industrial purposes. Therefore, ownership of the rehabilitated facility belongs to the concerned village council.

(3) Establishment of Coordination Committee

Spring water is generally utilized for domestic use, agriculture use, and sometimes industrial use. In order to operate the system properly, it is necessary to establish a coordination committee, which maintains the interests of each party. The committee should consist of representatives from various stakeholders, such as the village council, domestic water users, and water rights holders. The possible members of a coordination committee include:

- Village council: a body in charge of O&M and a body in charge of domestic water supply; and
- Representative from water rights holders: persons who have water rights to receive water from each outlet of the main water conveyance system.

The following roles and responsibilities for the coordination committee are considered:

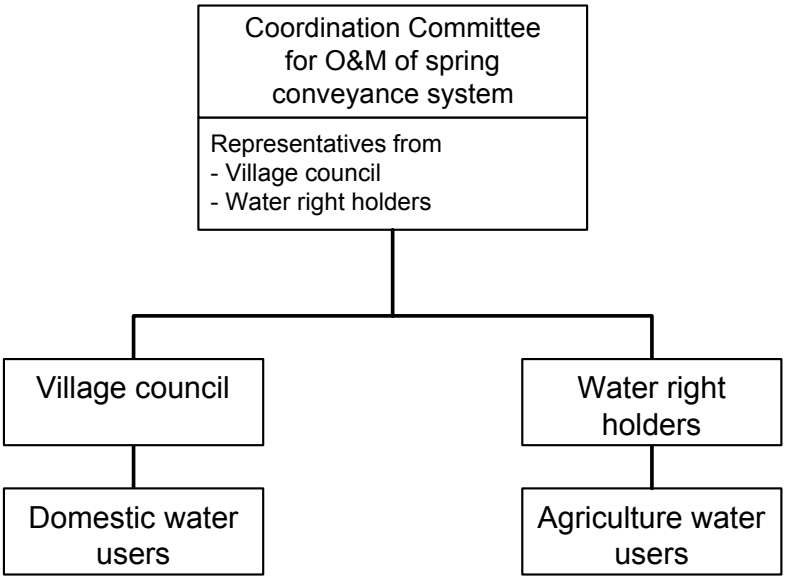
- Authorization of a water distribution plan;
- Appointment of staff for O&M;
- Setting the water fees and formulation of a tariff system;
- Authorization of a regulation on water supply;
- Authorization of the budget;
- Auditing account; and
- Resolution of disputes among stakeholders.

(4) Type of Operation and Maintenance System

Similar to the case in well rehabilitation, PWA has the responsibility to periodically monitor the condition of the rehabilitated spring water system from the technical and management view points. If any problems are identified, PWA has to give advice to the concerned village councils.

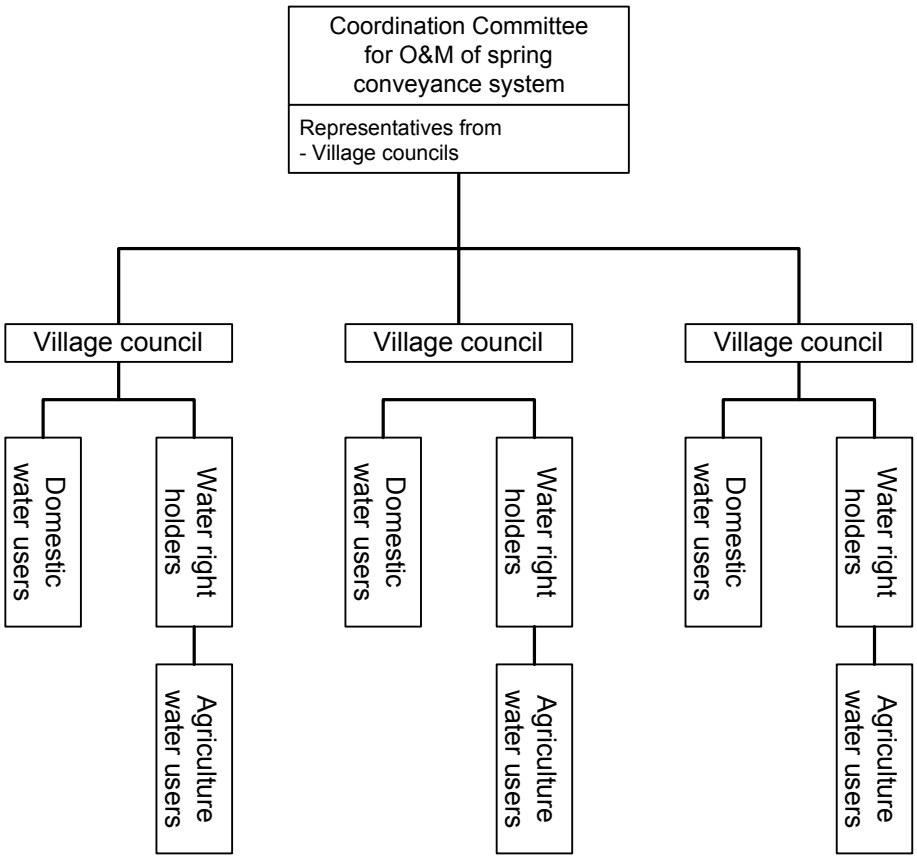
Type 1 (Single spring conveyance system)

In the case of one spring has a complete water conveyance system within a single local government jurisdiction area, the local government undertakes the O&M of the system under supervision of the coordination committee. The possible organization structure is illustrated below.



Type 2 (Integration of multiple spring conveyance systems)

In the case of multiple spring conveyance systems integrated into one large conveyance system, or if one spring conveyance system supply beyond one local government jurisdiction area, there will be a huge number of stakeholders from domestic, irrigation, and industrial water users. A coordination committee should be established to manage the whole system (see chart below). The coordination committee will consist of village councils from all the villages as representatives of their water users. With regards to O&M, the coordination committee does not have enough capacity to work on this directly. The committee will contract out the O&M of the whole system to other parties. The Joint Council for Services, Planning and Development (JCSPD) is one of candidate entities to implement this task. They are a management body to provide public services all over Jericho and Jordan River Rift Valley (JJRRV). Currently, they are providing solid waste management services in JJRRV.



(5) Introduction of Tariff System

In a similar way as the well, water fees should be collected fairly based on volume of water use. In the case of the spring conveyance system, O&M cost is much lower than that of a well, and depreciation cost will not be a big burden for water users. Therefore, full cost recovery can be applied as basis for the tariff calculation.