

4-4 Current Conditions of Irrigation Network System with Related Structures

4-4-1 Overview of Current Irrigation System

Current irrigation system which distributes water to 8,391 ha through Arzni-Shamiram canal, Lower Hrazdan canal and Ranchpar pump station, is divided into two (2) parts. First part is the east side of Kasakh River before Arzni-shamiram canal crossing the Kasakh River, which area irrigated by Arzni-shamiram canal. And the second part is the west side of Kasakh River after Lower Hrazdan canal passing the Kasakh River, which are irrigated by Lower Hrazdan canal.

The Ranchpar pump station consists of two (2) pumps; i.e. No.1 in Ararat Marz and No.2 in Armavir Marz. The station No.1 lifts up the collected drain water near lower part of Hrazdan River to pump station No.2, and lifted water is distributed to Lower Hrazdan canal through the No.2. These pump stations are operated by Water Supply Agency (WSA).

Table 4-4-1.1 lists the cultivated crops and those area under current irrigation plan. Those areas are located in Yeghvard WUA in Kotayk Marz, Ashrarak WUA in Aragatsotn and Armabvir Marzes, Vagharshapat WUA in Armavir Marz, and Khoy WUA in Armavir Marz respectively.

Table 4-4-1.1 Current Irrigation Area and Crops

Crop	Area (ha)
Wheat	1,560
Vegetable	2,819
Potato	669
Grape	1,110
Alfalfa	910
Fruit	831
Others	492
Total	8,391

Source) MOA

Most of the areas are irrigated by furrow irrigation method. However, the area lower part of Lower Hrazdan canal has issues about water shortage. It is caused by difficulty of pump's water distribution due to deficit of ground water, conveyance water loss and so on. The current situation of ground water level and amount of collected water volume by drain canal for irrigation use becomes worse year by year, especially in Akanalich and Metsamor pump stations, which located in Ararat Plain.

As a countermeasure to the water shortage, especially in Khoy and Vagharshapat WUAs, those WUA install a lot of wells and tackle with water shortage issues by themselves. Consequently, WUA strongly hope to shift from pump-based irrigation to gravity system. Figure 4-4-1.1 shows the scattered pump facilities which located in Khoy WUA and Vagharshapat WUA, Table 4-4-1.2 lists the number of pump facilities in those WUAs, and Figure 4-4-1.2 shows the current situation of schematic diagram of irrigation network.

Table 4-4-1.2 Pump Facilities in Khoy and Vagharshapat WUA

WUA	Deep Well	Pump Station
Khoy	61	10
Vagarshapat	72	3
Total	133	13

Note) Except for WSA of PS are. Akanalich, Metsamor, Ranchpar No.1, 2 pump stations
Source) JICA Study Team

4-4-2 Current Conditions of Irrigation Network System

Irrigation areas targeted by the Yeghvard irrigation system are divided into two(2) areas, namely;

- 1) The area is composed of Yeghvard and Ashtarak WUAs which are located at east of Kasakh River and are irrigated by a) Arzni-Branch canal and b) Takahan canal through Kasakh River.
- 2) The other area is composed of Vagharshapat and Khoyn WUAs which are located at west of the Kasakh River and are irrigated by c) Shah-Aru and d) Lower Hrazdan canals through Kasakh intake and Ranchpar pump station No.1 and No.2. These area, also, are irrigated by e) Upper Akhnalich, f) Inner Akhnalich and g) Metsamor canals sourced by two (2) pump stations (Akhnalich and Metsamor PSs).

The aim of the irrigation facility survey is to understand current irrigation situation for the targeted areas including the above seven (7) canals, "a" to "g", by field surveys as well as interviews to related WUAs and organizations.

A survey for target facilities are carried out for major irrigation facilities in the areas, of which location map is shown in Figure 4-4-2.1.

Responsibility	Facility and structure	Location
Yeghvard WUA	Arzni-Branch canal, BP. to PK120	
Ashtarak WUA	Arzni-Branch canal, PK120 to EP. Takahan canal	
Vagharshapat WUA	Shah-Aru canal Kasakh Intake at right bank	
Khoyn WUA	Upper Akhnalich canal	
	Inner Akhnalich canal	
	Metsamor canal	
	Kasakh Intake at left bank	
Water Supply Agency (WSA)	Lower Hrazdan canal	
	Akhnalich PS.	
	Metsamor PS	
	Ranchpar PS. 1	
	Ranchpar PS. 2	

Figure 4-4-2.1 Location Map of Irrigation Facilities

Inventory survey for the facilities in target area is conducted as followings;

- a) Survey on main canal in the Project areas
 - Condition of irrigation and facilities (Deterioration and damage)
 - Diversion from other water source
- b) Survey on Kasakh Intake and main pump stations
 - Condition of facilities and pump stations

(1) Result of inventory survey for targeted canal

a) Arzni-Branch canal system



Figure 4-4-2.2 Location of the Irrigation Facilities of Arzni Branch Canal

b) Takahan canal system

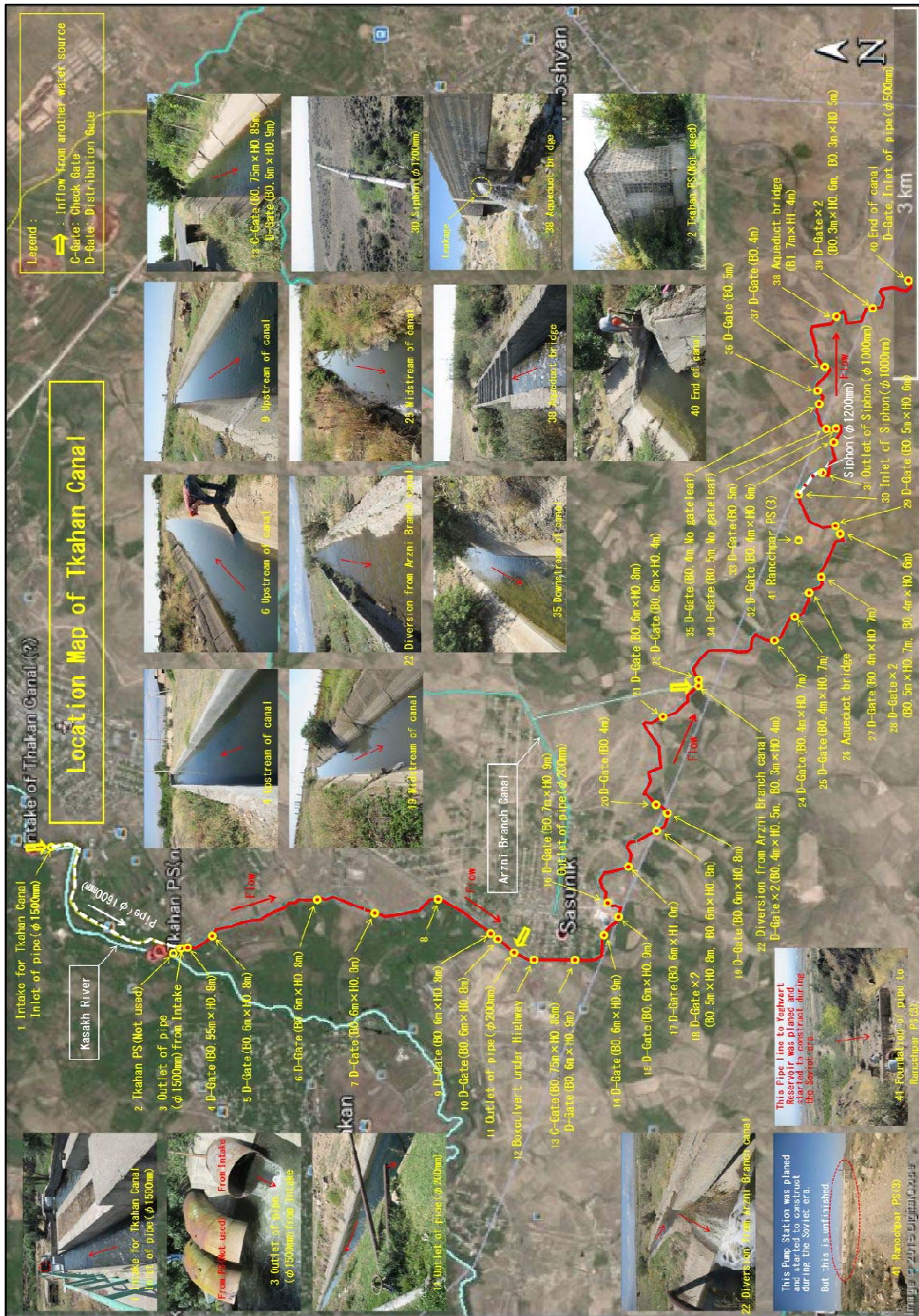


Figure 4-4-2.3 Location of the Irrigation Facilities of Takahan Canal

c) Shah-Aru canal system

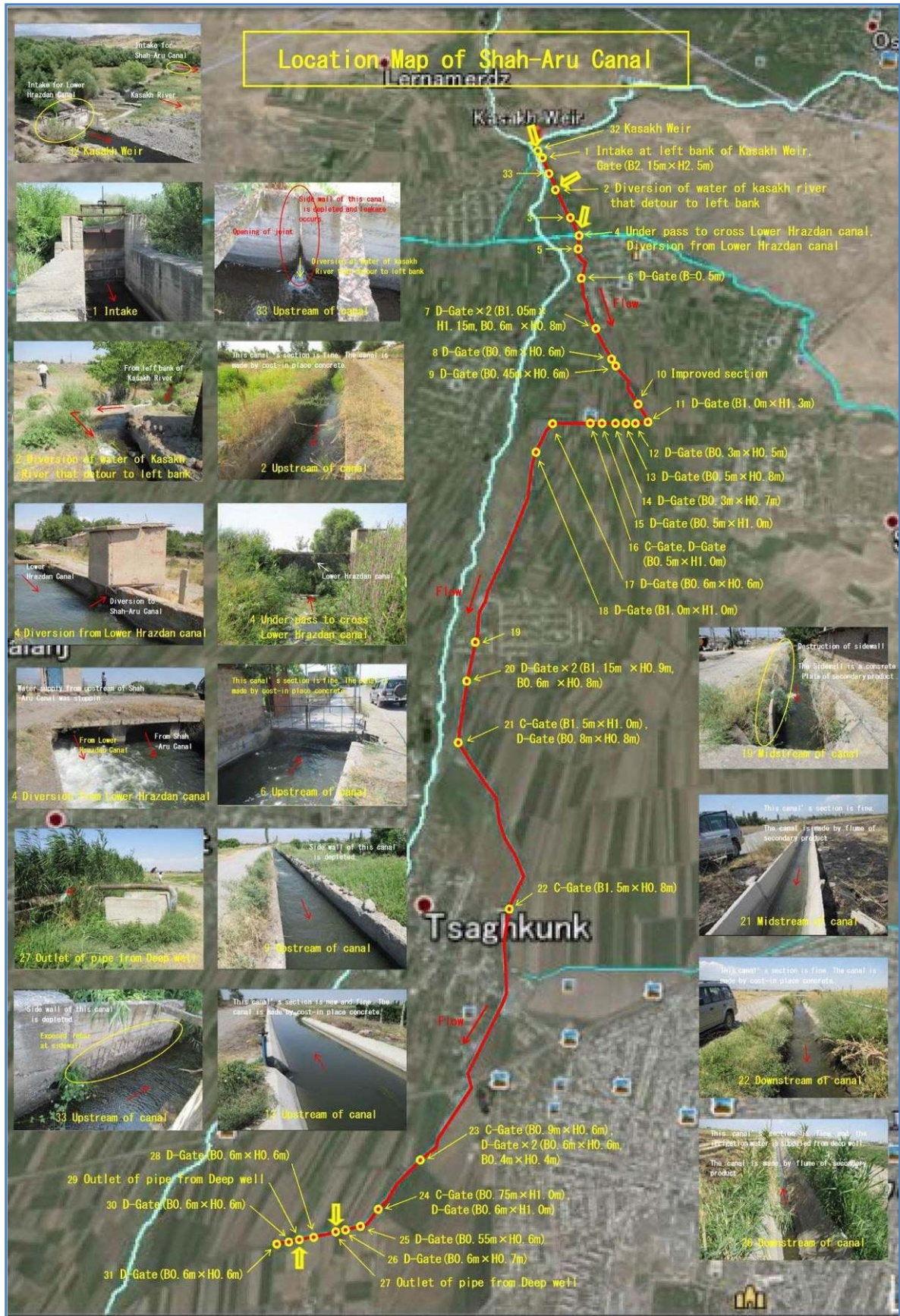


Figure 4-4-2.4 Location of the Irrigation Facilities of Shah-Aru Canal

d) Upper Aknalich canal

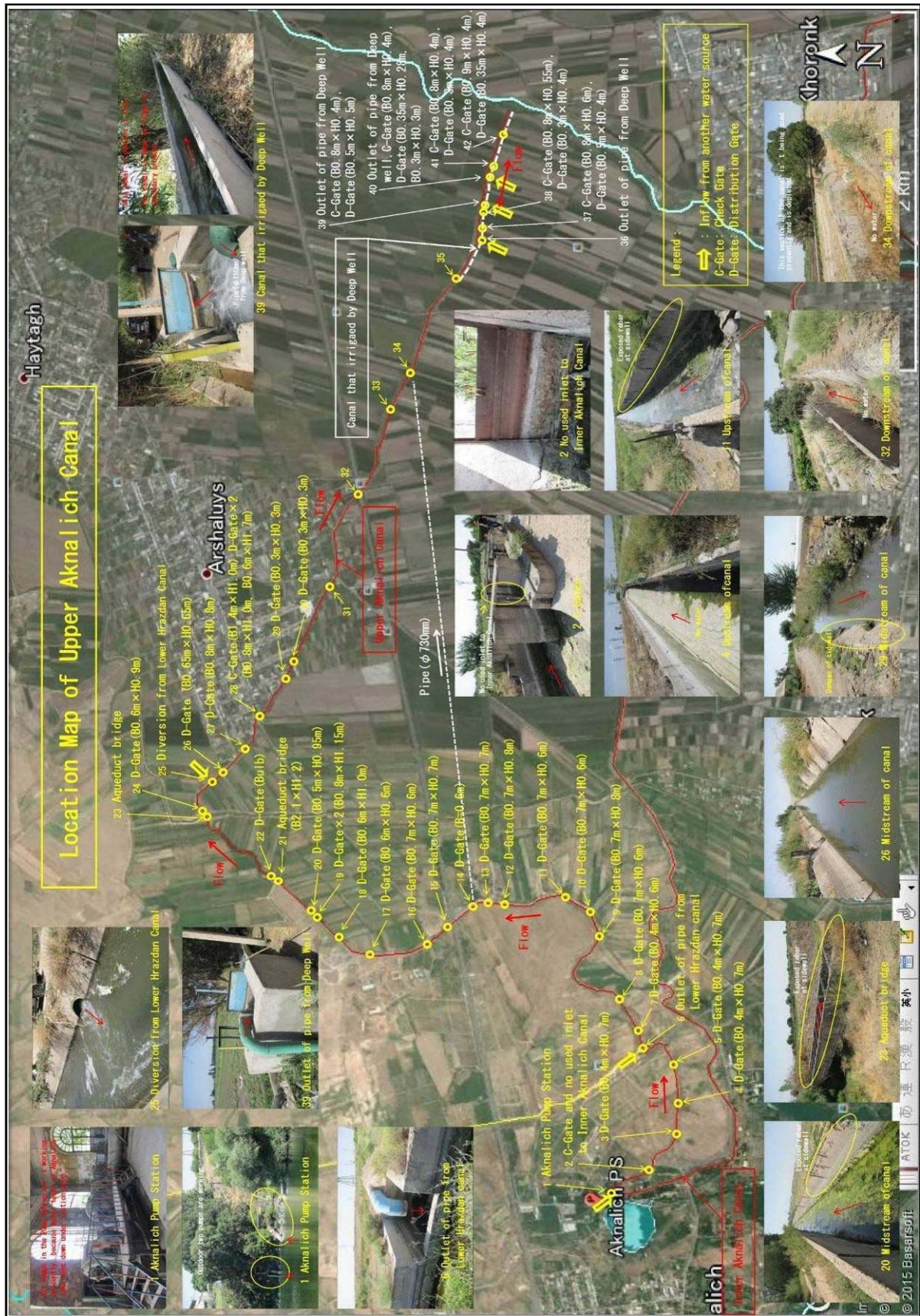


Figure 4-4-2.5 Location of the Irrigation Facilities of Upper Aknalich Canal

e) Inner Aknalich canal

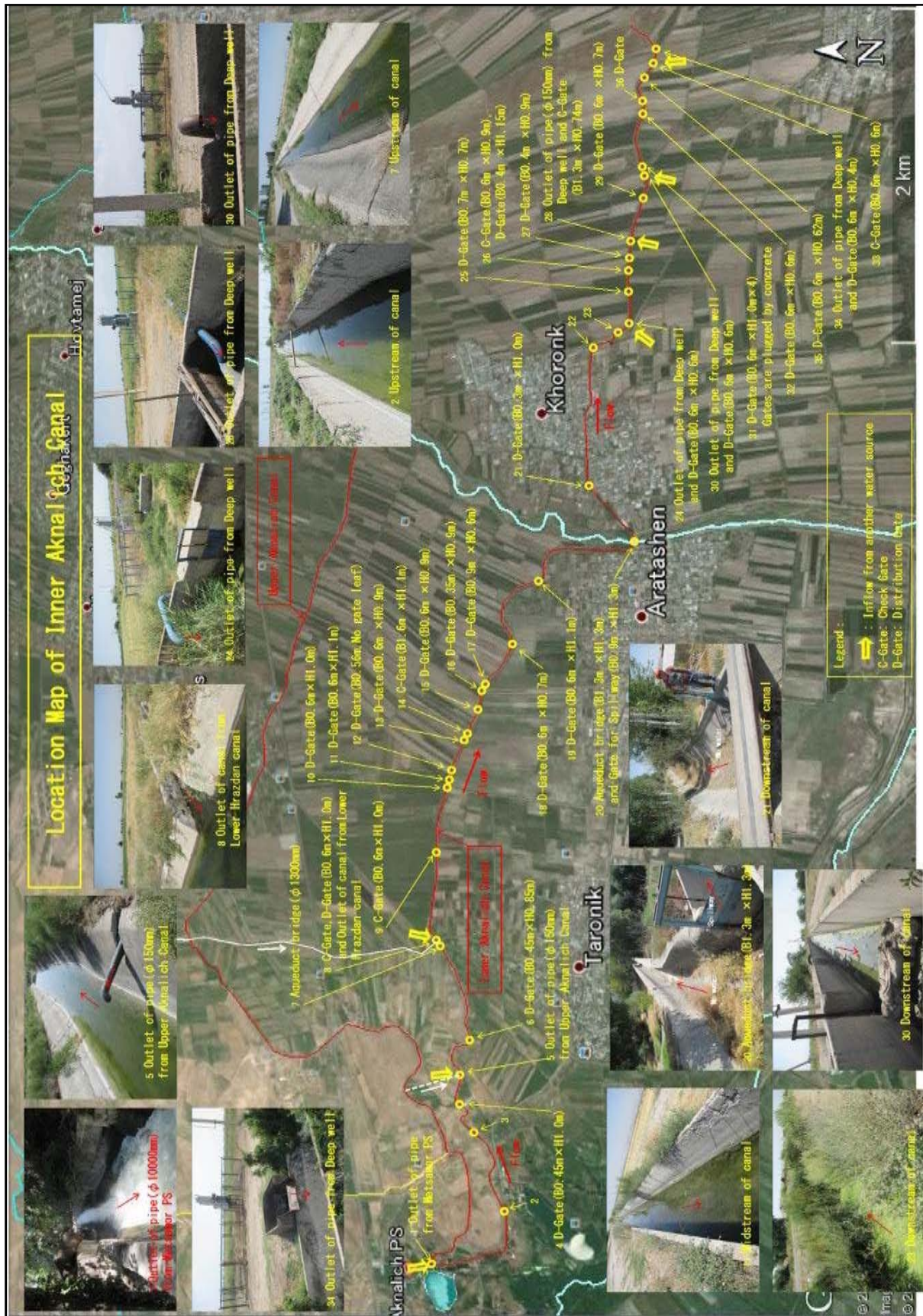


Figure 4-4-2.6 Location of the Irrigation Facilities of Inner Aknalich Canal

g) Lower Hrazdan canal

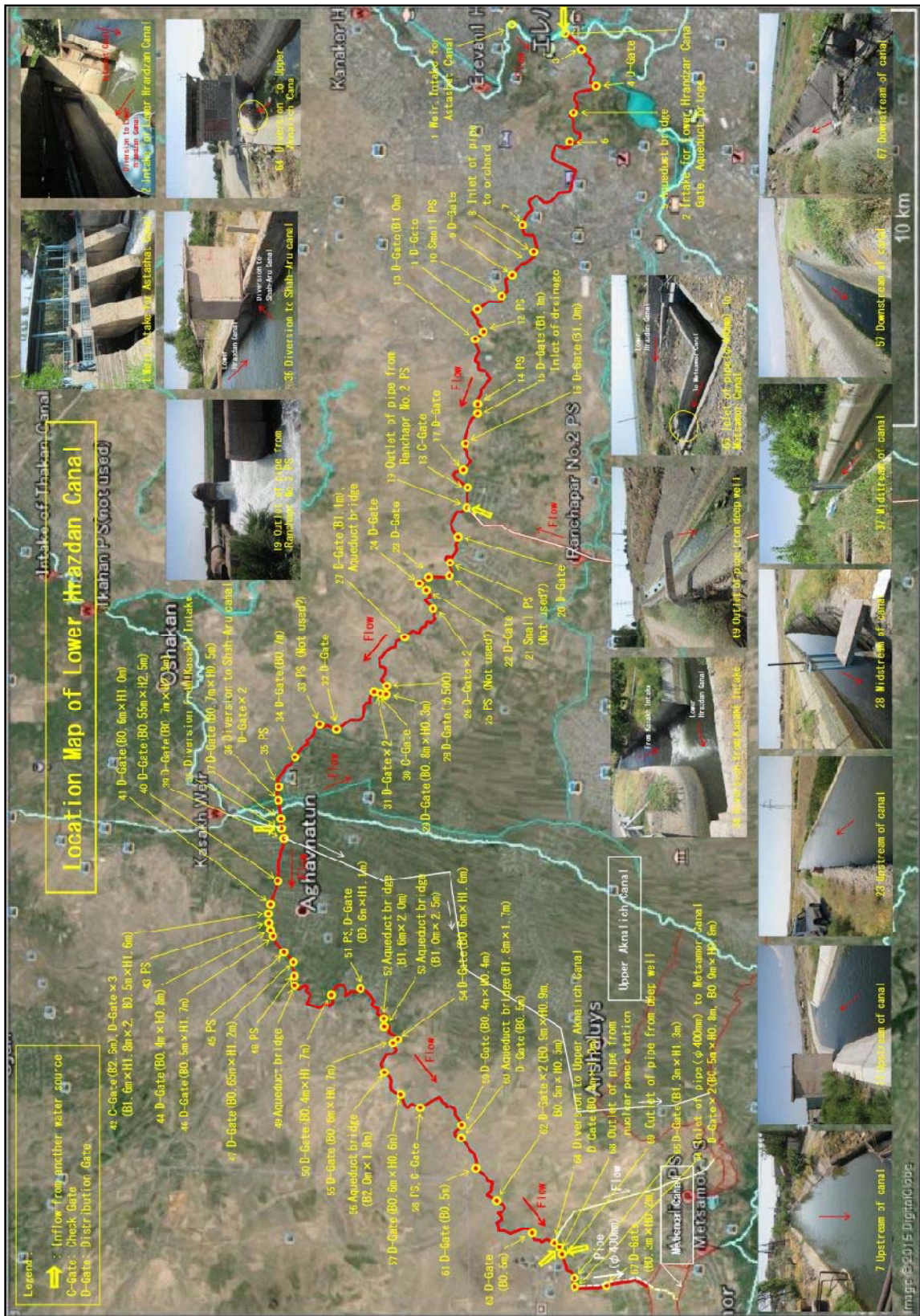


Figure 4-4-2.8 Location of the Irrigation Facilities of Lower Hrazdan Canal

(2) Structural dimensions and conditions of canal

According to the survey by WB Rehabilitation Program, structural dimensions and conditions of targeted canals are shown in Table 4-4-2.1 to 4-4-2.5.

Table 4-4-2.1 Arzni Branch Canal's Structural Dimensions and Conditions

Arzni branch canal							
NN	D/M	Length	Conser Code	b, m	B, m	H _{st.} m	Discharge Q, m ³ /s
1	0+00 0+90	90	C	1.0	2.5	1.5	7.0
2	0+90 2+00	110	C	1.0	2.5	1.5	7.0
3	2+00 2+35	35	C	0.7	2.2	1.5	7.0
4	2+35 4+95	260	C	0.6	2.1	1.5	7.0
5	4+95 6+00	105	C	0.7	2.5	1.8	7.0
6	6+00 10+20	420	C	0.8	2.8	2.0	7.0
7	0+25		B				7.0
8	3+50		B				7.0
9	8+80		B				7.0
10	9+10		B				7.0
11	10+00	-	G				-
12	10+20 11+20	100	C	0.8	2.6	1.8	7.0
13	11+20 11+50	30	C	2.5	2.5	2.5	7.0
14	11+50 29+00	1750	C	1.0 2.5	3.0 5.0	2.0 2.5	7.0
15	11+70	-	OUT				-
16	29+00 32+00	300	C	1.8	4.3	2.5	7.0
17	37+60	-	OUT				-
18	32+00 37+90	590	C	1.3	3.8	2.5	7.0
19	37+90 38+25	35	C	2.0	2.0	2.5	7.0
20	38+25 38+75	50	A	2.0	2.0	2.5	7.0
21	38+75 39+10	35	C	2.0	2.0	2.5	7.0
22	39+10 49+10	1000	C	1.5	4.0	2.5	7.0
23	46+00	-	OUT				-
24	49+10 52+00	290	C	8.0 1.5	3.1 4.5	2.5 3.0	7.0
25	52+00 56+00	400	C	1.2	3.8	2.6	6.0
26	56+00 56+50	50	C	1.3	3.9	2.6	6.0
27	56+50 61+00	450	C	1.3	3.9	2.6	6.0
29	59+00, 59+30; 59+40	3	OUT				-
30	61+00 64+50	350	C	1.2	3.6	2.4	6.0
31	64+50 69+00	450	C	1.2	3.7	2.5	6.0
32	69+00 72+80	380	C	1.3	3.3	2.0	4.3
33	72+80 88+00	1520	C	1.3	3.3	2.0	4.3
34	88+00 97+00	900	C	1.3	3.6	2.3	4.3
35	97+00 105+00	800	C	1.2	3.9	2.7	4.3
36	105+00 107+50	250	C	1.2	3.9	2.7	4.0
37	107+50	-	OUT				-
38	107+50 107+90	40	A	2.0	2.0	2.0	3.6
39	107+90 123+00	1510	C	1.5	4.1	2.6	3.6
40	123+00 130+00	700	C	0.8	2.0	1.2	2.8
41	130+00 136+00	600	C	1.0	2.7	1.7	2.8
42	136+00	-	OUT				-
43	136+00 137+50	150	C	0.8	2.3	1.5	2.8
44	137+50 143+00	550	C	0.8	2.3	1.5	2.8
45	143+00 143+80	80	C	1.5	1.5	1.5	2.8
48	143+80 144+50	70	C	0.4	1.6	1.2	2.8
49	144+50 145+00	50	A	1.5	1.5	1.2	2.8
50	145+00 145+50	50	C	0.8	2.3	1.5	2.8
51	145+50 148+50	300	C	0.5	2.0	1.5	2.0
52	148+50 152+50	400	C	0.5	1.9	1.4	2.0
53	152+00		S				2.0
54	152+50 170+50	1800	S		d = 700		2.0
55	145+50		B				2.8

Construction Code

C - Canal

S - Syphon

A - Aqueduct

IN - Intake

OUT - Outlet

G - Gally

B - Bridge

O - Others

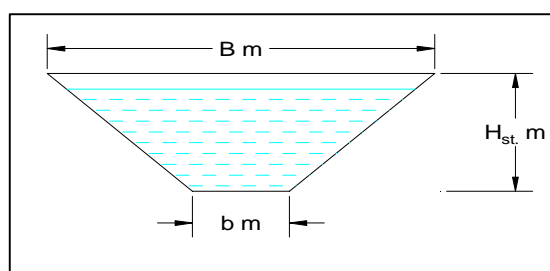


Table 4-4-2.2 Takahan Canal's Structural Dimensions and Conditions

Takahan Canal								
NN	D/M	Length m	Conser	Code	b, m	B, m	H _{st} , m	Discharge Q, m ³ /s
1	2	3	4	5	6	7	8	
1	0+00 3+50	350	C		2.5	2.5	1.5	4.3
2	3+50 5+00	150	C		2	4.5	2	4.3
3	5+00	1	B					
4	5+00 9+50	450	C		2	4.7	1.8	4.3
5	9+50 20+00	1050	C		2	5	2.1	4.3
6	20+00 22+50	250	C		1.8	4.6	1.9	4.3
7	22+50 25+50	300	C		2.8	2.8	1.5	4.3
8	25+50 27+50	200	C		2.8	2.8	1.5	4.3
9	27+50 28+60	110	C		2.8	2.8	1.5	4.3
10	28+00	1	OUT					-
11	28+60 32+60	400	C		1.6 2.0	4.2 5.0	1.7 2.0	4.3
12	32+60 50+00	1740	C		1.0 1.4	3.2 3.6	1.5	4.3
13	50+00 61+00	1100	C		0.6 1.0	2.8 3.2	1.5	4.0
14	61+00 82+00	2100	C		1	4	2	4.0
15	68+80; 80+00	1	OUT					-
16	82+00 83+00	100	C		1	3.2	1.5	3.0
17	83+00 83+50	50	A		1.5	1.5	1.8	3.0
18	83+50 84+50	100	C		1	3.2	1.5	3.0
19	84+50 86+00	150	C		1	3.4	1.6	3.0
20	86+05	1	OUT					-
21	86+00 95+00	900	C		1	3.5	1.7	3.0
22	90+05; 91+00	1	OUT					-
23	95+00 96+00	100	C		1	3.5	1.7	2.1
24	96+00 98+50	250	S		d=1200mm			2.1
25	98+50 120+00	2150	C		0.9	2.9	1.3	2.1
26	120+00 130+00	1000	C		0.8	2.6	1.2	2.1
27	20+00; 22+50; 31+50; 40+00; 41+00; 80+05; 86+00; 90+00		B		-	-	-	-
28	33+50; 50+00; 83+55		OUT		-	-	-	-

Construction Code
C - Canal
S - Syphon
A - Aqueduct
IN - Intake
OUT - Outlet
G - Gally
B - Bridge
O - Others

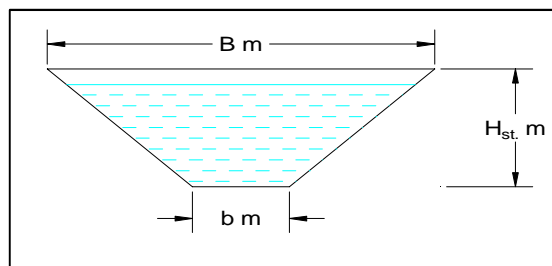


Table 4-4.2.3 Shah-Aru Canal's Structural Dimensions and Conditions

Shah-Aru Canal							
NN	D/M	Length	Conser Code	b, m	B, m	H _{st} , m	Discharge Q, m ³ /s
1	0+00 2+00	200	C	1.5	1.5	1.8	2.0
2	2+00 3+40	140	C	1.5	1.5	1.0	2.0
3	3+40 4+00	60	C	1.5	1.5	0.8	2.0
4	4+00 9+50	550	C	1.5	1.5	1.0	2.0
5	9+50 11+00	150	C	1.5	1.5	1.0	2.0
6	11+00 28+00	1700	C	2.2	2.2	1.0	3
7	28+00 34+00	600	C	2	2	1.0	3
8	34+00 41+00	700	C	1.5	3.5	1.0	2.0
9	41+00 50+00	900	C	1.0	3.0	1.0	2.0
10	50+00 56+00	600	C	1.0	3.0	1.0	2.0
11	56+00 59+00	300	C	1.0	3.0	1.0	1.5
12	59+00 67+00	800	C	1.0	3.0	1.0	1.0
13	67+00 68+50	150	C	1.0	3.0	1.0	1.0
14	68+50 70+00	150	C	1.0	3.0	1.0	1.0
15	70+00 84+00	1400	C	1.0	3.0	1.0	1.0
16	84+00 93+00	900	C	1.0	3.0	1.0	0.7

Table 4-4.2.4 Lower Hrazdan Canal's Structural Dimensions and Conditions (1/2)

Lower Hrazdan Main canal II stage							
NN	D/M	Length	Conser Code	b, m	B, m	H _{st} , m	Discharge Q, m ³ /s
1	0+00 3+00	300	S	3	3	1.5	7
2	3+00 6+50	350	C	2	6	2	7
3	6+50 21+50	1500	C	2	6	2	7
4	21+50 26+00	450	C	2	2	2.5	8
5	26+00 37+50	1150	C	2	6	2	8
6	37+50 40+00	250	C	2	6	2	5
7	40+00 46+70	670	C	2	6	2	5
8	46+70 47+70	100	A	3.5	3.5	2.5	3
9	47+70 80+35	3265	C	1.5	7.5	3	3
10	80+35 107+35	2700	C	1.5	7.5	3	3
11	107+35 159+35	5200	C	1.5	6.5	2.5	3
12	159+35 218+70	5935	C	1.5	5.5	2	3

Construction Code
C - Canal
S - Syphon
A - Aqueduct
IN - Intake
OUT - Outlet
G - Gally
B - Bridge
O - Others

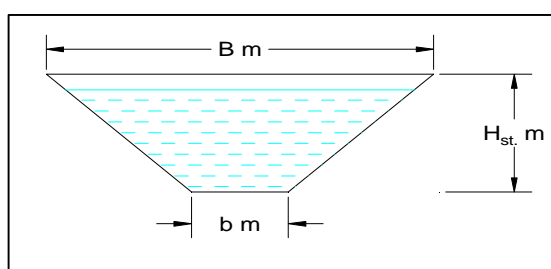
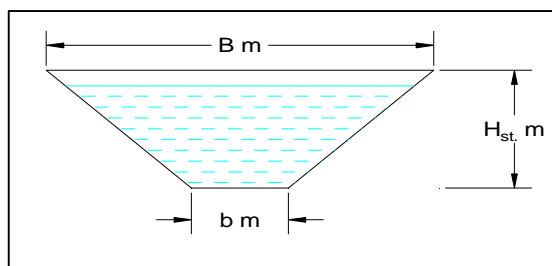


Table 4-4-2.5 Lower Hrazdan Canal's Structural Dimensions and Conditions (2/2)

Lower Hrazdan Main canal I stage							
NN	D/M	Length	Conser Code	b, m	B, m	H _{st.} , m	Discharge Q, m ³ /s
1	0+00	0	IN	5	5	3	13
2	0+00 1+13	113	A	3	3	3.5	10
3	1+13 4+15	302	C	3	6.5	3.5	10
4	4+15 4+80	65	C	6.5	3	3.5	10
5	4+80 12+00	720	C	3	10	3.5	10
6	12+00 12+50	50	C	3	10	3.5	10
7	12+50 14+80	230	C	3	10	3.5	10
8	14+80 15+80	100	C	3	10	3.5	10
9	15+80 34+20	1840	C	3	10	3.5	10
10	34+20 38+20	400	C	3	10	3.5	10
11	38+20 57+20	1900	C	3	10	3.5	10
12	57+20 61+00	280	C	3	10	3.5	10
13	61+00 64+80	380	C	3	10	3.5	10
14	64+80 73+10	830	C	4	4	2.5	10
15	73+10 77+20	410	C	4	4	2.5	10
16	77+20 77+70	50	C	4	4	2.5	10
17	77+70 83+44	574	C	3	10	3.5	10
18	83+44 84+05	71	A	3.5	3.5	3.5	10
19	84+05 88+05	400	C	3	10	3.5	10
20	88+05 90+50	245	C	3	10	3.5	10
21	90+50 93+40	290	C	3	10	3.5	10
22	93+40 98+00	460	C	3	10	3.5	10
23	98+00 98+70	7	A	3.5	3.5	3.5	10
24	98+70 107+00	830	C	3.5	3.5	3.5	10
25	107+00 118+00	1100	C	3	10	3.5	10
26	118+00 132+00	1400	C	3	10	3.5	10
27	132+00 144+50	1250	C	3	9	3	10
28	144+50 146+50	200	C	3	9	3	10
29	146+50 188+40	5650	C	3	9	3	10
30	188+40 203+00	1460	C	2	7	2.5	9
31	203+00 227+00	2400	C	3	9	3	9
32	227+00 248+00	2100	C	3	9	3	8
33	248+00 254+00	600	C	3	9	3	8
34	254+00 271+50	1750	C	3	8	2.5	8
35	271+50 273+50	200	C	2	7	2.5	8
36	273+50 282+12	862	C	2	7	2.5	8
37	282+12 282+60	48	C	4	4	3	7
38		35	OUT				

Construction Code
C - Canal
S - Syphon
A - Aqueduct
IN - Intake
OUT - Outlet
G - Gally
B - Bridge
O - Others



(3) Major pump station

The situation of existing pump stations is shown in Figure 4-4-2.9;








Responsibility	Facility and structure	Picture	
Khoy WUA	<p>Akmalich PS.</p> <p>Constructed in 1926 yr 3pumps at outside are installed P1 :0.065m³/s P2: 0.265m³/s P3 :0.75m³/s</p> <p>4pumps at house are installed P1 :0.4m³/s P2: -m³/s (expired) P3 :-m³/s (expired) P4 :-m³/s (expired)</p>		
	<p><u>Inside pump station</u></p>	<p><u>Outside pump station</u></p>	
Water Supply Agency (WSA)	<p>Metsamor PS</p> <p>Constructed in 1960yr 4pumps are installed P1 :0.32m³/s P2: 0.55m³/s P3 :0.95m³/s P4 :0.35m³/s</p> <p>P2 is only to operate in once per 2days. others are suspended.</p>		
	<p><u>Inside pump station</u></p>	<p><u>Pipeline from pump station</u></p>	
Water Supply Agency (WSA)	<p>Ranchpar PS. 1</p> <p>Constructed in 1985 yr</p> <p>Major rehabilitation in 2011 by Millennium Challenging Cooperation(MCC)</p> <p>4pumps made in Turkey are re-installed. P1 :1.75m³/s P2: 1.75m³/s P3 :1.75m³/s P4 :1.75m³/s</p> <p>※ Normally 5.3m³/s discharge of 75% Max.</p>		
	<p><u>Pump station (out view)</u></p>	<p><u>Pump station (inside)</u></p>	
Water Supply Agency (WSA)	<p>Ranchpar PS. 2</p> <p>Constructed in 1985 yr</p> <p>Major rehabilitation in 2011 by Millennium Challenging Cooperation(MCC)</p> <p>4pumps made in Turkey are re-installed. P1 :0.92m³/s P2: 0.92m³/s P3 :1.30m³/s P4 :1.30m³/s</p>		

Figure 4-4-2.9 Situation of Existing Pump Stations

(4) Kasakh intake

Existing Kasakh Intake has following situations by visual survey and interview.

- ✓ Construction in 1950s as headworks with intakes at both sides with length of 130m.
- ✓ Water taken from right bank reaches to Khoy WUA which is linked with Lower Hrazdan canal.
- ✓ Water taken from left bank reaches to Shah-Aru canal by earth canal which is connected at 70m upstream of headworks. It irrigates Vaghashapat WUA.

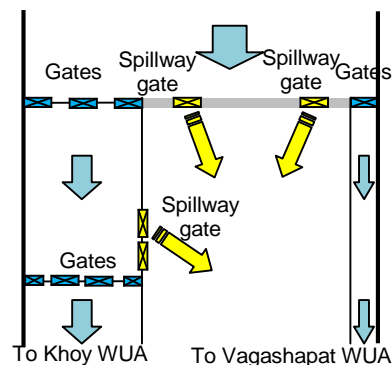


Figure 4-4-2.10 Kasakh Intake

- ✓ River discharge in peak is in March to April which is caused by melted snow. In these seasons, the fixed weir is sometimes submerged.
- ✓ 165m downstream at right side, four irrigation gates and two spillway gates are existed
- ✓ During flood season, all of irrigation gates are closed to prevent the water into canals. Two of radial gates at headworks are simultaneously opened to keep safe irrigation
- ✓ **Although the concrete structures are old, the intake and distribution have been functioned. The serious situation is not observed since the gates are still capable to operate.**

Picture	Description
	Kasakh intake general view Three irrigation gates are installed.
	Kasakh intake at right side One spillway gate is installed.

	<p>Kasakh intake at left side (1)</p> <p>One intake gate is installed.</p>
 <p>Operation dike</p>	<p>Kasakh intake at left side (2)</p> <p>At upstream of left gate, operation of intake is conducted by small dike. In off-irrigation season, dike is embanked to close the earth canal.</p>
 <p>Flow</p>	<p>Kasakh intake at left side (3)</p> <p>Shah-Aru canal is constructed by concrete canal.</p>
 <p>Flow</p>	<p>Kasakh intake at right side (1)</p> <p>Headrace canal go down along the Kasakh river and to reach Lower Hrazdan canal</p>
 <p>Flow</p>	<p>Kasakh intake at right side (2)</p> <p>Four irrigation gates are installed for regulation of main canal and two spillway gates at left side are installed which release excess water to Kasakh river.</p>

Figure 4-4-2.11 Situation of Existing Kasakh Intake

4-4-3 Current Operation and Maintenance on the Irrigation Network System

(1) Implementation arrangement (organization of WSA / WUA)

There are two (2) organizations for operating and maintaining of existing irrigation network system. One is WSA belonging to SCWE and another is WUA. Under WSA, there are two (2) organizations related to collecting irrigation fee, Sevan-Hrazdanyan Jrar CJSC and Akhuryan-Araks Jrar CJSC. Operation and maintenance in the Project area has been carried out by the Sevan-Hrazdanyan Jrar CJSC.

This WSA has been carrying out the operation and maintenance (O/M) for Arzni-shamiram canal, Lower Hrazdan canal, Ranchpar and Aknalich pump stations. One of the major activities of the WSA is proper water distribution for irrigation system. WSA is a responsible organization for distributing irrigation water from main canal to secondary canal.

WUA has a responsible for appropriate water distribution for farmers, and O/M along the secondary and tertiary canals. WUA also collect the water fee from farmers. There are Yeghvard, Ashtarak, Vagarshapat and Khoy WUAs in the Project area.

Administrative responsibility demarcation point between WSA and WUA is an intake gate facility where the irrigation water is distributed from the main canal to branch canal. At the gates of the secondary canal' intakes, the operation and management are carried out by the WSA. This is the reason that WSA is the only organization to distribute irrigation water equally along the main canal. WUA has operated and maintained the gates and canals after the secondary canal's intake gate. Table 4-4-3.1 shows the major functions of WUA.

Table 4-4-3.1 Major Functions of WUA

Operation and maintenance	Provide training for members
Supply water to water users	Manage water supply
Rehabilitate the irrigation system	Implement necessary measures
Acquire irrigation water	Ensure environmental safety
Collection of water fee	

(2) Annual operation and maintenance (O/M) plan

a) Water supply method

WSA has been operating and maintaining from water source such as reservoir to the secondary canal's gates along the main canal since they have a responsible for appropriate water distribution. WSA sells the irrigation water to WUA. WUA has a responsible of water distribution technical support for farmers, maintenance of irrigation facilities, safety operation, discharge measurement by measuring-record equipment and others. WUA collects the water fee based on the cropped contracted area. Figure 4-4-3.1 shows the organizational chart of WUA.

Arzni-Shamiram canal and Lower Hrazdan canal has been operated and maintained by WSA. WSA decides water volume released from reservoir based on the water demand requested from farmers. Water demand is estimated by "Armenian irrigation norm".

Regarding the water fee for irrigation, WSA sells the gravity-based irrigation water by 1.01 AMD/m³ and the pump-based irrigation water by 11.52 AMD/m³ to WUA as shown in Table 4-4-3.2. On the other hand, WUA sells water to users by 11.00 AMD/m³ for both gravity-based and pump-based irrigation water. The cost of pump-based irrigation water is differed according to the location. However, WSA sells the constant price of pump-based water fee to every WUA in Armenia.

Based on the interview to PIU, the water fee by pump-based irrigation costs around 50 AMD/m³ in actual maximum cases. Therefore, the difference cost between the actual cost and the selling price from WSA to WUA has been covered by Armenian government as subsidy.

Table 4-4-3.2 Water Fee for Selling Price and Buying Price

Irrigation type	Water Fee (AMD/m ³)	
	Selling Price (from WSA to WUA)	Buying Price (by Farmer)
Gravity based Area	1.01	11.00
Pump based Area	11.52	11.00

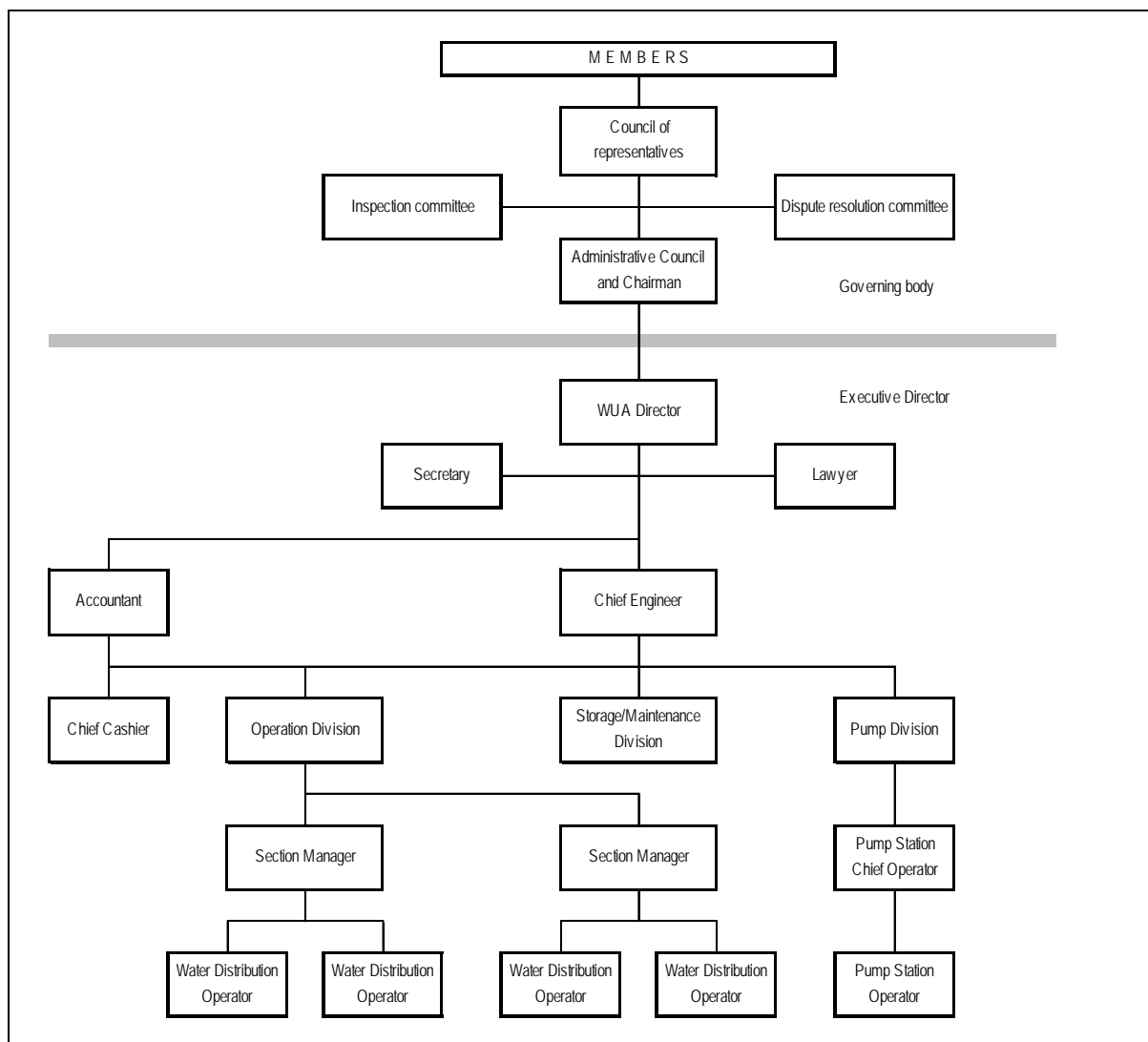


Figure 4-4-3.1 Organization Chart of WUA

b) Maintenance with monitoring (inspection) method

As shown in Figure 4-4-3.2, water level is monitored at the major points along the main canal. This monitoring is carried out twice a day by WSA’s remote staff and are reported to the WSA’s head office. The remote staff of WSA observe the water level at boundary point between each WUA, and inspects so that irrigation water is diverted to each WUA appropriately. There are six (6) monitoring points along Arzni-Shamiram canal and four (4) monitoring points along Lower Hrazdan canal, respectively.

The observed data are converted to the discharge and the 10 day’s average data have been recorded and stored as shown in Table 4-4-3.3.

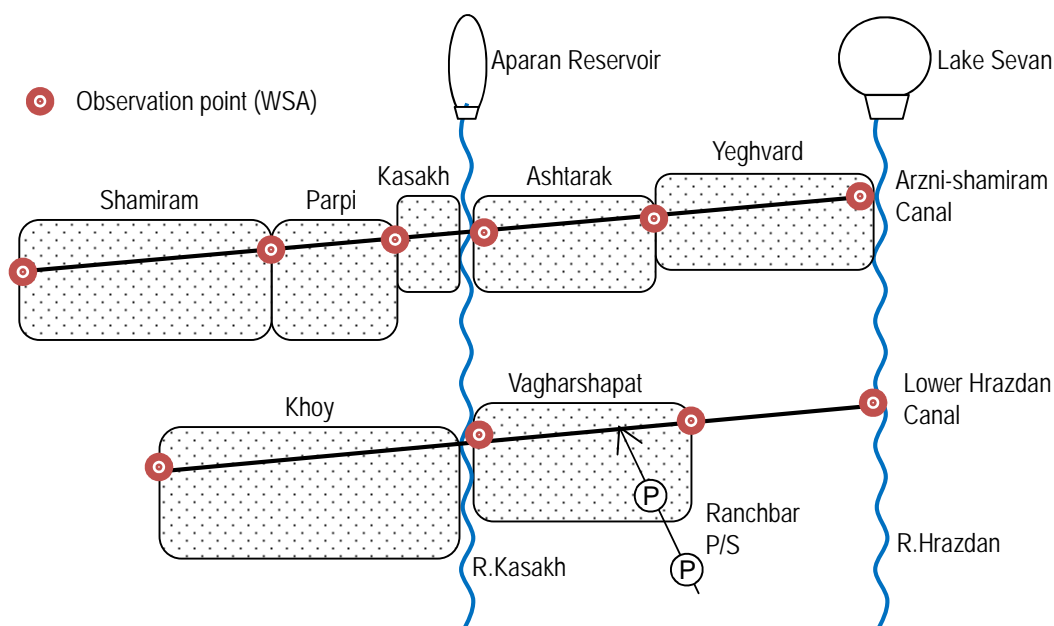


Figure 4-4-3.2 Location of Observation Point along the Main Canal

Table 4-4-3.3 Water Level’s Observed Point and Interval of Observation along Main Canal

Canal	Number of Observation point	Observation interval
Arzni-Shamiram	6	2 times/day (10 days average)
Lower Hrazdan	4	2 times/day (10 days average)

In general, irrigation starts from middle of April and ends in November. While WSA and WUA maintain the irrigation facilities such as canals and gates during the non-irrigation period in winter season, maintenance such as cleaning, annual repairing, etc. of irrigation facilities is carried out after February when the accumulated snow begins to melt.

(3) Annual budget for O/M

Figure 4-4-3.3 describes the average maintenance cost for each WUA from 2013 to 2015. The figure indicates that Vagharshapat, Khoy, Ashtarak and Yeghvard WUAs spend 104 million AMD, 116 million AMD, 23 million AMD and 15 million AMD respectively. The total maintenance cost is 258 million AMD.

While maintenance cost is different from the size of irrigation area and irrigation facilities, 40% to 50% of total maintenance cost spends for canal cleaning, and remaining percentage used for the rehabilitation works for canals, pumps and deep wells. Table 4-4-3.4 shows the unit cost for maintenance. Vagharshapat WUA spends a lot for maintenance in comparison with other WUAs.

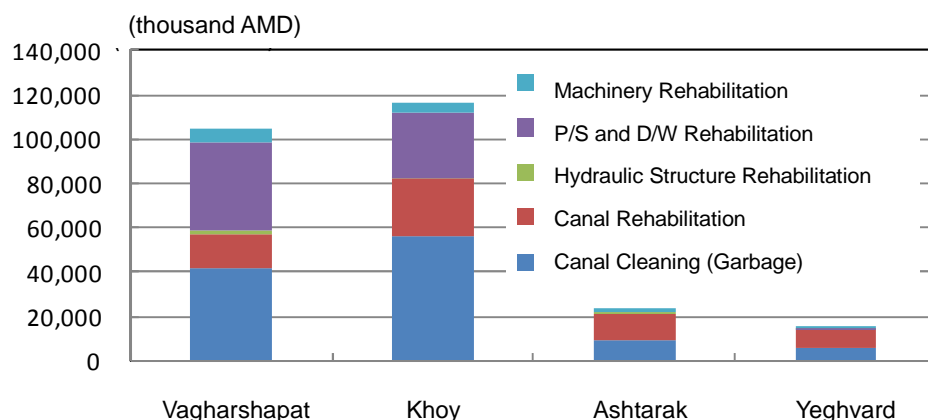


Figure 4-4-3.3 Maintenance Cost for each WUA

Table 4-4-3.4 Unit Cost of Maintenance for each WUA

WUA	Maintenance Cost (million AMD)	Current Area (ha)	Unit Price (AMD/ha)
Vagharshapat	104	2,488	42,000
Khyo	116	4,460	27,000
Ashtarak	23	801	29,000
Yeghvard	15	642	23,000
Total	258	8,391	31,000

4-4-4 Current Issues on Irrigation Network System

Current situation and issues on target canals are shown in Table 4-4-4.1. And detailed current situations of each canal are shown in Appendix A.

In the basis of results of irrigation facility survey, findings on current situations and issues are summarized below;

- 1) Deterioration/damage such as cracks and exfoliated concrete panels on canals at a number of sections,
- 2) Lack of cross-section area to convey the design discharge at a number of sections,
- 3) Sections of open canal replaced by pipeline system due to changing WUA administrative boundary,
- 4) Areas where substitution new canals are required in the case that existing pumping stations (such as Aknalich PS and Metsamor PS) will be abolished due to the policy of the Project, and
- 5) Some areas irrigated by unclear water source.



Figure 4-4-4.1 Crack at Side Wall of Canal (Arzni-Branch Canal at No.26)



Figure o 4-4-4.2 Connection Canal to Takahan Canal (Arzni-Branch Canal at No.42)



Figure 4-4-4.3 Leakage at Separation of Joint at Sidewall (No.33)



Figure 4-4-4.4 Outlet of Pipe from Arzni-Shamiram Canal (φ800mm) (Arzni-Branch Canal at No.25)

Table 4-4-4.1 Current Situation and Issues on Target Canals (1/3)

Canal	Current situation	Problems
Azni-Branch	<p>1) Upstream portion of this canal is being managed by Yeghvard WUA and downstream portion by Ashtarak WUA. Water intake from the Arzni-Shamiram canal is performed every WUA. Ashutarak WUA takes water from Arzni-Shamiram canal directly by the pipeline and distributes by a pipeline network to the beneficiary areas of Arzni-Branch Canal.</p> <p>2) Downstream of the canal from No.33 point on Figure 4-4-2.2 is not currently in use. Other water is used for irrigation of agricultural land around Sasuke town.</p> <p>3) Although the connection canal for water injection into Takahan Canal near the end of this canal can be confirmed, it is not currently used.</p> <p>4) The upstream portion of this canal under the control of Yeghvard WUA was renovated in 2012, except for the most upstream section,</p> <p>5) The inflows from other water sources are confirmed at five locations in the middle of this canal. All of these inflows come from Arzni-Shamiram canal by pipelines.</p>	<p>1) There is a damaged concrete portion at side wall at about 500m section of the non-renovation of downstream of crossing point of railway portion near the intake structure of this canal.</p> <p>2) There is water leakage from the joint of the side wall of the No.18 on Figure 4-4-2.2 spot aqueduct bridge.</p> <p>3) There are significant damaged concrete portions and cracks at side wall and bottom of channel within section that is currently being used up to No.33 point on Figure 4-4-2.2.</p> <p>4) No.33 point on Figure 4-4-2.2 later canal is not currently being used, it is devastated.</p>
Takahan canal	<p>1) The condition of canal is observed generally to good condition except for an aqueduct bridge.</p> <p>2) The inflow by connection canal from Takahan Canal has been secured and it is considered that the water from Arzni-Shamiram canal by pipeline is in-flow into the middle of the link canal.</p> <p>3) The section between No.3 point and No.22 point on Figure 4-4-2.3 will be rehabilitated in recent years by the support of the World Bank. The condition of canal will be good.</p>	<p>1) The top portion of the aqueduct bridge of No.35 point on Figure 4-4-2.3 is the exposed rebar by frost damage, etc. and deterioration of concrete is observed.</p>
Shakhi-Aru canal	<p>1) High discharge season of Kasakh River is observed in spring only. Therefore, since the irrigation water from the Kasakh Intake has become chronically shortage of water for irrigation period, the water intake from the Lower Hrazdan is the main water source currently.</p> <p>2) There are inflows from a distribution gate of Lower Hrazdan canal at No.4 point, from two outlets of pipe(φ150mm) from deep wells and No.29 point on Figure 4-4-2.4.</p> <p>3) The sections between No.10 point and No.19, No.21 point and No.22, and No.25 point and No.31 point on Figure 4-4-2.4 had been rehabilitated from 2008 to 2010 by the support of the World Bank and the millennium project. The condition of canal is good.</p>	<p>1) Water leakage due to the separation of the joint and the exposed rebar can be observed on the side walls at canal section(No.33 point) of shortly downstream of Kasakh Intake.</p> <p>2) The deterioration of side wall of canal is serious at No.9 point on Figure 4-4-2.4.</p> <p>3) The side walls of the canal at No.19 point on Figure 4-4-2.4 is worried about water leakage.</p>

Table 4-4-4.1 Current Situation and Issues on Target Canals (2/3)

Canal	Current situation	Problems
Upper Aknalich canal	<p>1) Aknalich pumping station was built in 1926 and seven pumps in total were installed, three pumps in outside (Capacity $Q = 0.065m^3/s$, $0.265m^3/s$ and $0.75m^3/s$), four pumps in the pump house (One only operation, Capacity $Q = 0.4m^3/s$).</p> <p>The current maximum water discharge amount is $0.75m^3/s$. Among them, it is possible to send irrigation water of the amount of $0.38m^3/s$ to this canal (Upper Aknalich Canal) and irrigation water of the amount of $0.27m^3/s$ to Inner Aknalich Canal.</p> <p>However, sufficient irrigation water is not supplied from Aknalich PS to this canal due to the drawdown of Aknalich lake presently.</p> <p>2) The pipeline ($\phi 730mm$) for irrigation was built in the direction from No.14 point to No.32 point on Figure 4-4-2.5 by IFAD in 2004.</p> <p>3) There was an inlet of headrace (pipeline) to the Inner Aknalich Canal at No.2 point on Figure 4-4-2.5, but it is closed with concrete presently.</p> <p>4) There are inflows by pipe ($\phi 600mm$) from Lower Hrazdan canal, by earth canal from Lower Hrazdan and by three pipe($\phi 150mm$) from deep wells at No.36 point, No.40 point and N.40 point on Figure 4-4-2.5.</p>	<p>1) Downstream canal from the road crossing of the No.32 point on Figure 4-4-2.5 is not currently being used, it has been expired.</p> <p>2) The flume canal was installed in parallel to this canal from No.35 point on Figure 4-4-2.5 to end of canal. Water from deep wells is supplied to the canal, it is irrigating surrounding farmland. In addition, this canal and other canal irrigated by deep well is not connected.</p> <p>3) The deterioration such as exposed rebar is serious at canal sidewall No.8 to No.9 on Figure 4-4-2.5</p> <p>4) Large cracks and partial broken etc. has observed at canal sidewall from the aqueduct bridge at No.21 point on Figure 4-4-2.5 to the road crossing point at No.32 point and deterioration is serious.</p> <p>5) WUA staff told that even if canal is repaired in the section from No.8 point to No.9 point and in the section from No.21 point to No.32 point on Figure 4-4-2.5, enough water is not capable to come from the pumping station, so, it is unnecessary to repair it.</p> <p>6) The deterioration of concrete and exposed rebar by frost damage are serious at sidewall of the aqueduct bridges at No.21 point and No.23 point on Figure 4-4-2.5.</p>
Inner Aknalich canal	<p>1) Currently, irrigation water is not passed through only from the beginning point to Highway near No.17 point on Figure 4-4-2.6. Previously water had been reached up to the end of canal.</p> <p>2) Water from deep wells is supplied to this canal section from No.24 point on Figure 4-4-2.6 to end of canal, it is irrigating surrounding farmland.</p> <p>3) Near the No.2 point and No.19 point on Figure 4-4-2.6, a new deep well is scheduled to be added in next year.</p> <p>4) There are inflows by pipe($\phi 150mm$) from Aknalich canal at No.5 point, by earth canal from Hrazdan Canal at No. 8 point and by four pipe($\phi 150mm$) from deep wells at No.24 point, No.28 point, No.30 point and No.34 point on Figure 4-4-2.6.</p> <p>5) This canal had been rehabilitated from 1997 to the next year by the support of the World Bank.</p>	<p>1) The exposed rebar can be seen at the top of sidewalls (L=600m) from No.2 point to No.4 point and near No.12 point and No.14 point on Figure 4-4-2.6.</p> <p>2) Grass is flourishing in the canal in section from upstream 520m point of No.22 point to No.24 point and the canal has been expired. It is necessary to rehabilitate it in order to pass water until the end of canal again.</p>

Table 4-4-4.1 Current Situation and Issues on Target Canals (3/3)

Canal	Current situation	Problems
Metsamor canal	<p>1) This canal is divided into main line for the north side and branch line for the south side. The main line is trapezoidal concrete canal and branch line is a flume canal by pre-casted U-shaped. The water is supplied by pipe (1,200mm) at No.1 point on Figure 4-4-2.7 from mainly Metsamor PS. To the branch line, the water is supplied mainly by pipeline from the same PS. In addition, as the pump station stopped, main line and branch line are supplied by open canal and pipeline from Lower Hrazdan canal.</p> <p>2) This canal will be rehabilitated in recent years by the support of the World Bank. The condition of canal will be good.</p> <p>3) There are inflows by pipe(ϕ400mm) from Lower Hrazdan canal at No.25 point, by connection canal from Hrazdan canal at No.6 point, and by pipe(ϕ150mm) from deep well at No.25 point on Figure 4-4-2.7.</p>	<p>1) The Metsamor pump station has total four pumps and all pumps are working. Capacity of the pumps is $P1=0.32m^3/s$, $P2=0.55m^3/s$, $P3=0.95m^3/s$ and $P4=0.35m^3/s$. However only P2 is usually running once in two days because inlet water is not enough to operate all pumps. It is observed that suitable irrigation water is not supplied to canal from this pump station.</p> <p>2) Gate leafs at 6 places are missing.</p>
Lower Hrazdan canal	<p>1) The situation of canal network from this canal to the secondary canals is as follows.</p> <p>a) Regarding connection canal from this canal to Metsamor canal, it is possible to convey water through the pipeline (ϕ400mm L=about 3.0km) from the inlet of pipe at No.66 point on Figure 4-4-2.8 in this canal to the confluence box at No.25 point in Metsamor canal and it is possible to convey water from end of this canal to the confluence at No.6 point in Metsamor canal.</p> <p>b) Regarding connection canal from this canal to Upper Aknalich canal, it is possible to convey water by pipeline (ϕ600mm L=about 6.0km) from the inlet of pipe at No.64 point in this canal to outlet of pipe at No.6 point on Figure 4-4-2.8 in Upper Aknalich Canal. It is possible to convey water ($Q=0.15m^3/s$) by earth canal (L=5.0km) from around No.39 point in this canal to No.25 point in Upper Aknalich canal.</p> <p>c) Regarding connection canal from this canal to Inner Aknalich canal, it is possible to send water ($Q=0.15m^3/s$) through the earth canal (L=8.0km) from around No.39 point in this canal to No.8 point in Inner Aknalich canal.</p> <p>d) There are inflows by pipe from Ranchapr No.2 PS at No.19 point, from a connection canal from Kasakh intake at No. 38 point and by pipe(ϕ150mm) from deep wells at No.69 on Figure 4-4-2.8.</p>	<p>1) This canal was built in 1954, all sections of canal is aging.</p> <p>2) Since the freeboard of this canal is not enough, over flow is suspected to be occur during irrigation season. In particular at shortly downstream of the outlet of pipe from Ranchapapr PS No.2, it should be cared of operation.</p>

4-5 Agricultural Production and Farm Management

4-5-1 Agricultural Surveys Carried Out

The Survey team carried out the following surveys in order to collect necessary information for the agricultural planning. Details about the planning structure and the surveys are described in Appendix B-3 to B-6.

- 1) Farm household survey
- 2) WUA workshops
- 3) Data/information collection (the Ministry of Agriculture, Marz Agricultural Support Centers, Community Offices, marketing & processing agents, inputs sellers & dealers, etc.)

4-5-2 Number of Farm Households and Family Size

It is reported that the population of Armenia has been decreasing since the 1990s (the population in 1991 was reported as 3,450,000) due to several factors such as excess number of transmigration, decrease in birth rate, and the tendency of slight decrease is still continuing. Regarding the agricultural labor force population, it showed dramatically rising after Armenia's independence from around 180,000 in 1988 to 500,000 in 1994 and it peaked at 570,000 in 2000. However, the population began to decrease since then because of the growth of other economic sectors.

Meanwhile, the population of the project area where locates surrounding area of the biggest city Yerevan indicates only fractional increase in recent five years. According to collected data from concerned communities, total population in the project area is 76,070 in 2014. The population is stable from 2010 to 2014 (see Table 4-5-2.1).

Table 4-5-2.1 Population in the Project Area (2010-14)

WUA	Sex	2010	2011	2012	2013	2014
Yeghvard (3 communities)	Male	8,736	8,702	8,828	8,979	8,883
	Female	8,925	8,776	9,192	9,014	9,133
	Total	17,661	17,478	18,020	17,993	18,016
Ashtarak (4 communities)	Male	6,649	6,645	6,779	6,791	6,715
	Female	6,585	6,924	6,854	6,818	6,855
	Total	13,234	13,569	13,633	13,609	13,570
Vagharshapat (7 communities)	Male	7,613	7,794	7,590	7,638	7,563
	Female	7,758	7,816	7,873	7,923	7,932
	Total	15,371	15,610	15,463	15,561	15,495
Khoy (13 communities)	Male	14,739	14,493	14,484	14,598	14,571
	Female	14,351	14,296	14,672	14,569	14,418
	Total	29,090	28,789	29,156	29,167	28,989
Total	Male	37,737	37,634	37,681	38,006	37,732
	Female	37,619	37,812	38,591	38,324	38,338
	Total	75,356	75,446	76,272	76,330	76,070

Source) 27 Community Offices Concerned

As regard to population density in 2014, the average is 305 person/ km² in the Project area. The Project area has high population density because of its location. Among WUA areas, Yeghvard is the most congested area, followed by Vagharshapat, Koy and Ashtarak as shown in Table 4-5-2.2. Yeghvard and Vagharshapat WUA areas, having relatively higher figures, are much influenced by urbanization from Yerevan city and Ejimiatsin city, respectively.

Table 4-5-2.2 Population Density in the Project Area in 2014

WUA	Yeghvard (3 communities)	Ashtarak (4 communities)	Vagharshapat (7 communities)	Khoy (13 communities)	Total
Population Density (person/km ²)	359.7	256.3	349.4	284.3	305.0

Source) 27 Community Offices Concerned

Number of households in the Project area is increasing in recent years, even slightly. The number in agrarian sector, however, stays constant. Total number of households and the number of farm households in the project area is 16,849 and 13,574, respectively in 2014 (see Table 4-5-2.3).

The percentage of farm households is about 80% in the Project area. In Khoy and Vagharshapat WUA areas, agricultural households are highly dominating (96–98% of the total households). In contrast, the percentages in Ashtarak and Yeghvard WUA areas are only 60-65%, and the percentages are declining in recent years. It implies that farm abandonment in Ashtarak and Yeghvard WUA areas is advancing as farmers are facing more difficult condition for continuing their farming than the other two WUA areas. A comparative blessed farmland condition, e.g. land fertility, flatness and accessibility to irrigation gives Khoy and Vagharshapat WUA areas an advantage over Ashtarak and Yeghvard WUA areas in establishing stable farm management. According to farmers interviewed during the surveys, many farmers (especially young male farmers) despaired of continuing farming, and started subsidiary business or even abandoning farming. While there is a wide range of variations in the farmers' difficulties, shortage of irrigated farmland must be one of them.

Table 4-5-2.3 Number of Households in the Project Area (2010-14)

WUA	Sector	2010		2011		2012		2013		2014	
		H.H.	%	H.H.	%	H.H.	%	H.H.	%	H.H.	%
Yeghvard (3 communities)	Agri.	2,730	63.3%	2,757	63.7%	2,748	63.8%	2,655	61.2%	2,672	60.2%
	Non-Agri.	1,585	36.7%	1,571	36.3%	1,558	36.2%	1,680	38.8%	1,766	39.8%
	Total	4,315		4,328		4,306		4,335		4,438	
Ashtarak (4 communities)	Agri.	2,381	67.1%	2,369	66.5%	2,386	67.5%	2,358	66.4%	2,279	65.4%
	Non-Agri.	1,167	32.9%	1,195	33.5%	1,151	32.5%	1,193	33.6%	1,205	34.6%
	Total	3,548		3,564		3,537		3,551		3,484	
Vagashapat (7 communities)	Agri.	2,589	98.2%	2,582	98.0%	2,681	97.8%	2,709	97.7%	2,709	97.7%
	Non-Agri.	48	1.8%	52	2.0%	61	2.2%	65	2.3%	65	2.3%
	Total	2,637		2,634		2,742		2,774		2,774	
Khoy (13 communities)	Agri.	5,927	96.2%	5,936	96.3%	5,936	96.2%	5,919	96.3%	5,914	96.1%
	Non-Agri.	231	3.8%	226	3.7%	236	3.8%	230	3.7%	239	3.9%
	Total	6,158		6,162		6,172		6,149		6,153	
Total	Agri.	13,627	81.8%	13,644	81.8%	13,751	82.1%	13,641	81.2%	13,574	80.6%
	Non-Agri.	3,031	18.2%	3,044	18.2%	3,006	17.9%	3,168	18.8%	3,275	19.4%
	Total	16,658		16,688		16,757		16,809		16,849	

Source) 27 Community Offices Concerned

Table 4-5-2.4 shows the average number of family members (family size) per household in the Project area. The average family size is stable in recent years at about 4.5 person/family. While the highest is in Vagharshapat WUA area at 5.6 person/family, the lowest is in Ashtarak WUA area at 3.9 person/family in 2014. The family size in Yeghvard WUA area is almost same with the size in Ashtarak WUA area.

Table 4-5-2.4 Family Size in the Project Area (2010-14)

WUA	Unit: person/family				
	2010	2011	2012	2013	2014
Yeghvard	4.1	4.0	4.2	4.2	4.1
Ashtarak	3.7	3.8	3.9	3.8	3.9
Vagharshapat	5.8	5.9	5.6	5.6	5.6
Khoy	4.7	4.7	4.7	4.7	4.7
Total	4.5	4.5	4.6	4.5	4.5

Source) 27 Community Offices Concerned

4-5-3 Land Use and Farmland Use

1) Land use

The Project area extends across 27 communities in 3 Marzes, and it is divided into four (4) WUA areas

under management of Yeghvard, Ashtarak, Vagharshapat and Khoy WUAs. Since WUA area boundaries and boundaries of 27 concerned communities are not overlapped, only 22,754 ha or 91% out of 24,937 ha of the 27 communities' total land area is included in the Project area (see Table 4-5-3.1).

Table 4-5-3.1 Community Area and Project Area

Area Category		Yeghvard	Ashtarak	V. Shapat	Khoy	Total
Community Area	(ha)	5,008.5	5,295.5	4,435.0	10,198.0	24,937.0
Project Area	(ha)	4,512.5	3,608.5	4,435.0	10,198.0	22,754.0
	(%)	90.1	68.1	100.0	100.0	91.2
Number of Communities		3	4	7	17	27

Source) PIU and 27 Community Offices Concerned

Table 4-5-3.2 shows acreage of farmland and their irrigated land in the Project area by 4 WUAs. Approximately a half or more of each WUA's land in the Project area are categorized in farmland. Khoy WUA has the largest farmland area, while Ashtarak WUA has the lowest area. There is a big difference in irrigation condition between Yeghvard & Ashtarak WUAs and Vagharshapat & Khoy WUAs. Yeghvard & Ashtarak WUAs areas have lower percentages of irrigated farmland than the other two WUA areas. Especially in Khoy WUA area, most of all farmlands are irrigated. The difference represents different water distribution condition for agriculture and geographical condition among 4 WUAs. Yeghvard and Ashtarak WUA areas which locate North-Western part of the Project area, where are dominated by gentle slope plateaus, have less water distribution sources such as canals and wells than the other two WUA areas where locate in Ararat plain.

Table 4-5-3.2 Farmland in the Project Area

Land Category	Yeghvard		Ashtarak		Vagharshapat		Khoy		Total	
	Area (ha)	(%)	Area (ha)	(%)	Area (ha)	(%)	Area (ha)	(%)	Area (ha)	(%)
1. Farmland in Cadaster (Crop field & backyard)	2,427.9	53.8	1,738.9	48.2	2,797.1	63.1	5,236.9	51.4	12,200.8	53.6
(1) Irrigated land (WUA contract 2013)	1,050.6	23.3	915.0	25.4	2,161.0	48.7	5,093.0	49.9	9,219.6	40.5
(2) Non-irrigated land	1,377.3	30.5	823.9	22.8	636.1	14.3	143.9	1.4	2,981.2	13.1
2. Non-farmland	2,084.6	46.2	1,869.6	51.8	1,637.9	36.9	4,961.1	48.6	10,553.2	46.4
Total Project Area	4,512.5	100.0	3,608.5	100.0	4,435.0	100.0	10,198.0	100.0	22,754.0	100.0

Source) PIU

2) Farmland use

The Survey team made an estimation average farmland size per farm household in the project area with available information. It is estimated that the average farmland size is about 0.97 ha as shown in Table 4-5-3.3.

Table 4-5-3.3 Average Farmland Size per Farm Household in the Project Area

	WUAs	Yeghvard	Vagharshapat	Khoy	Total
1 Farmland (in Cadaster) (ha)		2,427.9	2,797.1	5,236.9	10,461.9
2 Number of farm households in 2014		2,672	2,709	5,414	10,795
3 Average farmland (ha/farm household)		0.91	1.03	0.97	0.97

Note) Ashtarak is excluded from the calculation as only 68.1% of the community area is included in the project area (see Table 4-5-3.1)

Source) PIU (farmland) and 27 Community Offices Concerned (number of farm households)

The farm household survey carried out by the Survey team reveals farmland use, classified as farmland for annual crop, orchard including vineyard, pasture and other types of land as for home garden and etc. It is also classified by irrigation condition (see Table 4-5-3.4). The average size of own

land in Table 4-5-3.4 is 2.12 ha in total which is more than 2 times of the estimation in Table 4-5-3.3 even excluding home garden and etc. It is noted that farm households having bigger farmland than the average level are mainly sampled for the farm household survey.

Table 4-5-3.4 Farmland Use in the Project Area

Farm Land Use	Irrigated + Non-irrigated Land (ha)				
	Own manage, own land	Rent out to tenant	Own land total	Rent in	Total managed land
	(1)	(2)	(3)	(4)	= (1) - (2) + (4)
Annual crops	1.25	0.03	1.29	1.37	2.59
Orchard/vineyard	0.57	0.00	0.57	0.27	0.84
Pasture	0.08	0.00	0.08	0.01	0.08
Others (Home garden, etc.)	0.19	0.00	0.19	0.02	0.21
Total	2.09	0.03	2.12	1.67	3.72

Farm Land Use	Irrigated Land only (ha)				
	Own manage, own land	Rent out to tenant	Own land total	Rent in	Total managed land
	(1)	(2)	(3)	(4)	= (1) - (2) + (4)
Annual crops	1.17	0.03	1.20	1.34	2.48
Orchard/vineyard	0.56	0.00	0.56	0.27	0.83
Pasture	0.08	0.00	0.08	0.01	0.08
Others (Home garden, etc.)	0.18	0.00	0.18	0.02	0.20
Total	1.98	0.03	2.02	1.64	3.59

Source: JICA Survey Team (Farm household survey)

Table 4-5-3.4 implies that crop farming mostly concentrates on irrigated farmland, and majority of farmland are used for growing annual crops in the Project area. Only a few annual crops, maybe cereals in plateau areas, are grown in non-irrigated farmland. Comparing the farmland use among 4 WUAs, percentage of orchard/vineyard area to the total farmland area is bigger in WUAs located in plateau areas, i.e. Yeghvard and Ashtarak than WUAs located in plain areas, i.e. Vagharshapat and Khoy (see Table 4-5-3.5). While home garden is generally used for growing vegetables, herbs and some fruits mainly for home consumption, substantial number of farm households generates a certain amount of cash income from surplus production from their home gardens according to collected information. In Vagharshapat and Khoy WUAs, many farmers even construct a simple greenhouse in home gardens for growing vegetables for marketing.

Table 4-5-3.5 Farmland Use in the Project Area by WUA

Farm Land Use	Total Managed Land, Irrigated + Non-irrigated Land (ha)											
	Yeghvard			Ashtarak			Vagharshapat			Khoy		
	Own	Rent in	Total	Own	Rent in	Total	Own	Rent in	Total	Own	Rent in	Total
Annual crops	0.56	0.36	0.92	0.47	0.36	0.83	1.78	2.34	4.12	1.28	1.36	2.64
Orchard/vineyard	0.76	0.09	0.85	0.41	0.13	0.53	0.32	0.00	0.32	0.71	0.50	1.22
Pasture	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.20	0.04	0.01	0.06
Others (Home garden, etc.)	0.10	0.00	0.10	0.08	0.00	0.08	0.38	0.01	0.38	0.15	0.03	0.18
Total	1.42	0.45	1.86	0.96	0.48	1.45	2.67	2.36	5.02	2.19	1.91	4.10

Source) JICA Survey Team (Farm household survey)

It is interesting that the sample farmers rent not a small farmland from other land holders. On the other hand, a few sample farmers rent out their farmland to other farmers (see Table 4-5-3.4). The majority of farmland rented-in is used for growing annual crops. The result implies that farmers, who have farmland above a certain level and actively engaged in farming in the Project area, make an effort to expand the size of farmland under their management by renting farmland from other land holders who may be aged, transmigrated or busy for off-farm jobs/business. Farmers in Vagharshapat and Khoy WUAs are more active in renting in farmland than farmers in Yeghvard and Ashtarak WUAs.

4-5-4 Profile of Farmers and Farm Household Economy

The following consideration is derived mainly from outputs of the farm household survey in August-September, 2015, covering 81 farm households in 27 concerned communities (3 farm households from each community).

1) Profile of farmers

Age and farming experience

The average age of head of the sample farm households is 55.8 years old, while the age ranges from 30 to 82. As regard to farming experience, the average is 25.9 years, while the experience ranges from 8 to 66 years. It shows that many farmers have a certain long experience in farming. However, number of the head having farming experience above 24 years remains only 19 out of 81 or 23.5 % of the total. Many farmers have newly started farming after the land privatization policy of the country, as the related law was passed in 1990 (see Table 4-5-4.1 and Table 4-5-4.2 for details).

Table 4-5-4.1 Age and Farming Experience of Head of the Sample Farm Households

WUA area	Number of H.H.	Age		Farming experience (Year)		Farming experience +24 years
		Range	Average	Range	Average	
Yeghvard & Ashtarak	21	38-82	58.8	15-66	26.6	5
Vagharshapat	21	30-78	51.7	8-51	24.8	4
Khoy	39	33-79	56.9	10-62	26.3	10
Total	81	30-82	55.8	8-66	25.9	19

Source) JICA Survey Team (Farm household survey)

Table 4-5-4.2 Years when the Sample Farm Households Obtained Property Rights of Farmland

WUA area	1990-94		1995-99		After 2000		Total	
	Number	%	Number	%	Number	%	Number	%
Yeghvard & Ashtarak	10	48	6	29	5	24	21	100
Vagharshapat	13	62	6	29	2	10	21	100
Khoy	20	51	16	41	3	8	39	100
Total	43	53	28	35	10	12	81	100

Source) JICA Survey Team (Farm household survey)

Education background

Majority of head of the sample farm households are well educated as shown in Table 4-5-4.3. Most of them completed their secondary school education, and the percentage of university graduates or more accounts 21%. This situation would be a big advantage for the Government to disseminate new technologies and knowledge to the farmers.

Table 4-5-4.3 Educational Background of the Sample Farm Households

Education	Ashtarak & Yeghvard		Vagharshapat		Khoy		Total	
	Number	%	Number	%	Number	%	Number	%
No Education	0	0	0	0	0	0	0	0
Elementary	0	0	0	0	0	0	0	0
Middle	2	10	0	0	2	5	4	5
High / Upper middle	7	33	6	29	15	38	28	35
Vocational	7	33	7	33	18	46	32	40
University or Upper	5	24	8	38	4	10	17	21
Total	21	100	21	100	39	100	81	100

Source) JICA Survey Team (Farm household survey)

Membership of WUAs

Table 4-5-4.4 shows that overwhelming majority of the sample farm households are members of WUAs. It is confirmed that two (2) non-member farmers actually enjoy an irrigation service, as the farmers share water with other family member, such as farther who has WUA membership. It shows that irrigation is an indispensable condition to encourage efficient and stable farm management in the project area.

Table 4-5-4.4 Membership of WUAs of the Sample Farm Households

WUA Membership	Ashtarak & Yeghvard		Vagharshapat		Khoy		Total	
	Number	%	Number	%	Number	%	Number	%
Members	20	95	21	100	38	97	79	98
Non-members	1	5	0	0	1	3	2	2
Total	21	100	0	100	39	100	81	100

Source) JICA Survey Team (Farm household survey)

Family members (who live together and share livelihood)

Table 4-5-4.5 shows number of family members of the sample farm households. The average number is 5.81 person/family, which is bigger than the statistical data collected from 27 communities concerned as shown in Table 4-5-2.4. Out of 5.81 persons, about 4 persons are categorized into the working active age (15-64 years old).

Table 4-5-4.5 Family Members of the Sample Farm Households

Age	Male			Female			Total		
	Total Number	%	Average per H.H.	Total Number	%	Average per H.H.	Total Number	%	Average per H.H.
Under 14	56	23	0.69	38	17	0.47	94	20	1.16
15-64	163	67	2.01	162	71	2.00	325	69	4.01
Over 65	25	10	0.31	27	12	0.33	52	11	0.64
Total	244	100	3.01	227	100	2.80	471	100	5.81

Source) JICA Survey Team (Farm household survey)

It is interesting that an ordinary farm household may have at least 1 person of permanent employee, including self-employment, as shown in Table 4-5-4.6. It implies that many farm households depend on not a small income from non-farming activities.

Table 4-5-4.6 Number of Permanent Employees, including Self-Employed of the Sample Farm Households

WUA area	Male		Female		Total	
	Total Number	Average per H.H.	Total Number	Average per H.H.	Total Number	Average per H.H.
Ashtarak & Yeghvard	16	0.76	12	0.57	28	1.33
Vagharshapat	20	0.95	8	0.38	28	1.33
Khoy	21	0.54	11	0.28	32	0.82
Total	57	0.70	31	0.38	88	1.09

Source) JICA Survey Team (Farm household survey)

2) Income and expenditure

Mid-level or more experienced farmers who have more than the average living standards might be mainly selected for the farm household survey according to their profiles as describe above. Average annual income in 2014 declared by sample households is AMD 5,979.1, while the average expenditure is AMD 4,103.3. The highest average income WUA is Vagharshapat and the lowest average WUA is Yeghvard & Ashtarak (see Table 4-5-4.7).

Table 4-5-4.7 Income and Expenditure of Farm Household in 2014

WUA	Number of H.H.	Income (thousand AMD/year)		Expenditure (thousand AMD/year)	
		Range	Average	Range	Average
Yeghvard & Ashtarak	21	270 – 8,880	2,958.9	450 – 5,500	2,461.3
Vagharshapat	21	2,220 – 27,000	8,305.7	1,500 – 18,000	5,466.7
Khoy	39	750 – 32,270	6,126.7	500 – 30,000	4,382.1
Total	81	270 – 32,270	5,979.1	450 – 30,000	4,103.3

Source) JICA Survey Team (Farm household survey)

3) Income source

Importance of income sources evaluated by sample households is shown in Table 4-5-4.8 Naturally, income from farming, especially from crop sales, is the most important income source. It is interesting that salary or wages from non-agriculture sector is the second important income source, while salary or wages from agriculture sector is a very minor source for the farm households. It implies that many farm households in the Project area have family members who have off-farm side-jobs or have main jobs in non-agricultural sector. It seems that pension is a small but considerable supplementary income source for many farm households.

Table 4-5-4.8 Important Income Sources of Farm Household in 2014

Unit: %

Income Sources	WUA															Total (81 H.H.)				
	Yghvard & Ashtarak (21 H.H.)					Vagharshapat (21 H.H.)					Khoy (39 H.H.)									
	Negligible / None	Minor	Subsidiary	Important	Principal	Total	Negligible / None	Minor	Subsidiary	Important	Subsidiary	Principal	Total	Negligible / None	Minor	Subsidiary	Important	Subsidiary	Principal	Total
Sales of crops	14	19	33	33	100	0	0	10	90	100	0	3	18	79	100	4	6	20	70	100
Sales of livestock / milk / eggs	38	14	5	43	100	57	10	10	24	100	59	8	18	15	100	53	10	12	25	100
Salary or wages (agriculture)	95	0	5	0	100	95	0	0	5	100	95	0	5	0	100	95	0	4	1	100
Salary or wages non-agriculture	24	5	19	52	100	14	10	38	38	100	51	8	13	28	100	35	7	21	37	100
Own-business (self-employed)	81	0	10	10	100	90	5	0	5	100	90	0	5	5	100	88	1	5	6	100
Sales of handicraft	95	0	5	0	100	100	0	0	0	100	97	0	3	0	100	98	0	2	0	100
Pension of family members	48	14	29	10	100	43	24	19	14	100	49	28	18	5	100	47	23	21	9	100
Remittance	90	5	0	5	100	71	14	5	10	100	79	8	5	8	100	80	9	4	7	100
Public supports	95	5	0	0	100	100	0	0	0	100	92	5	3	0	100	95	4	1	0	100
Others	100	0	0	0	100	95	0	5	0	100	100	0	0	0	100	99	0	1	0	100

Source) JICA Survey Team (Farm household survey)

While Table 4-5-4.8 shows difference result among WUAs, the difference gives the following implications.

Yeghvard & Ashtarak WUA

- Income from crop farming is low due to low % of irrigated farmland.
- There are many farm households whose income from livestock is higher than the income from crop farming.
- There are many farm households whose income from non-agriculture sector is higher than the income from farming.

Vagharshapat & Khoy WUA

- There are many farm households who enjoy a substantial income from crop farming, mainly

from vegetables.

- However, only income from farming is not enough for managing family budget.
- There are many farm households whose family member(s) has (have) a stable job in non-agricultural sector.

4) Expenditure items

Table 4-5-4.9 shows priority expenditure items of sample farm households. It is also natural that the first priority expenditure item is “agricultural inputs and management”. After it, “food and beverage” and “housing, home-consumables and public services” are second priority items. In Yeghvard & Ashtarak WUA, the priority for “food and beverage” is very high, maybe, due to high % of low income families. The table implies that the expenditures to “medical care and health” and “clothes” are almost equally important to many farm households. Difference among WUAs in Table 4-5-4.9 is not much comparing the income source evaluation as shown in Table 4.5-4-8.

Table 4-5-4.9 Priority Expenditure Items of Farm Household in 2014

Unit: %

Expenditure Items	WUA															Total (81 H.H.)					
	Yghvard & Ashtarak (21 H.H.)					Vagharshapat (21 H.H.)					Khoy (39 H.H.)					Negligible / None	Minor	Important	Subsidiary	Principal	Total
	Negligible / None	Minor	Important	Subsidiary	Principal	Total	Negligible / None	Minor	Important	Subsidiary	Principal	Total	Negligible / None	Minor	Important						
Agricultural inputs and management	0	5	14	81	100	0	0	10	90	100	0	3	10	87	100	0	2	11	86	100	
Foods and beverage	0	0	24	76	100	0	0	38	62	100	0	15	44	41	100	0	7	37	56	100	
Clothes	5	10	62	24	100	0	19	57	24	100	0	38	38	23	100	1	26	49	23	100	
Housing, home-consumables and public services	0	5	33	62	100	0	14	52	33	100	0	18	46	36	100	0	14	44	42	100	
Electric appliances, furniture, Cars, and durable goods	57	24	10	10	100	43	29	14	14	100	54	15	13	18	100	52	21	12	15	100	
Medical care and health	33	29	14	24	100	38	19	10	33	100	28	26	18	28	100	32	25	15	28	100	
Education and recreation	43	24	10	24	100	48	19	19	14	100	56	21	15	8	100	51	21	15	14	100	
Recreation and Entertainment	62	33	5	0	100	33	43	14	10	100	41	38	18	3	100	44	38	14	4	100	
Social relation	5	62	33	0	100	0	38	43	19	100	5	38	36	21	100	4	44	37	15	100	
Other	90	10	0	0	100	62	10	5	24	100	74	0	0	26	100	75	5	1	19	100	

Source) JICA Survey Team (Farm household survey)

5) Strategy to increase living standards of family

Table 4-5-4.10 shows that there are many farm households who maintain good motivation to continue crop farming, while majority of them has a negative vision for livestock farming. Simultaneously, a substantial number of households look for a good job opportunity in local area. Many farm households also consider that education for children is important for increasing living standards of family, because education brings a good job opportunity. Such conditions imply that a movement to abandon farming is slowly progressing among farm households in the Project area.

Table 4-5-4.10 Strategy to Increase Living Standards

Unit: %

Strategy	WUA												Total (81 H.H.)			
	Yghvard & Ashtarak (21 H.H.)				Vagharshapat (21 H.H.)				Khoy (39 H.H.)							
	Less important	Important	very important	Total	Less important	Important	very important	Total	Less important	Important	very important	Total	Less important	Important	very important	Total
To devote to crop farming	29	14	57	100	23	10	67	100	19	14	67	100	23	12	64	100
To devote to livestock farming	43	19	38	100	59	3	38	100	62	10	29	100	56	9	36	100
To find out a new good job/business in local area	57	14	29	100	41	28	31	100	33	5	62	100	43	19	38	100
To go to other area/country for getting jobs	86	14	0	100	72	13	15	100	71	10	19	100	75	12	12	100
To educate children for getting good jobs	29	10	62	100	36	15	49	100	38	0	62	100	35	10	56	100
To sell processed (value added) foods/products	57	14	29	100	44	15	41	100	67	14	19	100	53	15	32	100

Source) JICA Survey Team (Farm household survey)

4-5-5 Agricultural Production

1) Project area

Table 4-5-5.1 shows production of major crops in 27 communities extended across the Project area in compiling statistical data collected from the community offices.

Table 4-5-5.1 Production of Crops in 27 Communities Extended across the Project Area* (2010-2014)

Planted Area (ha)					
Crops	2010	2011	2012	2013	2014
Wheat	1,704.9	1,544.6	1,558.9	1,613.1	1,822.4
Barley	77.2	121.9	119.0	78.0	91.9
Maize	13.4	17.6	42.0	46.1	37.0
Alfalfa	768.8	758.6	825.1	838.2	968.4
Potato	726.5	776.8	856.9	705.3	728.1
Other miscellaneous food & forage crops	280.2	343.2	290.7	372.6	334.3
Tomato	402.2	466.0	421.1	469.6	507.9
Cucumber	249.9	254.8	256.3	202.6	225.1
Eggplant	82.2	74.0	100.7	95.3	119.2
Sweet pepper	126.4	115.9	137.3	131.4	109.2
Cabbage	217.4	243.1	256.9	214.8	219.1
Water melon	199.0	299.3	270.2	273.1	409.3
Other miscellaneous vegetables	1,364.9	1,288.2	1,407.2	1,472.6	1,343.9
Grape	1,313.5	1,291.6	1,321.4	1,303.0	1,300.2
Apricot	375.1	371.8	371.4	382.9	381.3
Peach	155.7	155.4	157.7	144.1	141.8
Apple	213.3	209.8	209.2	206.4	200.5
Pear	53.2	50.9	45.4	47.4	48.2
Other miscellaneous fruits & berries & nuts	106.6	120.1	115.9	132.4	150.8
Total	8,430.4	8,503.6	8,763.3	8,728.9	9,138.6
Production (ton)					
Crops	2010	2011	2012	2013	2014
Wheat	5,344.8	5,622.9	5,443.9	6,058.5	6,850.1
Barley	230.4	349.2	253.2	171.4	315.1
Maize	32.8	45.8	102.6	62.0	83.5
Alfalfa	8,654.3	8,334.9	9,351.8	9,500.1	11,092.8
Potato	22,927.0	25,205.2	31,327.4	29,455.8	29,102.0
Other miscellaneous food & forage crops	569.0	670.6	616.6	736.9	646.6
Tomato	19,434.5	20,668.9	19,754.5	23,678.8	24,283.3
Cucumber	8,938.4	10,048.9	8,779.5	8,509.2	9,009.8
Eggplant	4,410.4	3,771.4	5,343.5	4,321.0	4,562.0
Sweet pepper	4,892.2	4,642.5	5,221.5	5,443.2	3,947.9
Cabbage	6,565.7	7,434.7	6,966.7	6,998.0	6,230.2

Water melon	9,014.0	12,312.2	11,470.5	12,134.5	16,552.0
Other miscellaneous vegetables	21,090.2	25,232.6	24,819.7	29,647.0	26,989.0
Grape	12,848.7	13,636.7	14,295.4	15,922.2	17,501.9
Apricot	2,002.8	2,436.3	2,658.9	2,880.4	290.1
Peach	1,374.7	1,372.5	1,543.1	1,553.8	1,396.4
Apple	944.8	1,271.6	1,682.3	1,831.2	3,399.8
Pear	333.4	350.0	367.7	432.1	440.4
Other miscellaneous fruits & berries & nuts	750.8	768.3	869.7	877.2	818.7

Yield (ton/ha)

Crops	2010	2011	2012	2013	2014
Wheat	3.1	3.6	3.5	3.8	3.8
Barley	3.0	2.9	2.1	2.2	3.4
Maize	2.4	2.6	2.4	1.3	2.3
Alfalfa	11.3	11.0	11.3	11.3	11.5
Potato	31.6	32.4	36.6	41.8	40.0
Other miscellaneous food & forage crops	2.0	2.0	2.1	2.0	1.9
Tomato	48.3	44.4	46.9	50.4	47.8
Cucumber	35.8	39.4	34.3	42.0	40.0
Eggplant	53.7	51.0	53.1	45.3	38.3
Sweet pepper	38.7	40.1	38.0	41.4	36.2
Cabbage	30.2	30.6	27.1	32.6	28.4
Water melon	45.3	41.1	42.5	44.4	40.4
Other miscellaneous vegetables	15.5	19.6	17.6	20.1	20.1
Grape	9.8	10.6	10.8	12.2	13.5
Apricot	5.3	6.6	7.2	7.5	0.8
Peach	8.8	8.8	9.8	10.8	9.8
Apple	4.4	6.1	8.0	8.9	17.0
Pear	6.3	6.9	8.1	9.1	9.1
Other miscellaneous fruits & berries & nuts	7.0	6.4	7.5	6.6	5.4

Note*) Acreage of the project area is only 91.2% of total acreage of the 27 communities

Source) 27 Community Offices concerned

Various kinds of crops are grown in about 8,500-9,000 ha in total every year in the 27 communities, while the annual average is 8,713 ha during 2010-2014. In terms of planted area, wheat is the largest crop, while vegetables and fruits including grapes are also widely grown. Considering a price advantage of vegetables and fruits over cereals, many farmers in the 27 communities generate agricultural profit mainly from vegetables and fruits. The Project area is characterized as a leading area of vegetables and fruits production in the country. As regard to vegetables, planted area of other miscellaneous vegetables is more than 2 times bigger than the area of tomato, while tomato is the largest single crop in terms of planted area among vegetables. It seems that diversification of vegetable crops including herbs is progressed in the 27 communities. On the contrary, fruits and grapes are dominated by some limited crops, i.e. grapes, apricot and apple. Planted area of grapes is remarkably bigger than other fruits in the 27 communities. Higher productivity of many crops in the 27 communities comparing the national average proves that the Project area is a leading crop farming area in the country.

Table 4-5-5.2 shows number of livestock in the 27 communities. Out of 13,574 farm households in the communities, only 4,749 farm households or 35% of total farm households are growing some sort of livestock in 2014. In general, livestock farming is not popular among farmers in the 27 communities. In terms of the number, chicken is the largest, followed by cows/cattle, sheep, pigs and few goats and horses. It seems that cows/cattle are the most important animal to livestock farmers in the 27 communities. As regard to number of cows/cattle, the number of milk cows is much bigger than the number of meat cattle. As same as in case of chicken, the number of layer hen is much bigger than the number of chicken for meat.

Table 4-5-5.2 Number of Livestock in 27 Communities Extended across the Project Area (2010-2014)

Livestock		2010	2011	2012	2013	2014
Household growing livestock		5,460	5,158	4,953	4,725	4,749
1	Milk cows/Cattle total	11,543	12,865	12,754	13,584	13,044
1-1	Milk cows (milking)	5,167	5,459	5,725	6,036	5,872
1-2	Meat cattle (adult)	1,039	804	1,058	604	457
1-3	Infant/Infertile	5,337	6,602	5,971	6,944	6,715
2	Pigs	3,481	3,097	2,822	3,942	4,329
3	Sheep	12,474	11,299	10,815	15,110	12,136
4	Goats	126	212	171	309	199
5	Horses	30	10	31	44	42
6	Chicken total	50,868	44,033	40,991	43,578	46,644
6-1	Layer hen (egg)	43,236	36,898	35,395	37,717	39,811
6-2	Other chicken	7,632	7,135	5,596	5,861	6,833

Source) 27 Community Offices concerned

2) WUA areas

While 4 WUAs extend their command areas in the Project area, crop and livestock farming in each WUA area is discussed here. Detailed statistical data on crops and livestock by 4 WUA areas is attached in Appendix B-7 respectively, and abstractive information related to agriculture collected from each community office is summarized in Appendix B-8 for easy understanding.

Yeghvard WUA area: (represented by information from 3 communities concerned)

There are 3 communities related to the Project in Yeghvard WUA area. Cropped area in the Yeghvard 3-communities is mainly irrigated by Arzni Branch Canal. Crop planted area in the Yeghvard 3-communities was about 625-680 ha in total during 2010-2014, while the average was 643 ha. The area is only 7.4 % of the total cropped area in the 27 communities.

Cropped area of alfalfa is the largest, followed by apple and apricot. Fruits production is the most popular farming in the Yeghvard 3-communities, by utilizing well-drained soil, hilly land condition and long duration of sunshine. The Yeghvard 3-communities have a long history of fruits cultivation, since they were developed as Sovkhozes to produce fruits and grapes during Soviet era. On the contrary, vegetables are not popular among farmers, except for growing them in backyard mainly for own consumption. Productivity of each crop is still lower than other 3 WUA areas, due to mainly inferior irrigation condition and relatively low soil fertility. Production of vegetables and fruits, however, tend to increase because of increased productivity of those crops in recent years.

Although a general understanding that livestock farming is more popular in Yeghvard WUA area than the other 3 WUA areas, only 627 farm households or 23% of total 2,672 farm households were growing some sort of livestock in the Yeghvard 3-communities in 2014. Nevertheless, the Yeghvard 3-communities grow a big number of livestock comparing to the other WUA areas. In case of cows/cattle which are the most important livestock for farmers, 4,930 heads or 37.8% of the total (13,044 heads) in the 27 communities were grown in 2014 in the area. There must be specialized livestock farmers, even not a large number, who manage a large number of animals. The order of importance among livestock is almost same as the other areas except for sheep. Number of growing sheep is more than the number of cows/cattle in the area.

Ashtarak WUA area (represented by information from 4 communities concerned)

There are 4 communities related to the Project in Ashtarak WUA area. Cropped area in the Ashtarak 4-communities is mainly irrigated by Lower Hrazdan Canal and Takahan Canal. Most of the present cropped area in 3 communities along to Lower Hrazdan Canal, i.e. Noraket, Baghramyan and Merdzavan, is located outside of the Project area. Only the area located on the northern side of Lower

Hrazdan Canal in the 3 communities, where is located at higher altitude than the canal and is extended on gentle slopes, is included in the Project area.

Crop planted area in the Ashtarak 4-communities was about 1,110-1,140 ha in total during 2010-2014, while the average was 1,122 ha. The area is only 12.9 % of the total cropped area in the 27 communities. As same as the Yeghvard 3-communities, 3 communities out of the 4 communities were developed as Sovkhozes to produce mainly grapes during Soviet era. Remained one community, Merdzavan, was also developed as a managing community of research farms including a grape research farm. Influenced by the history, more than a half of farmland is occupied by fruits and grapes. In terms of cropped area, grapes are the extremely biggest, followed by alfalfa, apricot, wheat, barley and various fruits.

Collected data shows considerable rise of grape production from 2010 to 2014. While there is no significant difference in planted area of grapes, the productivity has been improved. Meanwhile, several commercial investors have already started to convert idle lands into vineyard or orchard. Though there is no single vegetable crop which has widely produced, total vegetable cropped area is not so small, probably due to diversified vegetable crops. Except for fruits and cereals, productivity is lower than the average of the 27 communities.

Only 522 farm households or 23% of total 2,279 farm households were growing some sort of livestock in the Ashtarak 4-communities in 2014. The percentage is same as the percentage of the Yeghvard 3-communities. Though the order of importance among livestock is almost same as the other areas, number of pigs is relatively bigger in this area.

Vagharshapat WUA area (represented by information from 7 communities concerned)

There are 7 communities related to the Project in Vagharshapat WUA area. Cropped area in the Vagharshapat 7-communities is mainly irrigated by Shah-Aru Canal and Upper- and Lower- Akhnalich Canals. Because of unreliable water supply from the canals due to reduced water resources suppling to Upper- and Lower- Akhnalich Canals, and deteriorated canal networks to individual farmers, many farmers depend on tube-wells powered by electricity to irrigate their crops.

Crop planted area in the Vagharshapat 7-communities was about 2,340-2,620 ha in total during 2010-2014, while the average was 2,489 ha. The area is continuously expanding year by year in 2010-2014. In terms of cropped area wheat is the largest, followed by water melon, alfalfa, tomato, potato, grapes, cucumber and various vegetables. Comparing to annual crops, fruits production except for grapes is not popular in the area. The area is located in Ararat plain and is blessed with fertile soil. It is generally understood that Ararat plain is the most agricultural advanced area in the country. Productivity of many crops in the area is higher than the average of the 27 communities, except for fruits crops.

While farmers in the Vagharshapat 7-communities are very active in growing all annual crops in general, Vagharshapat WUA area is famous in vegetable cultivation. Vegetables production in the area shows a significant increase in 2010-2014 because of increased planted area. A blessed location of the area which has a good road access to big cities, such as Yerevan, Ejimiatsin, Armavir and Ashtarak, has made a big push to the increased production.

Farmers grow various kinds of vegetables and herbs in their backyard, beside crops, such as wheat, alfalfa, potato, cabbage and water melon which are mainly grown in relatively large scaled open field. More than a half of planted area is occupied by vegetables in 2014, if potatoes are counted in vegetables. Most of the farmers construct a simple greenhouse or tunnel in their backyard or a field near to their houses for growing vegetables for marketing purpose. Some of them even install a private tube well for securing stable irrigation water for their vegetables. Tomato and cucumber are the most

common crops cultivated in greenhouses. Multiple cropping in a year under greenhouse or tunnel is also popular in the area.

History of the Vagharshapat 7-communities is a reason why vegetable farming is very popular among farmers. Out of the 7 communities, 5 communities were Kolkhozes mainly growing vegetables, and 1 community was a Sovkhoz for vegetable seeds production in Soviet era. Considering the history, there have to be many farmers who have good experience in vegetable cultivation in the Vagharshapat 7-communities.

In contrast to crop farming, farmers in the Vagharshapat 7-communities are not so active in livestock farming. Though 1,189 farm households or 44% of total 2,709 farm households were growing some sort of livestock in 2014, total number of livestock grown in the area is relatively small except for chicken. Many farmers probably keep small number of livestock mainly for their own consumption in the area. According to collected information from community offices in the area, livestock farming is not a profitable business any more, as the communities lost a right to access to grazing pastures which they had in mountainous regions mainly in Aragatsotn Marz and Kotayk Marz before the independence. As same as the other areas, cows/cattle, especially milk cows are the most important livestock for farmers.

Khoy WUA area (represented by information from 13 communities concerned)

There are 13 communities related to the Project in Khoy WUA area. The communities are located on the north-western side of Vagharshapat WUA area, and extended on Ararat plain bordered on foothills. Cropped area in the Khoy 13-communities occupies almost a half of the total cropped area in the 27 communities. The area is mainly irrigated by Lower Hrazdan Canal, while a small part is irrigated by Upper Akhnalich Canal and Kasakh River (pump irrigation). Even though the area is endowed with the best irrigation condition in the Project area, not a small number of farmers depend on tube-wells for irrigating their crops although the dependence is lower than Vagharshapat WUA area.

Crop planted area in the Khoy 13-communities was about 4,350-4,750 ha in total during 2010-2014, while the average was 4,459 ha. The area is continuously expanding year by year in 2010-2014. In terms of cropped area wheat is the largest, followed by grapes, potato, alfalfa, tomato, cabbage, apricot, cucumber, and various vegetables and herbs. With blessed conditions to run farming business, i.e. good prepared irrigation, fertile and plain land and good access to the market, the area leads not only the Project area but also whole country in terms of crop farming together with Vagharshapat WUA area.

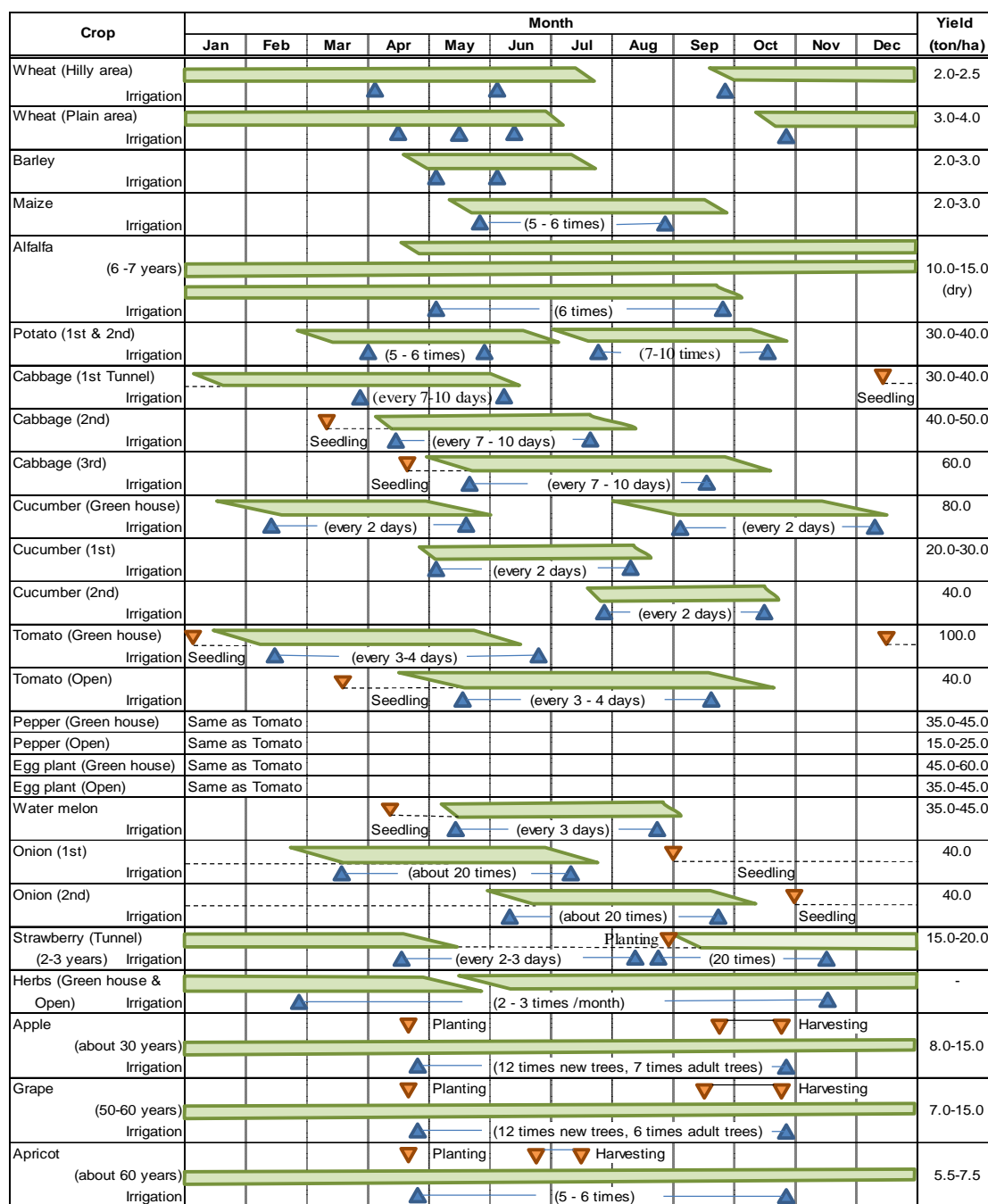
While farming system and cultivated crops is similar to Vagharshapat WUA area, a fruits farming mainly growing grapes is much popular in the Khoy 13-communities and cultivated crops are more diversified. Since 6 communities out of the 13 communities were Kolkhozes to grow grapes and fruits in Soviet era, while other communities were vegetable Kolkhozes except for one grape Sovkhoz, the history may influence to the difference. Another difference is a size of cropped field. An average size of cropped field in the area is generally smaller than the area in Vagharshapat WUA area, according to the observation, probably due to geographical condition mainly. As same as Vagharshapat WUA area, greenhouse or tunnel cultivation is popular among farmers in the area. Diversified vegetables and herbs are grown under greenhouses or tunnels. Several communities are getting famous in special crops, such as strawberries, tarragon, etc.

Farmers in the Khoy 13-communities are also not so active in livestock farming, except for Ferik community. Though 2,411 farm households or 41 % of total 5,914 farm households were growing some sort of livestock in 2014, total number of livestock grown in the area is not so large except for chicken. Many community offices in the area mentioned the issue of grazing land area similar to the

case of Vagharshapat WUA area. As same as the other areas, cows/cattle, especially milk cows are the most important livestock for farmers.

4-5-6 Cropping Calendar

Temperature, rainfall and availability of irrigation mainly determine cropping seasons of major crops in the Project area. Figure 4-5-6.1 indicates the cropping seasons of major crops based on collected information from various sources including a farm household survey by the Survey team. Mainly, the season of most crops begins in April and May, as rainfall increases when spring season starts in the Project area. The cropping ends in September and October before cold winter season comes. Wheat is an exception since it is widely sowed in autumn, when a certain rainfall is expected. In any case, the farming system in the Project area is designed based on timing with appropriate climate.



Source) JICA Survey Team

Figure 4-5-6.1 Crop Calendar of Major Crops in the Project Area

While rain-fed farming of wheat or forage crops, which require relatively small amount of water, is practiced in mountainous areas in Armenia with comparatively blessed rainfall, irrigation is required for growing all crops in Ararat plain where the Project area is located due to small amount of rainfall and high temperature.

4-5-7 Use of Farm Inputs

1) Inputs use

Agricultural inputs such as crop seeds, fertilizers, agrochemicals, farm machinery and farm facilities are significant inputs to achieve a stable and high production of agriculture. Table 4-5-7.1 indicates situation of agricultural inputs use by crops about interviewed 81 farmers by the Survey team's farm household survey. 82% and 61% of sampled farmers use fertilizers and herbicides respectively for their crop production, and those percentages are relatively higher compare to other inputs. While fertilizers are commonly used for almost all crops, herbicides are not much used for cereals and sweet pepper. Other farm inputs such as compost, pesticides and commercial seeds are used only by 20-35% of sampled farmers. Little number of farmers uses compost although fertilizers are popular among farmers. There are notable gap between the two inputs and others in respect to the popularity among farmers.

Many farmers has recognized that pests and diseases are serious problem for their crop production when the Survey team interviewed about their problems, but Table 4-5-7.1 shows that pesticides and fungicides are still not popular among them. They are still used selectively by limited farmers to limited crops. As regard to pesticides, wheat and maize are only crops for those pesticides are used by more than 50 % of growers. In case of fungicides, only grapes, greenhouse tomato and cucumber are such crops. Many farmers don't know well about basic information, even right names of herbicides, pesticides and fungicides which they use, according to the farm household survey. They usually make consultation with agrochemicals shops about appropriate chemicals to their crops when necessary.

As for commercial seeds and seedlings, those of cereals, potato, tomato, cucumber, cabbage and watermelon are often procured from market. It is noted that many growers of tomato and cucumber under greenhouse depend much on commercial seedlings.

Table 4-5-7.1 Use of Agricultural Inputs by Crops

Crops	No. of farmers to grow	Number of Users						
		Fertilizer	Compost	Herbicide	Pesticide	Fungicide	Marketed Seeds	Marketed Seedlings
Wheat	35	35	3	4	33	8	23	0
Barley	10	10	0	0	4	2	6	0
Maize	2	1	0	1	2	0	2	0
Alfalfa	26	13	2	20	0	0	4	0
Potato	29	28	3	26	13	9	27	0
Tomato	26	22	8	15	6	7	10	10
Tomato (green house)	18	18	11	11	2	10	2	16
Cucumber	30	28	3	23	3	11	23	1
Cucumber (green house)	12	11	8	8	0	7	0	12
Eggplant	17	11	6	10	2	2	0	7
Eggplant (green house)	0	0	0	0	0	0	0	0
Sweet Pepper	10	7	2	2	1	2	1	2
Sweet Pepper (green house)	6	6	4	1	0	0	0	0
Cabbage	9	7	0	8	2	3	5	4
Water melon	8	8	0	6	4	4	5	3
Grape	33	23	9	28	15	22	0	3
Apricot	20	10	11	16	0	8	0	3
Apple	16	11	7	8	1	6	0	3

Source) JICA Survey Team (Farm household survey)

According to the farm household survey by the Survey team, many farmers complained about high cost of farm inputs. It is implied that high price of inputs is a major reason of relatively low percentage of inputs users as shown in Table 4-5-7.1. In the same view point, a major reason of high percentage of fertilizer-users must be the government subsidy policy to fertilizers, and the reason of herbicide-users is the affordability of herbicides considering labor hiring cost for weeding.

As regard to fertilizers, there might be growing concern about an excessive use of nitrogen fertilizers in Armenia. A result of the farm household survey implies that many respondents use only nitrogen fertilizers and overuse them to their crops (see Table 4-5-7.2). According to the Agrochemical Service Company under the Ministry of Agriculture, an excessive use of nitrogen fertilizers is recognized throughout the country, while an underuse of phosphate fertilizers and potassium fertilizers is another concern. The company suggests that a balanced fertilizer application could bring about high-productivity and high-quality of harvest on sustainable basis.

Table 4-5-7.2 Chemical Fertilizer Use for Crop Cultivation

Crops*	Amount (kg/ha in chemical component)					
	Ave. of Respondent Farmers			Government Recommendation		
	N	P ₂ O ₅	K ₂ O	N	P ₂ O ₅	K ₂ O
Wheat	130.5	0.0	0.0	90 - 120	90	60 - 70
Barley	74.5	0.0	0.0	70 - 90	60 - 70	70
Alfalfa	63.3	0.0	14.3	0	90 - 120	45 - 60
Potato	332.2	0.0	0.0	120	90	90

Note*) Crops widely grown by sample farmers in terms of cropped area

Source) JICA Survey Team (Farm household survey)

2) Number of Farm Machinery

Many farmers in the Project area expressed serious shortages of farm machinery during an interview survey with them. Though there are agricultural machinery services by service providers in the Project area, shortages of farm machinery and improper timings of the services are serious issue for appropriate crop management works as planned. Table 4-5-7.3 shows number of farm machinery in the Project area.

Table 4-5-7.3 Number of Farm Machinery in the Project Area

Farm Machinery	2010	2011	2012	2013	2014
Tractors (main-body)	385	376	361	366	365
Tractor plows	123	125	131	127	129
Cultivators (for ridging)	92	86	92	88	88
Tractor seeder	52	53	53	54	54
Tractor mower	29	29	30	31	31
Baler (tractor operated)	27	27	28	29	31
Tractor trailers	154	150	155	158	155
Combine harvester	5	5	5	5	5

Source) 27 Community Offices concerned

While total number of tractors, which is the most important farm machinery, is 365 units in 2014, the number is not so small considering 9,139 ha of total planted area in the Project area in 2014 (see Table 4-5-7.4). It seems that 25 ha of planted area per tractor unit is theoretically within a reasonable level for managing farmland, if all tractors are in good working condition, and are properly operated in large scaled fields in accordance with well-organized schedule. About 10 ha is, however, the optimal land unit size per one tractor (80 HP) considering the present operation condition, according to a private tractor dealer.

Table 4-5-7.4 Numbers of Tractors and Planted Area in the Project Area

	Yeghvard	Ashtarak	V. shapat	Khoy	Total
Number of Tractors (unit)	28	40	132	165	365
Planted Area (ha)	630.2	1,142.6	2,622.5	4,743.3	9,138.6
Area/Tractor (unit/ha)	22.5	28.6	19.9	28.7	25.0

Source) 27 Community Offices Concerned

In Armenia, many over aged farm machinery such as tractors are still used at field, even from the Soviet time continuously. Age of those machineries is sometimes more than 30 years old. One of serious issues in agriculture sector in this country is renewal of those old machineries. Decline of tractor numbers as shown in Table 4-5-7.3 implies that number of break down tractors is overtaking the number of renewal. Meanwhile, fragmented farmland after the privatization policy is one of reasons why many farmers have faced to the shortages of farm machinery. Present farm machinery services cannot properly cope with requirements for managing a large number of fragmented farmlands owned by individual farmers.

3) Procurement Sources

Table 4-5-7.5 shows procurement sources of farm inputs. The table suggests that private market is the major source of farm inputs for farmers. Some farmers are managing self-produced inputs such as seeds and compost by themselves. Besides, government program is another major source of chemical fertilizers, as there is a government subsidy system of fertilizers to encourage farmers in their intensive farming. Farmers are able to procure three types of fertilizers, i.e. Ammonium nitrate, Double superphosphate and Potassium chloride, at 35 to 50 % cheaper price than the market prices through the subsidy system.

Table 4-5-7.5 Source of Procurement of Farm Inputs in 2014/2015

Farm Inputs	No use farmers	Self-pro duction/ manage ment	From Govt. program	From research institutes	From private/ market	From neighbor	From others	Total* (81 farmers)
Commercial seeds / seedlings	17	9	4	0	58	1	0	89
Compost	46	11	1	0	18	4	2	82
Chemical fertilizers	8	2	48	0	50	0	0	108
Pesticide / Fungicide / Herbicide	2	0	7	0	75	0	1	85
Mechanization services (machinery-hiring)	17	4	0	0	61	4	0	86
Fuel (diesel)	64	1	0	0	17	0	0	82

Note*) As one sample farm household has plural sources, total number is not equal to the sample number

Source) JICA Survey Team (Farm household survey)

4) Greenhouse

Greenhouse cultivation is becoming more popular in recent years in Armenia due to an increased demand for quality vegetables and flowers from urban area, as well as for export. Growing vegetables and flowers in greenhouses is more costly than open field cultivation, but it has its advantages: better quality products, more protection from rain, hail and pests, and possibility of harvest season control.

Table 4-5-7.6 shows total area and number of greenhouses by Marzes. Almost 95 % of total greenhouse areas in Armenia are concentrated in Ararat Marz and Armavir Marz which are located in Ararat plain. Vagarshapat WUA and Khoy WUA areas, located in Armavir Marz, are the center of greenhouse crop production in the Project area. Table 4-5-7.6 also implies that most of greenhouses installed in Armavir Marz are small size greenhouses for vegetable cultivation. Many farmers in the both WUA areas construct a simple greenhouse in or near by their backyard. Some advanced farmers install a personal tube well, and even a drip irrigation system with their greenhouses. According to

interviewed farmers and the Greenhouse Association, RA, tomato and cucumber are the most popular crops for greenhouse cultivation. In addition to those major crops, other crops such as pepper, eggplant, strawberry, herbs and ornament flowers are also grown under greenhouses.

In Armavir Marz, an average planted area of vegetables and melon from 2009 to 2013 counts 12,165 ha according to the data from the Ministry of Agriculture. Considering this figure, greenhouse area for vegetables in Armavir Marz is estimated to about 3 % of the total vegetables and melon planted area.

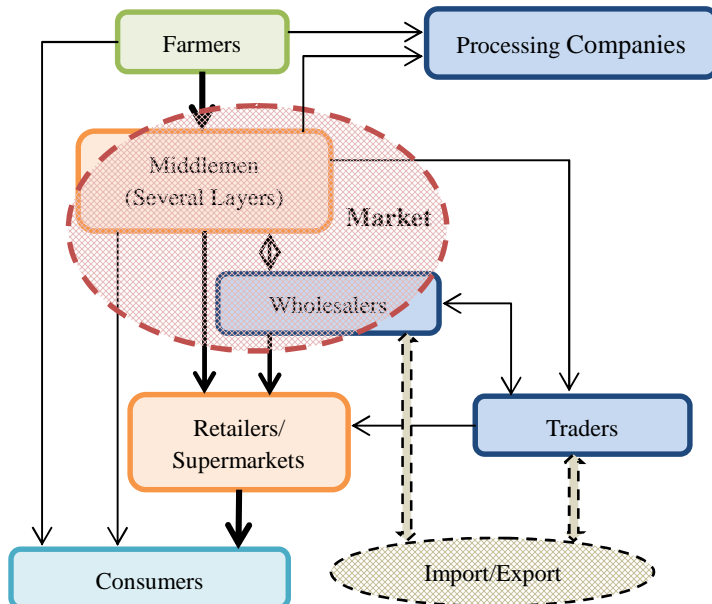
Table 4-5-7.6 Total Area of Greenhouses and Use by Region in 2014

No	Marz	Area						Farmer/Owner		Average (ha/h.h.)
		Vegetables		Flowers		Total (ha)	Farmer/Owner (h.h.)	Average (%)		
		(ha)	(%)	(ha)	(%)					
1	Ararat	120.0	70.9	49.3	29.1	169.3	27.6	2,212	28.0	0.08
2	Aragatsotn	1.9	70.4	0.8	29.6	2.7	0.4	11	0.1	0.25
3	Armavir	349.3	85.4	59.7	14.6	409.0	66.6	5,485	69.5	0.07
4	Gegharkunik	0.1	50.0	0.1	50.0	0.2	0.0	1	0.0	0.20
5	Kotayk	15.9	60.7	10.3	39.3	26.2	4.3	48	0.6	0.55
6	Lori	0.0	NA	0.0	NA	0.0	0.0	3	0.0	0.00
7	Syunik	1.3	37.1	2.2	62.9	3.5	0.6	6	0.1	0.58
8	Shirak	0.4	66.7	0.2	33.3	0.6	0.1	8	0.1	0.08
9	Vayots Dzor	0.6	100.0	0.0	0.0	0.6	0.1	5	0.1	0.12
10	Tavush	1.6	94.1	0.1	5.9	1.7	0.3	118	1.5	0.01
Total		491.1	80.0	122.7	20.0	613.8	100.0	7,897	100.0	0.08

Note) Figures in bold are Merzes placed in the project area
 Source) The Greenhouse Association, RA

4-5-8 Marketing of Agricultural Products

The Project area has an advantage location for marketing agricultural products to Yerevan city which is the biggest consuming place of agricultural products in the country. As mentioned in the Chapter 3-5, middleman is the most major buyers for farmers in the Project area. From retailer’s aspect, a stable supply of certain volume and quality of agricultural products are needed for their business. Middleman is playing the role of filter to collect up enough volume of products from farmers for retailer’s demand.



Source: JICA Study Team

Figure 4-5-8.1 Distribution Channel of Vegetables and Fruits

Limited number of farmers who are producing enough volume of products by commercialized large-scale farming can sell their products without middleman. Selling channel of agricultural products is significant issue for farmers because it is directly related to their income. Figure 4-5-8.1 describes the distribution channels of vegetables and fruits which are the most important farm income sources in the project area.

Contract farming is going to be developed in the Project area, even at an initial stage. Many processing companies and traders consider that they should depend in a large part of their handling products on contract farming if they will expand

their business. However, they still hesitate to get into expanded contract farming due to the following problems on the management.

- Quality control of the products produced by contract farmers
- Breach of contract (by contract farmers) when market price of the products increases

Table 4-5-8-1 indicates sale destinations of main 8 products from farmers based on result from the farm household survey.

Table 4-5-8.1 Marketing Channels of Major Agricultural Products in the Project Area

Products	Number of Farmers	Sale Destinations* from Farmers						
		Middle-man	Processor	Wholesaler	Retailer/ Supermarket	Cooperatives	Exporter	Customer/ Neighbor
Wheat	11	8	0	1	0	0	0	2
Potato	23	9	0	9	1	0	1	4
Tomato (open field)	15	7	8	2	1	0	0	0
Tomato (greenhouse)	18	12	0	4	0	0	0	2
Cucumber (open field)	18	9	1	5	0	0	0	4
Cucumber (greenhouse)	10	7	0	2	0	0	0	1
Grape	21	0	18	0	0	0	0	3
Apricot	14	3	0	4	2	0	2	3
Cow Milk	15	0	6	0	5	1	0	4
Cattle Meat	16	8	0	1	3	0	0	5

Note*) As some farmers have several sale destinations, the total number is not necessarily equal to the number of farmers
Source) JICA Survey Team (Farm household survey)

Potato, apricot and cow milk are sold through relatively wide varieties of selling channels. Milk and cattle meats are often sold directly to consumers who live in the same or surrounding communities, even Yerevan city. A direct selling doesn't always secure farmers a satisfactory profit, as it needs increased transportation cost and other indirect cost sometimes. However, a direct selling to customer can be one of options to maximize farmer's profit by disintermediation in such a suburban area. Majority of grape and some part of tomato, cucumber and milk are sold to processing companies. In case of grape, many farmers are doing contract cultivation with brandy distilleries and wineries. Since grape cultivation has been historically developed with development of the industries, and the industries are important foreign currency sources, the government supports the contract farming of grape. In case of tomato, the open field farmers tend to sell a large volume of their products to processors at a small profit. On the contrary, the greenhouse farmers are selling their products to middleman and others for fresh consuming. Agricultural cooperatives are not active in marketing in the Project area, except in a case of milk selling, while cooperatives can be an effective solution for farmers to increase their bargaining power in marketing.

Table 4-5-8.2 indicates the result of the farm household survey on the number of sample farmers who produced and marketed agricultural products by crops and livestock in 2014. According to the figures in the table, cereals and chicken products are mainly produced for self-consuming purpose. In contrast, many vegetables, grape and cattle products are mainly produced for marketing.

Table 4-5-8.2 Number of Growers to Marketed Products by Crops/Livestock

Crop / Livestock	Number of Farmers		
	Produced (h.h.)	Marketed (h.h.)	% of marketed
Wheat	35	11	31.4
Barley	10	2	20.0
Maize	2	2	100.0
Alfalfa	26	12	46.2
Potato	30	23	76.7
Tomato	28	15	53.6
Tomato (green house)	20	18	90.0
Cucumber	34	18	52.9
Cucumber (green house)	13	10	76.9
Eggplant	21	7	33.3
Eggplant (green house)	1	0	0.0
Sweet Pepper	14	4	28.6
Sweet Pepper (green house)	7	6	85.7
Cabbage	11	9	81.8
Water melon	8	7	87.5
Grape	39	21	53.8
Apricot	32	14	43.8
Apple	22	6	27.3
Cow milk	27	15	55.6
Beef Cattle/Meat	18	16	88.9
Broiler Chicken/Meat	22	0	0.0
Egg	40	4	10.0

Source) JICA Study Team (Farm household survey)

Table 4-5-8.3 indicates three categories of crop prices: farm-gate price, wholesale price and retail price of crops which are grown by many farmers and are commonly marketed by the growers. Potato represents longer storable crops, tomato represents vegetables and grape represents fruits.

Table 4-5-8.3 Price Variation of Major Crops in 2014/15

Crop	Price Category	(RMD)		
		Average (moderate)	Maximum	Minimum
Potato	Farm Gate	160	250	60
	Wholesale	200	280	80
	Retail	260	300	230
Tomato (High season) Jun-Oct	Farm Gate	131	500	40
	Wholesale	220	660	80
	Retail	238	400	130
Tomato (Off season) Nov-May	Farm Gate	562	800	50
	Wholesale	814	1,250	200
	Retail	563	800	300
Grape	Farm Gate	160	300	100
	Wholesale	440	1,200	180
	Retail	710	1,400	300

Source) JICA Survey Team

The result implies that middleman are generally selling the purchased products from farmers to other buyers with 20~30 % higher price. As regard to tomato's retail price (both in high season and in low season), logically it must indicate higher price than the wholesale price. But the wholesale prices in the table show higher prices than the retail prices. This is probably caused by complicated market condition of tomato, as tomato has various market segments, production sources and quality grades, such as for processing, for fresh consumption and for export, as well as from open field, from greenhouse and from import. A further survey is necessary to unravel out the confused information about tomato price.

More detailed information about farm-gate price collected through the farm household survey is listed in Appendix B-9. The prices show that there are huge gaps between minimum price and maximum price in every crop. Especially, the price gaps of tomato (both open field and greenhouse) are more than ten times. The prices of tomato are staying at the bottom due to the saturated situation in the market during in August to September when is the peak harvesting season of open-field tomato. Greenhouse farming is one of the effective ways for farmers to increase their profit by shifting the harvest season.

Figure 4-5-8.2 shows the price indexes of the 3 major crops: potato, tomato and grape to see their price fluctuation by season. Potato and tomato price indexes explain that farm-gate price tend to show wider fluctuation than wholesaler price and retail price. Those crops' farm-gate prices are sharply down during their harvesting season. Farmers must be tackling with lower selling price during the high harvesting season. It is noted that price fluctuation of tomato is much wider than that of potato. It means that potato has less seasonality than tomato due to its high storage performance. Difference in storable period of both crops may cause the wider gaps. As greenhouse cultivation of tomato is becoming popular, the crops are available in Armenian market even in autumn to winter seasons together with imported one. Some farmers grow tomato and other vegetables targeting to market during off season by foster culture or by suppression culture with greenhouses. The tomato price index, showing the peak during December to April, implies that greenhouse farmers generate a substantial income from their greenhouse crops.

On the contrary, the index of grape farm-gate price shows rather stable and seasonal than potato and tomato. The stable price is mainly due to the contract farming system guided by the government. The government provides a direction of minimum buying price to processors, so that farmers don't lose motivation to grow grape. While the indexes of wholesaler price and retail prices show wider fluctuation, it is probably caused by mixed information of two different market segments of grapes. One is cheaper grapes for processing and the other is expensive grapes for fresh consumption.

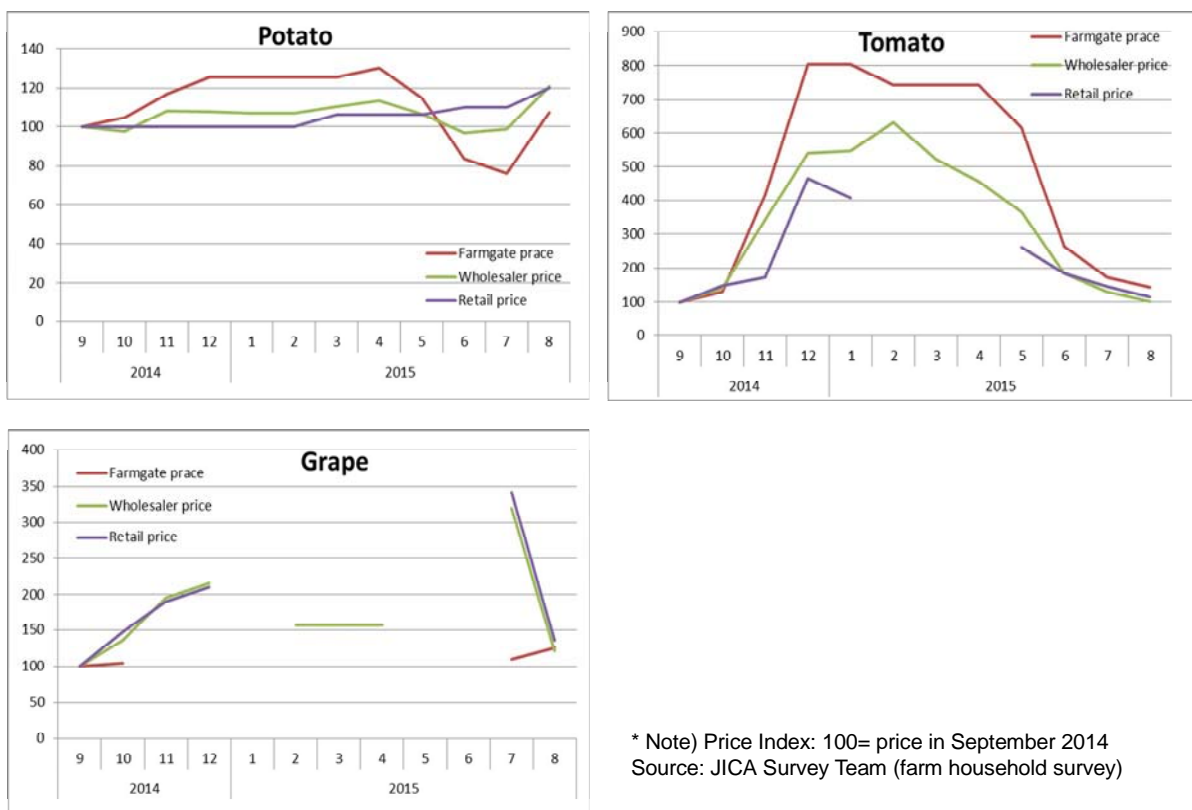


Figure 4-5-8.2 Price Index of Major Crops

4-5-9 Agricultural Cooperatives

In the Project area, agricultural cooperatives are not active. According to the result of the farm household survey, cooperatives are not a popular buyer of farm products for most of the interviewed farmers. It is quite rare to sell agricultural products to cooperatives except for dairy product (see Table 4-5-8.1). And also, a series of interviews to distributor, trader and processors of agricultural products reveals that it is uncommon for them to procure agricultural products from agricultural cooperatives. There is only a case that a wholesaler bought potatoes from cooperatives or farmers' group in the past year.

According to the head of division of agricultural cooperative support in the Ministry of Agriculture, not a small number of farmers are still suspicious about the benefit of agricultural cooperatives due to the negative mindset caused by their experiences during the Soviet era. There were many cooperatives established in short time by several projects even after the independence. However, many of them were not sustained. While a participatory process before the establishment and a careful monitoring for a certain long-period after the establishment are essential conditions to the development of self-sustained cooperatives, many projects fail to pay serious attention to them. Agricultural cooperatives are not yet became ingrained in farmers not only in the Project area but also in Armenia.

4-5-10 Agricultural Credit

Since April 2011, the government has been implementing an agricultural finance supporting program which compensates the interest rate of agricultural credit. The subsidized agricultural credit is provided through three private banks, i.e. ACBA Credit Agricole Bank, Ardshinvest Bank and Converse Bank. The compensation rate for the interest rate by the government is 4% (ordinary interest rate is 14 %), and more favorable rates (6%) of government compensation are implemented in the poverty-stricken areas. While 915 communities were involved in the program in 2015, 6% interest was applied for all the communities. The payback period of the credit is more than 1 year (depending on the loan condition), and the payments are to begin after 6 months of the borrowing.

Following Table 4-5-10.1 describes the total amount of the agricultural credit provided by the three private banks since 2000. According to the table, the loan amounts are hugely increasing since 2011 when the governmental supporting program started. The amount of agricultural credit without the government assistance also indicates a healthy growth. The total amount of agricultural credit from private financial agencies excluding the above three banks was about forty billion ADM in 2013.

Table 4-5-10.1 Agricultural Loans Provided by the 3 Private Banks (2000-2014)

Year	Loan Amount (Billion AMD)
2000	10.4
2001	9.4
2002	7.8
2003	8.2
2004	8.6
2005	11.3
2006	14.2
2007	22.4
2008	36.5
2009	44.2
2010	52.6
2011	73.4
2012	91.9
2013	103.2
2014 (up to June)	115.9

Source) MOA

Table 4-5-10.2 shows the result of interviews to farmers in the target area about constrains and problems related to accessibility of credit. Interviewees replied that accessibility to credit is not a little problem for their agricultural activities. Nearly 40% of interviewed farmers regard access to credit is a considerable issue of farm management. Other survey result suggests that there must be high potential demand for agricultural credit, as many farmers are burdened with high production cost issues such as payment for fertilizers, agrochemicals, farm-machinery, irrigation, etc.

As mentioned in previous paragraph, there are subsidized agricultural credit systems in Armenia but many surveyed farmers presumed that those credit systems are not applicable due to its repayment conditions. For instance, some farmers claimed that harvest of orchard will start after several years of seedling, but repayment of the loan will start only after 6 months of the borrowing. They insisted that the agricultural loan system should have more varieties with different payment conditions for different purposes such as loan for orchard reclamation, agricultural machinery and greenhouse construction.

Table 4-5-10.2 Result of Interviews about Accessibility to Agricultural Credit

Accessibility	Crop farming		Livestock farming	
	Farmers	%	Farmers	%
No problem	36	44.4	25	30.9
Slightly problem	7	8.6	3	3.7
Very problem	30	37.0	11	13.6
Not applicable/no idea	8	9.9	42	51.9
Total	81	100.0	81	100.0

Source) JICA Survey Team (Farm household survey)

4-5-11 Difficulties Confronting Farmers

A series of workshops with 4 WUA members in the Project area suggests that farmers in the area share the following common issues (see Table 4-5-11.1). A problem tree arranging the common issues in order based on the cause and effect is attached in Appendix B-10.

Table 4-5-11.1 Common Issues Recognized by Farmers

Field	Problems & Constrains
Production	Soil fertility is low
	Production of marketable products is not enough
	Farm input cost is too high (seeds, fertilizers etc.)
	Quality of farm inputs is low (seeds, fertilizers etc.)
	Extension and support from government is not enough
	Lack of accessible agricultural credit (high interest rate and short repayment term)
	Natural disasters (hail and low temperature)
	Damages from insects and disease
Irrigation	Shortage of water
	Breakages of water canals
	Many water losses
	Water fee is high
	Water is contaminated / Not clean
	Unequal distribution of irrigation water among the member
	Ground water level in down
Machinery	Shortage of farm machinery
	Tractor hiring service cost is expensive
	Machineries are old
	Timing of machinery service us not appropriate
	Tractor and spare parts are expensive
Marketing	Sales price is low and/or highly fluctuated
	Accessibility to the market (hard to find good buyers)
	Difficult to transport the products to the market
	Lack of information/knowledge about marketing
	No government support for marketing

Source) JICA Survey Team

The farm household survey carried out by the Survey team reveals seriousness of the farmers' issues recognized by farmers' themselves (see Table 4-5-11.2).

Table 4-5-11.2 Seriousness of Issues Recognized by Farmers

Problems and constraints	No problem	Slightly problem	Very problem	Not applicable / no idea	Total
Technical information /services	63	9	9	0	81
Own skill & knowledge	66	12	3	0	81
Land size (need more land)	64	4	13	0	81
Land fertility	32	15	34	0	81
Salinity of land	63	8	8	2	81
Water shortage	31	16	34	0	81
Conditions of irrigation facilities	26	15	40	0	81
Water conflict	39	19	23	0	81
No good varieties of crops	27	19	35	0	81
Pests & disease	11	13	57	0	81
Availability of inputs	55	12	14	0	81
Inputs cost	19	10	52	0	81
Man-power	39	14	22	6	81
Availability of machinery	44	7	25	5	81
Machinery/mechanization service cost	22	12	41	6	81
Conditions of storage facility	50	4	20	7	81
Means of transportation	52	12	13	4	81
Access to good markets /buyers	24	11	44	2	81
Selling price is low	6	5	68	2	81
Market price stability (Price fluctuation)	7	7	65	2	81
Access to credit	36	7	30	8	81
Other	11	2	9	59	81

Note) Color marked: More than a half respondents answered as "Very Problem"

Source) JICA Survey Team (Farm household survey)

The most serious problems are closely related to marketing. Many farmers have difficulty in adapting them to low or fluctuated market price. Farmers also look for good markets and buyers who may be able to buy their products at favorable and stable price. If it's hard to find out those kinds of buyers, farmers want to be purchased their products by the government as practiced during the Soviet era. Although more than 20 years have passed after the independence, not a small numbers of farmers still have nostalgic eyes for the government intervention in the marketing. While many farmers complain about (high) inputs cost, this problem is inextricably linked with the marketing issues. If farmers could sell their products at their good price, they should consider that inputs are quite affordable. Considering a high cost structure of Armenian crops represented by wheat, a comprehensive policy should be established for reducing inputs cost, for introducing a rational farming system and for streamlining the existing marketing system. Then, proper measures in line with the policy should be taken by all stakeholders including farmers.

Pests and disease are also serious concern of many farmers. Many farmers claim that they cannot control pests and disease properly because of low quality of insecticides/fungicides. They, however, don't seriously consider that their farming skill and knowledge is not enough or agricultural extension services supporting them are not enough for controlling pests and disease properly, according to Table 4-5-11.2. On the other hand, many farmers said during the workshops that they need assistance from extension agency or agrochemical shops in order to know proper way of spraying to prevent or to control disease and pests of their products. Actually, farmers fail to control pests and disease due to improper use of insecticides/fungicides in many cases. They should be used on proper time and with

right way for producing the due effect.

During the workshops, some participated farmers also complained about the quality of subsidized fertilizers. According to the farmers, the fertilizers are not inspected properly by the importing companies who are selected by the government. As a result of this circumstance, quality of imported fertilizers became lower than the Soviet era. Meanwhile, the head of state non-profit company “Agrochemical Service” under the Ministry of Agriculture said that farmers are not using fertilizers properly. The institution makes a soil analysis (content of basic nutrient elements: nitrogen, phosphate and potassium) every 5 years in each community nationwide. The result of the analysis indicates that farmers are not applying three main fertilizers in the right balance. Generally, farmers are fertilizing exceeded volume of nitrogen and less phosphate and potassium. The institution also inspects the quality of subsidized fertilizers whether it contains sufficient level of active elements, when the government imports them. According to the institution, lower production is not caused by low-quality fertilizers but unbalanced fertilization. There is a gap of recognition about the quality of subsidized fertilizers between farmers and the government institution.

It must be true that Armenian farmers have a certain good level of farming technology considering relatively high level of crop productivity at present. However, they should need more advanced farming skills and knowledge not only to control pests and disease, but also to adapt them to internationally competitive agriculture which the government aims at. Improvement of farmers’ technology through enhancement of agricultural R&D (research and development) and extension systems is a fundamental issue of Armenian agriculture, though many farmers don’t recognize it well.

Irrigation and mechanization are in the next group in seriousness. The both problems are mainly caused by low investment after the independence. Many over-aged facility and machinery are still used at field. Though they are maintained to some extent, they have already reached the end of their life span.

Figure 4-5-11.1 shows an image of current circumstance of farmers in the Project area by compiling the major issues described above. The issues are influenced each other and those issues finally amount to low farming income. A comprehensive measure to address every issue and constraint around farmers should be taken in order to develop agriculture in the Project area.

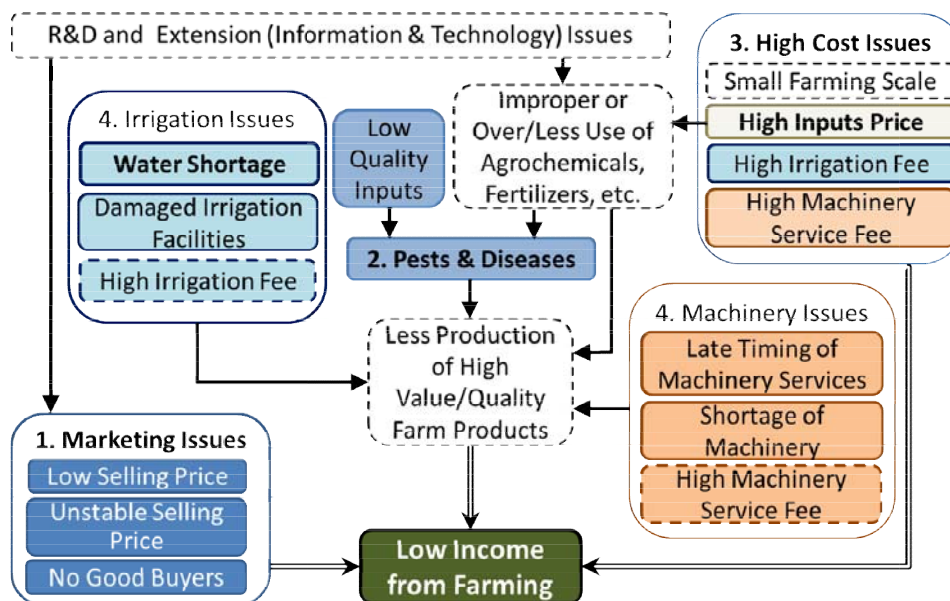


Figure 4-5-11.1 Constrains of Farmers in the Project Area

4-6 Information on Cost Estimate and Procurement

4-6-1 Condition of Cost Estimate

(1) Direct cost

Direct cost consists of 3 parts, i.e. 1) labor cost, 2) machinery and equipment operation cost and 3) material cost including transportation and storage expenses. Direct cost of construction work is derived by cost accumulation method of each work type.

(2) Indirect cost

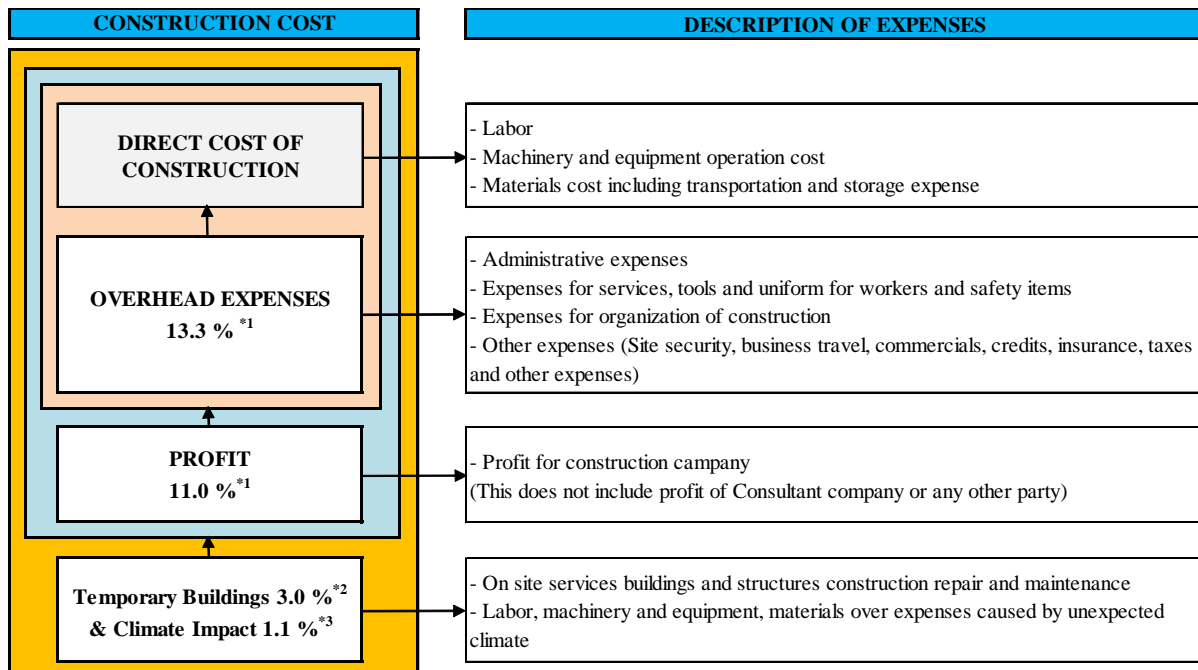
Indirect cost consist of Overhead expenses, Profit, Temporary buildings and Climate impact. Overhead expenses is including management cost of a contractor in site and head office such as administrative expenses, safety cost, insurance taxes and so on. Rate of overhead expenses is decided by Armenian construction law and its amount is 13.3% of the direct cost.

Profit is only for a contractor profit, for a consultant company's or other parties' profit are not included in this expense. 11.0 % of accumulated amount of direct cost and overhead expenses correspond to the profit.

Temporary building cost is used for a construction, repair and maintenance of buildings in the construction site. Its cost is decided as 3.0 % of accumulated amount of direct cost, overhead expenses and profit.

Climate impact cost compensates prospected expenses generated by unexpected climate and weather condition like a water shortage for the construction in dry season. This cost is also regulated 1.1 % of accumulated amount of direct cost, overhead expenses and profit.

Contents of construction cost (direct and indirect cost) are illustrated in Figure 4-6-1.1.



*1 23.06.2011 No.879-N about "Construction works current cost estimation" rules of MUD of RA (Paragraph 8)

*2 21.08.2001 of MUD of RA about "Establishment of norms of temporary buildings and structures of construction" Chapter V, point 32, "

*3 21.08.2001 of MUD of RA about "Establishment of norms of climate impact on construction" Area I, Chapter V, point 32,

Figure 4-6-1.1 Contents of Construction Cost

(3) Consultant fee

Detail design and supervision of the construction are included in the consultant fee. This cost is estimated as 6 % of construction cost.

(4) Price escalation (Price contingency)

Price Escalation (Price Contingency) is calculated based on an average price escalation rate in 5 years. Reflecting the inflation in each country, price escalation of foreign currency and local currency are calculated separately. The rate of price escalation 2016, base year of the Project, is 1.8 % for foreign currency and 2.7% for local currency.

Price escalation of total Project Cost is calculated from that of base year and base cost in each year shown in Table 4-6-1.1. Calculated rate is 10.24%.

Table 4-6-1.1 Price Escalation in Armenia
(Confidential)

(5) Physical contingency

Physical contingency is provided as 5% according to Yen loan rule.

(6) Exchange rate

Average exchange rate of 3 months from February to April 2016 is adopted in the cost estimation.

Exchange rate of US Dollar (USD) to Armenia Dram (AMD) is derived from the official rate of the Armenian Central Bank. The rate of US Dollar to Japanese Yen is calculated using the rate of declared by The Bank of Tokyo-Mitsubishi UFJ, Ltd. Calculated exchange rates are as follows,

1 US Dollar	=	486.99 Armenia Dram
1 US Dollar	=	113.65 Japanese Yen

4-6-2 Procurement of the Construction Machinery**(1) General construction machinery**

Several construction machinery manufacturers in Japan and Europe have agents in Armenia and general construction machinery such as backhoe, dump truck, bulldozer etc. are distributed in the market. These machineries are used under lease mainly. These agents have workshops for maintenance of machineries and provide the service of repairing.

(2) Soil mixing machine

Construction work using soil mixing machine which is utilized for making soil-cement mixture is not common in Armenia therefore the machine is not well distributed in construction market. However, construction machinery agents can import and distribute this machine. Additionally, some agents can repair and maintenance this machine in their maintenance workshop. Therefore, it is judged that operation of soil mixing machine is feasible in the Project.

4-6-3 Procurement of the Construction Materials

(1) Bentonite Products

1) Armenia

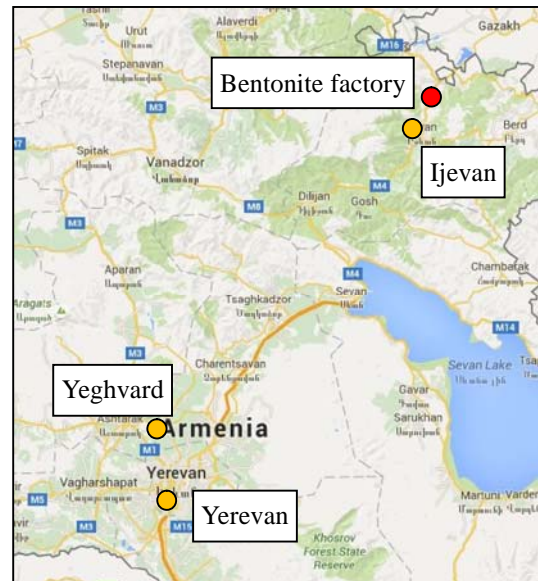
Armenia is an export country of bentonite and its mine is located in Ijevan, north east part of Armenia (see Figure 4-6-3.1). Mined bentonite includes montmorillonite over 80% and has enough quality for using anti-infiltration works. Capacity of produce is 2,000 ton/month but this volume is to be increased up to 20,000 ton/month by future investment in equipment and facilities.

Also part of produced bentonite is transported to Belarus and manufactured to bentonite sheet. This bentonite sheet is imported and available in construction market in Armenia.

2) Georgia

Even enhanced product from Ijevan is not enough considering the necessary volume of the reservoir construction. Therefore, a bentonite mine in the neighboring country, Georgia was surveyed.

Georgia also exports good quality bentonite which contains montmorillonite over 85%. Bentonite is mined in Mitispri, western part of Georgia (see Figure 4-6-3.2). Estimated amount of deposit is 50,000,000 ton and annual product is 400,000 ton. This amount is enough for the consumption in the construction in Yeghvard reservoir.



Source) Google map

Figure 4-6-3.1 Location of Bentonite Factory in Armenia



Source) Google map

Figure 4-6-3.2 Location of Bentonite Factory in Georgia

(2) Cement and aggregate

1) Cement

There are two cement companies in Armenia. Production of one company has low strength and used for interior work of buildings. For construction work, cement manufactured in Ararat city is used. Cement of this company is supplied for the North-South corridor road project financed by World Bank and construction of nuclear power plants which required high stability. Annual product is 150,000,000 ton and this amount is over the estimated consumption in the construction.

2) Fine aggregate

Good quality aggregate is only produced from Araks river and many sand pit are scattered along the river. Araks river is a border with Turkey and the amount of product is decided as fifty-fifty with Turkey according to an agreement. Annual product is reached over 100,000m³/year, however there is no danger of depletion for that sand is procured from upstream every year.

3) Coarse aggregate

Mine of coarse aggregate is located in suburb of Yerevan. Excavated solid basalt from open-pit quarry is send to crusher plant installed beside quarry. Crashed basalt sieved 6 categories by diameter are distributed in construction market. Alkali-aggregate reaction test is conducted but no negative result has been reported.

(3) Pipe

Pipes can be procured in Armenia. Some factories have laboratories for quality control and tensile test, water pressure test and compression test are conducted.

(4) Gate and valve

Gate and valve are exported from Europe, Russia and China. So that products made in Russia and China are inferior in quality, European product are installed for significant facilities in Armenia. Some European valve companies had their factories in Slovenia and valves distributed in Armenia widely.

(5) Observation instrument

There is little demand of observation instrument for reservoir in Armenia, these instrument is imported in the construction stage.

4-6-4 General Information for Construction

Main port where imported materials are unloaded is Poti port in Georgia. At the Poti port, there are almost no troubles about unloading including custom clearance by Georgia. Custom clearance by Armenia takes about 1 week and smooth pickup is secured. No remarkable troubles are reported when imported.

CHAPTER 5 ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

5-1 Environmental and Social Considerations

5-1-1 Project Components

Table 5-1-1.1 shows the structure and scale of proposed reservoir and canals. In addition, Figure 5-1-1.1 shows the location of the proposed structures. Concerning the open-canal, 5m width at both right and left sides will be secured for the canal management¹. Since steel pipe will be installed for all of the pipelines, while regulation valve for inner pressure of the pipe is not necessary. However, it is planned to set a regulation valve to regulate discharge to the Kasakh River and an energy absorber.

Table 5-1-1.1 Outline of the Structures

Structure	Scale	Location
Reservoir	Capacity: 94,000,000 m ³ (94MCM) Width of dam crest : 8m Full water surface area: 808ha Reservoir area:796ha	Yeghvard Reservoir
Feeder Canal 1 (Pipeline)	Length: 4.4km Steel pipe, ϕ 1,600mm	This canal diverts water from Arzni-Shamiram canal to Yeghvard Reservoir.
Feeder Canal 2 (Open canal)	Length: about 0.23km Concrete, Width : 4m	This canal diverts water from Arzni-Shamiram canal to Yeghvard Reservoir.
Outlet Canal 1 (Pipeline)	Length: 0.73km Steel pipe ϕ 1,200mm	This canal diverts reserved water to Arzni-Branch canal.
Outlet Canal 2 (Pipeline)	Length: 4.7km Steel pipe ϕ 1,700mm	This canal diverts reserved water from Dike 1 to existing Ashtarak pipeline and to Kasakh River

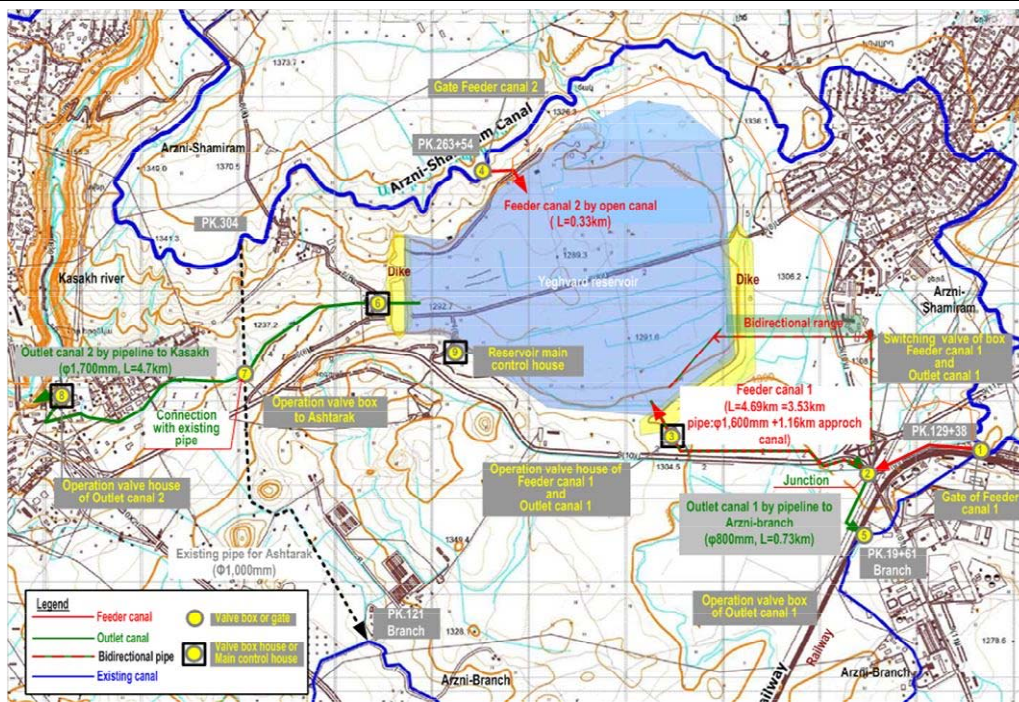


Figure 5-1-1.1 Proposed Project Components

In addition to the main structures above, rehabilitation and upgrading of the existing canal system, namely, Arzni-Shamiram Canal, Lower Hrazdan Canal, Arzni-Branch Canal, Shakhi-Au Canal, Inner Aknalich Canal, Upper Aknalich Canal will be implemented. Moreover, due to the Project, existing pump station and deep wells would be abolished, since pump-up irrigation system will be shifted to gravity irrigation system. Contents and scales of rehabilitation by the irrigation facility are described

¹ Space for canal management is called as “Protection Zone” and it should be secured in case of canal construction.

in the Table 5-1-1.2. It is noted that any cases of overflow in open canals have not been reported in Armenia.

Table 5-1-1.2 Rehabilitation Plan of Irrigation Canal System

Facility and structure	Rehabilitation outline
Arzni Shamiram	<ul style="list-style-type: none"> • L=5.5km (PK20 to PK45, PK70 to PK90 and PK95 to PK105) • Remove concrete panel and lining concrete
Lower Hrazdan part2, BP. to PK219	<ul style="list-style-type: none"> • L=17.8km (PK10 to PK188) • Add the concrete for raising to the sidewall • L=approx. 5km, Φ400mm pipeline (PK16) is installed toward Upper Aknalich • L=approx. 6km, Φ1000mm pipeline (PK188) is installed toward inner Aknalich
Aknalich PS.	<ul style="list-style-type: none"> • Abolished (4 pumps at house, 3 pumps at outside)
Metsamor PS.	<ul style="list-style-type: none"> • Abolished (4 pumps at house)
Ranchaper PS. 1	<ul style="list-style-type: none"> • Abolished (4 pumps at house)
Ranchaper PS. 2	<ul style="list-style-type: none"> • Abolished (4 pumps at house)
Arzni-Branch	<ul style="list-style-type: none"> • L=2.3km (BP to PK23) • Remove the current canal and construct the lining concrete and/or install the pre-casting concrete canal • Replacement of gates
Arzni-Branch, PK120 to EP (PK165+19).	<ul style="list-style-type: none"> • L=3.7km (PK120 to PK152 and PK161 to PK165+19) • Remove the current canal and construct the lining concrete and/or install the pre-casting concrete canal • Replacement of gates and aqueduct bridge
Tkhan canal, BP. to PK130	<ul style="list-style-type: none"> • L=5.9km (PK71 and PK130) • Remove the current canal and construct the lining concrete and/or install the pre-casting concrete canal • Replacement of gates and aqueduct bridge
Shakhi-Aru canal, BP. to PK118	<ul style="list-style-type: none"> • L=8.0km (BP. to PK31, PK69 to PK118) • Remove the current canal and construct the lining concrete and/or install the pre-casting concrete canal • Replacement of gates
Inner Aknalich canal	<ul style="list-style-type: none"> • Construction of intake at Kasakh River • Replacement of gates
Upper Aknalich cana BP to PK104	<ul style="list-style-type: none"> • L=10.4km (BP to PK104) • Replace the current canal to the concrete halfpipe canal • Replacement of gates and aqueduct bridge
Metsamor canal	<ul style="list-style-type: none"> • No rehabilitation works

5-1-2 General Conditions of the Project Area

5-1-2-1 Current Situation around the Yeghvard Reservoir and the Proposed Canals

As Figure 5-1-1.1 shows, four (4) canals are proposed for the Project. The situation around the Yeghvard reservoir and proposed canals are described below.

(1) Reservoir basin

The lands within the Reservoir basin are state land, communal lands and private land, and most of the land belong to Yeghvard Community (City) and Nor-Yerznka Community. Northern parts of the lands are farmlands, since they are close to the Arzni-Shamiram canal, on the other hand, western and southern parts of the Reservoir are used as farmlands and rangelands. In some parts, the land is not suitable, since top soil had been already taken, and no crop is cultivated. As of April 2016, 53 plots as farmlands have been identified within the Reservoir basin. Photos showing the situations in the Reservoir basin are as illustrated in Figure 5-1-2.1 and 5-1-2.2.



Figure 5-1-2.1 Overview of the Yeghvard Reservoir



Figure 5-1-2.2 Wheat Field in the Yeghvard Reservoir

(2)Feeder Canal-1 and Outlet Canal-1

Both Feeder Canal-1 and Outlet Canal-1 will be a pipeline and they will be located on south-east of the Reservoir. The Feeder Canal-1 is planned to divert water of the Arzni-Shamiram canal to the Reservoir. The proposed route of the canal is along the road, which is surrounded by farmlands as illustrated in Figure 5-1-2.3. Outlet Canal-1 will be constructed along the railway as shown in Figure 5-1-2.4, and the canal is planned to divert water of the Reservoir to the Arzni-Branch Canal. At the junction point of Outlet Canal-1 and Feeder Canal-1, water flow direction will be switched by bulb operation depending on the season. During water storage period at the Reservoir, namely, from March to May, water flow direction is from the Feeder Canal-1 to the Reservoir, while during irrigation season, water flow is from the Reservoir to the Feeder Canal-1.



Figure 5-1-2.3 Proposed Route of Feeder Canal-1



Figure 5-1-2.4 Proposed Route of Outlet Canal-1

(3)Feeder Canal-2

Feeder Canal-2 will be an open canal to divert water from the Arzni-Shamiram Canal to the Reservoir. The proposed construction site is grassland (see Figure 5-1-2.5), which is located on the northern part of the Reservoir.

(4)Outlet Canal-2

Outlet Canal-2 will be pipeline along the past



Figure 5-1-2.5 Proposed Route of Feeder Canal-2

waterway (see Figure 5-1-2.6). Proposed Outlet Canal-2 will divert water from the Reservoir to the existing pipeline for Ashtarak and to the Kasakh River. The proposed route is along the natural stream, where water is observed during only early spring and irrigation season.



Figure 5-1-2.6 Proposed Route of Outlet Canal-2

5-1-2-2 Natural Conditions

(1) Protected areas

In Armenia, 35 sites including national parks and sanctuaries have been specified as the Protected Areas. The distribution map of the 35 protected areas was prepared by the World Wildlife Fund (WWF) in collaboration with MNP in 2014 (see Figure 5-1-2.7). According to the map, there is no Protected Area around the Yeghvard Reservoir and command area. Therefore, it can be said that direct impacts on those Protected Areas by the Project is not expected. It is noted that the Lake Sevan, which is the largest lake in Armenia, is also identified as one of the Protected Areas and it is registered as the Ramsar site in 1993.

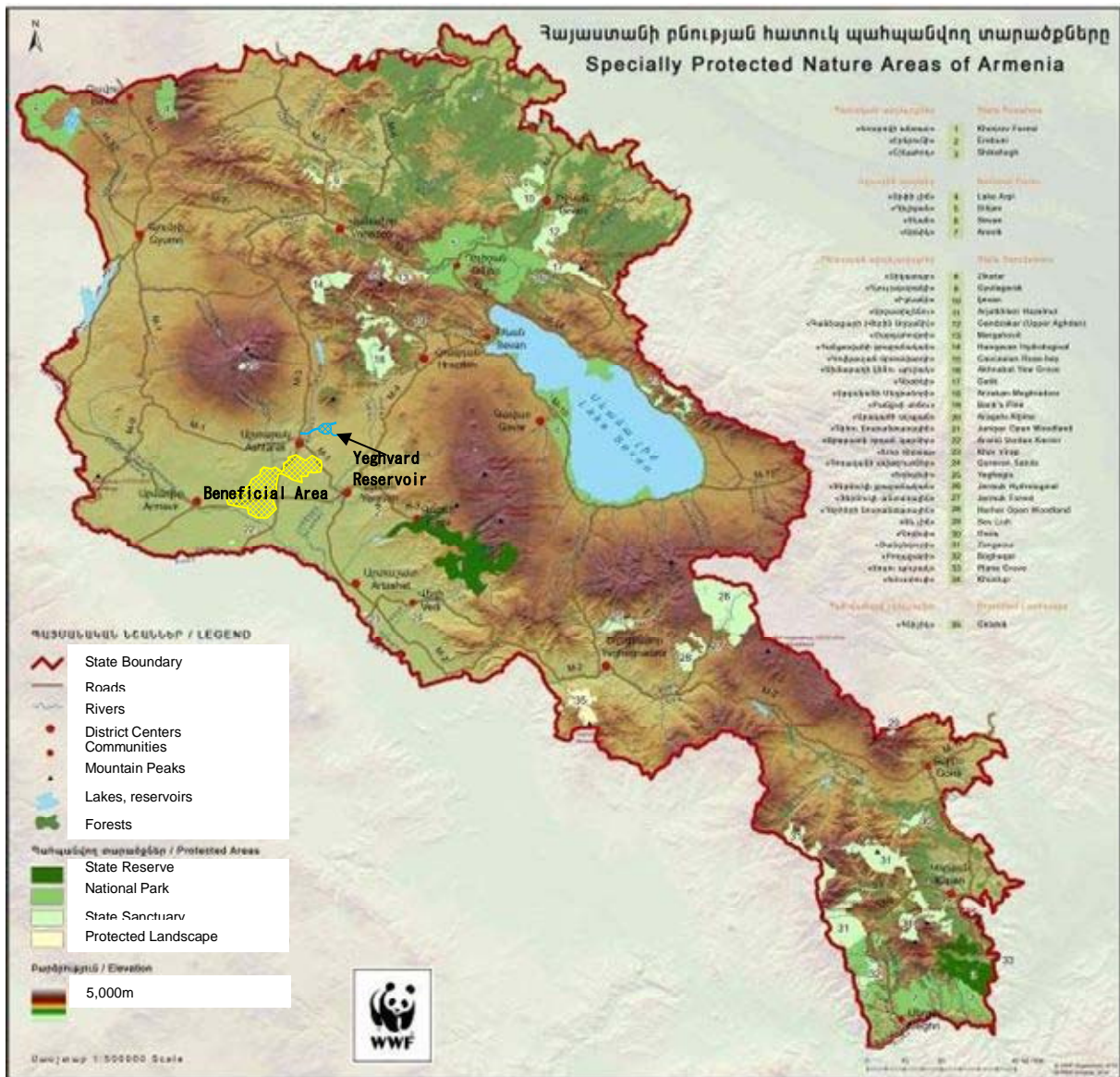


Figure 5-1-2.7 Distribution of Protected Areas in Armenia

Important Bird Areas (IBAs) are identified by the Armenian Society for the Protection Bird in collaboration with the Bird Life International and International Union for Conservation of Nature (IUCN). Figure 5-1-2.8 illustrates the location of IBAs in Armenia and the Project site. It can be said that the proposed project site is not located in and around the IBAs, therefore, any negative impacts on IBAs by the Project are not anticipated.

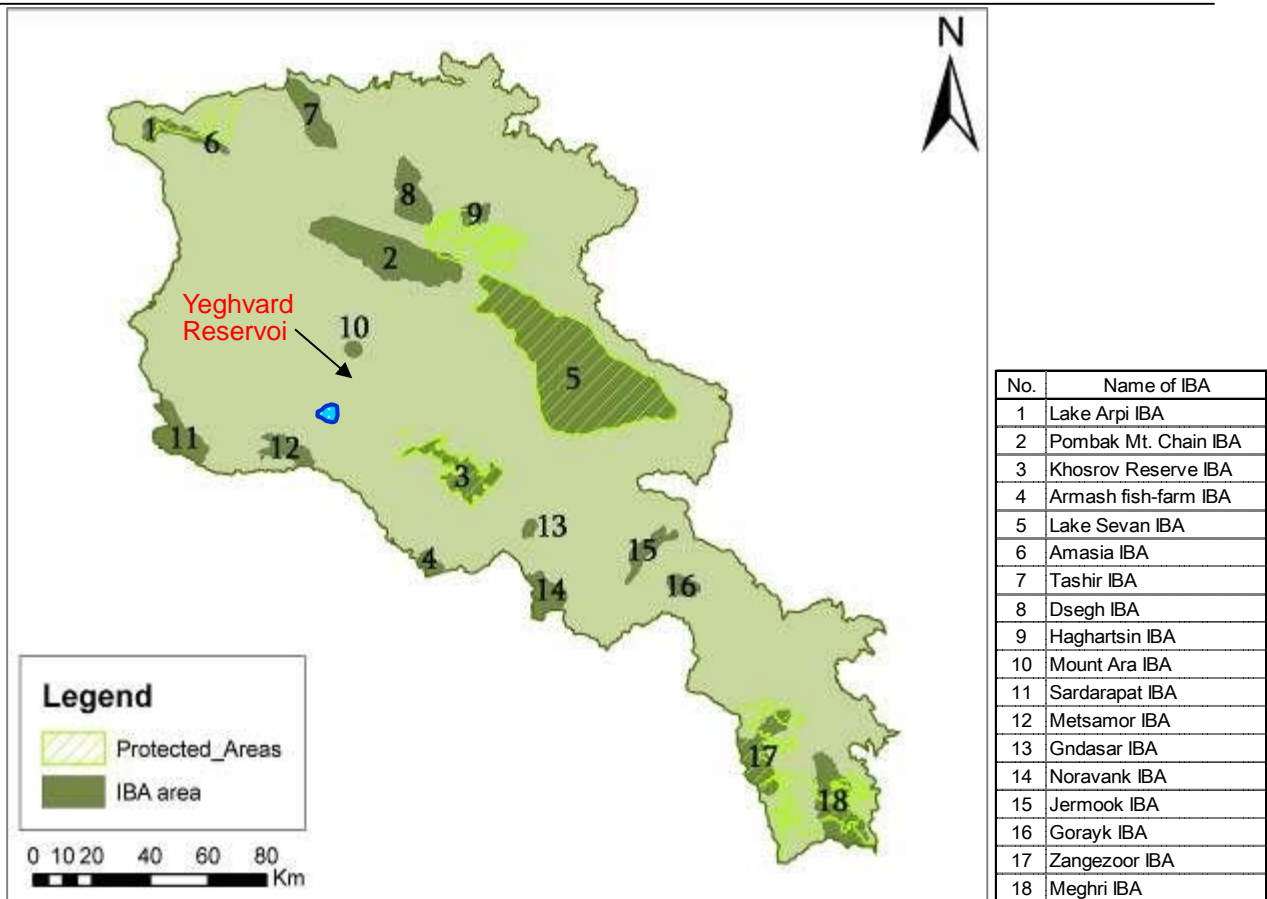


Figure 5-1-2.8 Distribution of IBA in Armenia

(2)Lake Sevan

The Lake Sevan is managed by “Sevan National Park” under the MNP. For promotion of conservation of the Lake Sevan, “The Law on Lake Sevan (2001)” and “The Law on Approval of Annual and Complex Measures on Conservation, Restoration, Reproduction, and Use of the Ecosystem of the Lake Sevan (2001)” have been established. The laws aim at conservation of the Lake Sevan and surrounding ecosystem by increase of the lake water level through integrated countermeasures, which contributes to sustainable development. Especially, the Arpa-Sevan tunnel has diverted a large amount of water to the Lake Sevan, consequently, the water level of the lake has been increased by 3.4m until now. On the other hand, due to the water level increase in recent years, part of forests, which had been planted during the period the water level was low, have been submerged. It causes water pollution due to rotten submerged trees. Not only trees but also some structures, which had been constructed, have been abandoned, since they cannot be used any more (see the photo right).



Due to the suspension of water diversion from the lake by the Yeghvard Project, it is estimated that water level of the lake will be increased by 4cm per year, which is very small compared with that by the Arpa-Sevan tunnel and so on, namely, 4m increase in 10 years (40cm/year). Therefore, it can be said that the Project will not result in submerge of existing structures and trees around the Lake Sevan.

The Government of Armenia has changed current watershed by construction of the Arpa-Sevan and Vorotan-Arpa tunnels for the Lake Sevan conservation. Furthermore, in 2001, the Government launched an environmental improvement strategy for Lake Sevan with the target of elevating its water level by 6m (up to 1,903.5m) by 2030. Additionally, amount of annual releasing (intake) water from Lake Sevan for irrigation is restricted to 170MCM, and operation period of hydropower stations along the Hrazdan River is limited to only irrigation period. Consequently, the lake water level has been recovered gradually.

5-1-2-3 Social Conditions

(1) Population

1) Beneficiary area

Under the Armenian administration system, there are ten (10) Marzes and Yerevan City, in total, eleven (11) regions. As mentioned before, the command area of the Project ranges Kotayk Marz, Aragatsotn Marz and Armavir Marz. The Yeghvard Reservoir is located in Kotayk Marz. In Kotayk Marz, energy industry such as electricity and food manufacture by using meat, fruit, vegetable, milk, wheat flour and beverage are actively operated. Total area of the Marz is 2,986km², half of the land, 1,546km², is used as farmlands. Concerning Aragatsotn Marz, main industry is agriculture, and cereals, grass, potato and so on are cultivated mainly. Other industries are food manufacture and mining. Total area of Aragatsotn Marz is 2,756km², farmland accounts (2,182km²) for about 80% of the whole area. Regarding Armavir, horticulture including grape cultivation and livestock such as sheep and goat are widely operated. Total area of the Marz is 1,242km² and around 80% of the area (971km²) is farmland.

The beneficial area consists of 27 communities in Korayk Marz, Aragatsotn Marz, Armavir Marz. The area is covered by four (4) WUA, Yeghvard WUA, Ashtarak WUA, Vagharshapat WUA and Khoy WUA. There is a tendency that the actual male residents' number is smaller than that of registered one, it depends on the community, though. It is probably because young men go to the urban area or foreign countries to work as seasonal workers. In case of women, the same trend is observed, however, the extent is small compared with that of men.

2) Project affected area

The Project affected area, construction site of reservoir and feeder/outlet canals, are located in Yeghvard Community and Nor-Yerznka in Kotayk Marz, and Ashtarak Community in Aragatsotn Marz. However, the affected area in Ashtarak Community is very limited. Yeghvard city is located from Yerevan City is around 20 km and its key sector is manufacturing industry, including production of food and beverages such distilled alcoholic beverages, dairy products, flour production as well as production of leather goods and shoes. The people of Yeghvard Community are also involved in agricultural sector, mainly grain farming. Nor-Yerznka Community is located on 20 km away from Yerevan City. The main industry of the community is agriculture, mainly fruit production and cattle rearing. Population each community in the affected area is shown in Table 5-1-2.1.

Table 5-1-2.1 Population of Affected Area by Community

Region (Marz)	Community	Living			Registered		
		Male	Female	Total	Male	Female	Total
Kotayk	Yeghvard	5,338	5,996	11,334	5,632	6,040	11,672
	Nor-Yerznka	716	796	1,512	822	806	1,628
Aragatsotn	Ashtarak	9,018	9,464	18,482	9,749	9,866	19,615
Total		15,072	16,256	31,328	16,203	16,712	32,915

Source) National Statistical Service of the Republic of Armenia, 2011

(2) Ethnic minority people

In Armenia, major ethnic is Armenian, while ethnic minority people, Russians, Yezidi, Assirian, Greeks, Kurds people also stay as citizens. For example, in Kotayk Marz, 98% of the population is Armenian, 1.2% of that is Yezidi. The minority people are generally well integrated with Armenian people and they are not classified into indigenous people. Basically, the minority people do not have difficulty of communication by Armenian language. The minority people are regarded as citizens of Armenia, they can get passport as Armenians and can purchase lands officially. One of the beneficiary communities, Ferik Community, there are many Yezidi people, and they will be beneficiaries of the Project. On the other hand, it was confirmed that there is no ethnic minority people in the affected areas.

(3) Gender issue

Generally, women do not take leaderships in Armenia, and traditionally it is thought that women have to be protected by men. There is a tendency that migrant labors to other countries/cities are men. In rural area, roles and responsibilities for farming are shared between men and women. For instance, heavy works such as harvest and irrigation works are shouldered by men, while relatively light works such as selection of harvested fruits to be packed are done by women. In other words, cereal production which needs operation of agricultural machines is implemented by men, while vegetable production which requires manual works is done by women. If heads of farm households are female, they can hire labors for those heavy works easily, since it is common for Armenian farmers to purchase seeds/fertilizers and employ labors by using loan. Sometimes, widows are supported by the neighbors, friends and relatives for the works.

The situations regarding gender issues is changing in Armenia, and the Head of Ashtarak Community, which is located on near the Project site, is female. Moreover, in June 2015, European Neighborhood Programme for Agriculture and Rural Development (ENPARD) was established under the support by the European Union and Austrian Development Cooperation. The ENPARD does not focus on gender mainstreaming, however, one of the program component is to enhance women's leadership in farming activities. The program will support 56 agricultural groups, and it is planned that more than 40% of leaders of target groups have to be female. Considering those situations mentioned above, gender issue in Armenia is not a big problem.

5-1-2-4 Farming Conditions in the Beneficial Area

The beneficial area is covered by four (4) WUAs. The area utilizes the Lake Sevan and the Hrazdan River as main irrigation sources, additionally, it utilizes pumped-up water through pump stations from the Metsamor River.

The crop diversification is well advanced in the area. The planted area of each WUA is summarized as follows.

- Yeghvard WUA: High percentage of orchard and perennial grass (Alfalfa), and low percentage of vegetables and wheat
- Ashtarak WUA: High percentage of grape, and low percentage of vegetables and wheat
- Vagarshapat WUA: High percentage of wheat and vegetables, and low percentage of fruits and others
- Khoy WUA: All kinds of crops are equally planted. Representing the cropping in the target irrigation area

According to the Department of Horticulture Crop Production and Plant Protection, MOA, applied agrichemicals in Armenia are imported from various countries. Consequently, prices of agrochemicals are relatively high, and the amount of agrichemical consumed by farmers is not very big. During Soviet Union period, agrichemical had been applied for farming in the Ararat Plain intensively, however, it has not been done very much after the independence. Moreover, no case of agrichemical pollution of irrigation canals and rivers has been reported so far in Armenia according to the official personnel of MOA and Ministry of Nature Protection (hereinafter “MNP”). On the other hand, there is no surface water quality or soil quality standard regarding agrichemical in Armenia. Hydrogeological Monitoring Center under the MNP conducts water quality monitoring of some river waters regularly, however, the monitoring does not cover agro chemical.

5-1-3 Institutional and Legislative Framework for Environmental and Social Considerations

5-1-3-1 Responsible Organization for Environmental and Social Considerations in Armenia

The MNP is responsible for natural conservation, sustainable use and restoration of natural resources, environmental improvement and so on in Armenia. Also, the MNP formulates national policies for environmental conservation, environmental standards, environmental guideline, etc. In the Ministry, there are various departments and agencies, and also thirteen (13) State Non-Commercial Organizations (SNCOs). The number of staff of MNP is around two thousands in total and the organization structure of the MNP is illustrated in Figure 5-1-3.1.

The Center of Expertise for Environmental Impact Assessment SNCO, MNP is the responsible for examination and approval of environmental and social impact assessment (ESIA) report. The number of staff of the Center is 17 (seventeen) in total, the organization examines the ESIA report under the support from other agencies under the MNP, other ministries and private companies according to necessity.

As illustrated in Figure 5-1-3.1, the divisions are under the departments according to the Homepage of the MNP. There is no clear mention about relationship among the departments within the MNP, however, cooperation between some departments are practiced. For instance, when an official letter is submitted to the Environmental Impact Expertize Center in the MNP, the response in the documents is issued after the approval by the Legal Department.

Under the MNP, the Environmental Impact Monitoring Center is an institution responsible for environmental analysis. The Center has been supported by the USAID through provision of some analytical instruments, and has been requested for water quality analysis by some international organizations such as FAO. Therefore, it can be said that the Center has sufficient experience and ability, which leads to fair and appropriate analysis.

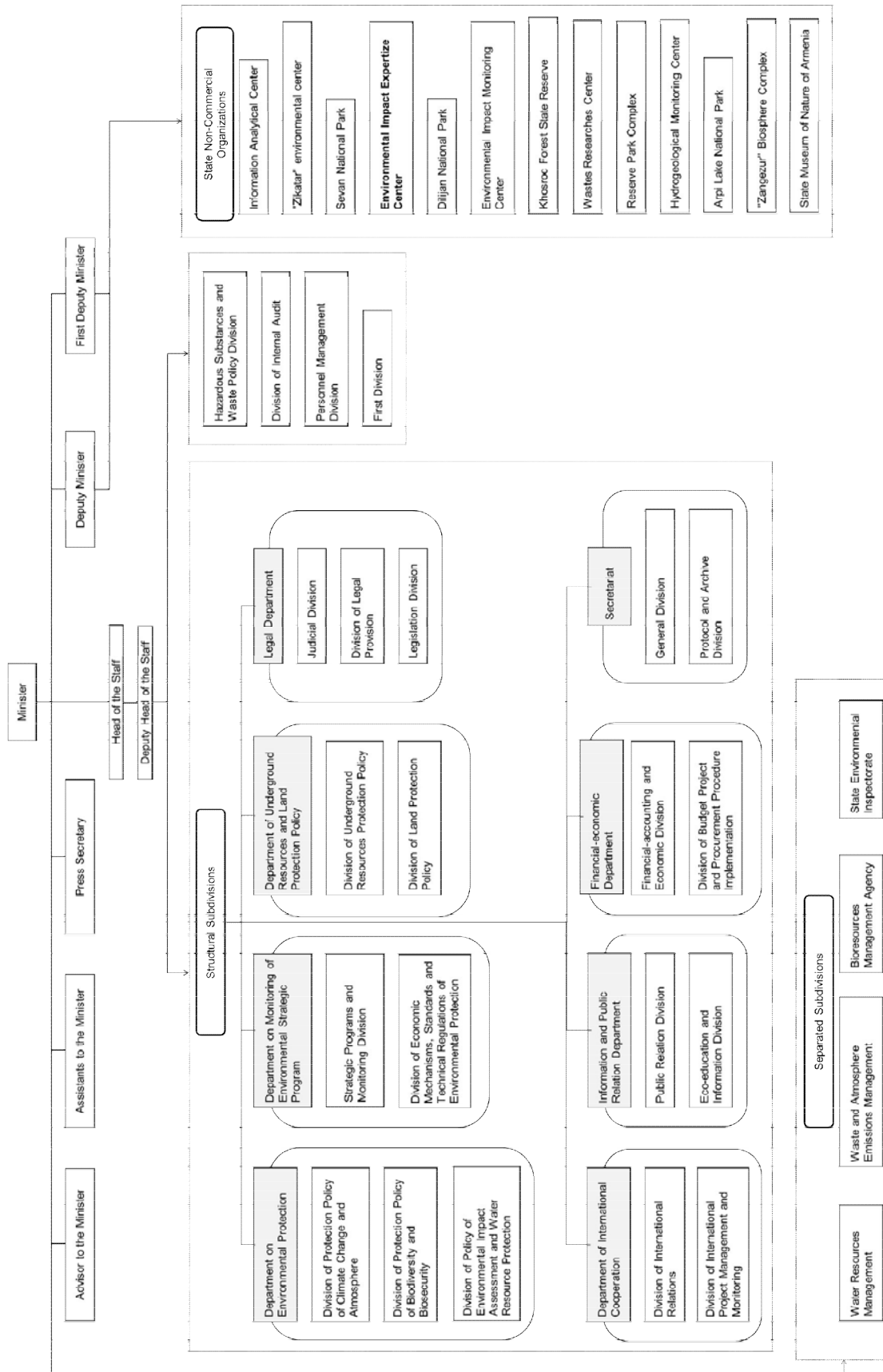


Figure 5-1-3.1 Organization Structure of the MNP

Source) Homepage of the MNP, 2015
 (The organization chart is modified based on description in the Homepage)

5-1-3-2 Relevant Laws on Environmental and Social Considerations

Armenia has laws on the environmental conservation as shown in Table 5-1-3.1. The “Law on Environmental Impact Assessment and Expertise” is the one concerned to the environmental and social considerations.

Table 5-1-3.1 Laws on Environmental Conservation

Adaption/ Amended	The name of Laws (in English)
1991/ 2006	Law on Specially Protected Natural Areas
1992	Law on Ensuring Sanitary- epidemiological Security of the RA Population
1994	Law on Atmosphere Air Protection
1995	Law on Environmental Impact
1996	Law on Automobile Roads
1998	Law on the Protection and Use of Fixed Cultural and Historic Monuments and Historic Environment
1998	Law on Environment and Nature Use Charge
1999	Law on Flora
2000	Law on Fauna
1991/ 2001	Land Code
2001	Law on Hydro-meteorological Activity
2001	Law on Environmental Education
2002	Code on Underground Resources
1992/ 2002	Water Code
2002	Law on Seismic Defense
2002	Law on Water Users' Associations and Federations of the Water Users Associations
2004	Law on Waste
2005	Forest Code
2005	Law on Environmental Supervision*
2006	Law on Rates of Environmental Charges Decree of the Government on Approval of Technical Regulation of the Requirements for Decision of Norms for Removal of Fertile Soil Layer, and Storage and Usage of the Removed Fertile Layer**
2006	Law on National Water Program
2008	Law on Oversight of Land Use and Protection
2010	Decree of the Government of RA N 71-N on Approval of the Red List of Animals of the RA Decree of the Government of RA N 72-N on Approval of the Red Book of Plants of the RA
2011	Decree of the Government of RA on Approval of the Order of Usage of Fertile Soil Layer, Annulment of the Decree No. 1622-N of the Government of RA dated on 19.09.2002, and Amendment of the Decree No. 286-N of the Government of RA dated on 12.04.2001**
2014	Law on Environmental Impact Assessment and Expertise
2014	Public notifications and discussions procedure, Decree No.1325-N

*The State Environmental Inspectorate under the MNP supervises soil transportation to minimize the environmental impact.

**In case of project which would disturb fertile top-soil, it is needed to transport the top-soil to outside of the area.

(1) Law on Environmental Impact Assessment

In 1991, after the independence of Armenia, it was unclosed that the environmental situation in this country had been deteriorated, and environmental conservation was identified as a high priority issue. Responding to the situation, various laws on environmental conservation have been formulated. The first relevant law to the Environmental Impact Assessment in Armenia was the “Law on Environmental Impact (hereinafter “the previous law”) in 1995. However, there were some gaps between the previous environmental law and international standards set by international organization such as WB, ADB, and so on. For the improvement of this issue, the “Law on Environmental Impact Assessment and Expertise (hereinafter “the new law”) was formulated in 2014.

The biggest difference between the previous law and the new law is that the new law regulates the

procedure of environmental assessment. In addition, under the new law, assessment is implemented by two stages (i) Initial Stage, which includes screening and categorization to category A, B and C according to the activity type; and (ii) Main Stage, during which an assessment for Category A and B is implemented in more detail. The Project corresponds to the construction sector which including over 1 million m³ of reservoirs, artificial lakes, or ponds (on No. 4 of Article 14 of the new law), and it is categorized as Category A. So far, MNP has approved only two projects under the new law, because it has been short time after the adoption.

Any projects are categorized into Category A, B and C depending on the scale and characteristics. Generally, Category A Projects are large scale, or can cause complicated environmental impacts. For instance, projects of construction of hydropower stations with the power of 30 MW and more are categorized into A. In case of water management project, construction of reservoirs, artificial lakes, water basins with 1 million m³ and more are classified into Category A. In case of Category B, medium-scale projects are categorized, e.g. hydropower stations with 10-30 MWt power and so on. Category C projects include Production of biogas or energy with biogas with the power of 1 MWt and more Hydropower stations with the power of 1-10 MWt and so on. There is no mention of reservoir scale in definition of Category B and Category C. Any projects which are classified into Category C do not need ESIA preparation.

(2)Necessity of environmental and social considerations at each stage

Regarding Environmental and Social Considerations for Master Plan and Development Strategy, a Strategic Environmental Assessment is necessary according to the Law. However, the Strategic Environmental Assessment is not categorized into Category A or B or C. On the other hand, if the project is categorized as Category A or B, the undertaker must prepare an ESIA Report on the Feasibility Study (F/S) Stage and the Detail Design (D/D) Stage. The contents of ESIA Report and the procedure, on F/S Stage and D/D Stage, are the same.

(3)Project which requires ESIA report preparation

As mentioned before, the procedure of preparing ESIA Report on the new law consists of Initial Stage and Main Stage (see Figure 5-1-3.2). When the project is categorized as a Category C at the Initial Stage, the undertaker doesn't need to prepare an ESIA Report. However, if it is categorized as Category A and B, ESIA Report preparation is needed. Furthermore, there's no difference between ESIA Report contents of Category A and that of Category B. The difference between the Category A and B is only period of ESIA Report examination, namely, 60 working days and 40 working days for Category A and Category B, respectively. In addition, the examination for Strategic Environmental Assessment Report is 60 working days.

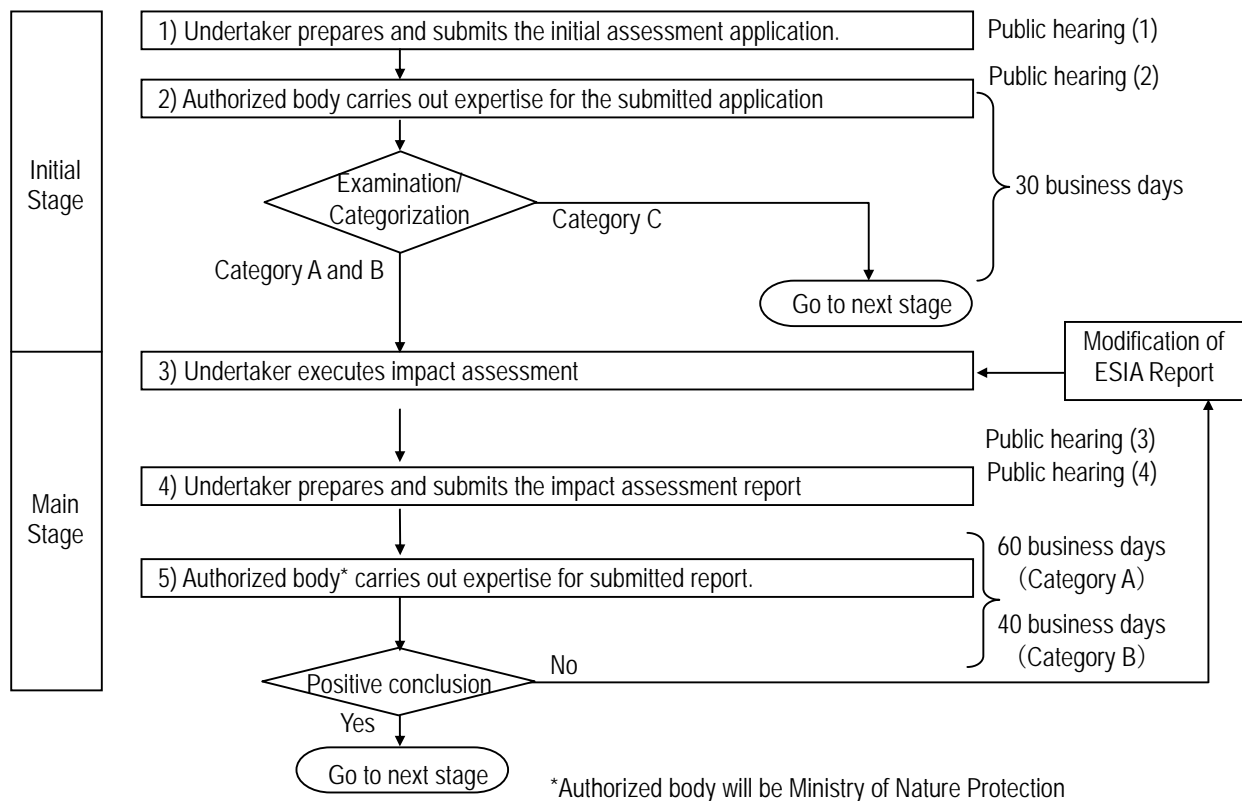


Figure 5-1-3.2 Process of Preparing, Application, and Approval of ESIA Report

1) Initial Stage

The undertaker prepares an initial assessment application and submits it to the MNP. The contents of the initial assessment application include the project components, estimation of the environmental impact by the project, results of Public Hearing and so on. After this, the MNP will notify results of the Category and contents which should be included in the ESIA Report, if the project is categorized as Category A or B. Before submission of the application document, the undertaker must hold the Public Hearing which explains the project outline and expected project impact, and include the results of Public Hearing to the application document. After that, the MNP will hold the other Public Hearing to confirm contents of the submitted application document. Based on the application, the MNP suggests the survey contents of ESIA Report.

2) Main Stage

Based on the notice from the MNP on Initial Stage, the undertaker should implement the environmental impact assessment and prepare an ESIA Report. The contents of Strategic Environmental Assessment Report and ESIA Report are shown below.

[Strategic Environmental Assessment Report]

- i. The aim of the master plan and the development strategy, and their relation and accordance with master plan of the given area,
- ii. International agreements and other related legal acts ratified by the Republic of Armenia related to the master plan and the development strategy,
- iii. The environmental issues related to the area subject to impact and their reflection in the master plan and the development strategy,
- iv. The natural environmental conditions and socio-economics situations of the area,

- v. The comparison of all possible options,
- vi. The mitigations,
- vii. The monitoring program,
- viii. The information on sources of data included in the report,
- ix. Information on assessment methods, and issues, including absence of data, arising during their application,
- x. Summary of the report.

[ESIA Report]

- i. The aim of the project
- ii. The natural environmental conditions and socio-economics situations of the area.
- iii. The consistency between the development plan of the area and the project
- iv. The comparison of all possible options
- v. The estimated impacts by implementation of the project (the impacts to natural resources and materials by the project, air pollution, drainage, waste, emergency situations, and so on)
- vi. The impacts to the natural environment and socio-economic environment by the project
- vii. The mitigations
- viii. The scales, possibilities, and reductions/ mitigations of estimated emergency situations²
- ix. The monitoring program
- x. The information on sources of data included in the report
- xi. Information on assessment methods, and issues, including absence of data, arising during their application.

In addition, the undertaker has to attach results of the Public Hearing, including the minutes, the attendance list, videotape, the notification for the Public Hearing, and so on. And if the project is on the F/S Stage, the summary of F/S report is required to be attached.

The ESIA Report is examined by the MNP. At this stage, the undertaker and MNP have the Public Hearing to explain the project impact and its mitigation measures again. For the examination by MNP, 60 working days and 40 working days are needed for Category A and Category B, respectively, however, if MNP needs more days for examination of ESIA Report, they can extend the period up to half of days of original period. When an ESIA Report is submitted to the MNP, summary of the project report such as F/S report shall be attached. If the ESIA report is satisfactory, the MNP gives positive conclusion, and the project can proceed to next step as Figure 5-1-3.2.

Table 5-1-3.2 shows the gap between the Environmental Law in Armenia and the JICA Environmental and Social Guidelines (hereinafter referred to as “JICA Guidelines”).

Table 5-1-3.2 Gap Analysis between the Environmental Law in Armenia and JICA Guidelines

Items	JICA Guidelines	Environmental Law in Armenia	GAP	Measure for settlement
Procedure	JICA confirms that projects comply with the laws or standards related to the environment and local	The procedure of the Environmental Impact Assessment is regulated in Law on Environmental Impact	None	—

² Emergency situation includes natural disasters, man-made disasters, and accidents

Items	JICA Guidelines	Environmental Law in Armenia	GAP	Measure for settlement
	<p>communities in the central and local governments of host countries; it also confirms that projects conform to those governments' policies and plans on the environment and local communities.</p> <p>JICA confirms that projects do not deviate significantly from the World Bank's Safeguard Policies,</p>	Assessment and expertise (2014).		
Language of the Environmental Impact Assessment Report	ESIA Reports must be written in the official language or in a language widely used in the country in which the project is to be implemented. When explaining projects to local residents, written materials must be provided in a language and form understandable to them.	ESIA Report is to be prepared in Armenian. And the explanation of project is also implemented in Armenian. In general, the local people uses Armenian.	None	—
Information Disclosure	<p>In principle, project proponents etc. disclose information about the environmental and social considerations of their projects. JICA assists project proponents etc. by implementing cooperation projects as needed.</p> <p>JICA encourages project proponents etc. to disclose and present information about environmental and social considerations to local stakeholders.</p>	<p>Before submission of the application documents and ESIA Report to MNP, the Public Hearing is required to be held. In the Public Hearing, it is required to be explained to participants (e.g. relevant municipalities, residents, and so on) about the project outline and the estimated environmental impacts. Furthermore, the public notice, contents of Public Hearing, and the consent form from municipalities are required to be attached to the application documents and ESIA Report. (No. 26 of Article 16/ Law on Environmental Impact Assessment and Expertise).</p> <p>After the Public Hearing for the application, MNP would announce the category of the Project and the contents which the undertaker should implement the environmental impact survey. In addition, after the Public Hearing of submission of ESIA Report, MNP would present the result of the report to relevant person ("Public notification and discussion procedure," 2014).</p>	None	—
Access to ESIA Report	ESIA Reports are required to be made available to the local residents of the country in which the project is to be implemented. The ESIA Reports are required to be available at all times for perusal by project stakeholders such as local residents and copying must be permitted;	When the Public Hearing, the contents of ESIA Report is required to be explained (Article 26, Law on Environmental Impact Assessment and Expertise). Submitted ESIA Report to MNP would be disclosure on the website of MNP, and be allowed to copy or read. Furthermore, if the report revised, the revised version would be disclosure on website.	None	—
Consultation with Local Stakeholders	<p>In principle, project proponents etc. consult with local stakeholders through means that induce broad public participation to a reasonable extent, in order to take into consideration the environmental and social factors in a way that is most suitable to local situations, and in order to reach an appropriate consensus. JICA assists project proponents etc. by implementing cooperation projects as needed.</p> <p>In the case of Category A projects, JICA encourages project proponents etc. to consult with local stakeholders about their understanding of development needs, the likely adverse</p>	Before the application and submission ESIA Report, the Public Hearings are required to be implemented. The participants can make comments about the project, the estimated environmental impacts, and the mitigations. In addition, the undertaker has to consider the comments from participants. And if the comments are reasonable, the undertaker has to reflect them to ESIA Report. (Article 26, Law on Environmental Impact Assessment and Expertise). The undertaker have to attach the memorandum of the Public Hearing and recorded videotape to the	None	—

Items	JICA Guidelines	Environmental Law in Armenia	GAP	Measure for settlement
	impacts on the environment and society, and the analysis of alternatives at an early stage of the project, and assists project proponents as needed.	application documents and ESIA Report, and submit them to MNP (Article 26, Law on Environmental Impact Assessment and Expertise).		
Confirmation of Monitoring	JICA confirms with project proponents etc. the results of monitoring the items that have significant environmental impacts. This is done in order to confirm that project proponents etc. are undertaking environmental and social considerations for projects. The information necessary for monitoring confirmation by JICA must be supplied by project proponents etc. by appropriate means, including in writing. When necessary, JICA may also conduct its own investigations. In addition, JICA discloses the results of monitoring conducted by project proponents etc. on its website to the extent that they are made public in project proponents etc.	Monitoring Program is required to prepare. However, there is no mention that publication of results of Monitoring Program is required or not.	Necessity of Publication of monitoring results is not mentioned.	JICA would confirm the actual situations of publication of monitoring results.

In addition to the table above, some norms/standards are not established in Armenia as described in (3) below. Therefore, it is recommended to apply international standards as required.

(3) Environmental standards in Armenia

Some norms/standards regarding unified effluent from factories, soil contamination, and specific irrigation water quality, limitation of agricultural in surface water are not established in Armenia. Moreover, In case of groundwater, purposes of use are various, namely, drinking, domestic use, aquaculture and so on, there is no specific standard/norm. This sub-chapter describes existing regulation, norms/standard, laws concerning environmental conservation.

1) Air quality standard

National of ambient air quality standard in Armenia is speculated in “Norms of maximum allowable concentrations of ambient air pollutants in residential areas”. In the regulation, 389 parameters of quality are provided, however, parameters to be monitored are fixed depending on the location, and it is not necessary to monitor all of the parameters. In case of big cities such as Yeghvard City, dust, NO₂, SO₂ and CO are parameters to be monitored according to the MNP. Thus, only those parameters are regarded as the standard in the Project. The allowable values of those parameters are as shown in Table 5-1-3.3.

Table 5-1-3.3 Air Quality Standard in Armenia

Air pollutant	Maximum one-time concentration (mg/m ³)	Mean daily concentration (mg/m ³)
Dust	0.5	0.15
SO ₂	0.5	0.05
NO ₂	0.0085	0.04
CO	5.0	3.0

Source) Government Decree #160-N dated 02.02.2006

2) Industrial effluent standard

The Government of Armenia has yet to establish any uniformed standards regarding effluent discharge from industrial factories. According to the Water Code of Armenia, every commercial/industrial unit shall propose their own effluents' permissible values to be discharged to surrounding water basins. All factories should set the permissible level in the document based on the specified formula and submit it

to Water Resource Management Agency under the MNP to get approval on the proposed permissible values. During the operation of factories, another organization under the MNP, namely, State Environment Inspectorate is in charge of monitoring of the effluent discharge situations based on the proposed permissible level by themselves. The parameters, which are generally regulated in discharged water, are temperature, pH, TDS, SS, BOD, COD, SO₄, PO₄, NO₃-N, NO₂-N and so on.

3) Surface water standard in Armenia

In Armenia, there is a surface water quality standard which classifies 5 categories, and the water uses are determined based on the class of water quality. Concerning irrigation water, water which satisfies Class I to Class IV can be used. In Armenia, Background Concentration (BC) is specified for each river, and water quality threshold depend on the river. Rivers concerned to the Project are Kasakh River and Hrazdan River, and Background Concentrations of those rivers as well as general surface water quality standard is shown in Appendix-K-1 Table-1.

There is no regulation which focuses only irrigation water quality specifically in Armenia, the surface water quality standard has been established, though. According to the official personnel of the MOA, the international standards prepared by the Food and Agriculture Organization (FAO) are applied. There is no big difference between the surface water quality in Armenia and the FAO guidelines for irrigation for common water quality parameters, the Armenian standard is stricter for some parameters. FAO water quality standard is attached in Appendix-K-1, Table-2.

Concerning regulation of organic pollutants such as pesticide and insecticide in Armenia, any standards are not established yet. Therefore, staff of SNCO of Environmental Impact Monitoring Center under the MNP recommends applying the environmental quality standard for the Project mentioned in EU journal. The standard of the pollutants is shown in Appendix-K-1, Table-3.

4) Noise

Noise standard has been established in Armenia, and the threshold values are fixed depending on the surrounding conditions and time (daytime or night time). The norm for noise pollution control is described in Table 5-1-3.4.

Table 5-1-3.4 Noise Standard in Armenia

Facilities and buildings	Day time / night time	Noise equivalent level, dB	Noise maximum level, dB
Territories adjacent to residential buildings, clinics, ambulatories, rest houses, care homes, disabled persons homes, libraries, kindergardens, schools and other educational facilities	6:00 – 22:00	55	70
	22:00 – 6:00	45	60
Rooms of apartments, sleeping rooms of rest houses, care homes, disabled persons homes, kindergardens, boarding schools	6:00 – 22:00	40	55
	22:00 – 6:00	30	45
Noise in workplaces for construction works		80	

Source) Ministerial of Health Care of RA, Order No.138 on The Sanitary Norms N2-III-11.3 "Noise in the Work Places, Residential, Public Buildings and Residential Construction Sites" (2002)

5) Waste

"Law on Waste" has been established in 2004 in Armenia, waste are classified into six categories, namely, 1) household waste, 2) non-household waste, 3) industrial waste, 4) constructional waste, 5) big-scale waste, and 6) hazardous waste. Costs of waste disposal are maximum 3,000 AMD and 10,000 AMD, for 1 m³ and 1 ton, respectively. Authorized body for waste management is the MNP, and any construction companies which generate waste must make a "waste passport", and submit to the MNP. The permission of waste disposal is given by MNP. The place for disposal is also decided by the MNP.

5-1-4 Examination of Alternatives

5-1-4-1 Alternatives of Water Resources

In the Project, the construction of canals and a reservoir is proposed. These facilities together will be able to provide sufficient and stable irrigate water for the target area. Therefore, canals and the reservoir would be considered as one package. When alternatives of the project are examined, the package of canals and reservoir would be compared with others.

The aim of the Project is irrigation system improvement of the target area, and two options of water resources to fulfil the purpose can be considered. The first option is use of groundwater for irrigation and second one is use of surface water including meltwater. In addition, the case that the project is not implemented, called as "Zero- option", is also examined.

(1)Zero-option

The Government of Armenia has been controlling the amount of water taken from the Lake Sevan since 1980's and water diversion project for the Lake Sevan conservation, such as the construction of the tunnel for taking water from Arpa River and Vorotan River has been implemented. As a result, the water quantity has been recovered up to 38 billion m³, however, the government restricts the amount of water discharge from the lake to 170 MCM/year except for drought years. If the Project is not implemented, the target area will depend on the Lake Sevan as main irrigation water resource, as ever. It would cause to decrease the water level of Lake Sevan. On the other hand, when the water level of the Lake Sevan is conserved by means of reduction of discharge of irrigation water from the lake, the agricultural production in the Project target area can be reduced, since water demand for irrigation cannot be satisfied.

Yeghvard Reservoir was planned with the scale of 228 MCM, in the Soviet Union period, and the embankment had been constructed in the early 1980's. Because of financial issues, the construction was stopped in 1985. However, a part of the embankment was constructed. Therefore, if it will not be used, the investment in Soviet Union period would be useless. Furthermore, barley, wheat and alfalfa have been cultivated in the area of the Reservoir, however, the farmers understand that the construction of the Reservoir will be resumed. That's why they cannot invest enough such as construction of the irrigation systems and so on.

If Zero-option is adopted, it would not be possible to take effective countermeasure for conservation of Lake Sevan and the investment for the construction of Yeghvard Reservoir in the Soviet Union period would not be used. In addition, the farmers, who has cultivated in the Reservoir site, would be forced to keep on cultivating unproductively. Therefore, the Zero-option cannot be recommended.

(2)Use of groundwater

Under Ararat Plain, high-quality ground water is generated. The groundwater has been used for cultivation, and drinking water. In recent year, however, aquaculture by using ground water has been widely operated in the Ararat Plain. Therefore, the groundwater level of Ararat Plain has been decreased significantly. Comparing the depth of confined groundwater level between 1983 and 2013, it has been reduced by 6 to 9m (WB, 2014). The reduction of groundwater has caused the conflicts among water users for irrigation, drinking water, industries, cooling water for nuclear power, and so on.

In the command area, there are some cases that WUA is pumping up the groundwater and use it for irrigation. In such case, the Government has to shoulder operation cost for deep well pumps, which can be big burden for the national budget. The possible irrigation areas by pumping up groundwater

are limited, because the groundwater resources are limited. Considering the situations mentioned above, stable water supply for the project command area cannot be ensured by use of only groundwater.

(3) Use of surface water

As mentioned, the amount of flow of Armenian rivers varies depending on seasons. In early spring, after snow is melted, the flow of water is maximized and it is not used for irrigation (called as “free water”). Therefore, it is possible to take water from rivers, which have large watershed areas and large amount of flow, such as the Hrazdan River. It is proposed to divert the “free water” into the Yeghvard Reservoir through the existing canals during the period that river flow is more than demand. Presently, from June to October, available water volume is lower than that of irrigation demand, and the beneficiary areas depend on the Lower Hrazdan canal that intakes water from the Lake Sevan. If the free water can be used, it would be possible to irrigate instead of dependent on other water resources including the Lake Sevan, which can contribute to conservation of the lake. Moreover, if sufficient irrigation water is provided, agricultural production of the area and the livelihood will be improved.

The Government established the National Water Program in 2006 and promotes the conversion from the pumping up irrigation to gravity irrigation based on the policy, finally, aims at independence on groundwater by the effective use of surface. The Government of Armenia has published the concept “the shift from energy high input agriculture,” given that groundwater level has been reduced. If the gravity irrigation, which uses surface water, is operated, it would reduce dependence on ground water and contribute to conservation of groundwater in the Ararat Plain. In addition, by construction of the Reservoir, some pumps will not be used, which can reduce the numbers of pumps and working hours. Finally, it could reduce the maintenance cost.

Taking into consideration the above conditions, alternatives for water resources are examined. Table 5-1-4.1 shows the result.

Table 5-1-4.1 Examination of Alternatives for Water Resources

Item	Zero- option	Use of Groundwater	Use of Surface water
Impacts during the construction (Ex. Air quality, Water contamination, Noise, and so on)	—	—	△ During the construction period, air and water pollution are expected.
Conservation of Lake Sevan	× Lake Sevan would be used as the water sources for irrigation.	○ It would reduce the dependence to Lake Sevan, however, it is limited.	◎ The amount of water use from the Lake Sevan would be reduced, and it would contribute to conservation of the Lake Sevan.
Impacts to the groundwater of Ararat Plain	—	× Pumping-up might reduce the level of groundwater.	◎ The impacts on groundwater are not expected, because the project will not use groundwater.
Land acquisition	—	— No need	× Land acquisition is expected.
Impacts to the socio-economical activities Regional and development	—	× It would contribute to the irrigation development, but it also would give negative impacts on other industries.	○ Stable irrigation agriculture would be possible.
Possible irrigation area	8,391ha	8,391ha<area<12,347ha	12,347ha
Project cost	— However, the investment in the Soviet Period would not be used.	△ Relatively not expensive	× Expensive
Maintenance and management cost	—	△ Middle	○ Low
Comprehensive evaluation	Not adopted	Not Adopted	Adopted

— : No impact, × : Huge negative impact, △ : Negative impact, ○ : Positive impact, ◎ : Huge Positive impact

5-1-4-2 Alternatives of the Reservoir Site

Considering topographical conditions, there are 10 points that can be candidate sites for construction the Reservoir on the right and left banks of Hrazdan River. However, water holding capacities of those sites are very small. Even the Meghradzor site (see, Figure 5-1-4.1), which has the largest storage capacity (located Meghradzor Community of Kotayk Marz), about 30 million m³, and it is much smaller than 90 million m³ of Yeghvard reservoir. Thus, to ensure the same level of water storage capacity of the Yeghvard Reservoir, it is necessary to construct plural reservoirs. In such case, construction cost would be more expensive than that for construction of Yeghvard Reservoir and area for land acquisition would be larger, because they are new constructions. In and around the Meghradzor site, there is no protected area to be conserved, and it can be judged that there is no difference between Yeghvard Reservoir and Meghradzor site in terms of natural environment. The alternatives of reservoir site are examined based on scale of land acquisition and cost. Therefore, the site of Yeghvard Reservoir is considered as the most suitable. Table 5-1-4.2 illustrates comparison of the options for reservoir construction.



Figure 5-1-4.1 Locations of the Yeghvard Reservoir and Meghradzor Site

Table 5-1-4.2 Examination of Alternatives for Reservoir Site

Item	Yeghvard Reservoir	Meghradzor Site and Other sites
Land Acquisition	△ The land acquisition around canals is expected. However, the area of land acquisition would be limited, because the reservoir is one. And the lands of Yeghvard Reservoir are communal land. Furthermore, the farmers, who has cultivated in the present, understand the necessity to stop cultivation.	× In addition to the land acquisition and resettlement for canal construction, land acquisition of the reservoir construction is also required. Furthermore, the range and scale of land acquisition would be more serious.
Project cost	△ Expensive	× Very expensive
Comprehensive evaluation	Adopted	Not adopted

— : No impact, × : Huge negative impact, △ : Negative Impact

5-1-4-3 Alternatives of the Anti-infiltration Works in the Yeghvard Reservoir

The soil in the planned reservoir area has high permeability in terms of geological characteristics and it is necessary to apply anti-infiltration work. There are four (4) options for the anti-infiltration works, namely, 1) Bentonite sheet, 2) Bentonite-soil mixture, 3) Soil-cement, and 4) Soil-Cement with a sandwiched bentonite sheet. Those anti-infiltration works were examined in terms of reliability and cost. As a result, it is judged that the last one, namely, “Soil-Cement with a sandwiched bentonite sheet” is recommended as the best option. It is noted that there is no difference in terms of impacts on natural environment among the alternatives. The examination result is as shown in Table 5-1-4.3.

Table 5-1-4.3 Examination of Anti-infiltration Works for the Yeghvard Reservoir

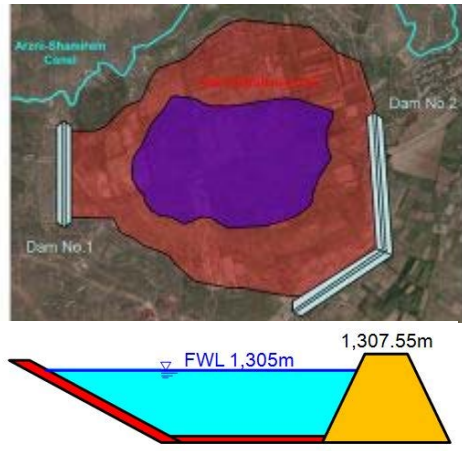
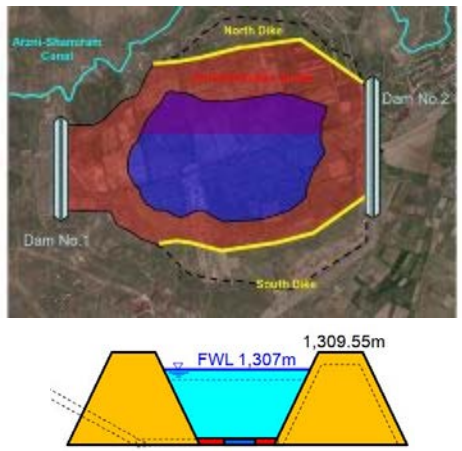
Parameters/Work	1. Bentonite sheet	2. Bentonite-soil mixture	3. Soil-Cement	4. Soil-Cement with a sandwiched bentonite sheet
1) Reliability	Even though due attention is paid during construction works, it is very difficult to prevent human error completely	If the applied material is not completely enclosed, it could be melted and flushed away.	Curing ³ is necessary.	Two kinds of materials are mixed to supplement each other, and execution management can be easy compared with the case of one kind of material.
2) Cost	Reservoir bottom: \$12.6/m ² North slope: \$22.4/m ² South slope: \$24.1/m ²	Reservoir bottom: \$18.3/m ² North slope: \$28.1/m ² South slope: \$30.4/m ²	Reservoir bottom: \$15.3/m ² North slope: \$15.3/m ² South slope: \$15.3/m ²	Reservoir bottom: \$14.5/m ² North slope: \$14.5/m ² South slope: \$14.5/m ²
Conclusion	-	-	-	Recommended as the anti-infiltration work

5-1-4-4 Examination of Dike Construction

There are two (2) options for dike construction, namely, Plan A: Utilization of existing dikes and Plan B: Construction new dikes. Those options are examined as illustrated in Table 5-1-4.4. In case of Plan A, cost is relatively low compared with that of Plan B. In addition, it is possible to use the existing dikes in the Reservoir. Concerning social aspect, in case of Plan B, the planned submerged area is small, since southern and northern parts of the Reservoir basin will not be submerged, however, these parts are not used for agricultural purpose at present. It means that there is no big difference between the Plan A and Plan B in terms of social aspect. Therefore, Plan A is proposed for the Yeghvard Reservoir.

³ “Curing” is to keep moisture of the applied soil cement for increase of strength and impervious capacity

Table 5-1-4.4 Examination of Dike Construction for the Yeghvard Reservoir

Plan	Plan A: Utilizing of existing dikes	Plan B: Construction of New Dikes
Outline		
Capacity	94 MCM	Same as on the left
LWL	1,290 m	Same as on the left
FWL	1,305 m	1,307 m
Dam Height	25.55 m	27.55 m
Reservoir Area	7.96 km	5.42 km
Anti-infiltration Area	5.44 km	3.10 km
Construction Cost	88.8 million USD	90.9 million USD
Social aspect	Existing farmlands (80ha), which are located on the center of the reservoir, will be submerged.	Existing farmlands (80ha), which are located on the center of the reservoir, will be submerged. Even though the area to be submerged is smaller than that of Plan A, productive places for farming are located on the central parts of the Reservoir, therefore, there is no big difference between the plans in terms of social aspect.
Selection	Adopted	Not adopted

5-1-4-5 Examination of Route of Outlet Canal-2

At the examination of route of the Outlet Canal 2, there are two options, which is planned to divert stored water at the Reservoir to the Kasakh River as shown Figure 5-1-4.2. First one, namely, Outlet Canal 2 (1) is planned to pass through the natural stream, while second one, Outlet Canal 2 (2) is proposed to go through the orchard and residential area. Concerning the first option, the area along the natural flow belongs to the Nor-Yerznka village, which enables to minimize the acquisition of private lands and no relocation is needed. In case of second one, relocation of several houses is necessary and orchard area along the canal 2 (2) will be damaged. Therefore, the route of Outlet Canal 2 (1) is selected finally as named Outlet Canal 2 as shown in Figure 5-1-1.1.

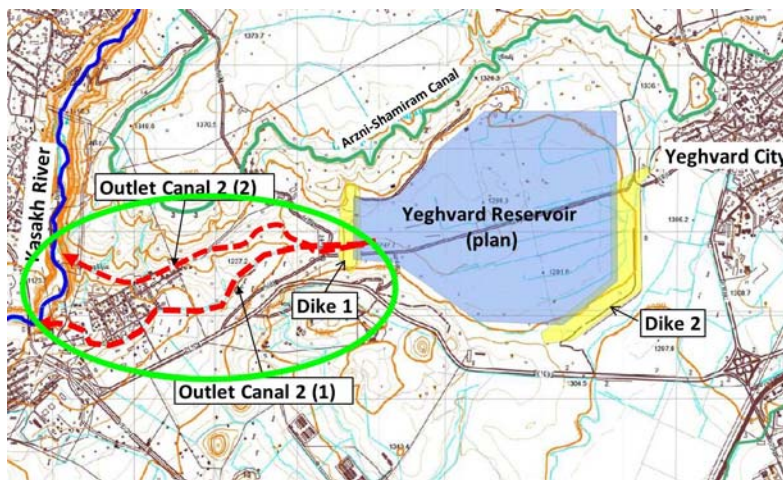


Figure 5-1-4.2 Examination of Options for Outlet Canal 2

5-1-4-6 Examination of Pipeline System and Open-canal System for the Proposed Canals

Regarding canal construction, there are two options, namely, open-canal system and pipeline system. Considering topographic conditions, cost, social impact, suitable system is proposed for each canal. As a result, pipeline system is proposed for all the canals except the Feeder Canal 1. Following table describes examination results:

Table 5-1-4.5 Examination of Open-canal System and Pipeline System for the Proposed Canals

(1) Feeder Canal 1

Parameter	Open-canal	Pipeline
Possibility of water storage at the Reservoir	If open-canal system is applied, it is needed to secure at least 15m head between the starting point of the Feeder Canal-1 and the full water level at the Reservoir. However, sufficient water head cannot be secured considering that the proposed canal should pass over the Dike No.2. If an open canal is installed, pump system should be installed to fill the Reservoir to the full water level.	Pipeline installation is not restricted by topographical conditions. It is possible to store planned water without pump system installation.
Social impact	3m width for the open canal and addition 4m width for maintenance road (7m width in total) should be secured for open canal construction, which results in permanent land acquisition.	Only temporary land acquisition is needed, which leads to less social negative impact compared with that in case of open-canal installation.
Cost	During operation stage, electrical fee for pump operation is needed.	Gravity irrigation system can be applied, and operation cost such as electrical fee is not needed.
Selection	Not adapted	Adapted

(2) Feeder Canal 2

Parameter	Open-canal	Pipeline
Possibility of water storage at the Reservoir	There is enough water head between the intake point from the Arzni-Shamiram Canal and the full water level of the Reservoir.	It is possible to store water at the Reservoir.
Social impact	The land in and around the proposed Feeder Canal 2 is not used for agricultural purpose, therefore, the impact on surrounding area by the open-canal construction is not significant.	Same as left
Cost	Cost of open-canal construction is relatively low.	Cost of pipeline installation is higher than that of open-canal.
Selection	Adapted	Not adapted

(3) Outlet Canal 1

Parameter	Open-canal	Pipeline
Possibility of water diversion from the Reservoir to the Arzni-Branch Canal	If open-canal system is applied, it is needed to detour highland, around E.L. 1,300m, which is higher than elevation at bottom of the Reservoir, EL 1,290m. In such case, the alignment length is 6.5km.	If pipeline system is applied, it is possible to share 1.2km length of the canal alignment with the Feeder Canal 1. The pipeline can cross over the railway, and the draft alignment length for outlet part is 0.73km (total canal length is 1.93km), which is much shorter than that of open-canal.
Social impact	Canal width and protection zone should be secured, which leads to larger affected area and permanent loss	Only temporary land acquisition is needed, which leads to minor social negative impact.
Cost	Due to long distance of canal alignment, it is costly.	Due to short length of the canal, the cost can be lower than that of open-canal.
Selection	Not adapted	Adapted

(4) Outlet Canal 2

Parameter	Open-canal	Pipeline
Possibility of water diversion to the end	If open-canal is applied, at least 14m head is needed between the bottom of Reservoir and the	It is possible to divert water to the Arzni-Branch Canal from the Reservoir.

Parameter	Open-canal	Pipeline
point of the Arzni-Branch Canal and Kasakh River from the Reservoir	end point of the Arzni Branch Canal. However, the estimated head is 13.7m, which is insufficient. Therefore, it is difficult to divert water to the Arzni-Branch Canal from the Reservoir through open-canal system.	
Social impact	The proposed route passes through farmlands and buildings. In case of open-canal, the area to be affected will be large and permanent.	In case of pipeline, affected area will be smaller, and only temporary land acquisition is needed.
Cost	Compensation for the affected area is large, since protection zone along the canal is needed.	Compensation for the affected area is smaller than that of open-canal system.
Selection	Not adapted	Adapted

5-1-5 Scoping and TOR for Environmental Examination

5-1-5-1 Scoping

At the scoping stage, due to construction of the Yeghvard Reservoir and irrigation canals, it is expected that some environmental impacts, namely, impacts on air quality, water quality and soil, noise, waste, land acquisition and so on will be caused. Scoping results is described in Table 5-1-5.1.

Table 5-1-5.1 Scoping Result

Environmental parameter	Evaluation		Reason of evaluation
	Before and during construction	Operation stage	
1. Air quality	B ⁻	D	<p>Construction stage: Dust and gas emission will be caused, especially, canal (3) is expected to pass through some villages, which leads to impacts on the villages.</p> <p>Operation stage: Increase of vehicles is not expected, and there is low possibility of air pollution.</p>
2. Water quality	B ⁻	C	<p>Construction stage: Mud water from the construction site will be caused.</p> <p>Operation stage: Water quality deterioration of the Hrazdan River, due to the Project is not expected, since minimum discharge of the river is secured. At the Yeghvard Reservoir, water from existing Arzni-Shamiram canal including snow water is stored, water quality of the Reservoir will not have problem in terms of quality. However, there is a possibility that outbreak of plankton will be caused during summer season. Considering that main crops in the command area are wheat, vegetables, grass and fruits, damage on the crops due to cold water irrigation cannot be expected.</p>
3. Waste	B ⁻	D	<p>Construction stage: Waste from construction works and labor camps will be generated.</p> <p>Operation stage: Dredging of canals is necessary, however, the amount is very small and negligible.</p>
4. Soil Contamination	B ⁻	C	<p>Construction stage: Oil leakage from construction vehicles and equipment is expected.</p> <p>Operation stage: Due to increase of irrigation area in the command area, soil can be affected by the agrichemical application increase.</p>
5. Noise and Vibration	B ⁻	D	<p>Construction stage: Noise and vibration due to construction works are expected.</p> <p>Operation stage: Given that traffic increase is not expected, noise and vibration will not be caused.</p>
6. Ground Subsidence	D	D	<p>Construction stage /Operation stage: During construction and operation, ground subsidence will not be caused, since there is no plan to use ground water.</p>

Environmental parameter	Evaluation		Reason of evaluation
	Before and during construction	Operation stage	
7. Offensive Odor	D	D	<u>Construction stage /Operation stage:</u> Any works to caused offensive odor is not planned.
8. Bottom sediment	D	D	<u>Construction stage /Operation stage:</u> Any works to caused bottom sediment is not planned. During the operation stage, bottom sediment will not be influenced since the canal concrete lining will be done.
9. Protected area	D	D	<u>Construction stage /Operation stage:</u> There is no protected area in and around the project site.
10. Ground water	D	C/B ⁺	<u>Construction stage:</u> Water level of ground water ranges around 100m deep, consequently, no impact on the ground water by the project is expected. <u>Operation stage:</u> Use of ground water is not planned. In the beneficial area, the project can contribute to recovery of ground water due to shift from use of ground water to use of surface water. On the other hand, there is a possibility that expansion of irrigated land will cause pollution of ground water by increase of application of fertilizers and agrochemicals.
11. Hydrological Situation	D	C	<u>Construction stage:</u> It is not planned to close any natural rivers nor to change /expand existing water courses, which will not result in hydrological change. <u>Operation stage:</u> The project will divert the free water of the Hrazdan River during March to May, considering the regulated minimum discharge. Therefore, the Project reserve the hydrological situation of the Hrazdan River. However, it is needed to examine any impacts on hydrological situation of the Hrazdan River. In addition, the Project could prevent from water level decrease of the Lake Sevan and it is possible to release surplus water to the Hrazdan River according to the necessity.
12. Ecosystem	B ⁻	B ⁻ /B ⁺	<u>Construction stage</u> Lands in and around the construction sites have been already developed for agricultural purpose and there is no virgin nature to be damaged by the Project. However, it is needed to confirm current ecosystem in and around the project site. Moreover, impacts on fish by the project during the construction works have to be examined. <u>Operation stage:</u> There is a possibility that bio-diversity will be richer than present, since the Reservoir construction will provide water birds with their habitats. It is planned to divert free-water of Hrazdan River including snow water through the Arzni-Shamiram Canal to the Yeghvard Reservoir. Minimum discharge of the Hrazdan River is regulated and the Project is proposed based on the minimum discharge. Moreover, instead of all of snow water except minimum discharge, 50% of snow water at peak will used for water diversion. Given that the minimum discharge is decided considering eco-system conservation of rivers, negative impacts on the eco-system in downstream is limited. However, it is necessary to examine the impacts on fish species in Hrazdan river by the diversion of the snow melted water. Moreover, it is needed to confirm the current ecosystem of Kasakh River to be affected by the Project, since a part of Hrazdan River water will be diverted to the Kasakh River, which results in mixture of different fish species. The project could reduce dependency of the command area on the Lake Sevan as the water resource, which can contribute to prevention from water level decrease of the lake. On the other hand, excessive water level increase of the lake causes negative impacts on the eco-system, e.g. submerge of surrounding trees.
13. Topography and Geographical	D	D	<u>Construction stage:</u> In 1980s, parts of dike had been constructed by the Government of Soviet Union, the existing dike can be used in the construction works. Therefore, it

Environmental parameter	Evaluation		Reason of evaluation
	Before and during construction	Operation stage	
features			<p>is not needed to change topographic features by the Project. Earth and sand for the construction will be gained within the Yeghvard Reservoir. The Reservoir will be submerged, it is, therefore, expected that no negative impacts will be caused.</p> <p>Operation stage: The Project will divert water of Arzni-Shamiram Canal instead of close of any natural rivers. Therefore, topographic change of the Hrazdan River is not expected. The water to be stored in the Yeghvard Reservoir will contain little sand, considering that the water will be diverted through the intake. Therefore, soil sedimentation at the Reservoir is not expected. Moreover, since water will not be diverted from the bottom of Reservoir to the Kasakh River through the canal, no sedimentation will be caused. It can be said that no topographic impact is expected.</p>
14. Involuntary Resettlement/ Land Acquisition	B ⁻	D	<p>Before construction stage: Due to the Reservoir construction, around 800ha of the Reservoir basin will be submerged, and the farmlands in the basin will be affected. Moreover, since the proposed canal will pass through the private lands, land acquisition will be necessary.</p>
15. The poor	C	C	<p>Construction/Operation stage: It is needed to confirm the situations by the field survey and hearing from the government concerned.</p>
16. Indigenous and ethnic people	C	C	<p>Before construction/Operation stage: It is needed to confirm the situations by the field survey and hearing from the government concerned.</p>
17. Livelihood/local economy	B ⁻ /B ⁺	B ⁺	<p>Construction stage: Given that the Project will provide job opportunities for the local people, positive impact is expected. On the other hand, the Project will cause negative impacts on some people whose land will be acquired.</p> <p>Operation stage: Stable agricultural production can be implemented due to stable irrigation water for the people, while the cost for pump operation shouldered by the government, will be reduced. It is expected that the Yeghvard Reservoir will attract tourists and the area will be developed.</p>
18. Land use and local resource utilization	B ⁻	D	<p>Construction stage: It is needed to acquire land for construction of reservoir and canals. Some of existing farmlands will be changed to stock yard for construction, construction office, canals and so on.</p> <p>Operation stage: No negative impact on land use and local resource utilization is expected.</p>
19. Water Usage or Water Rights and Rights of Common	D	B ⁻ /B ⁺	<p>Construction stage: 1) Since the Project will take water of the Hrazdan River through existing facilities, and severe impacts on the Hrazdan River is not expected. 2) Given that the construction works will not close natural rivers and change existing canals, scale of mud water due to construction works will be small.</p> <p>Operation stage: Free water, which is discharged without used, is observed during non-irrigation season. Therefore, there is no demand for snow water in early spring. So, it can be said that water usage in the downstream of the Hrazdan River will not be influenced negatively. In some parts of the beneficiary area, irrigation by using electric pumps is operated, which needs electric fee. After the project completion, irrigation system will be changed from pump irrigation to gravity irrigation, which enables stable irrigation by using water stored at the Yeghvard Reservoir. It is needed to identify impacts on water use apart from irrigation by the snow melted water diversion from the Hrazdan River to the Reservoir.</p>
20. Existing social infrastructures and services	B ⁻	D	<p>Construction stage: Due to increase of construction vehicles, traffic jam can be caused.</p> <p>Operation stage:</p>

Environmental parameter	Evaluation		Reason of evaluation
	Before and during construction	Operation stage	
			No impact on traffic is expected.
21. Social institutions	D	D	<u>Construction /Operation stage:</u> Given that there is no possibility of physical relocation and the number of the affected households will be not very large, any negative impact on decision maker in the area is not expected. Moreover, considering that most of the land acquisition will be temporary during the construction period, existing social institutions such as WUA will not be affected.
22. Misdistribution of benefit and damage	B ⁻	B ⁻	<u>Construction stage/:</u> The beneficial area and affected area are located on the different places, uneven distribution of positive and negative impacts between PAPs and beneficiaries will be generated due to the land acquisition during the construction stage. <u>Operation stage:</u> Due to the Project, the beneficiaries can enjoy the profit, while other farmers in non-project area cannot do Therefore, conflict between PAPs and beneficiaries can be caused during the operation stage.
23. Conflict	B ⁻	C	<u>Construction /Operation stage:</u> Due to the Project, stable irrigation water will be supplied, which does not bring about conflict on water use in the beneficial area. However, some conflict can be caused between beneficiaries and project affected persons, therefore, it is to be examined.
24. Cultural heritage	C	C	<u>Construction /Operation stage:</u> It is needed to confirm by the field survey.
25. Land scape	D	D	<u>Construction /Operation stage:</u> The areas in and around the project sites are mainly farmlands and residential area, therefore, special land scape to be reserved is not identified.
26. Gender	D	D	<u>Construction /Operation stage:</u> Negative impact on women is not expected.
27. Rights of the Child	D	D	<u>Construction /Operation stage:</u> Negative impact on children is not expected. According to the Labour Code of the Republic of Armenia, works by children under 14 years old is prohibited. There is few cases confirmed that children work as labor for agriculture and construction works and it is not recognized as a social issues in Armenia ⁴ .
28. Hazards (Risk), Infectious diseases such as HIV/AIDS	B ⁻	D	<u>Construction stage:</u> There is a possibility that infectious disease HIV/AIDS could be caused by employment of workers from other areas. It is needed to confirm other cases. <u>Operation stage:</u> After the construction works, no disease is expected.
29. Work environment	B ⁻	D	<u>Construction stage:</u> There is a concern of accident at the construction sites. It is needed to comply the labor code for safety. <u>Operation stage:</u> No labor environmental change in the beneficial area is expected, since irrigation farming has been operated in the area.
30. Accident	B ⁻	B ⁻	<u>Construction stage:</u> There is a concern of traffic accident at the construction sites. Moreover, there is a concern of accident to construction of canals, which will be very limited. <u>Operation stage:</u> Accidents that somebody drop to the reservoir and canals can be caused, the possibility is low, though.
31. Transboundary impact, climate change	D	C	<u>Construction stage:</u> Large amount of greenhouse gas, which can cause climate change, will not be emitted by the Project.

⁴ It is based on the interview to Project Implementation Unit, SCWE.

Environmental parameter	Evaluation		Reason of evaluation
	Before and during construction	Operation stage	
			<p>Operation stage: Based on amount of irrigation water demand in the Hrazdan River downstream and the regulated minimum discharge of the Hrazdan River, the project is designed. So, no severe damage to the downstream is expected. On the other hand, the Araks River flows down along the international boundary with Azerbaijan and Iran, finally flows into the Caspian Sea after the merge with the Kura River. Ratios of area of the Hrazdan River basin (around 1,200 km²) to that of sum of Araks River basin and Kura River basin (around 188,000 km²) is only 0.6%, which is very small⁵. Therefore, transboundary impacts by the Project is not expected. On the other hand, it is needed to confirm whether there are any international treaties on use of Hrazdan River water.</p>

A+/-: Significant positive/negative impact is expected.

B+/-: Positive/negative impact is expected to some extent.

C+/-: Extent of positive/negative impact is unknown. (A further examination is needed, and the impact could be clarified as the study progresses)

D: No impact is expected.

5-1-5-2 Terms of Reference for Environmental and Social Considerations

Concerning parameters which can cause negative and unknown impacts in the scoping mentioned above, environmental study by using desk study and field survey will be implemented as shown in Table 5-1.5.2.

Table 5-1.5.2 Terms of Reference for Environmental Examination

Environmental parameters	Study item	Method
Air quality	<ul style="list-style-type: none"> Confirmation of environmental standard in Armenia Impact to be caused during the construction stage 	<ul style="list-style-type: none"> Confirmation of environmental standards in Armenia Field survey (distribution of houses, hospital and schools in and around the project sites) Estimation of number of construction vehicles Data collection of similar projects
Water quality	<ul style="list-style-type: none"> Confirmation of environmental standard in Armenia Water quality of rivers and irrigation canal Water usage of the Hrazdan River Plankton occurrence at other reservoirs 	<ul style="list-style-type: none"> Confirmation of environmental standards in Armenia Field survey Data collection of similar projects Confirmation of other reservoirs and lakes Water quality check of rivers and canals concerned to the Project
Waste	<ul style="list-style-type: none"> Examination of waste disposal 	<ul style="list-style-type: none"> Data collection of similar projects for waste management Confirmation of environmental standards in Armenia
Soil contamination	<ul style="list-style-type: none"> Oil leakage from the construction vehicles Impact on soil by agricultural 	<ul style="list-style-type: none"> Estimation of number of construction vehicles Data collection of similar projects Laboratory works for agricultural concentration in soil of the beneficial area
Noise and vibration	<ul style="list-style-type: none"> Confirmation of environmental standards Noise and vibration by the Project 	<ul style="list-style-type: none"> Confirmation of environmental standards in Armenia Field survey (distribution of houses, hospital and schools in and around the project sites) Estimation of number of construction vehicles Data collection of similar projects
Ground water	<ul style="list-style-type: none"> Due to irrigation land expansion, ground water can be influenced by increase of pesticide and chemical fertilizer application. 	<ul style="list-style-type: none"> Water quality check of nitrite, nitrate and agrochemical of ground water
Hydrological situations	<ul style="list-style-type: none"> Possibility of release of surplus water to the Hrazdan River 	<ul style="list-style-type: none"> Examination of the possibility of release of surplus water to the Hrazdan River
Ecosystem	<ul style="list-style-type: none"> Ichthyological survey of Kasakh 	<ul style="list-style-type: none"> Desk study and field survey of ecosystem in and around

⁵ In general, ratio of river basin is equal to that of river discharge.

Environmental parameters	Study item	Method
	River and Hrazdan River <ul style="list-style-type: none"> Impacts on ecosystem of the Lake Sevan by the water level increase Ecosystem field survey in and around the construction sites 	the Yeghvard Reservoir and proposed canals <ul style="list-style-type: none"> Desk study and field survey to identify fish species in the Kasakh River and the Hrazdan River and seasonal migration and hatching period Impacts on surrounding ecosystem of the Lake Sevan by water level increase Impacts on surrounding ecosystem of the Hrazdan River and Kasakh River
Involuntary resettlement and land acquisition	<ul style="list-style-type: none"> Identification of areas to be resettle and acquired Preparation of abbreviated RAP 	<ul style="list-style-type: none"> Review of laws and decrees regarding involuntary resettlement and land acquisition in Armenia Identification of affected area Confirmation of land use of the area and existing structures to be affected Socio-economic survey and preparation of abbreviated RAP
The poor	<ul style="list-style-type: none"> The poor in and around the project area 	<ul style="list-style-type: none"> Identification of the affected area Site survey and interview to the people Hearing to the governmental organization concerned
Indigenous people/minority people	<ul style="list-style-type: none"> Indigenous people/minority people in and around the project area 	<ul style="list-style-type: none"> Identification of the affected area Site survey and interview to the people Hearing to the governmental organization concerned
Livelihood/local economy	<ul style="list-style-type: none"> Identification of affected area by involuntary resettlement and land acquisition 	<ul style="list-style-type: none"> Identification of the affected area Confirmation of land use of the area and existing structures to be affected Preparation of abbreviated RAP
Land use and local resource utilization	<ul style="list-style-type: none"> Examination of area to be acquired 	<ul style="list-style-type: none"> Review of laws and decrees regarding land acquisition in Armenia Identification of the affected area Confirmation of land use of the area to be affected Preparation of abbreviated RAP
Water usage or water rights and rights of common	<ul style="list-style-type: none"> Confirmation of water distribution system of the Hrazdan River 	<ul style="list-style-type: none"> Hearing to the governmental organization concerned
Existing social infrastructure and services	<ul style="list-style-type: none"> Traffic jam due to the construction works 	<ul style="list-style-type: none"> Confirmation of road conditions around the construction sites Data collection of other similar projects
Misdistribution of benefit and damage	<ul style="list-style-type: none"> Identification of areas to be resettle and acquired 	<ul style="list-style-type: none"> Identification of affected area Confirmation of land use of the area and existing structures to be affected Preparation of abbreviated RAP
Conflict	<ul style="list-style-type: none"> Possibility of conflict due to misdistribution of benefit and damages 	<ul style="list-style-type: none"> Data collection of other similar projects Hearing to the governmental organization concerned
Cultural heritage	<ul style="list-style-type: none"> Cultural heritage in and around the project sites 	<ul style="list-style-type: none"> Identification of affected area Confirmation of existing structures to be affected Site survey and interview to the people Hearing to the governmental organization concerned
Hazard (Risk) Infectious diseases such as HIV/AIDS	<ul style="list-style-type: none"> Possibility of inflectional diseases occurrence by hiring of labors 	<ul style="list-style-type: none"> Data collection of other similar projects
Work environment including safety	<ul style="list-style-type: none"> Possibility of accident 	<ul style="list-style-type: none"> Data collection of other similar projects
Accident	<ul style="list-style-type: none"> Possibility of accident 	<ul style="list-style-type: none"> Data collection of other similar projects
Transboundary impacts and climate change	<ul style="list-style-type: none"> Confirmation of international treaty on water usage of the Hrazdan River 	<ul style="list-style-type: none"> Hearing to the governmental organization concerned

5-1-6 Results of Environmental Examination

This sub-chapter discusses the expected environmental impacts by the Project. It is noted that the impacts will be caused by the newly constructed facilities, namely, the Reservoir, Outlet Canals and Feeder Canals. On the other hand, the rehabilitation of the existing canals such as Arzni-Shamiram Canal, Lower Hrazdan Canal will cause only very minor impacts, and the extend will be negligible, since the main works are rehabilitation such as lining of the canals and abolishment of existing pump

stations. It is planned to rehabilitate the existing facilities during winter season, which will result in no disturbance of farming and water distribution. The irrigation water in the canals does not flow in winter, and mud water by the rehabilitation works will not be caused. Moreover, land acquisition or physical relocation are not necessary. Therefore, the following description focuses on the expected impacts by the newly construction works.

5-1-6-1 Air quality

For the purpose of identification of current conditions concerning air quality, gas emissions (SO₂, NO₂, and CO) and dust have been measured at six (6) points in and around the proposed construction site as shown in Figure 5-1-6.1. The measurement of SO₂, NO₂, and CO was done by using indicator tubes with mobile sampling pump. Dust concentration was measured by usage a mass concentration method (simple filtering).

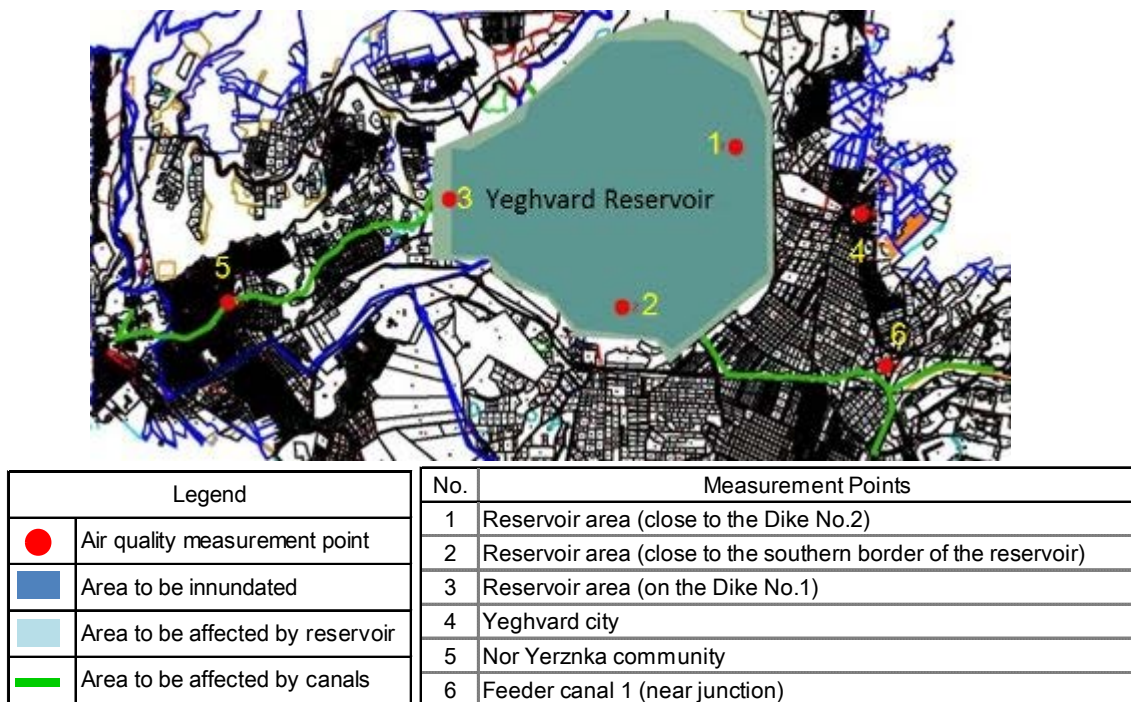


Figure 5-1-6.1 Air Pollutants Measurement Points

The measurement results of concentration of ambient air pollutants are presented in Table 5-1-6.1. The concentrations of gas pollutants (SO₂, NO₂ and CO) in ambient air at sensitive receptors locations haven been detected, which means that concentrations of those parameters are within the norms. The results of dust measurements range from 0.037 mg/m³ (in the area of feeder/outlet canal) and 0.076 mg/m³ (in Yeghvard city), which means that current conditions in and around the construction site satisfy the standard of air pollution at this moment.

Table 5-1-6.1 Results of Ambient Air Pollution

Parameter	Location	Measured value (mg/m ³)	Maximum one-time concentration (mg/m ³)	Mean daily concentration (mg/m ³)
Dust	Reservoir (1)	0.060	0.5	0.15
	Reservoir (2)	0.057		
	Reservoir (3)	0.045		
	Yeghvard	0.076		
	Nor-Yerznka	0.050		
	Feeder Canal-1	0.037		
SO ₂	Reservoir (1)	Not detected (ND)	0.5	0.05

Parameter	Location	Measured value (mg/m ³)	Maximum one-time concentration (mg/m ³)	Mean daily concentration (mg/m ³)
	Reservoir (2)	ND		
	Reservoir (3)	ND		
	Yeghvard	ND		
	Nor-Yerznka	ND		
	Feeder Canal-1	ND		
NO ₂	Reservoir (1)	ND	0.0085	0.04
	Reservoir (2)	ND		
	Reservoir (3)	ND		
	Yeghvard	ND		
	Nor-Yerznka	ND		
	Feeder Canal-1	ND		
CO	Reservoir (1)	ND	5.0	3.0
	Reservoir (2)	ND		
	Reservoir (3)	ND		
	Yeghvard	ND		
	Nor-Yerznka	ND		
	Feeder Canal-1	ND		

Source) JICA Survey Team, 2016

Remarks) Detection limits for SO₂, NO₂, and CO are 0.01, 0.05 and 0.5, respectively.

During the construction stage, in total 50 construction vehicles per day will be operated. However, most of them will be used around the Reservoir area, while 3 to 6 vehicles per day are operated around the Feeder Canals and Outlet Canals. The nearest residential area from the construction sites is Nor-Yerznka Community, it is planned that six (6) construction vehicles will be operated. However, the six vehicles will come to the community one by one, and gas emission will be limited. Proposed excavation period for the Outlet Canal 2 is 10 days, which will not result in severe dust generation, since water will be sprayed during the excavation. Moreover, moisture of soil cement should be kept at the certain level for reliability of anti-filtration, as a result, heavy dust generation can be avoided. On the other hand, in and around the Reservoir basin, most of the land use is for agricultural purpose, and the number of residential buildings around the reservoir is very limited. According to the in-situ test, all of parameters of ambient air are within the standard, especially, SO₂, NO₂ and CO were not detected. It is planned to spray water to minimize dust generation. At the residential area, which is sensitive for air pollution, the number of vehicles to be operated is very limited. It is noted that strong wind is observed in around Nor-Yerznka Community in May to June, and it is needed to keep sufficient moisture around the construction sites to minimize dust generation. Generally, air pollution by the Project will be small, and probably, the air pollution which exceeds the standard will not be caused.

5-1-6-2 Water quality

(1) Mud water

Due to the construction works, it is expected that mud water will be discharged from the construction site. However, it will be temporary and the situation will be caused during only construction period. It is needed to take countermeasures to minimize the impact to the downstream. It is needed to set up sedimentation ponds to store the mud water from the construction sites, which will make it possible to minimize the mud water discharge to the surrounding environment.

(2) Eutrophication of the Reservoir

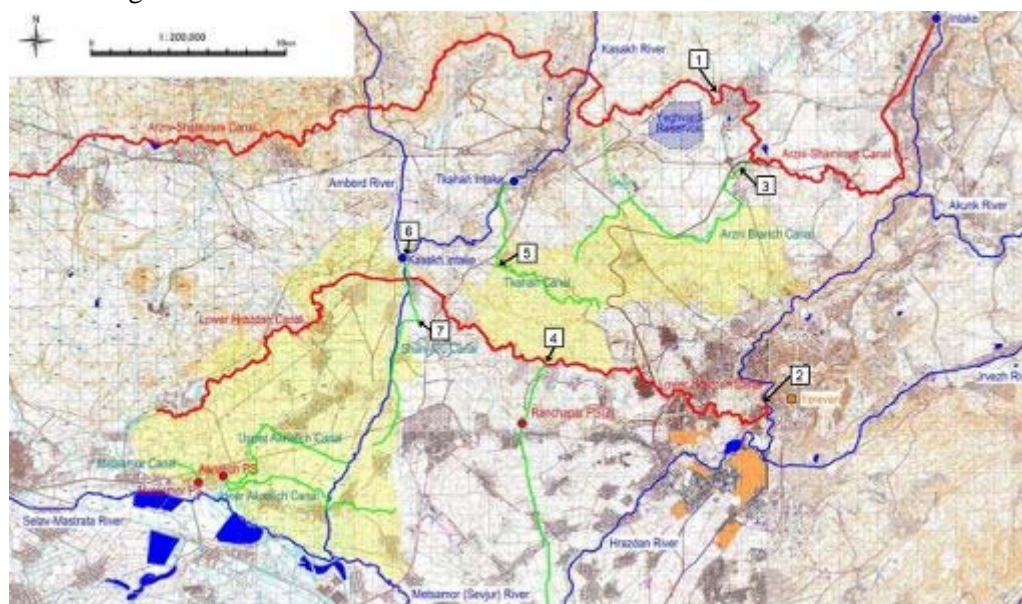
Water source of the Reservoir is melted snow water in the Hrazdan River, and there is no waste water

inflow point in the Hrazdan River before the Intake to the Arzni-Shamiram Canal. Moreover, water quality of Hrazdan River is suitable for irrigation as mentioned in Table 5-1-6.2. It means that the water quality at the Reservoir will be clean. It is planned to store water at the Yeghvard Reservoir from March to May and to divert the water for irrigation in summer season. It is expected that water flow, namely, from the Reservoir to the proposed canals, will be generated, as a result, water in the Reservoir will not be stagnant completely. Moreover, any cases that reservoir eutrophication have not been reported so far in Armenia according to the official personnel of PIU, SCWE. Therefore, it can be judged that eutrophication in the Reservoir will not be caused.

(3) Water pollution in the canal/river

In Armenia, no case of water pollution in surface water by agrichemicals has been reported so far, according to the Head of Department of Horticulture crop production and Plant protection, MOA. In his opinion, since prices of agrichemicals are relatively high for farmers in general, they cannot apply sufficient amount of agrichemicals in their fields, which results in no water pollution. On the other hand, there has been no case that agrichemical has been interfused into the canals and rivers in Armenia, according to the PIU member. As a whole, water pollution by agrichemicals is not an issue in Armenia at this moment, and this situation will not be changed after the Project. Therefore, water pollution by the agrichemicals by the Project is not expected.

For the purpose of the confirmation of water quality as irrigation water in the project area, water quality check was implemented. Considering the surface water standard in Armenia and FAO irrigation water quality standard, pH, EC (Electric Conductivity), TDS (Total Dissolved Solid), SS (Suspended Solid), Temperature, BOD (Biological Oxygen Demand), COD (Chemical Oxygen Demand), DO (Dissolved Oxygen), NO₃-N (Nitrate-Nitrogen), PO₄ (Phosphate), Na (Sodium), Cl (Chloride), Magnesium (Mg) and Calcium (Ca) have been determined as parameters. Sampling point is illustrated in Figure 5-1-6.2.



1	Arzni-Shamiram Canal at cross point of road
2	Hrazdan River before intake to Lower Hrazdan Canal
3	Arzni-Branch Canal before outlet under the railway
4	Lower Hrazdan Canal after outlet of pipeline from Ranchpar Pump station
5	Cross point between Tkahan Canal and road
6	Kasakh Intake at Kasakh River
7	Middle point of Shah-Aru Canal

Figure 5-1-6.2 Water Sampling Points

Table 5-1-6.2 shows the water quality test result.

Table 5-1-6.2 Results of Water Quality Test

Parameter	Unit	Sample No.							Standard	Used analytical method
		1 Canal	2 River	3 Canal	4 Canal	5 Canal	6 River	7 Canal		
Temperature	°C	11.5	13.8	10.8	16.1	11.8	12.4	13.1	-	-
TSS	mg/l	16.8	15.4	9.5	12.3	12.1	11.1	17.5	<30*	Gravimetric analysis
pH	-	7.88	7.06	7.83	8.08	8.31	8.34	8.32	6.5 – 8.4**	pH meter
DO	mg/l	13.14	9.5	10.27	16.4	13.7	10.3	10.7	>5*	DO meter in-situ
Chloride ion	mg/l (meq)	21.9 (0.62)	257.6 (7.26)	20.9 (0.59)	216.2 (6.09)	18.0 (0.51)	17.0 (0.48)	15.817 (0.45)	<142** (<4**)	Ion chromatography
Nitrate (NO ₃ -N)	mg/l	0.592	2.103	0.542	1.168	0.129	0.976	1.106	<5**	Ion chromatography
Mineralization	mg/l	401	1,888	362	1,740	342	333	328	<1,000*	Electrochemical analysis
Phosphates	mg/l	0.089	0.296	0.074	0.445	0.252	0.252	0.282	<0.4*	Spectrophotometric analysis
BOD	mg/l	3.24	2.98	6.46	6.58	3.3	1.67	2.85	<9*	Electrochemical analysis
COD (Cr)	mg/l	14	12	14	32	12	34	14	<40*	Dichromate oxidizability
EC	uS/cm (dS/m)	590 (0.59)	2,768 (2.768)	533 (0.533)	2,568 (2.568)	503 (0.503)	490 (0.49)	482 (0.482)	<700 (<0.7)**	Electrochemical analysis
Na	mg/l (meq)	42.77 (1.86)	284.76 (12.38)	40.06 (1.74)	263.22 (11.44)	36.44 (1.58)	34.46 (1.50)	33.42 (1.45)	69 (<3**)	ICP- Mass Spectrometry (ICP-MS)
Mg	mg/l (meq)	22.19 (1.85)	28.70 (2.39)	21.58 (1.80)	30.34 (2.53)	18.94 (1.58)	18.45 (1.54)	18.32 (1.53)	<100 (<5)**	ICP-MS
K	mg/l	9.13	7.38	7.68	8.29	7.09	6.74	6.84	-	ICP-MS
Ca	mg/l (meq)	47.02 (2.35)	64.03 (3.20)	43.06 (2.15)	63.86 (3.19)	40.61 (2.03)	40.23 (2.01)	39.20 (1.96)	<200** (<10)**	ICP-MS

Source) JICA Survey Team (2015) , sampled on 19th October 2015

*Ecological Norm (Protocol Of Government RA, 27.01.2011 27 N 75-N), "Moderate" is applied.

** FAO Irrigation Guidelines, Table -1 "None Restriction on Use" is applied.

This analysis was done by SNCO of Environmental Impact Monitoring Center under the MNP and it has various experiences to work international organizations.

Considering the result of water quality test mentioned above, water quality is generally appropriate for irrigation water. It can be said that water quality of Arzni-Shamiram Canal is suitable for irrigation. On the other hand, salinity of the water at No.2 and No.4 sampling points is high. It is probably because that waste water from surrounding residential areas is discharged into the Lower Hrazdan Canal and Hrazdan River. The water sampling was done on October, almost end of irrigation period and there was small discharge, therefore, water quality was affected by the waste water at the point No.4. In October, main cultivated crop is wheat, which has moderate salinity tolerance according to the "Water Quality for Agriculture" (FAO), and the farmers can depend on rain in autumn. Therefore, the high salinity in the irrigation water is not an issue at this moment. Regarding sampling point No.2 (Hrazdan River), it is natural flow, and discharge is small compared with the inflow of waste water. It flows within the Yerevan City, therefore, the water was deteriorated by the effluence from the residential area.

Main irrigation water source for the Yeghvard Reservoir is Arzni-Shamiram Canal. Considering water quality in the Canal, water quality in the Reservoir will be appropriate for irrigation. On the other hand, the water in the Lower Hrazdan Canal contains relatively high salinity. However, it is noted that the sampling was done at almost end of the irrigation season, and the discharge was low. Average water discharge in the irrigation season from the end of April to mid of September is 6.9m³/s, while the

discharge in early October is $1.5 \text{ m}^3/\text{s}$ ⁶. It means that saline concentration will be low during the irrigation peak season. So far, no crop damage due to water salinity has been observed, according to the Director of Ashtarak WUA, which use the Lower Hrazdan Canal. The salinity does not have direct relation with the Project. In other words, further salinization of the water is not caused. It can be judged that no water quality deterioration due to the project is expected.

It is noted that there is saline soil called as “Alkali meadow sodium-sulfate-chloride” which is saline soil along the Araks River in the Ararat Plain (see Appendix K 4). However, the beneficial area of the Project is located on other types of soil. Moreover, the water source of the Project is snow melted water, which has low salinity. Concerning groundwater, the main direction of the ground water flow is to the southwest, toward the Kasakh River canyon and Total Dissolved Solid of the ground water is 0.21 - 0.54 g/l ($\approx 0.34 - 0.86\text{dS/m}$ of EC),⁷ which can be regarded fresh. Taking into consideration those conditions mentioned above, soil salinization due to the Project is not expected.

5-1-6-3 Waste

During the construction stage both household and hazardous waste (oil, fuel, iron scrap, contaminated soil, oiled clothes, wood, construction waste, etc.) will be generated. They should be classified, separately stored in marked containers and disposed in accordance with the Law on Waste at the specified place specified by the MNP. It is necessary to get permission for waste disposal from the MNP. A large amount of soil waste also will be generated, however, it will be recycled for the construction works as much as possible. As whole, the impact is temporary and can be managed by implementation of proper waste handling procedures. In case that the Reservoir becomes a sightseeing point, waste will be generated around the Reservoir.

5-1-6-4 Soil Contamination and Groundwater Pollution

(1) Oil leakage

Oil leakage from construction vehicles is expected during construction stage, however, it will be limited and temporary. Such impact can be minimized by proper and regular management of construction vehicles.

(2) Pollution of soil and groundwater by the Project

There is a possibility that application amount of fertilizer and agrichemicals (pesticide, insecticide and herbicide) will be increased due to expansion of irrigation area by the Project. There is no drainage in the command area to other areas, there is no possibility applied fertilizers and agrichemicals will be transported to other areas through surface water. However, soil and groundwater can be influenced by increase of fertilizer and agrichemical application due to irrigation farming promotion. Therefore, chemical analysis of soil and ground water was implemented to examine the impacts.

1) Analysis of soil and groundwater

(a) Agrichemical analysis in the soil

In general, agrichemical are applied to vegetables and fruits more than to wheat and feed crop such as alfalfa according to a FAO staff in Armenia. Based on the situation, nine (9) communities (Aratashen, Taronik, Baghramyan, Tsiatsan, Tsaghkalanj, Aragats, Aghavnatun, Mrgastan and Hovtamej), where vegetable and fruits trees have been intensively cultivated, were selected from the target 27 communities. In addition, one control point (no chemical application) was set for comparison in

⁶ Source) Sevan-Hrazdan Jrar, Closed Joint Stock Company, SCWE

⁷ Source) “Feasibility Study of the Design and Construction of a Reservoir on Hrazdan River in Armenian SSR”, Report on Engineering-Geological and Hydro-Geological Surveys and Study on Yeghvard Reservoir, Part II, Book 2, 1980

Taronik community. Therefore, the number of sampling points was ten (10) in total. One farmland plot that agrichemicals have been applied was identified at each community mentioned above, six (6) soil samples per each plot, totally 60 samples were taken. The soil samples were analyzed for the parameters listed in the surface water standard in EU⁸, since there is no regulation for soil and water for agrichemical in Armenia.⁹

(b) Agrichemical and fertilizer analysis in the groundwater

Flow direction of the groundwater in the command area shows the same trend of that of the surface water, namely, from northern part to southern part. When applied fertilizers and agrichemicals will be infiltrated into the underground, the concentration of them could be higher in south-western part of the area. Based on the idea, ten (10) groundwater samples were taken from the private and communal tube wells in the four communities, namely, Artimet, Khoronk, Aratashen, and Griboyedov, which are located on south-west part of the command area. Concentrations of nitrate, nitrite¹⁰ and agrichemical¹¹ in the groundwater were analyzed. Those sampled groundwater are mainly used for domestic purpose and irrigation, not for drinking. Furthermore, given that there are many green houses, vegetable farmlands and orchards in the four communities, it was thought that the groundwater quality in the communities has been influenced by those farming activities. Location of soil and groundwater sampling points are illustrated in Figure 5-1-6.3.

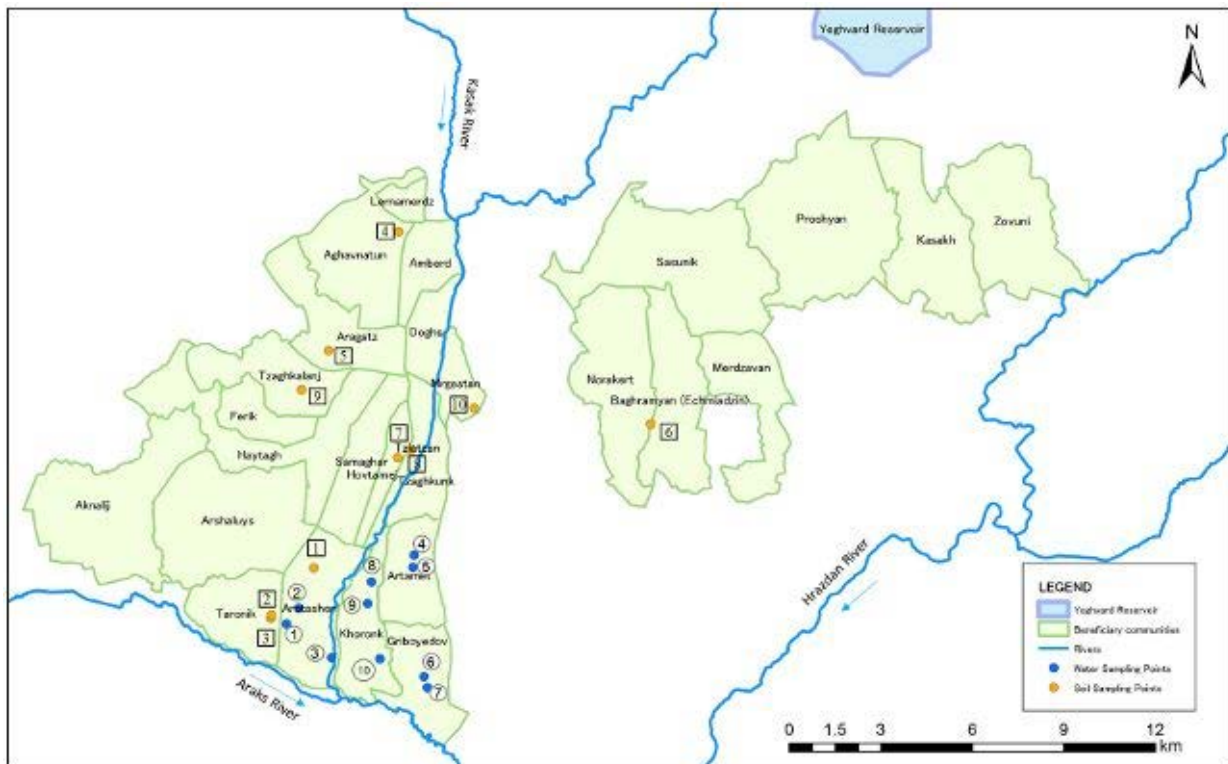


Figure 5-1-6.3 Location of Soil and Groundwater Sampling Points

⁸ Environmental Quality Standards for Priority Substances and Certain Other Pollutants

⁹ According to the Environmental Impact Expertise Center SNCO under the MNP, the EU environmental quality standard is recommended to be applied. Only qualitative analysis (detected/not detected) for some agrichemical parameters can be practiced in Armenia.

¹⁰ Mainly, chemical fertilizers contain nitrogen, phosphor and potassium, and nitrogen is the most influential for groundwater quality after the application and nitrogen fertilizers is very popular in Armenia. Nitrogen is detected as nitrate or nitrite anaerobic condition.

¹¹ Analyzed parameters of agrichemical types are the same for soil and groundwater.

2) Results of analysis

(a) Soil analysis result

Soil analysis result is attached in Appendix-K-2. Chlorfenvinphos¹², which is one of organophosphorus pesticides, was detected from eight (8) farm plots including non-cultivated land out of 10 sampling plots. The agrichemical has strong toxicity, and its utilization has been already banned in the USA and EU countries. In Armenia, Chlorfenvinphos is not described in the officially registered agrichemical list by the MOA as of March 2016. It means that use of the Chlorfenvinphos is illegal in Armenia, however, the agrichemicals is applied in the plural communities in the command area at this moment.

The first half-life of Chlorfenvinphos is 10-45 days, and the chemical is categorized into “Moderate” in terms of degradation according to FAO¹³. In general, degradation of organophosphorus pesticides is high. Therefore, detected Chlorfenvinphos will be decomposed by ultraviolet radiation and micro-organisms in soil gradually. Moreover, water solubility of the chemical is very low, and possibility of filtration of the chemical through soil moisture would be also low. On the other hand, Chlorfenvinphos was detected in the non-cultivated field in Taronik (sample No.3) also. Given that the chemical was detected at another sampling point in Taronik and those two sampling points are located at opposite site on the road, it can be thought that the detected Chlorfenvinphos is originated from the neighboring farm plot.

Benzene was detected at all of the soil samples, however, the values are around 1µg/kg soil and Benzene is volatile chemical. It is noted that according to the EU environmental quality standard for surface water, the standard value of Benzene is not over 8µg/l it is not suitable to compare those values unconditionally, though. Taking the situations into consideration, it can be said that residue of Benzene in soil is not a big problem.

(b) Groundwater quality analysis

Result of ground water quality analysis is attached in Appendix-K-3. One sample at the private tube well in Khoronk community (sample No.8) shows high concentration of NO₃-N, 31.74mg/l, it is categorized into “Severe” in terms of use restriction according to the FAO irrigation guidelines¹⁴. Five (5) samples are more than 5mg/l, it is not desirable for nitrogen sensitive crops e.g. apple, apricot and grains (FAO guidelines, Rev.1, 1994). Overall, groundwater quality in the area is not significantly polluted by the fertilizer application, however, it is not very suitable for crops. It is noted that according to the WHO Guidelines for Drinking-Water Quality (Version 4, 2011), allowable nitrate concentration value is 50mg/l (11 mg/l as NO₃-N). Most of the samples satisfy the value, the groundwater in the area is not used as drinking water, though.

No agrichemicals except Benzene are detected in the groundwater samples, and the concentrations of Benzene are within the regulated value in the EU standard. Therefore, it can be said that underground is not polluted by agrichemical application so far, even though residual agrichemical is detected in some soil samples.

3) Examination of impact on soil and groundwater

(a) Impacts by fertilizer application

The MOA subsidizes fertilizer for farmers in Armenia, moreover, international donors such as United

¹² Only qualitative analysis is possible for the chemical.

¹³ FAO, 2000, Assessing soil contamination A reference manual, APPENDIX 3 “Fact sheets on pesticides, Chlorfenvinphos (Birlane)”

¹⁴ “Guidelines for Interpretation of Water Quality for Irrigation” (FAO, Rev. 1, 1994) is applied as the irrigation norm in Armenia, since no guideline of water quality for irrigation is established according to Ministry of Armenia.

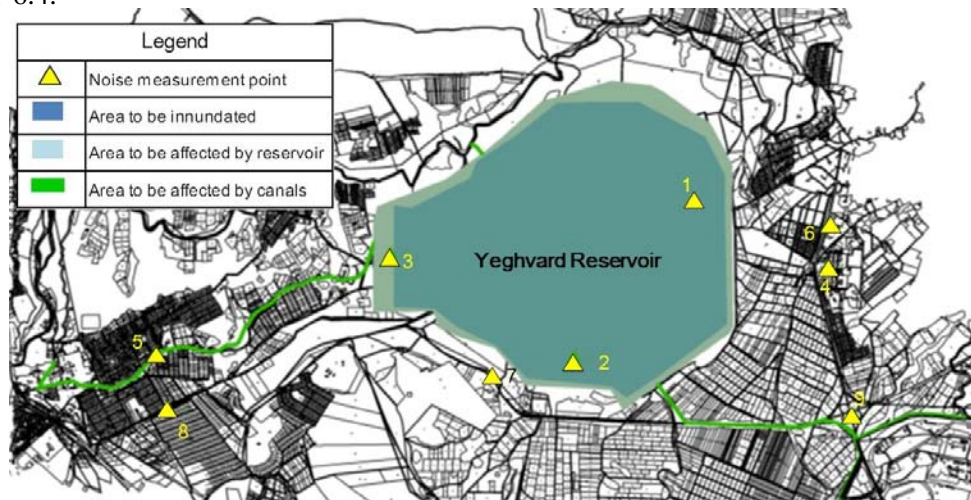
Nation Development Programme also provides nitrogen fertilizers. At this moment, nitrogen pollution of groundwater is not very severe. Therefore, it can be said that groundwater quality will not be deteriorated seriously by the Yeghvard Reservoir construction and irrigation farming promotion. However, proper amount of fertilizer application should be promoted through awareness by staff of MOA in the future. Furthermore, instead of groundwater, melted snow water will be mainly used for irrigation after the Project, conditions for nitrogen sensitive crop cultivation could be better than present.

(b) Impacts by agrichemicals

Illegal agrichemical has been detected in soil samples in plural communities, and it is an issue to be considered. Staff of MOA regularly visit agrichemical dealers for monitoring of quality, expiration date for use, types and so on of their goods, however, sale of illegal agrichemical are found every year. However, the staff do not have authority to make an order to the sellers. The agrichemical handbook, which stipulates proper amount of agrichemical to be applied or suitable application timing, is issued annually, however, only thousands of them are distributed in nationwide due to the budgetary limitation. Due to the Project, it cannot deny the increase of the illegal agrichemical, even though the illegal agrichemical application is not direct effect of the Project. Regardless of the Project implementation, enhancement of the monitoring and proper agrichemical application should be promoted. On the other hand, given that agrichemical concentration in the groundwater is acceptable level, it can be concluded that negative impact due to increase of application by the Project is not very severe.

5-1-6-5 Noise and Vibration

For the purpose of examination of impact regarding noise by the project, it is needed to confirm current conditions. Noise measurements was implemented at nine points in and around the construction site as follows. In addition, the location map of noise measurement points is illustrated in Figure 5-1-6.4.



Location	
1: Reservoir area (1) (close to the Dike 2)	6: H4 highway (1) ¹⁵ (near Yeghvard city)
2: Reservoir area (2) (close to the southern border of the Reservoir)	7: H6 highway (1) ¹⁶ (south of the Reservoir)
3: Reservoir area (3) (on the Dike 1)	8 - H6 highway (2) (south of the proposed Outlet Canal 2)
4: Yeghvard city	9 - H4 highway (2)
5: Nor Yerznka community	

Figure 5-1-6.4 Locations of Noise Measurement Points

¹⁵ H4 Road: Road between Yerevan and Yeghvard

¹⁶ H6 Road: Road between Yeghvard and Nor-Yerznka

At each point, instrumental measurements of noise levels are performed by using a Sound Level Meter (SL-834) during 10 minutes. Generally, noise levels at most sensitive receptors, namely, at Yeghvard and Nor-Yerznka communities are within the threshold limit value according to the norm. The measurement result is presented in Table 5-1-6.3.

Table 5-1-6.3 Results of Noise Measurements in and around of the Project Site

No	Measurement points	Measured Noise Level		Noise standard	
		Equivalent level (dBA)	Maximum level (dBA)	Equivalent level (dBA)	Maximum level (dBA)
1	Reservoir area (close to the Dike No.2),	38.8	53.8	80	
2	Reservoir area (close to the southern border of the Yeghvard Reservoir)	41	59.6	80	
3	Reservoir area (on the Dike No.1)	39.8	56.9	80	
4	Yeghvard city	55	68.9	55*	70*
5	Nor Yerznka community	49	68.4	55*	70*
6	H4 highway (near Yeghvard city)	60	70.7	80	
7	H6 highway (south of the Yeghvard Reservoir)	58.3	78.7	80	
8	H6 highway (south of the proposed Outlet Canal 2)	58.7	80	80	
9	H4 highway	59.1	79.4	80	

Source) JICA Survey Team

*They are located in Yeghvard and Nor Yerznka communities correspondingly and for such locations 55 dBA of equivalent sound/noise level and 70 dBA of maximum sound/noise level are applied, while 80dBA (for Noise in workplaces for construction works) is applied for other places.

During the construction stage, traffic density also will be increased due to the delivery of materials and workforce and removal of soil and waste from the Project sites. The distance between the eastern dam of reservoir and the nearest residential building is approximately 400 m, however, the construction works will not be done within the Yeghvard Community, the noise and vibration by the Project will be limited. Regarding, Nor Yerznka community, disturbance by noise during the construction will be inevitable. However, the period of noise disturbance due to soil excavation will be 10 days only, and noise by back hoe operation will be expected for 30 days. Therefore, the impact will be temporary, and efforts to minimize works during night time around the residential area will be made. It can be judged that noise and vibration are not significant. The number of the vehicles to be operated around the communities concerned is very limited, the possibility that noise by the Project will exceed the standard level is very low. Still, it is needed to avoid concentration of vehicles in and around the communities.

5-1-6-6 Ground Water

As mentioned before, there is a possibility that ground water will be polluted by nitrogen fertilizers due to the irrigation area expansion after the Project completion, and promotion of proper fertilizer application is necessary in operation stage. On the other hand, the Project can reduce groundwater use for irrigation by promotion of gravity irrigation, which will result in conservation of groundwater resource in the beneficial area.

5-1-6-7 Fauna and Flora in and around the Yeghvard Reservoir

(1) Current condition of fauna

The survey on eco-system in and around the Yeghvard Reservoir and proposed canals was implemented through literature review and field survey. The survey of terrestrial animals has been

conducted using the methods by Formozov (1951 and 1976), and Novikov (1953). Concerning mammals, footprints, traces of animal feeding (remains of food, stubs and so on), animals scat, nests, holes were confirmed through the field survey. Birds monitoring was conducted using binocular "Bushnell" and monocle "Kowa". The observation distance for relatively big bird species was 100-500 m. Information/data about the reptiles, amphibians and insects were obtained based on the combination of field survey and literature review. The field survey for all of the species was done on 15th September 2015 and 7th March, 2016.

The survey result, namely, identified number of species is shown in Table 5-1-6.4. Ten (10) mammals, 56 birds, one (1) Amphibian, five (5) Reptiles and 36 insects were identified. The bird diversity is rich compared with others, and four bird species are registered in the red list of Armenia. Moreover, one (1) species, namely, Egyptian Vulture (*Neophron percnopterus*) is categorized into “Endangered” in the IUCN Red list and also registered in the red list of Armenia. In addition, one snake, *Elaphe quatuorlineata* is categorized as “Near threatened” in the IUCN red list.

Table 5-1-6.4 Identified Species in and around the Project Site

Category	No. of species	No. of species registered in Red list
Mammals	10	0
Birds	56	4 species in the red list of Armenia (1 for IUCN red list)
Amphibians	1	0
Reptiles	5	1 for IUCN red list
Insects	36	0

Source) JICA Survey Team

1) Mammals

Ten (10) species of mammals were identified and they are Hedgehog, Hare, Wolf, Fox, Marten and Rodents (Hamster, Mouse, Vole and Gerbil). No species is resisted in the IUCN and Armenian red list. The identified species can be categorized into three groups as follows:

(i) Species that uses the area for transition purposes:

The group includes species with rather high activity and movement during the day, namely, wolf (*Canis Lupus*) and Red fox (*Vulpes vulpes*, see photo). They sometimes pass through the area, but rarely use it for feeding.

(ii) Species that partially uses the area:

The group includes European hare (*Lepus europaeus*), Beech marten (*Martes foina*, see photo) with less movement and activity during the day, which can live in project area or in adjacent territories. Furthermore, they can use these areas for feeding also.

(iii) Inhabitants of the project area:

The group consists of species, who permanently lives in the project area and whose movement areal is



not large. They are Hedgehog (*Erinaceus concolor*), Least weasel (*Mustela nivalis*, see photo), number of small rodents. Rodents attract predator birds and sometimes even some types of mammals.

2) Birds

Out of all identified birds in the area, 17 species are nested in and around the project site. They are Red-backed Shrike (*Lanius collurio*, see photo), Hoppoe (*Upupa epops*, see photo), European roller (*Coracias garrulous*, see photo) and so on. European roller (*Coracias garrulus*), which is registered in the red list of Armenia, is nested within the project area, however, it is regarded as a migratory bird in Armenia.



Out of total 56 bird species, 16 species seems occasionally drop by the area for hunting, taking a rest, drinking water and so on, and they are not nested in and around the project area. These species include Black Kite (*Milvus migrans*, see photo), Green Sandpiper (*Tringa ochropus*, see photo) and so on. Some of them are migratory and rarely observed in Armenia.



There are four (4) bird species, which are registered in the red list for IUCN and Armenia, were identified in the area. All of them are categorized into “full migrant” in terms of moving pattern in the IUCN, and their habitats and ecological characteristics are described below:

(i) Egyptian Vulture (*Neophron percnopterus*): registered in both IUCN red list and red list of Armenia

The species is migratory and forms a nest on ledges, caves, large trees, buildings. No nest is in the reservoir basin and seemingly it was accidentally identified by the survey. Probably, the project area is not suitable to nest for the species, considering the situation in the Reservoir basin, where wheat and barley fields are extended without high trees.

(ii) Short-toed Eagle (*Circaetus gallicus*): registered in the red list of Armenia

Movement pattern is full migrant. It forms a nest in the low trees. No nest is in the reservoir area and

probably it was accidentally identified in the survey.

(iii) Golden Eagle (*Aquila chrysaetos*): registered in the red list of Aremani

No nest is in the reservoir area and it was casually identified. It widely ranges on flat or mountainous, and open habitat area. The species forms a nest on cliff ledges, large trees and artificial structures.

(iv) European Roller (*Coracias garrulus*) : registered in the red list of Aremani

There is nest of the species in the Reservoir. The bird prefers an open countryside with forests, orchards, mixed farmlands and the project area is suitable for the species to nest. It is regarded migratory bird in Armenia.

3) Reptiles and amphibians

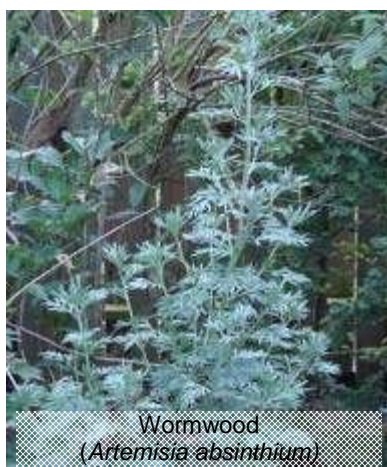
Concerning Reptiles which range in and around the project area, Blind snake (*Typhlops vermicularis*), Snakes (*Eirenis collaris*, *Elaphe quatuorlineata* and *Vipera lebetina*), Lizard (*Laudakia caucasica*) were identified. On the other hand, regarding Amphibians, only one frog (*Laudakia caucasica*) was identified. Out of snakes, *Elaphe quatuorlineata* is categorized as “Near threatened” in the IUCN red list, it is not registered in the red list of Armenia, though. The snake is generally found in forest, cultivated area, open woodland and near water body. It tend to have very large home range¹⁷. Since poisonous snake species is identified, there is possibility that the snake comes to neighboring villages.

4) Insects

36 species of Insects were identified. Ground beetles are dominating in the project area. Compared with the existing data list in the past, composition of insect species was drastically changed. It is probably because that fertile top soil had been taken and earth works was done during the Soviet Unit period.

(2)Current conditions of flora

Until 1980s, vineyard had been operated in the Reservoir, and after the independence in 1991, some parts of the reservoir has been utilized as farmlands such as wheat and barley fields, while other parts have been used for grazing. At this moment, the Project area is mostly steppe zones with few trees, and wormwood and mixed herbs-wormwood are prevailing. Main species are Wormwood (*Artemisia absinthium*), Chicory (*Cichorium intybus*), Goldenrod (*Solidago virgaurea*), Scorzonera suberose (*Scorzonera suberosa*), Quackgrass (*Elytrigia repens*) and so on. Representatives of other plant families are Stinging nettle (*Urtica dioica*), Catch weed (*Galium aparine*).



¹⁷ IUCN Red list



There are various herbs in the area, however, they are common species in Armenia. There are no flora species which are rare, threatened, endangered, vulnerable. No flora species in and around the Project site is registered in the Red Book of the Armenia and IUCN Red List.

(3) Expected impacts on fauna and flora

The reservoir area had been developed as vineyards until 1980s, and after the independence, it has been utilized as grassland and farmland for wheat and barley. Therefore, the area is not virgin land with original nature. 10 species of mammals were identified in and around the project site, and they can be regarded as the ones which have adjusted such man-made environment so far. Those species can easily migrate to other areas which have similar characters, namely, orchards, farmland, grassland and so on around the project site. Considering the situation, the mammals in the area will not be affected by the Project very severely.

There are four (4) birds which are registered in the IUCN and Armenia red list. However, their movement patterns are categorized into as “full migratory” according to the IUCN, and all of them except European Roller are not nested in the project site. Given that European Roller prefers to mixed farmland and orchard for nesting, they can easily find new places for their nests outside of the project area, where farmlands and orchards are extensively operated. Generally, the birds as well as mammals have adapted themselves to surrounding conditions, which is not primitive natural zone, so far. Consequently, it can be said that negative impacts on the birds by the Project. Rather than that, after the works, it is expected that the reservoir is attractive for birds as water resource, especially migratory birds, which will result in biodiversity promotion.

Regarding the snake, *Elaphe quatuorlineata*, is registered in the IUCN as “Near threatened”. The

species is generally identified in forest, cultivated area, open woodland and near water body, and it has very large home range and can move to other areas. Taking consideration into the characteristics, and it is not difficult for the species to find preferable habitat in the outside of the reservoir. Therefore, it can be judged that severe negative impact on the snakes by the Project is not expected. In general, severe negative impact on fauna in and around the project site is expected. Still, it is noted to consider the poisonous snake species, which ranges the Reservoir, will also escape to outside of the Reservoir, and it is needed to promote awareness of the surrounding persons how to handle the snake.

Concerning flora, no dangers species were identified according to the survey. The area in and around the Project site has been developed by human beings and used for agricultural purpose so long time, therefore, mainly, weeds and grasses, which have relationship with the people and do not represent primitive natural conditions, will be inundated by the Project. However, the species can survive in other areas, since similar natural conditions. Therefore, significant negative impact on the flora by the Project in the area is not anticipated.

5-1-6-8 Hydrological Conditions

(1) Hrazdan River

Hrazdan River is one of tributaries originated in the Lake Sevan and flows into the Araks River, which flows along the international boundary with Iran. Hrazdan River is not an international river, therefore, there is no international treaty regarding water distribution of the Hrazdan River according to SCWE. For the purpose of conservation of the river, minimum discharge considering ecology is regulated in the Decree N 927-N (2011), however, in serious drought year, irrigation is given higher priority than that of ecological conservation.

The Hrazdan River has been mainly used by irrigation and hydro power generation. Natural Hrazdan River flows down in parallel with canal as shown in Figure 5.1.6-5. At each reservoir for hydro power generation, the natural Hrazdan River and Hrazdan Canal interflow, after that, the water is diverted into Hrazdan canal and natural Hrazdan River again. As illustrated in Figure 5.1.6-5, there are seven Hydro Power Plants (HPP) between the Lake Sevan and the Yerevan Lake¹⁸, namely, Sevan HPP, Hrazdan HPP, Gyumush HPP, Arzni HPP, Qanker HPP, Yerevan HPP-1 and Yerevan HPP-3¹⁹. In addition, Arzni-Shamiram canal, Artashat canal and Lower Hrazdan canal are diverted from the Hrazdan River. It is possible to divide the Hrazdan River into 3 sections, namely, 1) upstream, 2) middle stream and 3) downstream. At the point of intake for the Arzni-Shamiram Canal, upstream and middle stream can be divided, since no impact will be caused in the upstream of the intake by the Project. Moreover, downstream of the Lake Yerevan can be regarded as downstream.

According to the gate keeper of the Arzni Intake before the Argel Reservoir, the flow capacity of channel to Arzni HPP is 67m³/s. If the amount of discharge is 70m³/s at the Argel Reservoir (confluence point of canal and natural of Hrazdan River), the water is diverted to the channel to Arzni HPP at 67m³/s and natural river at 3m³/s, respectively. Most of the water is discharged to the channel to Arzni HPP, while only minimum discharge is taken to the natural river at this moment. The same water distribution system is applied in other parts of the Hrazdan River during the irrigation season, namely, March to October.

¹⁸ An artificial lake located on Yerevan City

¹⁹ Operation of HPP-2 has been suspended many years ago.

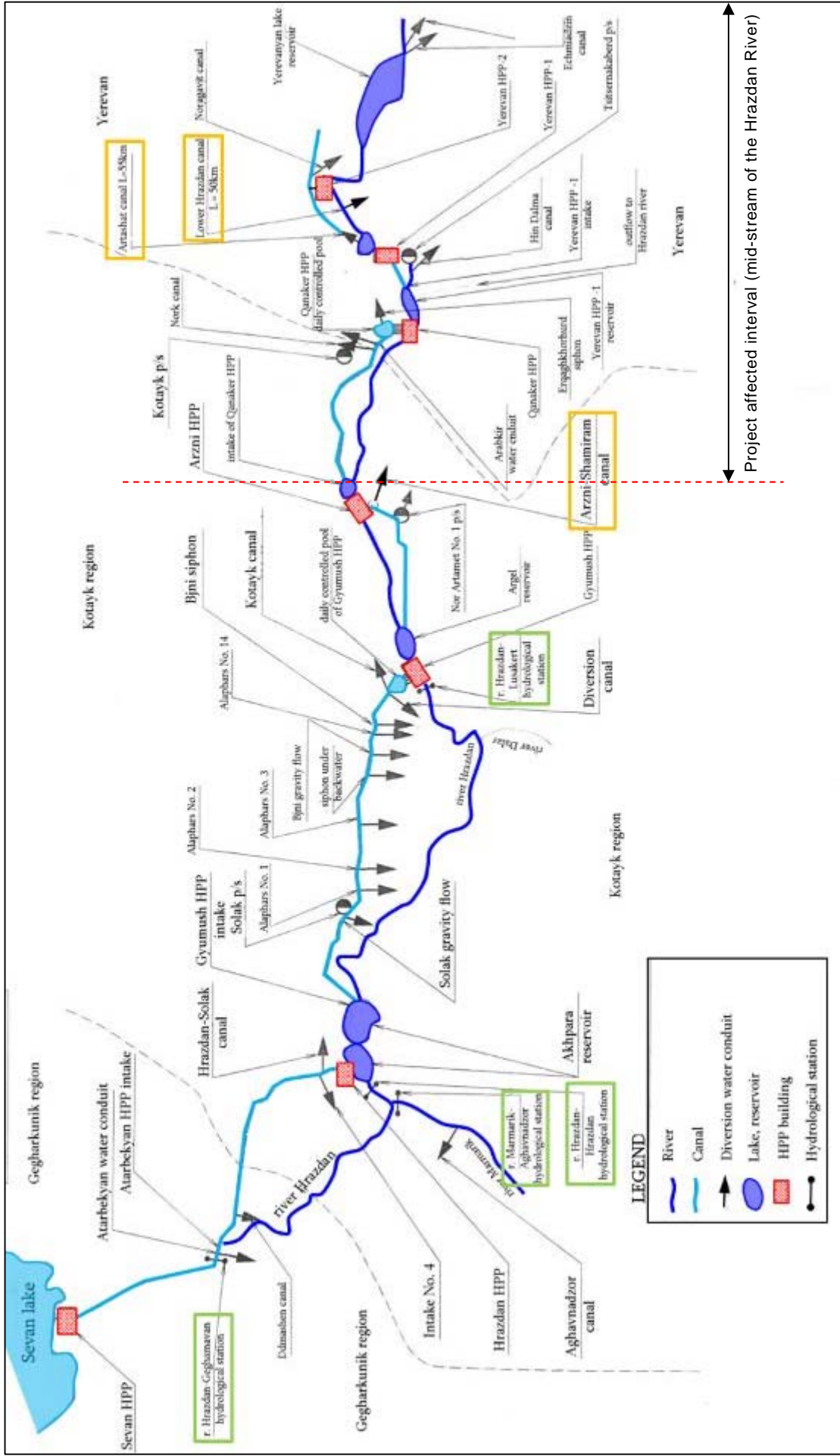


Figure 5.1.6-5 Natural River and Canal in the Hrazdan River

Lusakert Observatory is located on just upstream of the Intake for Arzni-Shamiram Canal, which is the channel for the Yeghvard Reservoir as illustrated in Figure 5-1-6.6. At the point, a water mark is fixed for measurement of water level and it is easy to observe the seasonal water level change. Therefore, focusing on the Observatory, the periodical change of water level snow melting season, namely, from February to April, has been monitored.

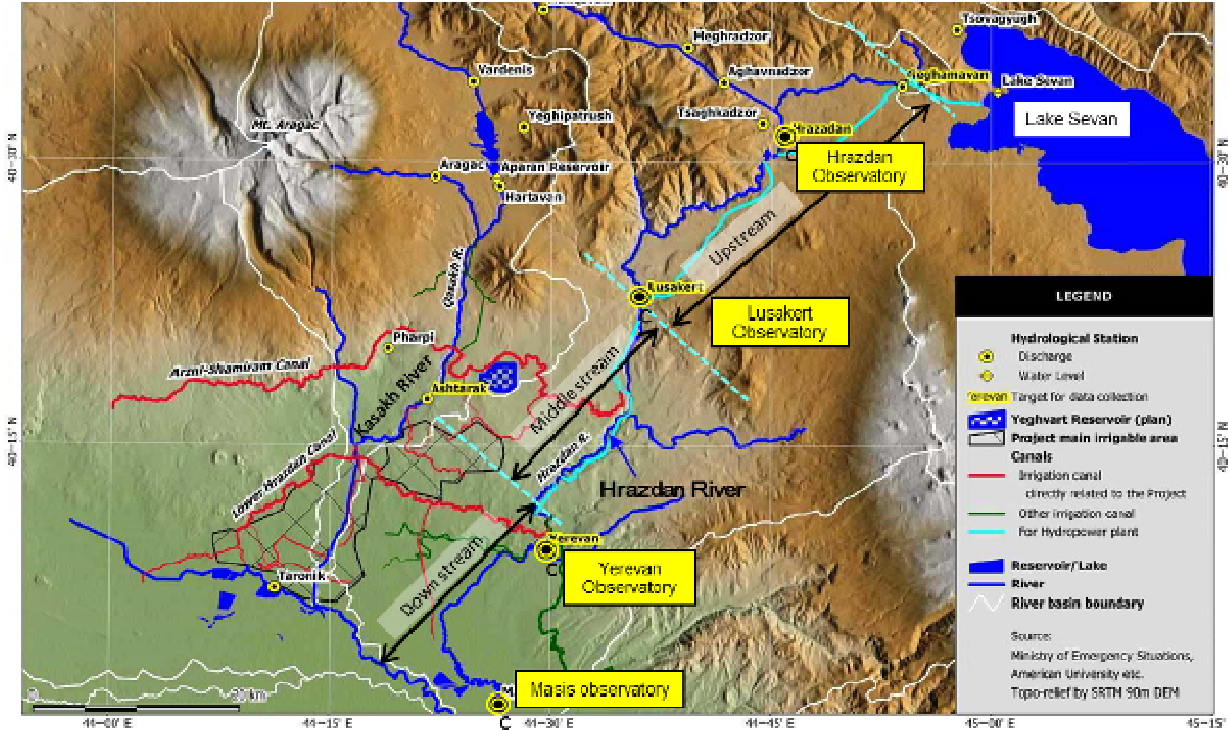
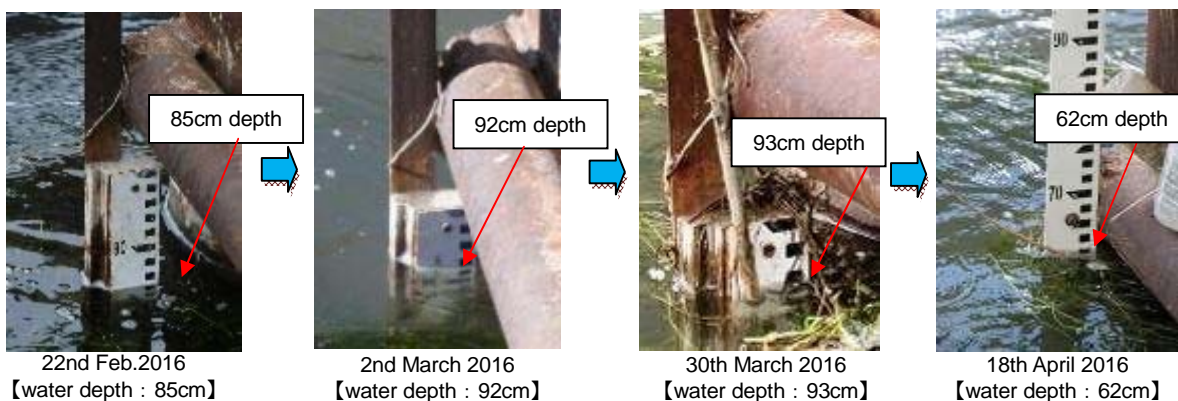


Figure 5-1-6.6 Location Map of Observatory Stations

At the Lusakert Observatory (just upstream of the Gyumush HPP and Argel Reservoir), the water depth has not been changed so drastically during snow melting period as shown following photos taken in 2016, probably due to water diversion to the canal of Hrazdan River at the upstream. Rather than that, on 18th April, water level has been decreased, which implies that the discharge of natural flow in Hrazdan River is not influenced by the snow-melted water directly.



The Hrazdan River has been utilized for irrigation and power generation even now. The water of Hrazdan River is diverted to the natural flow and canal, and those flows are merged after the power generation, and such operation is repeated again and again. Ecological minimum discharge is secured for the natural flow at this moment based on the regulation. The same water management system will be continuously applied after the Project implementation, and drastic change of hydrological situation in the middle stream is not expected.

Concerning the downstream of the Hrazdan River, from the Yerevan Lake to the Araks River, there is no big-scale of canal and weir. At Masis Observatory, water depth is changed monthly, and it was highest in April and lowest in July in 2003. The lowest depth is around 2m (1.98m) in July 2003 as illustrated in Figure 5-1-6.7.

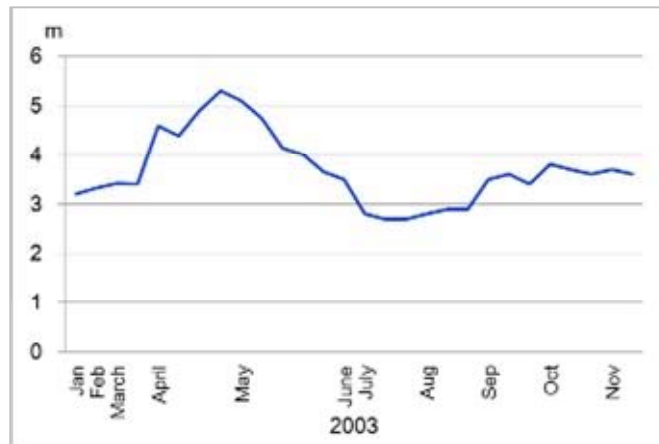


Figure 5-1-6.7 River Water Depth at Masis Station in 2003

Source) Armenian State Hydro-metrological and Monitoring SNCO

It is planned to take 103 MCM water for the Yeghvard Reservoir. The amount of 103MCM will be taken 33MCM, 45MCM and 25MCM in March, April and May, respectively. Based on the conditions, trends of discharge after the Project at Yerevan Observatory and Masis Observatory are estimated, as illustrated in Figure 5-1-6.8. The Hrazdan River discharge would be reduced by the Project, and peak season could be changed from March-June to April-May, which means the peak period could be shorter than present. However, the similar pattern/trend of the discharge peak will be still kept. On the other hand, According to the operator of the Ranchapar Pump Station No.1 in the downstream of Hrazdan River, the drainage conditions around the pump station during snow-melting season is poor, which means the Hrazdan River in the downstream keeps high water level in the season. Therefore, it can be thought that the Project will not cause significant impacts on hydrological conditions in the downstream.

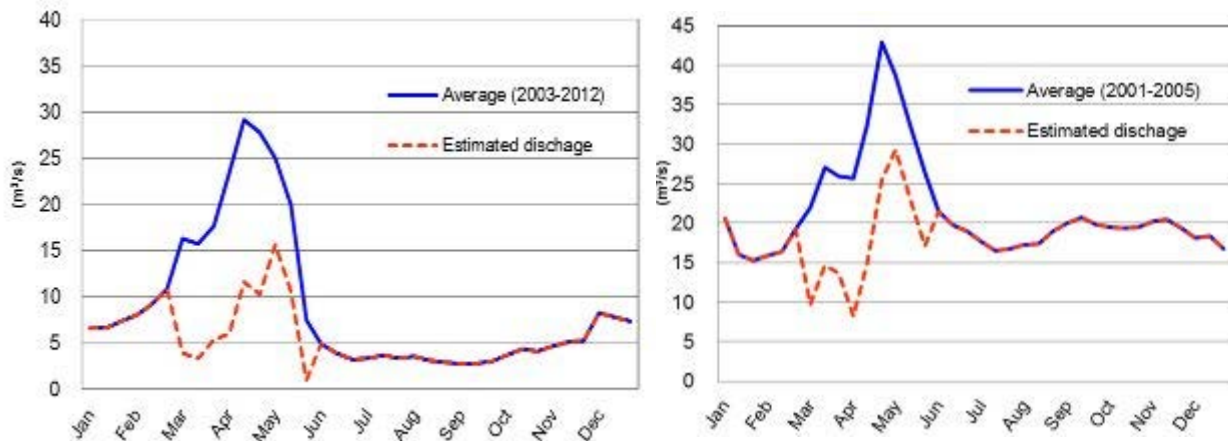


Figure 5-1-6.8 Current and Estimated Discharge (left: Yerevan Observatory, right: Masis Observatory)

Source) Armenian State Hydro-metrological and Monitoring SNCO (for blue line)

(2) Kasakh River

The river water is diverted at Tkanhan Intake into the Tkhhan Canal, and it is taken at the Kasakh Intake to the both Lower Hrazdan Canal and Shah-Aru Canal. As shown in following photo (August 2015) and Figure 5-1-6.9, almost all of river water is at the Kasakh Weir except early spring, and main

stream of the river is suspended and water flow is not observed.

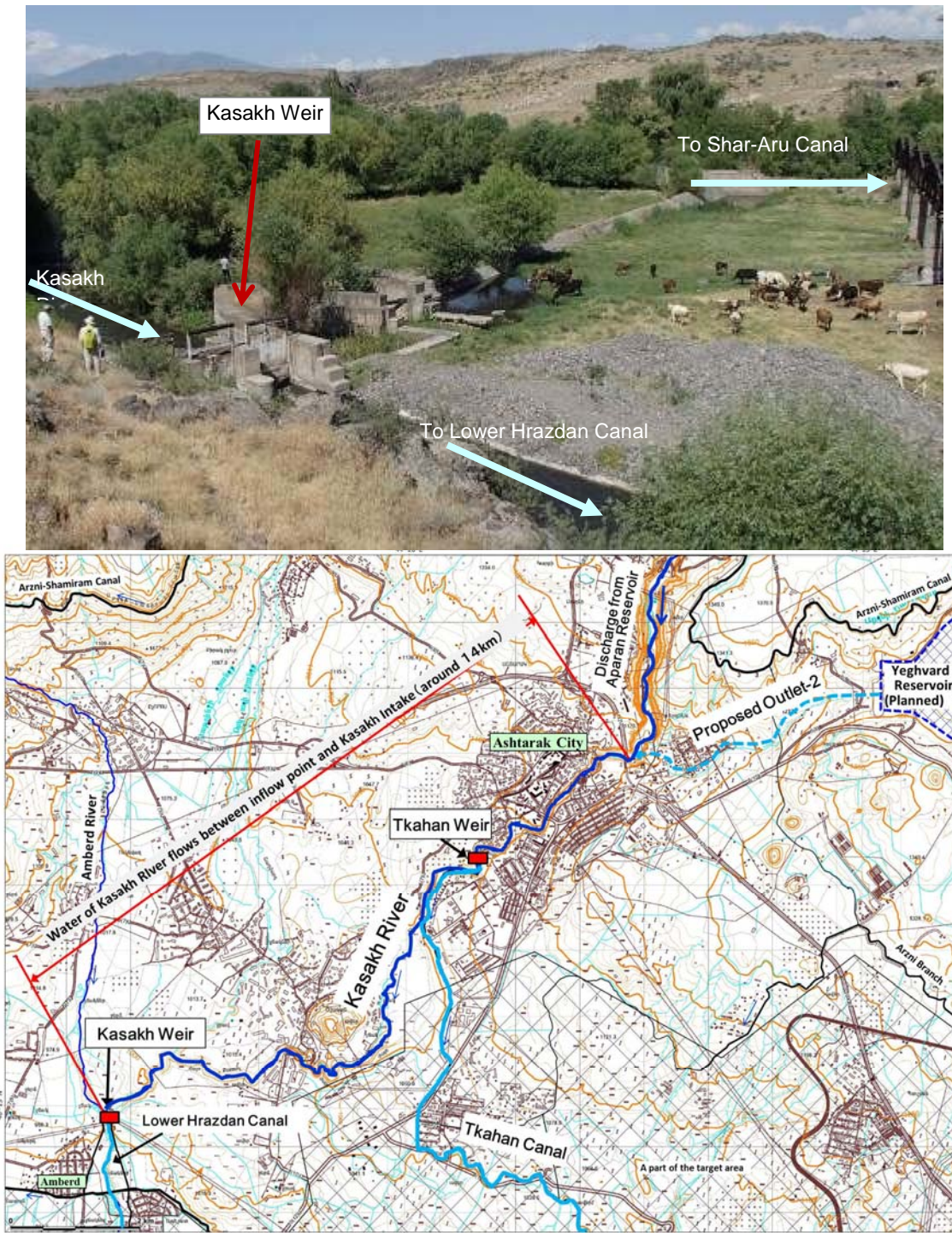


Figure 5-1-6.9 Kasakh River and Irrigation Canals

Discharge of the Kasakh River at Ashtarak Observatory, which is located on near the inflow point from proposed outlet-2, has the peak flow in April, and generally around 3m³/s through year except that in April (See Figure 5-1-6.10). The river water flows within interval of only 14km, between the Kasakh Intake and inflow point from the Outlet-2. In other words, there is no water in downstream of the Kasakh Intake in the Kasakh River. However, due to the inflow of other streams after the Kasakh Intake, river water is sustained and finally flows into the Araks River.

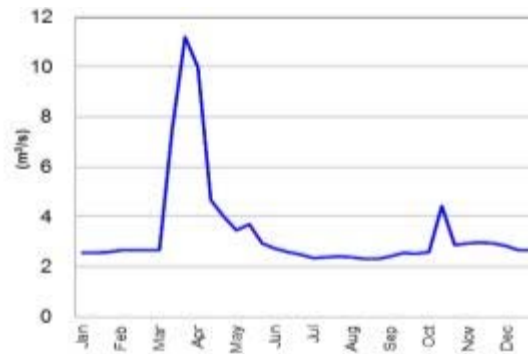


Figure 5-1-6.10 Average Discharge of Kasakh River (1983-2013)

Source) Armenian State Hydro-metrological and Monitoring SNCO

5-1-6-9 Ichthyological System in Hrazdan River and Kasakh River

(1) Current ichthyological situations

1) Fish species in Hrazdan River

A series of Ichthyological surveys in the Hrazdan River was implemented in October to November 2015. Ten (10) points were identified for capture of fish in Hrazdan River as shown in Figure 5-1-6.11. It is noted that Hrazdan River has been highly controlled and utilized for irrigation and hydro power generation, and there are seven (7) weirs between the Lake Sevan and Lake Yerevan. Based on the current situation and project design, Hrazdan River can be divided into 1) upstream, 2) middle stream and 3) downstream as illustrated in Figure 5-1-6.6. Water for Yeghvard Reservoir will be diverted through Arzni-Shamiram Canal at upstream of weir in Argel (No.4), upstream is from No.1 to No.4. In the midstream, existing weirs for hydropower prevent fish migration even at this moment due to no fish gate. In the downstream, fish can migrate without difficulty due to no weir.

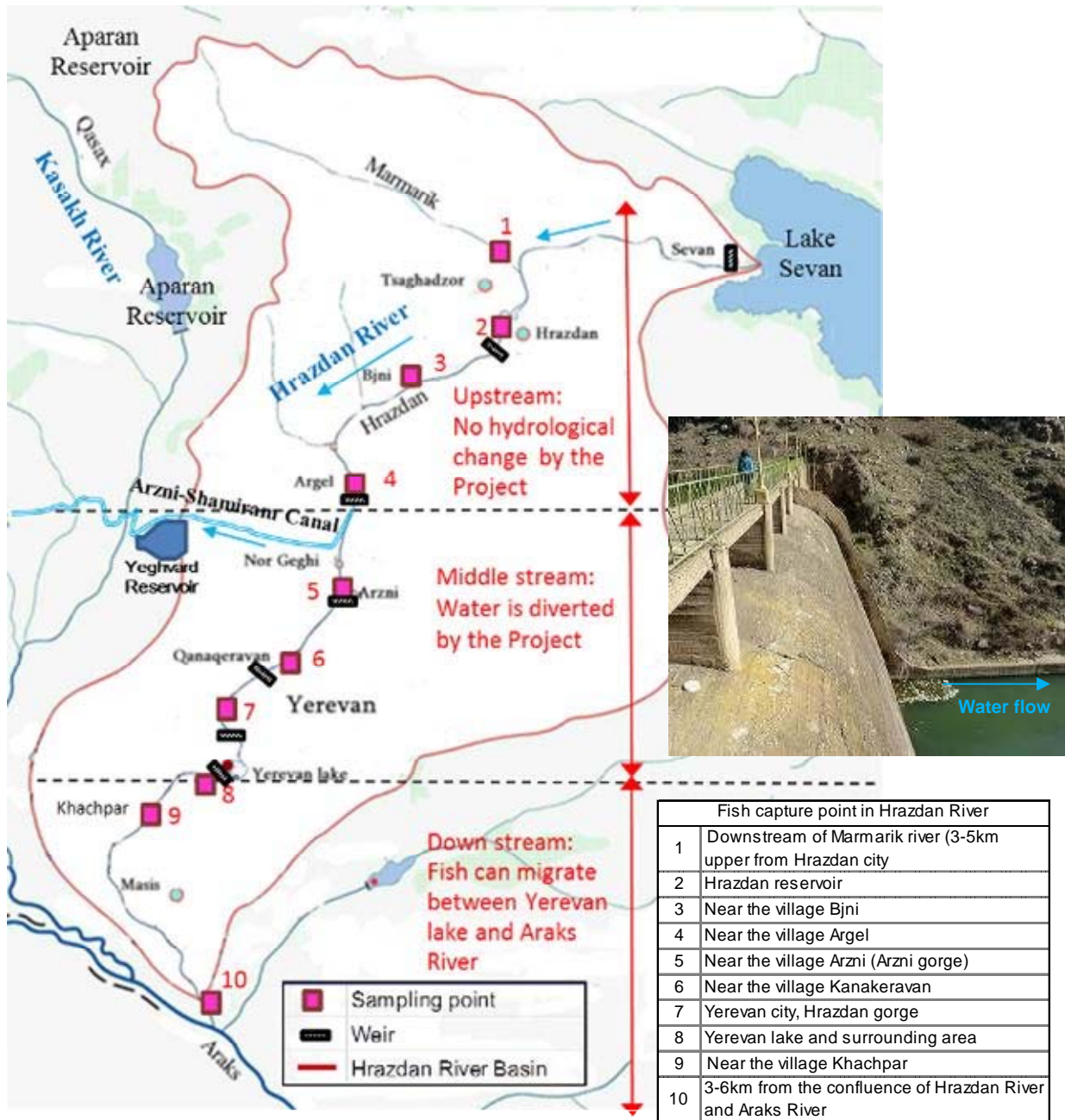


Figure 5-1-6.11 Fish Capture Point in Hrazdan River

In total, twenty-eight (28) species were identified in Hrazdan River by the ichthyological survey (JICA, 2015) in October and November, 2015. One fish which is listed in International Union for Conservation of Nature and Natural Resources Red List of Threatened Species (IUCN Red list) and three species are listed Armenian Red list. At the fish capture points of No.8, 9 and 10, more species were observed, it is probably because that discharge in the downstream is more than that in upstream, and there are no weir or HPP in the downstream. Considering that the water for the Yeghvard Reservoir is planned to be diverted at downstream of the Sampling point No.4, no hydrological change is expected in the upstream, therefore, ichthyological ecosystem in the area will not influenced by the Project. The fish species in the Hrazdan River is as shown in Table 5-1-6.5.

Table 5-1-6.5 Identified Fish in Hrazdan River

Point No.	Fish species	Date of survey
1.	Kura barbell (<i>Barbus lacerta cyri</i>), Sevan khramulya (<i>Capoeta capoeta sevangi</i> Varicorhinus capoeta sevangi) , South Caspian sprilin (<i>Alburnoides eichwaldii</i>), Prussian carp (<i>Carassius gibelio</i>), Brown trout (<i>Salmo trutta fario</i>), Rainbow trout (<i>Oncorhynchus mykiss</i>)	Oct. 17
2.	Kura barbell (<i>Barbus lacerta cyri</i>), Kura nase (<i>Chondrostoma cyri</i>), Chub (<i>Squalius orientalis</i>), Sevan khramulya (<i>Capoeta capoeta sevangi</i>) , South Caspian sprilin (<i>Alburnoides eichwaldii</i>), Prussian carp (<i>Carassius gibelio</i>), Rainbow trout (<i>Oncorhynchus mykiss</i>), Topmouth gudgeon (<i>Pseudorasbora parva</i>)	Oct.17
3.	Kura barbell (<i>Barbus lacerta cyri</i>), Sevan khramulya (<i>Capoeta capoeta sevangi</i>) , South Caspian sprilin (<i>Alburnoides eichwaldii</i>), Prussian carp (<i>Carassius gibelio</i>), Brown trout (<i>Salmo trutta fario</i>)	Oct.18
4.	Kura barbell (<i>Barbus lacerta cyri</i>), Sevan khramulya (<i>Capoeta capoeta sevangi</i>) , South Caspian sprilin (<i>Alburnoides eichwaldii</i>)	Oct.18
5.	Kura barbell (<i>Barbus lacerta cyri</i>), Sevan khramulya (<i>Capoeta capoeta sevangi</i>) , South Caspian sprilin (<i>Alburnoides eichwaldii</i>), Kura loach (<i>Oxynoemacheilus brandtii</i>), Prussian carp (<i>Carassius gibelio</i>), Rainbow trout (<i>Oncorhynchus mykiss</i>)	Oct.31
6.	Kura barbell (<i>Barbus lacerta cyri</i>), Sevan khramulya (<i>Capoeta capoeta sevangi</i>) , South Caspian sprilin (<i>Alburnoides eichwaldii</i>), Kura loach (<i>Oxynoemacheilus brandtii</i>), Topmouth gudgeon (<i>Pseudorasbora parva</i>), Prussian carp (<i>Carassius gibelio</i>), Rainbow trout (<i>Oncorhynchus mykiss</i>)	Oct.31
7.	Kura barbell (<i>Barbus lacerta cyri</i>), Sevan khramulya (<i>Capoeta capoeta sevangi</i>) , South Caspian sprilin (<i>Alburnoides eichwaldii</i>), Angora loach (<i>Oxynoemacheilus angorae</i>), Kura loach (<i>Oxynoemacheilus brandtii</i>), Topmouth gudgeon (<i>Pseudorasbora parva</i>), Prussian carp (<i>Carassius gibelio</i>), Rainbow trout (<i>Oncorhynchus mykiss</i>)	Nov. 7 and Nov.21
8.	Kura barbell (<i>Barbus lacerta cyri</i>), Sevan khramulya (<i>Capoeta capoeta sevangi</i>) , Kura khramulya (<i>Capoeta capoeta capoeta</i>), South Caspian sprilin (<i>Alburnoides eichwaldii</i>), Angora loach (<i>Oxynoemacheilus angorae</i>), Sunbleak (<i>Leucaspius delineatus</i>), Topmouth gudgeon (<i>Pseudorasbora parva</i>), Prussian carp (<i>Carassius gibelio</i>), Monkey goby (<i>Neogobius fluviatilis</i>), Common carp (<i>Cyprinus carpio</i>) , Eastern mosquitofish (<i>Gambusia holbrooki</i>).	Nov.7 and Nov. 21
9.	Blackbrow bleak (<i>Acanthalburnus microlepis</i>), Kura barbell (<i>Barbus lacerta cyri</i>), White bream (<i>Blicca bjoerkna transcaucasica</i>), Kura nase (<i>Chondrostoma cyri</i>), Gudgeon (<i>Gobio gobio</i>), Chub (<i>Squalius orientalis</i>), Sevan khramulya (<i>Capoeta capoeta sevangi</i>) , Kura khramulya (<i>Capoeta capoeta capoeta</i>), South Caspian sprilin (<i>Alburnoides eichwaldii</i>), Angora loach (<i>Oxynoemacheilus angorae</i>), Kura loach (<i>Oxynoemacheilus brandtii</i>), Sunbleak (<i>Leucaspius delineatus</i>), Topmouth gudgeon (<i>Pseudorasbora parva</i>), Prussian carp (<i>Carassius gibelio</i>), Monkey goby (<i>Neogobius fluviatilis</i>), Bulatmai barbell (<i>Luciobarbus capito</i>), Mursa (<i>Luciobarbus mursa</i>), Common carp (<i>Cyprinus carpio</i>) , Rainbow trout (<i>Oncorhynchus mykiss</i>), Eastern mosquitofish (<i>Gambusia holbrooki</i>).	Oct. 10 and Oct. 24
10.	Blackbrow bleak (<i>Acanthalburnus microlepis</i>), North Caucasian bleak (<i>Alburnus hohenackeri</i>), Kura bleak (<i>Alburnus filippii</i>), Kura barbell (<i>Barbus lacerta cyri</i>), White bream (<i>Blicca bjoerkna transcaucasica</i>), Kura nase (<i>Chondrostoma cyri</i>), Gudgeon (<i>Gobio gobio</i>), Chub (<i>Squalius orientalis</i>), Sevan khramulya (<i>Capoeta capoeta sevangi</i>) , Kura khramulya (<i>Capoeta capoeta capoeta</i>), European bitterling (<i>Rhodeus amarus</i>), South Caspian sprilin (<i>Alburnoides eichwaldii</i>), Angora loach (<i>Oxynoemacheilus angorae</i>), Sunbleak (<i>Leucaspius delineatus</i>), Topmouth gudgeon (<i>Pseudorasbora parva</i>), Prussian carp (<i>Carassius gibelio</i>), Monkey goby (<i>Neogobius fluviatilis</i>), Armenian roach (<i>Rutilus rutilus schelkownikovi</i>) , Asp (<i>Aspius aspius</i>) , Bulatmai barbell (<i>Luciobarbus capito</i>), Mursa (<i>Luciobarbus mursa</i>), Common carp (<i>Cyprinus carpio</i>) , Common bream (<i>Abramis brama</i>), Wels catfish (<i>Silurus glanis</i>), Eastern mosquitofish (<i>Gambusia holbrooki</i>).	Oct. 10 and Oct. 24

Source) JICA Survey Team (2015)

*1. It is controversial whether Kura khramulya (*Capoeta capoeta capoeta*) is different species from *Capoeta capoeta sevangi*, and *Capoeta capoeta* is called as Sevan Khramulya (*Varicorhinus capoeta sevangi*) according to Wikipedia. Sevan khramulya (it was also called as *Varicorhinus capoeta sevangi*) are identified at many points as shown in the table above, and the fish is common in many rivers in Armenia recently, while it has been decreased in the Lake Sevan rapidly and listed in the Armenian Red list.

*2. Armenian Roach (*Rutilus rutilus schelkownikovi*) is synonym of *Rutilus rutilus*.

*3. Fish species shown in bold are endangered species as follows:

- 1) Common carp: Vulnerable (VU) A2ce in the IUCN Red list;
- 2) Sevan khramulya (*Capoeta capoeta sevangi* or *Varicorhinus capoeta sevangi*): VU A1cd in the Armenian Red list;
- 3) Armenian roach (*Rutilus rutilus schelkownikovi*): Endangered (EN) B 1ab (iii) +2ab (III) in the Armenian Red list; and
- 4) Asp (*Aspius aspius*): VU B1ab (iii) in the Armenian Red list.

2) Fish species in Kasakh River

A series of Ichthyological surveys in the Kasakh River was implemented by JICA Team in October to November 2015. Eight (8) points were identified as the fish capture points in the Kasakh River as

shown in Figure 5-1-6.12. Kasakh River passes through the Aparan Reservoir and the river discharge is influenced by the discharge from the reservoir. After the merge with the Amberd River, Kasakh River flows and merges with the Metsamor River, and finally it flows into the Araks River.

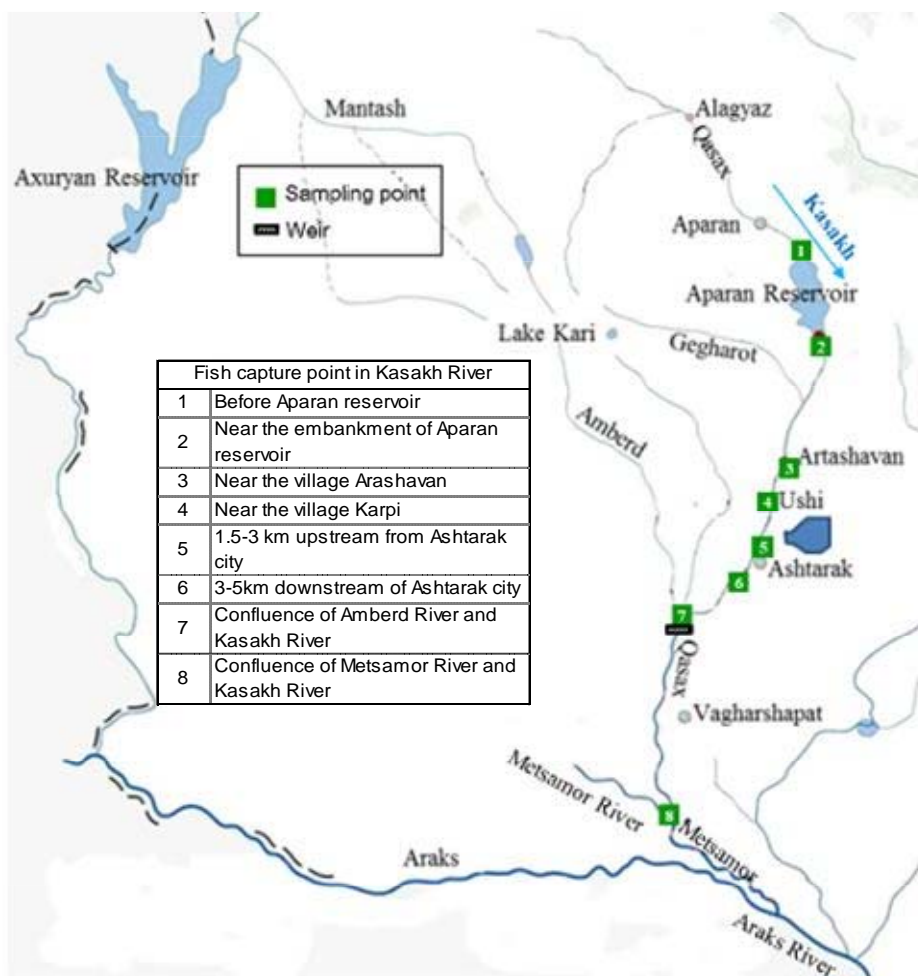


Figure 5-1-6.12 Fish Capture Point in Kasakh River

In Kasakh River, only fifteen (15) species were identified by the survey in October and November, 2015 as shown in Table 5-1-6.6. It is probably because that water of the Kasakh River has been utilized maximally for irrigation at the Kasakh Weir (sampling point), which results in no water in and after the Kasakh Intake.

Table 5-1-6.6 Identified Fish in Kasakh River

Point No.	Fish species	Date of survey
1.	South Caspian sprilin (<i>Alburnoides eichwaldii</i>), Kura barbell (<i>Barbus lacerta cyri</i>), Sevan khramulya (<i>Capoeta capoeta sevangi</i>) , Prussian carp (<i>Carassius gibelio</i>), Brown trout (<i>Salmo trutta fario</i>)	11.Oct.
2.	South Caspian sprilin (<i>Alburnoides eichwaldii</i>),Kura barbell (<i>Barbus lacerta cyri</i>), Chub (<i>Squalius orientalis</i>), Sevan khramulya(<i>Capoeta capoeta sevangi</i>) , Prussian carp (<i>Carassius gibelio</i>)	11.Oct.
3.	South Caspian sprilin (<i>Alburnoides eichwaldii</i>), Kura barbell (<i>Barbus lacerta cyri</i>), Topmouth gudgeon (<i>Pseudorasbora parva</i>), Prussian carp (<i>Carassius gibelio</i>)	09.Oct.
4.	South Caspian sprilin (<i>Alburnoides eichwaldii</i>), Kura barbell (<i>Barbus lacerta cyri</i>), Sevan khramulya (<i>Capoeta capoeta sevangi</i>) , Topmouth gudgeon (<i>Pseudorasbora parva</i>), Prussian carp (<i>Carassius gibelio</i>), Rainbow trout (<i>Oncorhynchus mykiss</i>)	09.Oct.
5.	South Caspian sprilin (<i>Alburnoides eichwaldii</i>), Kura barbell (<i>Barbus lacerta cyri</i>), Sevan khramulya (<i>Capoeta capoeta sevangi</i>) , Kura khramulya (<i>Capoeta capoeta capoeta</i>), Prussian carp (<i>Carassius gibelio</i>), Rainbow trout (<i>Oncorhynchus mykiss</i>)	08.Nov.

Point No.	Fish species	Date of survey
6.	South Caspian sprilin (<i>Alburnoides eichwaldii</i>), Kura barbell (<i>Barbus lacerta cyri</i>), Kura nase (<i>Chondrostoma cyri</i>), Topmouth gudgeon (<i>Pseudorasbora parva</i>), Prussian carp (<i>Carassius gibelio</i>), Mursa (<i>Luciobarbus mursa</i>), Common Common carp (<i>Cyprinus carpio</i>) , Rainbow trout (<i>Oncorhynchus mykiss</i>)	08.Nov.
7.	South Caspian sprilin (<i>Alburnoides eichwaldii</i>), Kura bleak (<i>Alburnus filippii</i>), Kura barbell (<i>Barbus lacerta cyri</i>), Kura nase (<i>Squalius orientalis</i>), Chub(<i>Alburnus filippii</i>), Sevan khramulya (<i>Capoeta capoeta sevangi</i>) , Topmouth gudgeon (<i>Pseudorasbora parva</i>), Prussian carp (<i>Carassius gibelio</i>), Brown trout (<i>Salmo trutta fario</i>), Rainbow trout (<i>Oncorhynchus mykiss</i>)	14.Nov.
8.	South Caspian sprilin (<i>Alburnoides eichwaldii</i>), Kura bleak (<i>Alburnus filippii</i>), Kura barbell (<i>Barbus lacerta cyri</i>), Kura nase (<i>Squalius orientalis</i>), Chub(<i>Alburnus filippii</i>), Sevan khramulya (<i>Capoeta capoeta sevangi</i>) , Kura khramulya (<i>Capoeta capoeta capoeta</i>), Angora loach (<i>Oxynoemacheilus angorae</i>), Topmouth gudgeon (<i>Pseudorasbora parva</i>), Prussian carp (<i>Carassius gibelio</i>), Bulatmai barbell (<i>Luciobarbus capito</i>), Mursa (<i>Luciobarbus mursa</i>), Common Common carp (<i>Cyprinus carpio</i>) , Rainbow trout (<i>Oncorhynchus mykiss</i>)	15.Nov.

Source) JICA Survey Team (2015)

Fish species shown in bold are endangered species as follows:

- 1) Common carp: Vulnerable (VU) A2ce in the IUCN Red list; and
- 2) Sevan khramulya (*Capoeta capoeta sevangi*/*Varicorhinus capoeta sevangi*): VU A1cd in the Armenian Red list.

(2) Impact on ichthyological ecosystem by the Project

1) Impact on existing ichthyological ecosystem in the Hrazdan River

Generally, spawning trigger of fresh water fish are water temperature change and generation of discharge peak. Moreover, enough water depth for spawning is necessary. When impacts on fish in the Hrazdan River are examined, it is possible to category 1) fish in the upstream of the intake for Arzni-Shamiram Canal, 2) fish in the middle stream (from the intake to the Lake Yerevan) and 3) fish in the downstream of the Hrazdan River. This matter is discussed as shown below.

(a) Fish in the upstream

The fish in the upstream will not be damaged at all, since the area is upstream of the water intake point of the Arzni-Shamiram Canal for the Reservoir.

(b) Fish in the middle stream

As mentioned before, there are natural flow and canal in the Hrazdan River, and discharge in the natural flow is small. In addition, weirs for the hydro power generation prevent fish from migration between upstream and downstream. Such conditions will not be changed by the Project. Even now, the discharge in the middle stream of Natural Hrazdan River is not drastically increased by the meltwater. At this moment, 2-3 m³/s discharge in the natural flow in the middle stream is observed as shown in following photos and it will be kept after the Project. Therefore, it can be said that spawning conditions for fish in middle stream will not be changed and the impacts on fish will be limited.



Natural Hrazdan River on 2nd March 2016, at just upstream of Lake Yerevan
(Left: beside of a restaurant along the river, right: just downstream of the point of the photo of left)

(c) Fish in the downstream

In the downstream of the Hrazdan River, namely, from the Yerevan Lake to the Araks River, there is no big-scale of canal and weir. At Masis Observatory in the downstream, water depth is changed monthly, and it was highest in April and lowest in July in 2003. The lowest depth is around 3m in July 2003 as illustrated in Figure 5-1-6.7. Sufficient water depth for spawning will be secured in the downstream even in the lowest period, considering necessary depth for fish spawning is 0.2m to 0.5m as shown in Appendix-K-5.

Triggers for spawning are various depending on species, and they are summarized in Table 5-1-6.7. Spawning trigger for the thirteen (13) species, out of identified 28 fish species in the Hrazdan River, is a certain level of water temperature. It means that water diversion for the Yeghvard Reservoir will not give significant damages to the spawning of the 13 species. Concerning remaining species, the condition is unknown, however, even if their spawning trigger is discharge peak, they can also survive after the Project, since discharge peak will be secured as mentioned in Figure 5-1-6.8. Consequently, it can be judged that the current ichthyological system in the Hrazdan River will not be influenced by the Project significantly.

Table 5-1-6.7 Trigger for Spawning

No.	Species of fish	Trigger	Remarks
1	Angora loach (<i>Oxynoemacheilus angorae</i>)	No data	-
2	Armenian roach (<i>Rutilus rutilus schelkovnikovi</i>)	In case of <i>Rutilus rutilus</i> , the trigger is mainly water temperature, the suitable one is very various from more than 6°C to 10-12°C. Roach spawned synchronously with rapid increase in temperature, whereas they had a prolonged spawning with low or with slow increase in water temperature. ¹	Registered in the Red list in Armenia
3	Asp (<i>Aspius aspius</i>)	Above 8°C ²	Registered in the Red list in Armenia
4	Blackbrow bleak (<i>Acanthalburnus microlepis</i>)	No data	-
5	Brown trout (<i>Salmo trutta fario</i>)	Spawn in autumn	It ranges in the upstream of Hrazdan River, and it will be conserved after the Project.
6	Bulatmai barbel (<i>Luciobarbus capito</i>)	No data	-
7	Chub (<i>Squalius orientalis</i>)	No data	It ranges in the upstream of Hrazdan River, and it will be conserved after the Project.
8	Common bream (<i>Abramis brama</i>)	Above 15°C ²	-
9	Common carp (<i>Cyprinus carpio</i>)	17-18°C ^{*3}	Registered in the IUCN Red list
10	Eastern mosquitofish (<i>Gambusia holbrooki</i>)	No data	It is regarded as "invasive species" ⁴
11	European bitterling (<i>Rhodeus amarus</i>)	No data	-
12	Gudgeon (<i>Gobio gobio</i>)	Above 13°C for spawning ²	-
13	Kura barbel (<i>Barbus lacerta cyri</i>)	No data	It ranges in the upstream of Hrazdan River, and it will be conserved after the Project.
14	Kura bleak (<i>Alburnus filippii</i>)	No data	-
15	Kura khramulya (<i>Capoeta capoeta capoeta</i>)	If the species is synonymy of Sevan khramulya (<i>Capoeta Capoeta Sevangi</i>), Spawning start at 12°C and peaks at 15°C ⁵ .	-
16	Kura loach (<i>Oxynoemacheilus brandtii</i>)	No data	-
17	Kura nase (<i>Chondrostoma cyri</i>)	No data	It ranges in the upstream of Hrazdan River, and it will be conserved after the Project.

No.	Species of fish	Trigger	Remarks
18	Monkey goby (<i>Neogobius fluviatilis</i>)	Above 13°C ^{*2}	-
19	Mursa (<i>Luciobarbus mursa</i>)	No data	-
20	North Caucasian bleak (<i>Alburnus hohenackeri</i>)	Above 18~23°C for spawning ^{*2}	-
21	Prussian carp (<i>Carassius gibelio</i>)	Above 14°C for spawning ^{*7}	It ranges in the upstream of Hrazdan River, and it will be conserved after the Project. However, it is regarded as an invasive species.
22	Rainbow trout (<i>Oncorhynchus mykiss</i>)	In the wild, there are rainbow trout populations that spawn in autumn and there are other populations that spawn in spring ^{*6}	It ranges in the upstream of Hrazdan River, and it will be conserved after the Project.
23	Sevan khramulya (<i>Capoeta capoeta sevangi</i>)	Spawning start at 12 °C and peaks at 15°C ^{*3}	It ranges in the upstream of Hrazdan River, and it will be conserved after the Project. Registered in the Red list in Armenia
24	South Caspian sprilin (<i>Alburnoides eichwaldii</i>)	No data	It ranges in the upstream of Hrazdan River, and it will be conserved after the Project.
25	Sunbleak (<i>Leucaspius delineates</i>)	When temperature reaches 16°C ^{*2}	-
26	Topmouth gudgeon (<i>Pseudorasbora parva</i>)	No data	It ranges in the upstream of Hrazdan River, and it will be conserved after the Project. However, it is regarded as pest due to its high reproductive rate. ^{*2}
27	Wels catfish (<i>Silurus glanis</i>)	Above 20°C ^{*2}	-
28	White bream (<i>Blicca bjoerkna transcaucasica</i>)	Above 15°C for spawning ^{*2}	-

Remarks: Highlighted fish are registered in IUCN Red list and Armenian Red list.

Source) *1: Environmental Biology of Fishes Vol. No.3, p19-227, 1987, "Reproductive biology of stream spawning roach, *Rutilus-Rutilus*"

*2: IUCN Red list

*3: FAO, Cultured Aquatic Species Information Programme, "*Cyprinus carpio*"

*4: Global Invasive Species Database

*5: FAO, Corporate Document Repository, Fish and Fisheries in Lake Sevan, Armenia, and in some other high altitudes lakes of Caucasus. Since Kura khramulya (*Capoeta capoeta capoeta*) and Sevan khramulya (*Capoeta capoeta sevangi*) could be the same species, it is presumed that their spawning conditions are the same.

*6: FAO, 2011, Fisheries and Aquaculture Technical Paper 561, Small-scale rainbow trout farming

*7: Pipoyan S., Ichthyofaunal of Armenia, 2012

2) Impact on existing ichthyological ecosystem in the Kasakh River

There are some species which range in both Hrazdan River and Kasakh River. The number of species in the Hrazdan River is much more than that in Kasakh River, and 15 species are common as shown in Table 5-1-6.8. Since the water of Hrazdan River will be diverted between sampling point No.4 and No.5 to the Yeghvard Reservoir, the fish which are identified at No.5 sampling point may be moved to the Kasakh River through the Yeghvard Reservoir and they could mix with the fish in Kasakh River. They are Kura barbell (*Barbus lacerta cyri*), Sevan khramulya (*Capoeta capoeta sevangi*), South Caspian sprilin (*Alburnoides eichwaldii*), Kura loach (*Oxynoemacheilus brandtii*), Prussian carp (*Carassius gibelio*) and Rainbow trout (*Oncorhynchus mykiss*). All of them except Kura loach are identified in the Kasakh River also. Considering the situation, the Project will not change the ichthyological eco-system in the Kasakh River.

Table 5-1-6.8 Comparison of Identified Fish in Hrazdan River and Kasakh River

No.	Fish Species	In Hrazdan River	In Kasakh River
1	Angora loach (<i>Oxynoemacheilus angorae</i>)	+	+
2	Armenian roach (<i>Rutilus rutilus schelkovnikovi</i>)	+	-
3	Asp (<i>Aspius aspius</i>)	+	-
4	Blackbrow bleak (<i>Acanthalburnus microlepis</i>)	+	-
5	Brown trout (<i>Salmo trutta fario</i>)	+	+
6	Bulatmai barbel (<i>Luciobarbus capito</i>)	+	+
7	Chub (<i>Squalius orientalis</i>)	+	+
8	Common bream (<i>Abramis brama</i>)	+	-
9	Common carp (<i>Cyprinus carpio</i>)	+	+
10	Eastern mosquitofish (<i>Gambusia holbrooki</i>)	+	-
11	European bitterling (<i>Rhodeus amarus</i>)	+	-
12	Gudgeon (<i>Gobio gobio</i>)	+	-
13	Kura barbel (<i>Barbus lacerta cyri</i>)	+	+
14	Kura bleak (<i>Alburnus filippii</i>)	+	+
15	Kura khramulya (<i>Capoeta capoeta capoeta</i>)	+	+
16	Kura loach (<i>Oxynoemacheilus brandtii</i>)	+	-
17	Kura nase (<i>Chondrostoma cyri</i>)	+	+
18	Monkey goby (<i>Neogobius fluviatilis</i>)	+	-
19	Mursa (<i>Luciobarbus mursa</i>)	+	+
20	North Caucasian bleak (<i>Alburnus hohenackeri</i>)	+	-
21	Prussian carp (<i>Carassius gibelio</i>)	+	+
22	Rainbow trout (<i>Oncorhynchus mykiss</i>)	+	+
23	Sevan khramulya (<i>Capoeta capoeta sevanqi</i>)	+	+
24	South Caspian sprilin (<i>Alburnoides eichwaldii</i>)	+	+
25	Sunbleak (<i>Leucaspius delineatus</i>)	+	-
26	Topmouth gudgeon (<i>Pseudorasbora parva</i>)	+	+
27	Wels catfish (<i>Silurus glanis</i>)	+	-
28	White bream (<i>Blicca bjoerkna transcaucasica</i>)	+	-
	Total number of fish species	28	15

+ : identified, - : not identified

Highlighted fish species are the ones identified at No.5 of Hrazdan River

The table is prepared based on the Table 5-1-6.5 and Table 5-1-6.6.

5-1-6-10 Involuntary Resettlement and Land Acquisition

Since there are no residential buildings in close proximity to the Yeghvard Reservoir and proposed Feeder/Outlet Canals construction sites, no physical relocation is expected by the Project. However, the Yeghvard Reservoir basin will be submerged and some farmlands along the proposed canals will be affected. In total, 819.36.ha will be influenced by the construction works. The detailed is described in Chapter 5-2.

5-1-6-11 The Poor

In the affected area in and around the construction site, some households which get pension and poverty allowance are identified. It is needed to pay some special attention to them, through employment of them as labors of the Project construction works with high priority and lump sum money payment.

5-1-6-12 Indigenous People/Minority People

As mentioned before, some minority groups stay in the beneficial area, and they will be able to access to irrigation water more stably as the Project beneficiaries. They do not have difficulty to communicate in Armenian language and they will not be excluded from the benefit by the Project. On the other hand,

in the affected area, it is confirmed that there is no minority people.

5-1-6-13 Livelihood/Local Economy

The farmers in the beneficial area will be able to stable irrigation water more than present, and crop diversification will be promoted, which will result in production increase and income improvement for each household. It is expected that such improvement can contribute to the local economy activation. On the other hand, the affected persons in and around the construction site will lose parts of their lands and livelihood measures by the Project. It is needed to provide compensation or/and considerations/support to such negatively affected people to minimize the impacts.

5-1-6-14 Land Use and Local Resource Utilization

The reservoir basin has been used for farmland and grazing. The cultivators within the reservoir will lose their farmland and which can lead to decrease of their income, and it is needed to pay considerations to the affected persons. Concerning grazing land, some parties use the reservoir basin for livestock grazing, however, they do not stay in the same place continuously, and they are moving from flat grassland to mountainous area with their livestock. According to one person who was grazing in the Reservoir basin, there are sufficient places for grazing, the loss of grassland area by the Project is not a big issue for him. Consequently, negative impacts on land use and local resource utilization will not be significant.

The people of Yeghvard Community and Nor-Yerznka Community request the Project to transport fertile top-soil of the Reservoir to their farmlands. At the construction stage, it is needed to classify the top-soil into useful soil for farming, and waste soil to be disposed. After the classification, the fertile soil will be transported, stored and distributed among the people. The detail procedure and method of soil transportation, storage and distribution cannot be determined at this stage. However, after the Loan Agreement for the Project between the Government of Japan and the Government of Armenia, the councils of the communities concerned are expected to discuss those issues. It is possible for the communities to distribute the soil to the affected persons by the Project with high priority. Based on the procedure agreed at the councils, the Project will transport the top-soil to the specified soil storage sites.

5-1-6-15 Water Usage or Water Rights and Rights of Common

It has been approved to take 17.7 m³/s of water volume for 210 days (in total 320 MCM per year) from the Hrazdan River for the Arzni-Shamiram canal by the Water Resource Management Agency, under the MNP. Out of 320 MCM mentioned above, 160 MCM water from the Hrazdan River has been annually used for irrigation so far, while proposed water intake volume for Yeghvard reservoir is 103 MCM. It means that water intake of 103 MCM is within the specified volume under that water use right, and the Project will not encroach other water use right. In addition, 103 MCM water diversions for Yeghvard reservoir accounts for only 5.5% of total discharge of Hrazdan River for hydro power generation, namely, 1,875 MCM in 2013.

In Hrazdan River, around 500 million kWh is generated by seven (7) hydro power plants. If 103 MCM water is taken, 27.5 million kWh (=103/1,875*500) power generation will be affected. However, considering the total power generation in Armenia is around 7,800 million kWh annually, the affected amount is only 0.35%. Therefore, the impact by the Project on the power generation will be very limited.

5-1-6-16 Existing Social Infrastructure and Services

During the construction works, traffic jam can be caused by the increase of traffic volume. The

expected number of construction vehicles is around 50 per day. The vehicles will be operated within the Reservoir basin mainly and they will be parked in the area during the night. It means that the construction works within the Reservoir will not cause severe traffic jam. On the other hand, along the proposed Outlet Canal-2, the existing road is very narrow, and temporary road closure will be needed for around 30 days, which leads to inconvenience for the residents. However, it is possible for the people to access another road and the impact will be temporary. Therefore, it can be judged that the impact will not be significant. It is recommended to decentralize the use of construction vehicles to avoid traffic jam.

5-1-6-17 Misdistribution of Benefit and Damage, and Conflict

In the Project, there are beneficiaries and negatively affected persons, and it is planned to provide compensation to the affected persons to restore their livelihood to the original level. Given that there is sufficient distance between the beneficial area and affected area, the affected persons will not have a feeling of jealousy against the beneficiaries. Moreover, no case that any conflicts between beneficiaries and affected persons due to some projects have been reported so far in Armenia according to the official personnel of PIU. Therefore, the possibility of misdistribution of benefit and damage, and conflict is very low.

5-1-6-18 Cultural Heritage

There are some cultural heritages to be conserved around the construction site, namely, Second World War victim's monument and memorial fountain. However, they are 100-200 m away from the construction sites and they will not be affected by the Project. It is noted that there is a possibility that some buried historical assets will be found during the construction works, in such case, it is needed to report the fact to the Ministry of Culture.

5-1-6-19 Hazard (Risk) Infectious Diseases such as HIV/AIDS

There could be no possibility of HIV infection during the construction works, given that there has no such case reported in Armenia so far. Moreover, malaria is not a common disease in Armenia, and case of Malaria is very few. The proposed reservoir will have enough water depth, where mosquito cannot survive in the Reservoir. Therefore, no risk of infectious diseases by the Project is expected.

5-1-6-20 Work Environment

Improper working environment for labors can cause some accident related to construction works. It is needed to distribute necessary tools, proper uniform, helmet and glasses to the construction workers, and proper work shift management of the labors is essential to minimize the accident. Working condition, such as work hours per day shall be based on the regulation in Armenia.

5-1-6-21 Accident

During the construction stage, there is a possibility of traffic accident due to the increase of traffic volumes, it is needed to control construction vehicles and to set signboard showing construction site for warning surrounding people.

5-1-6-22 Transboundary Impacts and Climate Change

A certain amount of greenhouse gas emission, such as CO₂, during the construction period is expected, however, it will be temporary and the scale will not be large, which result in no climate change. Rather than that, the Project can contribute to saving electricity through the shift from pump irrigation to gravity irrigation, which leads to reduction of greenhouse gas emission.

The Project will take 103 MCM water for the Reservoir, while annual discharge amount of the whole

Hrazdan River is 1,875 MCM as of 2013, which means that the proposed water intake will not give a serious damage to the Hrazdan River. On the other hand, the flow of Hrazdan River is completed within the territory of Armenia and it is not an international river. Therefore, no international treaties on water use of Hrazdan River have been established. The river finally flows into the Araks River, which is an international river and runs through the boundary with Turkish. The area of the Araks River basin is around 102,000 km², while that of Hrazdan River basin is around 1,200 km², namely, the ratio of Hrazdan River basin to that of the Araks River basin is only 1.2%. Considering those situations, it can be said that the impact will not cause transboundary impacts.

5-1-7 Evaluation

Based on the discussion in the previous sub-chapter, the stage-wise expected impacts by the Project are summarized in Table 5-1-7.1.

Table 5-1-7.1 Impact Examination Result

Environmental parameter	Evaluation at Scoping		Evaluation based on survey result		Reason of evaluation
	Before and during construction	Operation stage	Before and during construction	Operation stage	
1. Air quality	B ⁻	D	B ⁻	D	<p>Construction stage: Dust and gas emission will be caused, especially, Outlet Canal-2 is expected to pass through residential area, which leads to impacts on the area. In addition, strong wind can cause dust and give damage to Nor-Yerznka Community.</p> <p>Operation stage: Increase of vehicles is not expected, and there is low possibility of air pollution.</p>
2. Water quality	B ⁻	B ⁻	B ⁻	D	<p>Construction stage: Mud water from the construction site will be caused.</p> <p>Operation stage: There is no case reported that surface water is polluted by agrichemicals in Armenia²⁰. Moreover, there is no drainage from the farmland in the target area, and no impact on surrounding environment through surface water, even though increase of applied amount of fertilizers and agrichemicals is expected.</p> <p>Irrigation water by using canals and rivers quality will not be deteriorated by the Project. Water flow direction in the Reservoir will be generated through water supply from the reservoir to the Kasakh River, thus, the water in the Reservoir will not be stagnant.</p>
3. Waste	B ⁻	D	B ⁻	B ⁻	<p>Construction stage: Waste from new construction sites and rehabilitation sites of existing irrigation system will be generated and proper disposal is needed.</p> <p>Operation stage: Dredging of canals is needed, however, the amount will be limited. If the Reservoir becomes a sightseeing point and some restaurants are constructed, waste will be</p>

²⁰ It is based on hearing to official personnel of MNP, PIU and MOA.

Environmental parameter	Evaluation at Scoping		Evaluation based on survey result		Reason of evaluation
	Before and during construction	Operation stage	Before and during construction	Operation stage	
					generated. In such case, the owners should shoulder the cost for waste disposal. Regardless of tourism or other activities, it is needed to follow laws of Armenia, and there is no special regulation for waste management in tourism.
4. Soil Contamination	B ⁻	C	B ⁻	B ⁻	<p>Construction stage: Oil leakage from construction vehicles and equipment is expected.</p> <p>Operation stage: Due to the irrigation area expansion, application of illegal agricultural chemicals can be increased, which leads to pollution.</p>
5. Noise and Vibration	B ⁻	D	B ⁻	D	<p>Construction stage: Noise and vibration due to construction works are expected.</p> <p>Operation stage: Given that traffic increase is not expected, noise and vibration will not be caused.</p>
6. Ground Subsidence	D	D	D	D	
7. Offensive Odor	D	D	D	D	
8. Bottom sediment	D	D	D	D	
9. Protected area	D	D	D	D	
10. Ground water	D	C/B ⁺	D	B ⁻ /B ⁺	<p>Construction stage: No impact on the ground water by the project is expected.</p> <p>Operation stage: The project can contribute to recovery of ground water resource due to shift from use of ground water to use of surface water. Irrigation area expansion can cause increase of chemical fertilizer application, which can result in groundwater pollution by nitrogen.</p>
11. Hydrological Situation	D	C	D	D	<p>Construction stage: It is not planned to suspend any natural rivers nor to change /expand existing water courses, which will not result in hydrological change.</p> <p>Operation stage: The project will divert the free water of the Hrazdan River during March to May, considering the regulated minimum discharge. Even now, most of the Hrazdan River water is used for canal, while only minimum discharge is secured for the natural flow, thus, dynamic hydrological change is not expected. In the downstream, enough depth and seasonal discharge peak will be kept, and no significant impact is expected.</p>
12. Ecosystem	B ⁻	B ⁻ /B ⁺	B ⁻	B ⁻ /B ⁺	<p>Construction stage: Lands in and around the construction sites have been already developed for agricultural purpose and there is no virgin nature to be damaged by the Project. Thus, expected</p>

Environmental parameter	Evaluation at Scoping		Evaluation based on survey result		Reason of evaluation
	Before and during construction	Operation stage	Before and during construction	Operation stage	
					<p>impact is not severe.</p> <p>Wildlife within the Reservoir will be able to escape to the outside and to survive during construction if the construction site is divided into 4 blocks.</p> <p>Poisonous snake species is identified in the Reservoir, and there is possibility that the snake comes to neighboring villages. It is needed to take measures against the snake.</p> <p><u>Operation stage:</u></p> <p>There is a possibility that bio-diversity will be richer than present, since the reservoir construction will attract birds. There are 4 birds register in the red list and 1 snake registered in the red list in the reservoir basin, however, they can move to other areas which have similar characteristics of the reservoir area.</p> <p>Concerning ichthyological system, ecological minimum discharge of the Hrazdan River secured. Even now, most of the river water is used for irrigation and power generation in the middle stream, amount of natural flow is only minimum discharge. In the downstream, necessary depth for spawning will be expected, and some rare fish species survive in Hrazdan River.</p> <p>Some fish species are common in Hrazdan River and Kasakh River. Therefore, if Hrazdan River water is mixed with the Kasakh River water by the water diversion through Yeghvard Reservoir, the eco-system in the Kasakh River will not be affected.</p> <p>The project could reduce dependency of the command area on the Lake Sevan as the water resource, however, water level of the lake is increased by only several centimeters by the Project.</p>
13. Topography and Geographical features	D	D	D	D	
14. Involuntary Resettlement/ Land Acquisition	B	D	B	D	<p><u>Before and during construction stage:</u></p> <p>819.36 ha area in and around the construction site will be affected by the construction works and land expropriation is needed, however, no physical relocation is planned.</p> <p><u>Operation stage:</u></p> <p>No impact is expected.</p>
15. The poor	C	C	B	D	<p><u>Before and during construction stage:</u></p> <p>There are some households who get poverty allowance in the affected area, they can be influenced by the Project, and it is needed to pay special considerations to such persons.</p> <p><u>Operation stage</u></p> <p>No impact on the poor people is expected.</p>
16. Indigenous and	C	C	D	D	<p><u>Before and during construction stage:</u></p>

Environmental parameter	Evaluation at Scoping		Evaluation based on survey result		Reason of evaluation
	Before and during construction	Operation stage	Before and during construction	Operation stage	
ethnic people					<p>There is an ethnic minority household in the affected area. They are to be compensated for their land loss based on the law/regulation.</p> <p>Operation stage: There are ethnic minority people in the target area, and they can access to the project benefit as well as other beneficiaries.</p>
17. Livelihood/local economy	B/B ⁺	B ⁺	B/B ⁺	B ⁺	<p>Construction stage: Given that the Project will provide job opportunities for the local people, positive impact is expected. On the other hand, the Project will cause negative impacts on some people whose land will be acquired.</p> <p>Operation stage: Stable agricultural production can be promoted by stable irrigation water. The cost for pump operation shouldered by the government, will be reduced. It is expected that the Yeghvard Reservoir will attract tourists and the area will be developed.</p>
18. Land use and local resource utilization	B ⁻	D	B ⁻	D	<p>Construction stage: It is needed to acquire land for construction of reservoir and canals. Some of existing farmlands will be changed to stock yard for construction, construction office, canals and so on.</p> <p>Operation stage: No negative impact on land use and local resource utilization is expected.</p>
19. Water Usage or Water Rights and Rights of Common	D	B/B ⁺	D	D	<p>Construction stage: 1) Since the Project will take water of the Hrazdan River and use existing facilities, new construction will be not done, impacts on the downstream of the Hrazdan River is not expected. 2) Given that the construction works will not close natural rivers and change existing canals, scale of mud water due to construction works will be small and the impact is negligible.</p> <p>Operation stage: The water use permission was given by the MNP for the Arzni-Shamiram Canal. The proposed amount of water intake for the Reservoir is within the approved volume. Therefore, the Project will not interfere with other water use of Hrazdan River water.</p>
20. Existing social infrastructures and services	B ⁻	D	B ⁻	D	<p>Construction stage: Due to increase of construction vehicles, traffic jam can be caused.</p> <p>Operation stage: No impact on traffic is expected.</p>
21. Social institutions	D	D	D	D	
22. Misdistribution of benefit and damage	B ⁻	B ⁻	D	D	<p>Construction stage: There are some person who will lose their lands in the affected area, while beneficiaries</p>

Environmental parameter	Evaluation at Scoping		Evaluation based on survey result		Reason of evaluation
	Before and during construction	Operation stage	Before and during construction	Operation stage	
					can enjoy the stable irrigation water. However, the former will be compensated for the loss. Thus, misdistribution of benefit and damage, is not expected. Operation stage: While the farmers in the project target area can enjoy the project benefit, while other farmers in non-command area cannot. Still, in Armenia, no case has been reported that non-beneficiaries envy or feel antipathy to beneficiaries, which results in conflict in between, according to the PIU official personnel. Therefore, it can be said that no big issue will be caused by the Project.
23. Conflict	B ⁻	C	D	D	Construction stage: Probably the affected persons will not have jealousy to the beneficiaries, since there is enough distance between the both groups and they will be provided with compensation. Thus, any conflicts are not expected. Operation stage: While the farmers in the project target area can enjoy the project benefit, while other farmers in non-command area cannot. Given that there is no case that conflict in between beneficiaries and non-beneficiaries has been identified so far in Armenia, according to the PIU official personnel. Therefore, it can be said that no conflict due to the Project is expected.
24. Cultural heritage	C	C	D	D	Before and Construction stage No cultural heritage to be conserved in and around the construction site is identified. If some assets are found during the construction, immediate report should be done. Operation stage: <u>The Project plans to cover existing farming area that has been developed, instead of virgin land, therefore, no damage to cultural asset in operation stage is is expected.</u>
25. Land scape	D	D	D	D	
26. Gender	D	D	D	D	
27. Children rights	D	D	D	D	
28. Hazards (Risk), Infectious diseases such as HIV/AIDS	B ⁻	D	D	D	Construction stage: Any cases of Infectious diseases such as Malaria and HIV during construction works have not been reported in Armenia.
29. Work environment	B ⁻	D	B ⁻	D	Construction stage: There is a possibility of accident during the construction works. Special considerations to prevent and minimize the possibility by distribution safety goods and proper labor management are needed.

Environmental parameter	Evaluation at Scoping		Evaluation based on survey result		Reason of evaluation
	Before and during construction	Operation stage	Before and during construction	Operation stage	
30. Accident	B ⁻	B ⁻	B ⁻	D	<p>Construction stage: There is a possibility of accident during the construction works in and around the construction site. Warning by setting signboard for the surrounding people is needed.</p> <p>Operation stage: There is a possibility of accident in and around the Reservoir. However, the potential is very limited.</p>
31. Transboundary impact, climate change	D	C	D	B ⁺	<p>Construction stage: Construction vehicles are operated, which bring about greenhouse gas emission, however, it is temporary and not huge scale.</p> <p>Operation stage: The Project proposes to shift from pump irrigation to gravity irrigation, which can contribute to reduction of greenhouse gas emission. Proposed water intake is very small compared with the total discharge of Hrazdan River. Moreover, area of Hrazdan River basin accounts for only 1% of the Araks River, an international river. Consequently, transboundary impact and climate change are not expected.</p>

A+/-: Significant positive/negative impact is expected.

B+/-: Positive/negative impact is expected to some extent.

C+/-: Extent of positive/negative impact is unknown. (A further examination is needed, and the impact could be clarified as the study progresses)

D: No impact is expected.

5-1-8 Mitigation Measure

Taking into consideration expected environmental impacts discussed in previous sub-chapter, Environmental Management Plans (EMPs) showing mitigation measures by stage are proposed. Based on the EMPs, monitoring plans by stage and monitoring formats are also presented. In construction stage, mitigation measures will be mainly taken by the construction company, and PIU/SCWE will supervise the measures as planned in collaboration with the private consultant. The consultant will provide technical advices to the PIU/SCWE for the supervision. In the operation stage, instead of the PIU/SCWE, MNP will be responsible for supervision while WUA/WSA and MOA will implement take countermeasures. The EMPs during construction stage and operation stage are shown in Table 5-1-8.1 and Table 5-1-8.2, respectively.

Table 5-1-8.1 Environmental Management Plan (Construction Stage)

Environmental parameters	Mitigation measures	Responsible organization	Supervising agency	Cost
1. Air quality	<ul style="list-style-type: none"> Regular check and full maintenance of construction vehicles Water spray in and around entrances of construction sites to minimize dust generation and dust diffusion Store and handle granular materials appropriately to limit dust (e.g. protect with 	Construction contractor	PIU/SCWE and Consultant	Included in construction cost

Environmental parameters	Mitigation measures	Responsible organization	Supervising agency	Cost
	<ul style="list-style-type: none"> taraulins) Prohibit open burning of construction / waste material at the site 			
2. Water quality	<ul style="list-style-type: none"> Disposal of waste water from construction site and labor camp before discharge into rivers Mud water treatment at the construction site before discharge to downstream Repair any damage to riparian areas, including river/canal banks and river/canal beds (if any), as soon as construction is complete 	Construction contractor	PIU/SCWE and Consultant	Included in construction cost
3. Waste	<ul style="list-style-type: none"> Reuse of excavated soil as other construction materials as much as possible Store flammable waste (e.g. oil, fuel, spill contaminated soil, scrap, oiled clothes), construction and municipal waste separately Sign contracts with licensed organizations specialized in the area of hazardous and municipal waste collection from the site, treatment/recycling or disposal 	Construction contractor	PIU/SCWE and Consultant	Included in construction cost
4. Soil Contamination (oil leakages)	<ul style="list-style-type: none"> Proper management of construction vehicles Proper storage of all liquid materials and lubricants 	Construction contractor	PIU/SCWE and Consultant	Included in construction cost
5. Noise and Vibration	<ul style="list-style-type: none"> Setting of temporary enclosure Minimize construction work during night time Reduce vehicle speeds (stick to recommended speeds) in residential areas Regular check and full maintenance of construction vehicles Notify nearby residents and businesses at least 24 hours in advance if particularly noisy activities are anticipated For workers noise levels shall be kept below 80 dB (A), wherever possible. In case of exceeding this value, hearing protections must be provided to workers 	Construction contractor	PIU/SCWE and Consultant	Included in construction cost
6. Ecosystem	<ul style="list-style-type: none"> Set-up 4 blocks of the Reservoir basin and start of construction works by block in order to secure enough time for the wildlife to evacuate themselves to outside of the Reservoir area Confirmation of nature of poisonous snake identified in the Reservoir area, and awareness of the measure against the snake to the people 	Construction contractor	PIU/SCWE and Consultant	Included in construction cost
7. Involuntary Resettlement/Land acquisition	<ul style="list-style-type: none"> Preparation of an abbreviated RAP Compensation to the affected persons and special considerations to the vulnerable people and affected persons who do not have legal status 	Community concerned, PIU/SCWE	PIU/SCWE Yeghvard, Nor Yerznka Ashtarak communitis and Consultant	Included in project cost
8. The poor	<ul style="list-style-type: none"> Attention to the poor in the affected area 	Community concerned, PIU/SCWE	PIU/SCWE Communitis concerned and Consultant	Included in project cost
9. Livelihood	<ul style="list-style-type: none"> Preparation of an abbreviated RAP Compensation to the affected persons and 	Community concerned,	PIU/SCWE	Included in

Environmental parameters	Mitigation measures	Responsible organization	Supervising agency	Cost
economy	special considerations to the vulnerable people and affected persons who do not have legal status	PIU/SCWE	Communités concerned and Consultant	project cost
10.Existing social infrastructures and services	<ul style="list-style-type: none"> Decentralization of construction vehicles as much as possible 	Construction contractor	PIU/SCWE	Included in construction cost
11.Land use and local resource utilization	<ul style="list-style-type: none"> Preparation of an abbreviated RAP Compensation to the affected persons and special considerations to the vulnerable people and affected persons who do not have legal status 	Community concerned, PIU/SCWE	PIU/SCWE Communités concerned and Consultant	Included in project cost
12.Working environment	<ul style="list-style-type: none"> Compliance with labor law and proper labor control Proper management of sanitary conditions for labors, including hand-washing facilities and rest rooms Provision of special uniforms, helmets, masks , goggles and so on Preparation of first aid kits Instruction for workers on health and safety practices 	Construction contractor	PIU/SCWE	Included in construction cost
13.Accidents	<ul style="list-style-type: none"> Proper management of construction vehicle operation to minimize centralization Identify nearby medical centers to secure urgent health care for injured workers Instruction on compliance with prescribed routes, speed, to drivers of construction vehicles Health examination of drivers initially and periodically 	Construction contractor	PIU/SCWE	Included in construction cost
14.Historical and cultural monuments	<ul style="list-style-type: none"> Implementation of Chance Find Procedure and training of the construction workers Report to the Ministry of Culture of RA, Department Protection of Monuments and Historical Sites, in case of cultural asset detection 	Construction contractor	PIU/SCWE, Ministry of Culture	Included in construction cost

Table 5-1-8.2 Environmental Management Plan (Operation Stage)

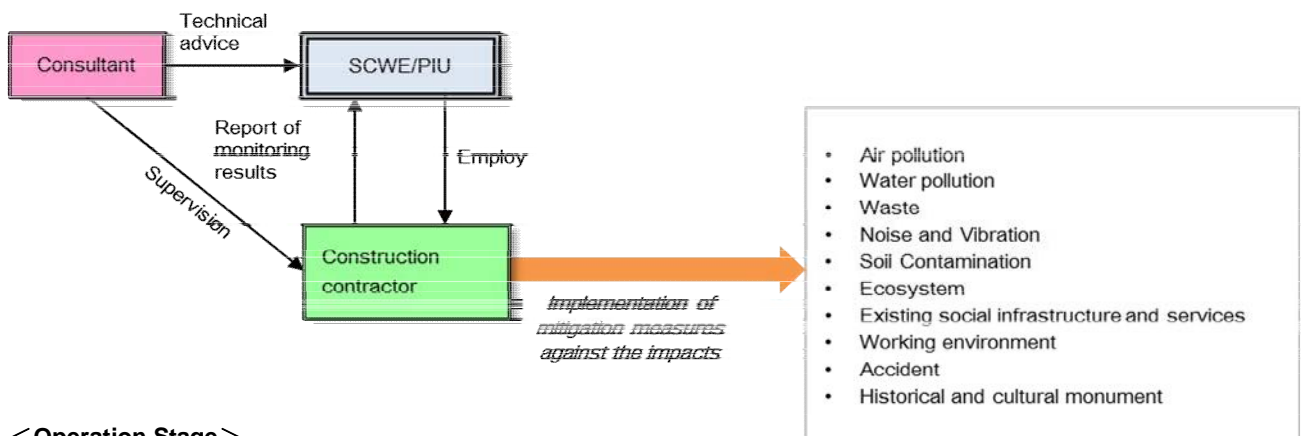
Environmental parameters	Mitigation measures	Responsible organization	Supervising agency	Cost
1. Waste by tourists when restaurants and shopd are constructed around the Reservoir	<ul style="list-style-type: none"> Proper disposal of waste based on the regulation regarding waste 	Owners of shops and restaurants	WSA	Shouldered by the owners of restaurant and shop
2. Soil contamination due to improper agrichemical application	<ul style="list-style-type: none"> Further promotion of proper application of pesticides/insecticides Enhancement control of illegal pesticide/insecticide Establishment of monitoring system of pesticides/insecticides in water, soil and crops 	MOA	MNP	Within budget for routine work
3. Ground water pollution due to excessive fertilizer application	<ul style="list-style-type: none"> Promotion of proper application of fertilizers in accordance with the application standard in Armenia 	MOA	MNP	Within budget for routine work

Environmental parameters	Mitigation measures	Responsible organization	Supervising agency	Cost
4. Impact on fish ecosystem due to water diversion for the Yeghvard Reservoir	<ul style="list-style-type: none"> Compliance with minimum discharge/ecological flow for ecosystem conservation in Hrazdan River 	WUA & WSA	MNP	Within budget for routine work

5-1-9 Monitoring Plan

In the process of implementation of EMP, regular monitoring is necessary. The monitoring results will be compiled as a monitoring report by the responsible organization for mitigation measurement implementation using the proposed monitoring formats below. Based on the proposed monitoring indicators in the formats, it is needed to implement monitoring. In addition, it is important to record how the implementation agency took measures against any problems in the process. The report should be submitted to the supervising agency regularly. The proposed monitoring structure by stage is illustrated in Figure 5-1-9.1. It is noted that the mitigation measures or considerations for 1) Involuntary and land acquisition, 2) The poor, 3) Land use and local resource utilization, and 4) Livelihood /local economy are discussed in Chapter 5-2 in detail, and the proposed monitoring structure for those matters in the sub-chapter.

< Construction Stage >



< Operation Stage >

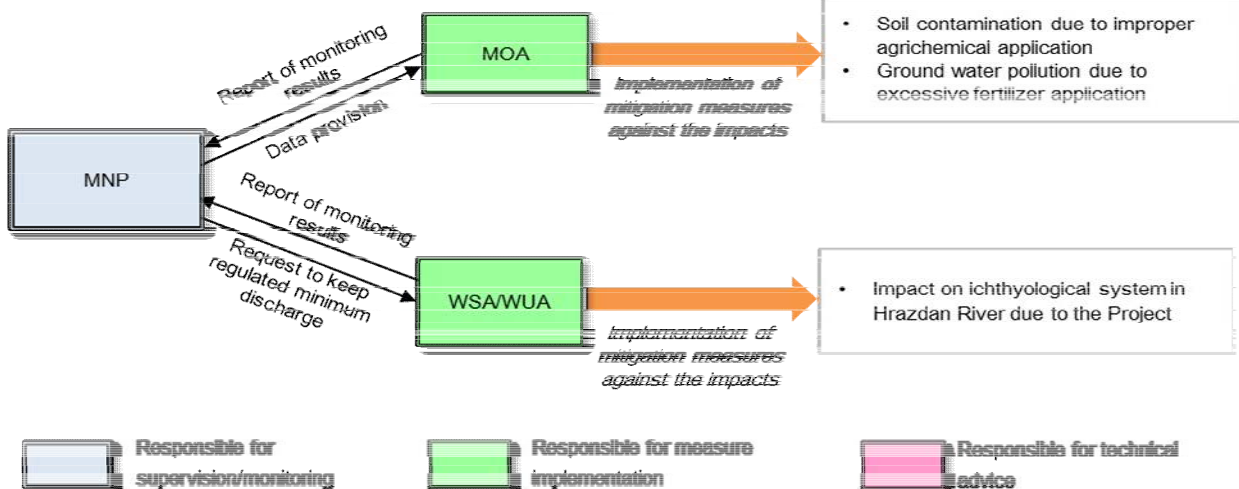


Figure 5-1-9.1 Proposed Structure for EMP Implementation and Monitoring

The monitoring plans during construction stage and operation stage are shown in Table 5-1-9.1 and Table 5-1-9.2, respectively. Draft monitoring forms during construction stage and operation stage are

described in Table 5-1-9.3 and Table 5-1-9.4, respectively.

Table 5-1-9.1 Monitoring Plan (Construction Stage)

Environmental Parameter	Monitoring Item	Survey point	Standard	Frequency	Responsible Organization
1. Air quality	Dust, NO ₂ , CO and SO ₂	At construction site and Nor-Yerznka Community (measurement points are No 1, 2, 3, and 5 in Figure 5-1-6.1)	Mean daily concentration Dust:<15mg/m ³ NO ₂ :<0.04 mg/m ³ CO:<3.0 mg/m ³ SO ₂ :<0.05 mg/m ³	Once per month	PIU/SCWE and Consultant
2. Water quality (mud water)	Suspended Solid (SS)	1) Outlet point from the Outlet Canal 2 to the Kasakh River 2) Outlet point from the Outlet Canal 1 to the Arzni Branch Canal	SS<30 mg/l	Once per month	PIU/SCWE and Consultant
3. Noise and vibration	Noise (dB)	At Yeghvard city and Nor Yerznka community (measurement points are No.4 and No.5 in Figure 5-1-6.4)	Allowable noise level in accordance with Armenian Norm	Once per month	PIU/SCWE and Consultant
4. Waste	Conditions of reuse of excavated soil and classification, proper disposal of garbage by field observation	At construction site and labor camp	-	Once per month	PIU/SCWE and Consultant
5. Soil contamination	Oil leakage	At construction site	-	Once per month	PIU/SCWE and Consultant
6. Ecosystem	<ul style="list-style-type: none"> Sequential construction works by block Number of accident by poisonous snakes 	At the reservoir	-	<ul style="list-style-type: none"> Once (when sequential construction is practiced) As required 	PIU/SCWE and Consultant
7. Involuntary Resettlement/L and acquisition*	Payment (before construction) Number of complaints and frequency	In Yeghvard community, Nor -Yerznka community and Ashtarak community	-	Quarterly before construction and yearly in construction stage	PIU/SCWE and Consultant
8. The poor*	Payment (before construction) Number of complaints and frequency	In Yeghvard community, Nor -Yerznka community and Ashtarak community	-	Quarterly before construction and yearly in construction stage	PIU/SCWE and Consultant
9. Livelihood/local economy*	Number of complaints and frequency	In Yeghvard community, Nor -Yerznka community and Ashtarak community	-	Quarterly before construction and yearly in construction stage	PIU/SCWE and Consultant
10. Existing social infrastructures and services (traffic jam)	<ul style="list-style-type: none"> Conditions of traffic jam by field observation Complaint from the 	Around construction site	-	Once per month	PIU/SCWE

Environmental Parameter	Monitoring Item	Survey point	Standard	Frequency	Responsible Organization
	residents				
11. Land use and local resource utilization*	Number of complaints and frequency	In Yeghvard community, Nor-Yerznka community and Ashtarak community	-	Quarterly before construction and yearly in construction stage	PIU/SCWE and Consultant
12. Safety/Working environment	Safety and working environment by field inspection	At the construction site	-	Once per month	PIU/SCWE
13. Accident	Number of accident	In and around the construction site	-	Every time any accidents are caused	PIU/SCWE
14. Historical and cultural monuments	Number of discovered historical and cultural assets	In and around the construction site	-	When any cultural assets are uncovered	PIU/SCWE and Consultant

*Detailed monitoring plan for parameters of No.7, No.8, No.9 and No.11 are described in Chapter 5-2.

Table 5-1-9.2 Monitoring Plan (Operation Stage)

Environmental Parameter	Monitoring Item	Survey point	Standard	Frequency	Responsible Organization
1. Waste	• Proper disposal of garbage by field observation	Around the Reservoir	-	Once per 3 months	WSA
2. Soil contamination	• Check of sale conditions of pesticide and insecticide at retailers • Check of application method of pesticide and insecticide by the farmers • Establishment of monitoring system residual pesticide/insecticide in water/soil/crops	At the project target communities	-	Once per 3 months	MNP
3. Ground water	• Check of application method of fertilizers by the farmers	At the project target communities		Once per 3 months	MNP
4. Impact on fish ecosystem due to water diversion for the Yeghvard Reservoir	Confirmation of river water discharge	At discharge observatory stations	-	3 times per year	MNP

Due to implementation of the abbreviated RAP, it is possible to mitigate expected impacts described in No.7, No.8, No.9 and No.11 in Table 5-1-9.1. Therefore, monitoring indicators for those matters can be set as “number of complaint by the affected persons” and “how the implementation agency (the Government of Armenia) takes measures against complaints” as mentioned in Table 5-1-9.3.

Table 5-1-9.3 Draft Monitoring Form (Construction Period)

(1) Response and actions by the government

Comments and response	Monitoring results
Number and contents of comments from the people	
Number and response to the comments from the government	

(2) Pollution

Environmental Parameter	Monitoring Item/standard	Measured value (min)	Measured value (max)	Survey point	Frequency
Air quality	Mean daily concentration Dust:<15mg/m ³ NO ₂ :<0.04 mg/m ³ CO:<3.0 mg/m ³			At construction site and Nor-Yerznka Community (measurement points are No 1, 2, 3, and 5 in Figure 5-1-6.1)	Once per month

Environmental Parameter	Monitoring Item/standard	Measured value (min)	Measured value (max)	Survey point	Frequency
	SO ₂ :<0.05 mg/m ³				
Water quality	SS<30mg/l			1) Outlet point from the Outlet Canal 2 to the Kasakh River 2) Outlet point from the Outlet Canal 1 to the Arzni Branch Canal	Once per month
Noise and vibration	Complaint from the people			At Yeghvard city and Nor Yerznka community (measurement points are No.4 and No.5 in Figure 5-1-6.4)	Once per month
Soil contamination	Oil leakage			Construction site	Once per month

(3) Natural Environment

Environmental Parameter	Monitoring indicator	Monitoring results	Measures taken
Waste	<ul style="list-style-type: none"> Waste classification Waste permission by the MNP Waste disposal point 		
Ecosystem	<ul style="list-style-type: none"> Whether Reservoir construction by bloc is implemented or not 		

(4) Social Environment

Environmental Parameter	Monitoring indicator	Monitoring results	Measures taken
Existing social infrastructures and services	<ul style="list-style-type: none"> Traffic conditions Complaint from the people 		
Historical and cultural monuments	<ul style="list-style-type: none"> Whether Historical and cultural monuments are discovered 		
Accident	Number of incidence		

Table 5-1-9.4 Draft Monitoring Form (Operation Period)**(1) Response and actions by the government**

Comments and response	Monitoring results	Measures taken	Frequency
Number and contents of comments from the people			
Number and response to the comments from the government			

(2) Natural Environment

Environmental Parameter	Methodology	Monitoring results	Measures taken	Frequency
Waste	Regular monitoring by field observation			
Soil contamination by illegal agrichemical application in the beneficial area	Regular monitoring activities by the MOA for control of illegal agrichemical sale			
Pollution of groundwater by excessive fertilizer application in the beneficial area	Regular monitoring activities by the MNP			
Keeping ecological minimum discharge of Hrazdan River to minimize impact on eco-system	Water distribution by WSA and WUA			

5-1-10 Stakeholder Meeting

According to the JICA Guidelines, it is needed to organize a series of Stakeholder Meeting, and the necessary procedure and purpose are almost same as those in Armenia. Therefore, the Public Hearing can be regarded as Stakeholder Meeting. Based on the Law on Environmental Impact Assessment and Expertise, the 1st Public Hearing under name of SCWE was organized at Scoping stage.

The 2nd Public Hearing on the Draft ESIA Report to explain the Project component and expected environmental impacts in the name of SCWE the after the Draft Final Report was submitted to the Government of Armenia. As a whole, the report was accepted by the participants. Apart from those hearing, Public Seminars to introduce the Project outline and expected environmental impact by the Project were also organized. The detailed discussion results are described in Chapter 5-2-10.

5-2 Involuntary Resettlement and Land Acquisition

5-2-1 Necessity of Resettlement and Land Acquisition

Due to the proposed facility to be constructed, land acquisition will be caused. Figure 1-4.1 illustrates anticipated affected areas.

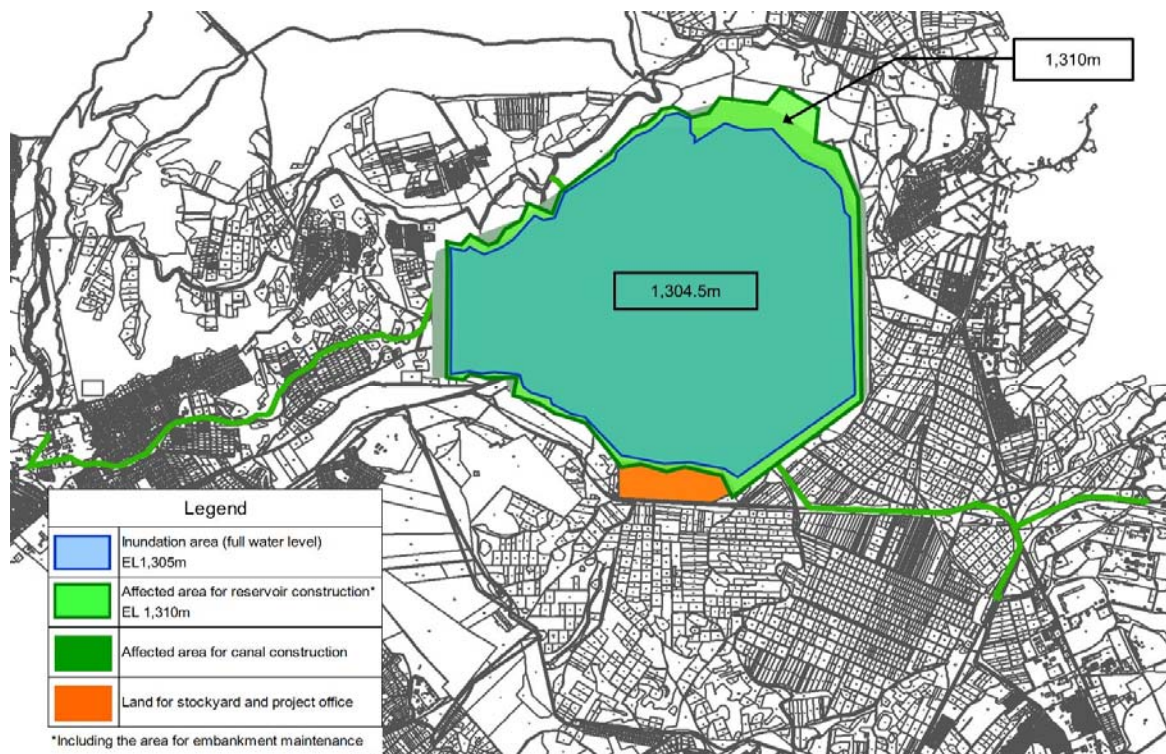


Figure 5-2-1.1 Anticipated Project Affected Area

While physical relocation will not be caused by the Project, land acquisition will be caused due to construction of the Reservoir and irrigation canals. Especially, the permanent land acquisition of 808ha is needed for construction of the Reservoir and Feeder Canal 2. On the other hand, concerning the area for Feeder Canal 1 and Outlet 1~2, the impacts are temporary during the construction period, since those canals are planned to be pipeline. However, there are some orchard plots and perennial grazing lands, they can be affected by the construction works even though the works are temporary.

5-2-1-1 Examination of Two Candidate Routes for Outlet Canal 2

At initial stage of the Survey, there were two options for the Outlet Canal 2 to divert water from the Reservoir to the Kasakh River, namely, 1) one route which passes through the orchard area, and 2) another route which passes through the natural flow. Finally, the second option, which can cause less impact in terms of land acquisition than the other route, was proposed. The detailed comparison of those two options is mentioned in Chapter 5-1-4-5.

5-2-1-2 Examination of Options to Minimize the damage to the Orchard

At the north-east of the Dike 1, a big scale of orchard with 24 ha area is located. According to the proposed project plan, approximately half of the orchard (11.4ha) will be submerged. Therefore, two options, namely, a) compensation for the damaged orchard and b) protection for the orchard by extension of Dike 1, are compared in terms of cost. Figure 5-2-1.3 shows the comparison result. Cost of compensation to the affected orchard is 17.7 million USD, which is much lower than that of dike extension, with 25.1 million USD. Therefore, it is concluded that extension of the Dike 1 is not

applied.

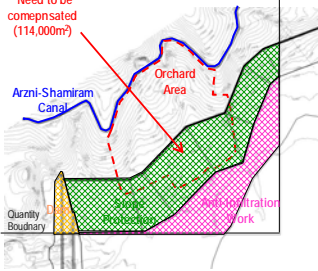
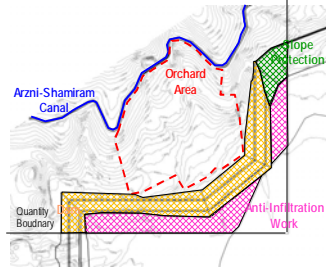
		Plan A (Compensation area is Maximum)	Plan B (Compensation area is Nil)					
Outline								
Compensation fee		Area/Volume (m ² /m ³)	Unit Cost (USD)	Sub Total (USD)	Area/Volume (m ² /m ³)	Unit Cost (USD)	Sub Total (USD)	
	Tree loss	114,000 m ²	x 0.18 =	20,520	0 m ²	x 0.18 =	0	
	Land loss	114,000 m ²	x 0.60 =	68,400	0 m ²	x 0.60 =	0	
Construction Cost	Slope Protection	Small Dike	10,000 m ³	x 33.14 =	331,400	990 m ³	x 33.14 =	32,809
		Slope protection	314,000 m ²	x 14.31 =	4,493,340	27,000 m ²	x 14.31 =	386,370
	Dam	Anti Infiltration Work	154,000 m ²	x 14.31 =	2,203,740	170,000 m ²	x 14.31 =	2,432,700
		Core	59,000 m ³	x 4.56 =	269,040	375,000 m ³	x 4.56 =	1,710,000
		Filter	5,700 m ³	x 11.52 =	65,664	31,000 m ³	x 11.52 =	357,120
		Surface Protection	7,700 m ³	x 33.14 =	255,178	57,000 m ³	x 33.14 =	1,888,980
		Sand-and-Gravel	130,000 m ³	x 4.91 =	638,300	919,000 m ³	x 4.91 =	4,512,290
		Sand-and-Gravel (Dam Crest)	1,500 m ³	x 4.91 =	7,365	7,900 m ³	x 4.91 =	38,789
		Scoria (Dam Crest)	240 m ³	x 4.91 =	1,178	1,300 m ³	x 4.91 =	6,383
		Counter Weight	7,100 m ³	x 3.83 =	27,193	49,095 m ³	x 3.83 =	188,032
Stripping	14,000 m ³	x 3.98 =	55,720	87,000 m ³	x 3.98 =	346,260		
	Direct Construction Cost			8,348,118			11,899,733	
	InDirect Cost (111% of Direct Cost)			9,266,411			13,208,704	
	Sub Total			17,614,529			25,108,437	
Total	(USD)			17,703,449			25,108,437	
	(Million USD)			17.7			25.1	

Figure 5-2-1.2 Comparison of Options to Minimize Damage to the Orchard

5-2-2 Legal and Administrative Framework

5-2-2-1 National Regulations Related to Resettlement and Land Acquisition

The Constitution of Armenia (2015) guarantees protection of ownership rights and provides that the ownership may be terminated in exclusive cases of land acquisition based on an established legislation with prior equivalent compensation for public and state interest. Land acquisition and compensation cases are envisaged in Land Code of the Articles 102 and 104, the RA Civil Code (1998), and Articles 218 to 221 of Armenian Law “On the Alienation of the Private Property for Public and State Needs” adopted on 27 November 2006. The Law was amended on 21 June 2014. Under the existing laws, the Armenian Government will issue a Decree determining the case of exclusive public and state priority needs based on the request from relevant state agencies.

Law of Armenia “On the Alienation of the Private Property for Public and State Needs” specifies the land acquisition procedures, compensation rights of titled landowners and owners of immovable property in cases of alienation of their property for public purposes. Upon enactment of the government decree on recognition of property as prevailing exclusive public interest, the authorized body shall compile minutes describing the alienated property according to the procedure, public interest requiring property alienation, deadlines defined by the government; Acquiring party, owners and those holding property rights towards the alienated property are to be compiled. Assessment of the real estate or the real estate rights shall be made in accordance with the procedure defined under the Act of the Armenia on Assessment of Real Estate in Armenia adopted in October 4, 2005. The list of main laws related to land acquisition in Armenia is shown in Table 5-2-2.1.

Table 5-2-2.1 Main Laws on Land Acquisition in Armenia

Adaption/ Amended	No. of the Law	The name of Laws (in English)
1995/ 2015	–	The Constitution of the Republic of Armenia
1998	No 1998/17	The Civil Code of the Republic of Armenia
1998	No 1988/20	The Code of Civil Procedure
2001	No 2001/17	The Land Code of the Republic of Armenia
2005	No 2005/71	The Law on Real Estate Valuation Activity
2006	No 2006/64	The Law on Alienation of Property for the Needs of Society and State
2007	No 2007/64	The Code of Administrative Procedure

5-2-2-2 JICA Guidelines on Resettlement and Land Acquisition

On the JICA Guidelines for Environmental and Social Considerations (hereinafter, “JICA Guidelines”), Resettlement and Land Acquisition are regulated as followings;

The key principle of JICA policies on involuntary resettlement is summarized below.

- I. Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives.
- II. When, population displacement is unavoidable, effective measures to minimize the impact and to compensate for losses should be taken.
- III. People who must be resettled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported, so that they can improve or at least restore their standard of living, income opportunities and production levels to pre-project levels.
- IV. Compensation must be based on the full replacement cost¹ as much as possible.
- V. Compensation and other kinds of assistance must be provided prior to displacement.
- VI. For projects that entail large-scale involuntary resettlement, resettlement action plans must be prepared and made available to the public. It is desirable that the resettlement action plan include elements laid out in the World Bank Safeguard Policy, OP 4.12, Annex A.
- VII. In preparing a resettlement action plan, consultations must be held with the affected people and their communities based on sufficient information made available to them in advance. When consultations are held, explanations must be given in a form, manner, and language that are understandable to the affected people.
- VIII. Appropriate participation of affected people must be promoted in planning, implementation, and monitoring of resettlement action plans.
- IX. Appropriate and accessible grievance mechanisms must be established for the affected people and their communities.

¹ Description of “replacement cost” is as follows.

Land	Agricultural Land	The pre-project or pre-displacement, whichever is higher, market value of land of equal productive potential or use located in the vicinity of the affected land, plus the cost of preparing the land to levels similar to those of the affected land, plus the cost of any registration and transfer taxes.
	Land in Urban Areas	The pre-displacement market value of land of equal size and use, with similar or improved public infrastructure facilities and services and located in the vicinity of the affected land, plus the cost of any registration and transfer taxes.
Structure	Houses and other Structures	The market cost of the materials to build a replacement structure with an area and quality similar or better than those of the affected structure, or to repair a partially affected structure, plus the cost of transporting building materials to the construction site, plus the cost of any labor and contractors' fees, plus the cost of any registration and transfer taxes.

Above principles are complemented by World Bank OP 4.12, since it is stated in JICA Guideline that "JICA confirms that projects do not deviate significantly from the World Bank's Safeguard Policies". Additional key principle based on World Bank OP 4.12 is as follows.

- X. Affected people are to be identified and recorded as early as possible in order to establish their eligibility through an initial baseline survey (including population census that serves as an eligibility cut-off date, asset inventory, and socioeconomic survey), preferably at the Project identification stage, to prevent a subsequent influx of encroachers of others who wish to take advance of such benefits.
- XI. Eligibility of Benefits include, the PAPs (Project Affected Persons) who have formal legal rights to land (including customary and traditional land rights recognized under law), the PAPs who don't have formal legal rights to land at the time of census but have a claim to such land or assets and the PAPs who have no recognizable legal right to the land they are occupying.
- XII. Preference should be given to land-based resettlement strategies for displaced persons whose livelihoods are land-based
- XIII. Provide support for the transition period (between displacement and livelihood restoration).
- XIV. Particular attention must be paid to the needs of the vulnerable groups among those displaced, especially those below the poverty line, landless, elderly, women and children, ethnic minorities etc.
- XV. For projects that entail land acquisition or involuntary resettlement of fewer than 200 people, abbreviated resettlement plan is to be prepared.

In addition to the above core principles on the JICA policy, it also laid emphasis on a detailed resettlement policy inclusive of all the above points; project specific resettlement plan; institutional framework for implementation; monitoring and evaluation mechanism; time schedule for implementation; and, detailed Financial Plan etc.

5-2-2-3 GAP Analysis between JICA Guidelines/ WB OP.4.12 and Armenian Legislation

Gaps between JICA Guidelines/ WB OP.4.12 and the laws on Armenia in terms of resettlement and land acquisition are analyzed as shown in Table 5-2-2.2.

Table 5-2-2.2 Gap Analysis between the Armenian Law and JICA Guidelines/ WB OP.4.12

No.	JICA Guideline/ WB O4.12	Armenian National Legislation	Gaps	Measure to fill the gaps
1	Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives (JICA GL)	The Article 4 of the "Armenian Law on Alienation of the property for public and state needs" (hereinafter mentioned as "the Land Alienation Law") sets that "The public interest should have higher priority than the interest of the proprietor of the alienated property". However, on the social norms, involuntary resettlement and losing livelihood should be avoided as much as possible.	None	-
2	When population displacement is unavoidable, effective measures to minimize impact and to compensate for losses should be taken (JICA GL)	The Article 11 on "the Land Alienation Law" sets the principle to compensate at market price of property plus 15% (= full replacement cost) for losses caused by involuntary property acquisition. The financial duties (taxes, fees, mandatory payments) related to property alienation are compensated by the acquirer.	None	-
3	People who must be resettled involuntarily and	According to the Article 11 of "the Land Alienation Law", "the compensation is	None	-

No.	JICA Guideline/ WB O4.12	Armenian National Legislation	Gaps	Measure to fill the gaps
	people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported, so that they can improve or at least restore their standard of living, income opportunities and production levels to pre-project levels (JICA GL)	based on market price plus 15%. It can be regarded that it is to restore Project Affected Persons (PAPs)' living standard to pre-project levels.		
4	Compensation must be based on the full replacement cost as much as possible (JICA GL)	As mentioned above, the compensation is based on the market price plus 15% of the alienated property.	None	-
5	Compensation and other kinds of assistance must be provided prior to displacement (JICA GL)	In the Clause 2, Article 3 of "the Land Alienation Law", adequate compensation for the alienated property is to be given at initial stage. Compensations is provided prior to displacement and property alienation.	None	-
6	For projects that entail large-scale involuntary resettlement, resettlement action plans must be prepared and made available to the public (JICA GL) For projects that entail land acquisition or involuntary resettlement of fewer than 200 people, abbreviated resettlement plan is to be prepared. (WB OP4.12 Para.25)	"The Land Alienation Law" does not set legal provision to elaborate the resettlement action plan.	It is not necessary to prepare RAP in Armenia.	Abbreviated RAP is to be prepared.
7	In preparing a resettlement action plan, consultations must be held with the affected people and their communities based on sufficient information made available to them in advance (JICA GL)	There are no clear legal requirements to hold consultations with the affected population for resettlement and property alienation in the National Legislation.	There is no provision about preparation or RAP and consultations.	In the process of RAP preparation, it is needed to organize consultations with the PAPs.
8	When consultations are held, explanations must be given in a form, manner, and language that are understandable to the affected people (JICA GL)	According to the Articles 3 and 4 of the Armenian Law on Language, all the official notifications within the land acquisition process should be proceed in Armenian Language. Public discussions should be held in Armenian language. For the ethnic minority groups, most of them can communicate in Armenian language without difficulty. Those who can understand Armenian language in the minority groups can support the PAPs in their own language.	None	-
9	Appropriate participation of affected people must be promoted in planning, implementation, and monitoring of resettlement action plans (JICA GL)	There are no clear legal requirements to assure participation of affected people in RAP planning, implementation and monitoring in the National Legislation. However, at the consultation meeting in the planning process, it is possible for the PAPs to join.	There is no mention about partition of affected people into RAP preparation, implementation and monitoring.	In the consultation and monitoring process, it is proposed to involve representative of PAPs.
10	Appropriate and accessible grievance mechanisms must be established for the affected people and their communities (JICA GL)	Article 9 of "the Land Alienation Law" sets provisions to establish grievance mechanisms. Affected population with legal ownership have the rights to appeal the Government decisions on evaluation of properties to be	No grievance system except for complaint about property evaluation result is established in the	An accessible grievance system for the PAPs should be established.

No.	JICA Guideline/ WB O4.12	Armenian National Legislation	Gaps	Measure to fill the gaps
		alienated. However, the grievance opportunity for PAPs is limited to submission of appeal for the preliminary investigation of the property. For the other issues (stages) appropriate and accessible grievance mechanisms are not established.	National Regulation.	
11	Affected people are to be identified and recorded as early as possible in order to establish their eligibility through an initial baseline survey (including population census that serves as an eligibility cut-off date, asset inventory, and socioeconomic survey), preferably at the project identification stage, to prevent a subsequent influx of encroachers of others who wish to take advantage of such benefits (WB OP4.12 Para.6)	As stated in the Clause 2, Article 7 of the RA Law "the Land Alienation Law", identification of affected people (property holders) and assets is to be done at the preliminary stage. There is no provision for cut-off date and socioeconomic survey.	There is no provision for cut-off date. There is no mention about socioeconomic survey implementation.	Cut-off date cannot be set at Feasibility Stage (F/S) stage. However, it can be set at Detailed Design (D/D) stage after concluding Loan Agreement. Socioeconomic survey and census survey targeting the PAPs should be implemented at early stage of the Project. In this F/S stage, socioeconomic survey and census survey to identify the PAPs were carried out, even though it was not official.
12	Eligibility of benefits includes, the PAPs who have formal legal rights to land (including customary and traditional land rights recognized under law), the PAPs who don't have formal legal rights to land at the time of census but have a claim to such land or assets and the PAPs who have no recognizable legal right to the land they are occupying (WB OP4.12 Para.15)	It clearly fixed in the Clause 6, Article 11 of "the Land Alienation Law" that compensation is provided only for property owners with legal status.	In the Armenian legislation, only legal property owners are eligible for compensation.	Compensation for land loss cannot be provided to the PAPs who do not have legal status. However, they will be provided with special consideration by the Project to mitigate the impact. Compensation for tree loss should be paid to all PAPs, regardless of legal status.
13	Preference should be given to land-based resettlement strategies for displaced persons whose livelihoods are land-based (WB OP4.12 Para.11)	The compensation strategy set by the national legislation (Article 11 of "the Land Alienation Law") includes only cash compensation regardless of livelihood and other social characteristics of the displaced people. Evaluator with license estimates the market price of land to be acquired including the land productivity.	Cash compensation for properties is principle in Armenia.	Cash compensation for land loss considering the land productivity is to be provided.
14	Provide support for the transition period (between displacement and livelihood restoration) (WB OP4.12 Para.6)	The national legislation does not envisage support for the transition period.	There is no mention in Armenian Legislation.	The Project will not cause physical relocation of local residents. Cash compensation for the land loss considering the land productivity is to be provided.
15	Particular attention must be paid to the needs of the vulnerable groups among those displaced, especially those below the poverty line, landless, elderly, women and children, ethnic minorities etc. (WB OP4.12 Para.8)	The National legislation does not set legal mechanisms to pay particular attention to the vulnerable groups of people.	There is no mention in Armenian Legislation.	Special consideration to the vulnerable people should be paid.
16	When impacts on the entire	The National legislation does not	There is no	The number of PAPs

No.	JICA Guideline/ WB O4.12	Armenian National Legislation	Gaps	Measure to fill the gaps
	displaced population are minor, or fewer than 200 people are displaced, abbreviated resettlement plan is to be prepared (WB OP4.12 Para.25).	envisage preparation of abbreviated resettlement action plans.	mention in Armenian Legislation for RAP.	to be relocated is nil, therefore, an abbreviated RAP preparation is necessary (instead of full RAP) for the Project.

5-2-2-4 Policy for Resettlement and Land Acquisition on the Project

The policy for Resettlement and Land Acquisition on the Project was proposed as followings;

- I. The Government of Armenia will use the Project Resettlement Policy (the Project Policy) for the Yeghvard Irrigation System Improvement Project specifically because existing national laws and regulations have not been necessarily designed to address involuntary resettlement according to international practice, including, JICA's policy. The Project Policy is aimed at filling-in any gaps in what local laws and regulations cannot provide in order to help ensure that PAPs are able to rehabilitation themselves to at least their pre-project condition. This section discusses the principles of the Project Policy and the entitlements of the PAPs based on the type and degree of their losses. Where there are gaps between the Armenian legal framework for resettlement and JICA's Policy on Involuntary Resettlement, practicable mutually agreeable approaches will be designed consist with Government practices and JICA's Policy.
- II. Land acquisition and involuntary resettlement will be avoided where feasible, or minimized, by identifying possible alternative project designs that have the least adverse impact on the communities in the Project area.
- III. Where displacement of households is unavoidable, all PAPs (including communities) losing assets, livelihoods or resources will be fully compensated and assisted so that they can improve, or at least restore, their former economic and social conditions.
- IV. Compensation and rehabilitation support will be provided to legal PAPs, that is, any person or household or business which on account of project implementation would have his, her or their:
 - Standard of living adversely affected;
 - Right to use any land (including premises, agricultural and grazing land, right in annual or perennial crops and trees or any other fixed or moveable assets, acquired or proceeded, temporarily or permanently;
- V. All affected people with legal status will be eligible for compensation and rehabilitation assistance, social or economic standing and any such factors that may discriminate against achievement of the objectives outlined above. In case of affected people without legal status will be eligible for considerations/supports to restore the current livelihood.
- VI. PAPs that lose only part of their physical assets will not be left with a portion that will be inadequate to sustain their current standard of living. The minimum size of remaining land and structures will be agreed during the resettlement planning process.
- VII. People temporarily affected are to be considered as PAPs and resettlement plans address the issue of temporary acquisition.
- VIII. The resettlement plans will be designed in accordance with the Laws related to resettlement and land acquisition and JICA's Policy on Involuntary Resettlement.
- IX. The Resettlement Plan will be translated into local languages and disclosed for the reference of PAPs as

well as other interested group.

- X. Payment for land and/or non-land assets will be based on the principle of replacement cost.
- XI. Compensation for PAPs dependent on agricultural activities will be paid by cash based on the laws in Armenia. The cost estimation of the compensation shall be done in accordance with the laws in Armenia.
- XII. The resettlement plan must consider the needs of those most vulnerable to the adverse impacts of resettlement (including the poor, those without legal title to land, ethnic minorities, women, children, elderly, and disabled) and ensure they are provided with special consideration in resettlement planning and mitigation measures identified. Assistance should be provided to help them improve their socioeconomic status.
- XIII. PAPs will be involved in the process of developing and implementing resettlement plans.
- XIV. PAPs and their communities will be consulted about the Project, the rights and options available to them, and proposed mitigation measures for adverse effects, and to the extent possible be involved in the rescissions that are made concerning their resettlement.
- XV. Adequate budgetary support will be fully committed and made available to cover the costs of land acquisition (including compensation and income restoration measures) within the agreed implementation period. The funds for all resettlement activities will come from the Armenian Government.
- XVI. Acquisition of assets, payment of compensation, and resettlement and start of the livelihood rehabilitation activities of PAPs, will be completed prior to any construction activities, except when a court of law orders so in expropriation cases. (Livelihood restoration measures must also be in place but not necessarily completed prior to construction activities, as these may be ongoing activities.)
- XVII. Organization and administrative arrangements for the effective preparation and implementation of the resettlement plan will be identified and in place prior to the commencement of the process; this will include the provision of adequate human resources for supervision, consultation, and monitoring of land acquisition and rehabilitation activities.
- XVIII. Appropriate reporting (including auditing and redress functions), monitoring and evaluation mechanisms, will be identified and set in place as part of the resettlement management system. Consultant will be hired to provide technical advices for the implementation agency during construction period.

Cut-off-date of Eligibility

The cut-off-date of eligibility refers to the date prior to which the occupation or use of the Project area makes residents/users of the same eligible to be categorized as PAPs and be eligible to Project entitlements. In the Project, after the loan agreement between the Government of Armenia and Government of Japan, namely, detailed design stage, cut-off date will be declared. This date will be disclosed to each affected village by the relevant local governments and the villages will disclose to their populations. The establishment of the eligibility cut-off date is intended to prevent the influx of ineligible non-residents who might take advantage of Project entitlements.

Principle of Replacement Cost

All compensation for land and non-land assets owned by households/shop owners who meet the cut-off-date will be based on the principle of replacement cost. Replacement cost is the amount calculated before displacement which is needed to replace an affected asset without depreciation and without deduction for taxes and/or costs of transaction as follows:

- a. Productive Land (agricultural, aquaculture, garden and forest) based on actual current market prices that

reflect recent land sales in the area and the price is evaluated by the professional land evaluator with license. Plus, 15% of the market values shall be included in the compensation fee.

- b. Residential land based on actual current market prices that reflect recent land sales, plus, 15% of the market values shall be included in the compensation fee.
- c. Existing government regulations for compensation calculations for building, crops and trees, "The Law on Alienation of Property for the Needs of Society and State" will be used where ever available. If the law does not cover properties to be affected, "Resettlement Policy Framework", which has been agreed between the Government of Armenia and ADB can referred.
- d. Annual crops equivalent to current market value of crops at the time of compensation;
- e. For perennial crops, cash compensation at replacement cost that should be in line with methods applied by ADB, if available, is equivalent to current market value given the type and age at the time of compensation.

5-2-3 Scope of Resettlement

5-2-3-1 Population Census Survey

The population census survey to identify PAPs was carried out in Yeghvard city, Nor-Yerznka village, and Ashtarak city, from March to April in 2016, based on the official cadastral map provided by State Committee of Real Estate Cadastral. However, it was found some illegal land users, who have cultivated in state and community lands to be affected.

(1) Illegal land users of the Project affected area for irrigation canals

In the Project, two feeder canals and two outlet canals area proposed to construct. Feeder Canal 1, Feeder Canal 2, and Outlet Canal 1 are planned to construct in Yeghvard city. There is no illegal land users in the area.

On the other hand, there are 7 illegal land users (households) with 44 family members in total in the area for Outlet Canal 2 in Nor-Yerznka village.

(2) Illegal land users of the Project affected area for the Reservoir

In the Reservoir basin, all of the illegal land users are not identified². On the other hand, 53 plots under cultivation were identified within the Reservoir basin. JICA Survey Team made a survey with the local farmers to identify the cultivated plots within the Reservoir basin. As a results, 53 plots were identified. Remaining parts are natural grazing land and infertile area³. Therefore, it is assumed that there are 53 Project Affected Households (PAHs) in maximum, if each household cultivates one plot. According to the socioeconomic survey, the number of family members in average is 5.59 person. Then, the number of PAPs of illegal land users within the Reservoir basin can be calculated by multiplying 5.59 persons and 53 PAHs. Accordingly, it is 296 persons.

(3) Labors for cultivation within the Reservoir basin

According to the interview to one cultivator who cultivates hiring labors within the Reservoir basin. The illegal land users cultivate 1.0 ha hire labors for 4 days per year in usual. And the labors work 4 hours per day. The main works of labors are followings;

- 1) Plowing; 40,000 AMD/ha (including salary of labor, and rental fee for a tractor)

² The detailed information about the illegal land users who have cultivated within the Reservoir basin is mentioned later (see, "3-3 Socioeconomic Survey").

³ JICA Survey Team carried out the field survey in the Reservoir basin to identify the cultivated plots, cultivated crops, and are of each cultivated plot.

2) Seeding; 10,000 AMD/ha

3) Watering; 10,000 AMD/ha

The illegal land users within the Reservoir basin hire one (1) labor for one (1) day per year, since the different labors are hired depending on the works. Some labors take on works outside of the Reservoir basin by using their own tractor, and some of them have their own farm lands. From those conditions, it can be said that the labors does not reply on the wage of works within the Reservoir basin significantly.

According to the interview, the relationship between the illegal land user and labors is not dense each other. Then, illegal land user do not have the contact number of the labors. For these reasons, there is no serious impact on the labors who are hired by illegal land users within the Reservoir basin. Thus, such labors are not included to PAPs, in the Project.

(4) Total number of PAPs

Physical relocation in the Project affected area is not required. And Table 5-2-3.1 shows the number of PAHs and PAPs counted with 418 PAPs in 75 PAHs.

Table 5-2-3.1 Numbers of PAHs and PAPs

Type of loss	No. of PAHs			No. of PAPs		
	Legal	Illegal	Total	Legal	Illegal	Total
1. Required for physical relocation						
1-1.HH (Structure owner on Gov. land)	Nil	Nil	Nil	Nil	Nil	Nil
1-2.HH (Structure owner on Private land)	Nil	Nil	Nil	Nil	Nil	Nil
1-3.HH (Tenants)	Nil	Nil	Nil	Nil	Nil	Nil
1-4.CBEs (Structure owner on Gov. land)	Nil	Nil	Nil	Nil	Nil	Nil
1-5.CBEs (Structure owner on Private land)	Nil	Nil	Nil	Nil	Nil	Nil
1-6.CBEs (Tenants)	Nil	Nil	Nil	Nil	Nil	Nil
1-7.Community owned structures including physical cultural resources	Nil	Nil	Nil	Nil	Nil	Nil
Sub-total (1)	Nil	Nil	Nil	Nil	Nil	Nil
2. Not required for physical relocation						
2-1.State or Community owned land ⁴	-	60	60	-	340	340
1) Canal area	-	7	7	-	44	44
2) Reservoir area	-	53	53	-	296	296
2-2.Private owned land	15	-	15	78	-	78
1) Canal area	12	-	12	64	-	64
2) Reservoir area	3	-	3	14	-	14
2-3.Labor [*]	-	-	-	-	-	-
Sub-total (2)	15	60	75	78	340	418
Total (Sub-total 1~2)	15	60	75	78	340	418

Source) JICA Survey Team, March-April of 2016

Remarks) 1. In the Project, farming labors are not included to PAPs.

2. CBEs; Commercial and Business Enterprises

(5) Cut-off date

The cut-off-date has not been declared at F/S stage, since the Project follow the general way of Armenia, namely, the cut-off date is established and declared at D/D stage. However, the PAPs have been already identified by the census survey and socioeconomic survey at F/S stage. In the D/D stage, cut-off date should be established on the first date of final census survey and declared to all PAPs in advance, to prevent new residents' influx to the Project affected area. For evidences, it is proposed to take pictures of the Project affected area and PAPs before several days from cut-off date.

Information and data about the PAPs during F/S stage will be used at D/D stage. The results of census

⁴ If the illegal users have cultivated one plot, there would be 53 illegal land users in maximum. Hence, the number of affected households are assumed as 53 households. In addition, according to the socioeconomic survey, the average number of family members in the Project affected area is 5.59 person. Then, the number of PAPs of illegal land users within the Reservoir area is assumed approximately 296 persons.

survey should be updated, since the situation of the Project affected area will be changed. According to the WB OP.4.12, the census survey must be carried out again, if the land acquisition has not conducted within two years from the last census survey. However, there is no regulation about such issue on the law of Armenia. Thus, it is proposed that the Project follows the regulation of WB OP.4.12, that is; the effective period of census survey is two years. It is planned to take 14 months for D/D stage, and cut-off date will be declared around 9th month of D/D stage⁵.

5-2-3-2 Assets and Lands Survey

For construction irrigation canals and the Reservoir, temporary or it is needed permanent land acquisition. The results of surveys of asset and land in the Project area are shown below.

(1) Project affected area

In the Project affected area, land ownerships are classified into three categories, namely a) State Lands, b) Communal Lands of Yeghvard city and Nor-Yerznka village, and c) Private Lands. The total Project affected area is 819.36 ha. And the area affected by construction of the Reservoir is 792.48 ha, which accounts for 97 % of the Project affected area.

Table 5-2-3.2 Project Affected Area by Land Ownership

Category	Plots	Affected Area (ha)
1) State	2	54.49
2) Community	77	738.94
3) Private	25	25.93
Total	104	819.36

Source) JICA Survey Team, March-April of 2016

1) State owned lands

Table 5-2-3.3 shows the land use of State owned, which utilize agriculture mostly.

Table 5-2-3.3 Project Affected Area (State Owned)

No.	Land Use	Affected Area (ha)
1	Agricultural	54.42
2	Other	0.07
Total		54.49

Source) JICA Survey Team, March-April of 2016

2) Community owned lands

Table 5-2-3.4 shows the land use of Community owned, which belongs to Yeghvard city mostly.

Table 5-2-3.4 Project Affected Area (Community Owned)

No.	Location	Land Use	Affected Area (ha)
1	Yeghvard city	Agricultural	705.66
2		Residential	0.00
3		Industrial	0.00
4	Nor-Yerznka village	Agricultural	27.89
5		Residential	3.47
6		Industrial	0.00
7	Ashtarak city	Agricultural	0.00
8		Residential	1.92
9		Industrial	0.00
Total			738.94

Source) JICA Survey Team, March-April of 2016

⁵ Detailed schedule is mentioned in Chapter 5-2-7.

3) Private owned lands

Table 5-2-3.5 shows the land use of Private owned, of which total affected area of private lands in 25.93 ha. Especially, the agricultural lands will be affected by the Project. Furthermore, Nor-Yerznka village will be the most affected among the three (3) communities concerned. The Project affected area in Nor-Yerznka village is 14.44 ha with 56 % of total.

Table 5-2-3.5 Project Affected Area (Private Owned)

No.	Location	Land Use	Affected Area (ha)
1	Yeghvard city	Agricultural	10.05
2		Residential	0.00
3		Industrial	0.00
4	Nor-Yerznka village	Agricultural	14.24
5		Residential	0.20
6		Industrial	0.00
7	Ashtarak city	Agricultural	0.00
8		Residential	0.54
9		Industrial	0.90
Total			25.93

Source) JICA Survey Team, March-April of 2016

(2) Project affected buildings

While the Project affected area involves some industrial and residential lands on the cadastral map. The proposed facilities are designed not to cause relocation of existing buildings. Therefore, physical relocation of buildings will not be occurred.

(3) Project affected trees

Table 5-2-3.6 shows the number of Project affected trees by species. Totally, 4,855 trees will be affected by the Project.

The Reservoir basin includes a private orchard, which has 3,003 pear and 200 apple trees. As mentioned at section 1-4 (2), comparison study it was examined comparison study between loss of this orchard, and the design changing. As a result, it is required those trees should be include in the compensation to the Project.

Table 5-2-3.6 Number of Project Affected Trees

No.	Location	Ownership	Species	Total	
1	Yeghvard city	Private owned	Apple	350	
2			Apricot	30	
3			Apple	56	
4	Nor-Yerznka village	Community owned (illegal land users)	Bird cherry	19	
5			Cherry	51	
6			Hazelnut	9	
7			Mulberry	5	
8			Nuts	52	
9			Oleaster	1	
10		Peach	15		
11		Pear	12		
12		Plum	19		
13		Private owned	Private owned	Apricot	41
14				Apple	763
15				Bird cherry	21
16	Cherry			24	
17	Grapevines			90	
18	Hazelnut			1	
19	Nuts			88	
20	Peach			59	
21	Pear			3,003	
22	Plum			146	
Total				4,855	

Source) JICA Survey Team, March-April of 2016

(4) Project affected cultivation areas

Table 5-2-3.7 shows 3.67 ha of cultivated area affected by irrigation canal construction. The Project affected crops which belong to privates.

Table 5-2-3.7 Project Affected Cultivated Areas by Construction of Irrigation Canals

No.	Location	Ownership	Species	Total
1	Yeghvard city	Private owned	Wheat	1.04
2	Nor-Yerznka village	Private owned	Alfalfa	2.57
3			Wheat	0.06
Total				3.67

Source) JICA Survey Team, March of 2016

Remarks) Apart from the census survey, 53 plots of cultivated lands, which are approximately 80ha within the reservoir basin, were identified. The detailed information is mentioned later.

Table 5-2-3.8 shows the Project affected cultivation area by construction the Reservoir. The Project affects cultivated lands of 79 ha which belong to state or communities. Those crops are cultivated by the illegal land users.

Table 5-2-3.8 Project Affected Cultivated Areas by Construction of the Reservoir

No.	Plants	Area (ha)
1	Barley, Wheat	54
2	Alfalfa, Sainfoin	20
3	Plowed lands	5
Total		79

Source) JICA Survey Team, March of 2016

The Project affects cultivation area with 82.27 ha in total, consisting of 3.67 ha by irrigation canals construction and 79.00 ha by the Reservoir construction (see, Table 5-2-3.9).

Table 5-2-3.9 Cultivation Area of Project Affected Crops

Area	Ha
Irrigation canal area	3.67
Reservoir basin	79.00
Total	82.27

Source) JICA Survey Team, March of 2016

5-2-3-3 Socioeconomic Survey

To identify characteristics and economic situation of the PAPs, the socioeconomic survey was conducted. The questionnaire format and result of the survey are shown in the Appendix K-10 and 11. The survey targeted 32 households of Yeghvard city and Nor-Yerznka village, including 14 households which have cultivated within the Reservoir basin.

Table 5-2-3.10 Total Number of Project Affected Households in Socioeconomic Survey

Location	Number of Affected Households			Number and percent of socioeconomic survey covered Affected households		
	Legal	Illegal	Total	Legal	Illegal	Total
Canal area	12	7	19	9	6	15
The Reservoir basin	3	53	56	-	11	11
Both areas				3	3	6
Total	15	60	75 (100%)	12	20	32 (43%)

Source) JICA Survey Team, March-April of 2016

Remarks) 1. There are 53 households by using number of cultivated lands within the Reservoir basin.
2. There are 6 PAHs which have cultivated within the Canal area and the Reservoir area.
3. The numbers in () shows the share on all PAHs.

PAHs can be categorized into 2 groups by the locations. And there are some households who cultivate in both the Reservoir basin and area along proposed canals. Accordingly, the result of socioeconomic survey is analyzed by three (3) groups of cultivators, as followings;

- 1) Cultivators in only Reservoir basin (n=11)
- 2) Cultivators in only area along the proposed canal (n=15)
- 3) Cultivators in both Reservoir basin and area along the proposed canal (n=6)

(1) General characteristics of PAHs

1) Affected population and family size

The number of targeted PAHs and population were identified by the survey. There are 179 persons in 32 PAHs which were conducted socioeconomic survey in the Project. 179 consists of 91 males and 88 females. The average of household member is 5.59 persons, with 2.84 males and 2.75 females respectively, as shown in Table 5-2-3.11.

Table 5-2-3.11 Project Affected Population and Family Size

Item	Male	Female	Total
1. Cultivators in only Reservoir basin (n=11)	3.18	2.73	5.91
2. Cultivators in area along proposed canal (n=15)	2.53	2.47	5.00
3. Cultivator in Both areas (n=6)	3.00	3.50	6.50
Total (n=32)	2.84	2.75	5.59

Source) JICA Survey Team, March-April of 2016

2) Female heads of PAHs

There are three households headed by female. It is only 9 % of total PAHs, as shown in Table 5-2-3.12. The similar trend can be seen in all of three categories.

Table 5-2-3.12 Household Heads of PAHs

Item	Male	Female	Total
1. Cultivators in only Reservoir basin (n=11)	10	1	11
2. Cultivators in area along proposed canal (n=15)	13	2	15
3. Cultivator in Both areas (n=6)	6	0	0
Total (n=32)	29 (91%)	3 (9%)	32 (100%)

Source) JICA Survey Team, March-April of 2016

3) Elderly persons of PAHs

There are 21 PAHs, which have persons who are elder than 65 years old. It is 66% of total PAHs, as shown in Table 5-2-3.13.

Table 5-2-3.13 Elderly Persons of PAHs

Item	No. of PAHs	Share of the households which have elderly persons (%)
1. Cultivators in only Reservoir basin (n=11)	7	64
2. Cultivators in area along proposed canal (n=15)	11	73
3. Cultivators in Both areas (n=6)	3	50
Total (n=32)	21	66

Source) JICA Survey Team, March-April of 2016

4) Disabled persons of PAHs

While there are 10 disabled persons in PAHs, there are 9 households (28%) which has disabled persons. The households of “3. Cultivators in Both areas” does not have disabled person, as shown in Table 5-2-3.14.

Table 5-2-3.14 Disabled Persons of PAHs

Item	No. of disabled population	No. of PAHs	Share of the households which have disabled persons (%)
1. Cultivators in only Reservoir basin (n=11)	2	2	18.2
2. Cultivators in area along proposed canal (n=15)	8	7	46.7
3. Cultivators in Both areas (n=6)	0	0	0.0
Total (n=32)	10	9	28.1

Source) JICA Survey Team, March-April of 2016

5) Educational status of PAHs

At least, all of PAPHs completed elementary school. Especially, the cultivators in the both area have highest education level, as show in Table 5-2-3.15.

Table 5-2-3.15 Educational Status of PAH Heads

Item	Total (n=32)	1. Cultivators in only Reservoir basin (n=11)	2. Cultivators in area along proposed canal (n=15)	3. Cultivators in Both areas (n=6)
1) None	0	0	0	0
2) Elementary	0	0	0	0
3) Primary (8, 9 grade)	1 (3%)	0	1 (7%)	0
4) Secondary general	14 (44%)	7 (64%)	6 (40%)	1 (16.5%)
5) Average Professional	9 (28%)	3 (27%)	5 (33%)	1 (16.5%)
6) Higher	8 (25%)	1 (9%)	3 (20%)	4 (67%)
Total	32 (100%)	11 (100%)	15 (100%)	6 (100%)

Source) JICA Survey Team, March-April of 2016

Remarks) The numbers in () shows the share by each categories.

(2) Financial characteristics of PAHs

1) Main income source

31 households get farm-income as main source. The one household have no farm-income, since lands of the household are fallow. The second largest answer was “livestock.” This same trend can be shown in all of 3 categories, as shown in Table 5-2-3.16 and Figure 5-2-3.1.

Table 5-2-3.16 Main Income Source

Item	Total (n=32)	1. Cultivators in only Reservoir basin (n=11)	2. Cultivators in area along proposed canal (n=15)	3. Cultivators in Both areas (n=6)
1) Farming	31	11	15	5
2) Aquaculture	0	0	0	0
3) House/Land lent income	2	1	1	0
4) Pension	18	6	9	3
5) Business/ Shop	1	0	1	0
6) Carpenter	0	0	0	0
7) Livestock	24	9	10	5
8) School Teacher	0	0	0	0
9) Public Officer	10	2	4	4
10) Labor for person's farmland	0	0	0	0

Item	Total (n=32)	1. Cultivators in only Reservoir basin (n=11)	2. Cultivators in area along proposed canal (n=15)	3. Cultivators in Both areas (n=6)
11) Factory Labor	2	1	0	1
12) Company Worker	2	1	1	0
13) Remittance from family members	1	0	1	0
14) Others	9	3	6	0

Source) JICA Survey Team, March-April of 2016

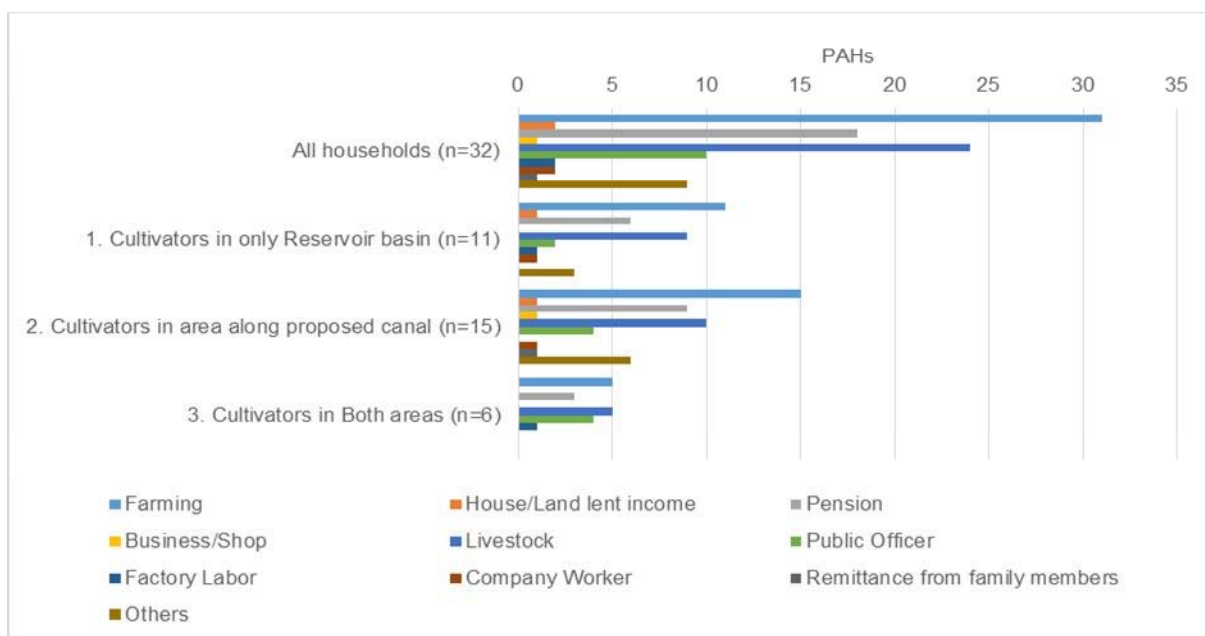


Figure 5-2-3.1 Main Income Source

2) Average annual gross income

The average annual gross income of all PAHs is 4,252,000AMD, including 2,357,000 AMD farm-income⁶, 1,504,000AMD off-farm income, and 391,000AMD from livestock, as shown in Table 5-2-3.17. The PAHs of “3. Cultivators in Both areas” get the highest annual income among the three categories. Oppositely, the PAHs of “1. Cultivator in only Reservoir basin” get the lowest annual income among the three categories.

Table 5-2-3.17 Average Annual Gross Income (AMD)

Item	Total (n=32)	1. Cultivators in only Reservoir basin (n=11)	2. Cultivators in area along proposed canal (n=15)	3. Cultivators in Both areas (n=6)
Farm-income				
Within the Reservoir basin	272,200	527,100	0	528,000
Within the Canal area	973,700	0	1,586,000	1,280,000
Not affected area	1,111,100	1,622,900	675,000	1,296,000
Sub-total	2,357,000	2,150,000	2,261,000	3,104,000
Non-farm income	1,504,000	936,800	1,921,700	1,500,000
Livestock	391,000	618,200	221,300	400,000
Total	4,252,000	3,705,000	4,404,000	5,004,000

Source) JICA Survey Team, March-April of 2016

Remarks) 1. Agricultural products for self-consumption, it was implemented imputation.

2. It was excluded one household, which has huge cultivated area compared with the other households, as the outlier.

⁶ Some PAHs cultivate crops for their self-consumption. To measure of the finance damage by the Project, it was implemented imputation, based on the unit price of selling price for agricultural products.

Figure 5-2-3.2 shows the share of incomes source. While annual gross income of “1. Cultivators in only Reservoir basin” is the lowest among three categories, the share of farm-income from cultivation within the Reservoir basin is 14 %. And they have much higher income from cultivation in the non-affected area than in affected area.

Annual gross income of “2. Cultivators in area along proposed canal” is almost same as its average of all households. While they will lose 36 % of income from cultivation in the Project affected area, they have farm-income in non-affected area, non-agricultural income, and livestock income.

Annual gross income of “3. Cultivators in both areas” is the highest among three categories. While they will lose 37 % (11 % + 26 %) of income from cultivation within the Reservoir basin and area along proposed canal, they have farm-income in non-affected area, non-agricultural income, and livestock.

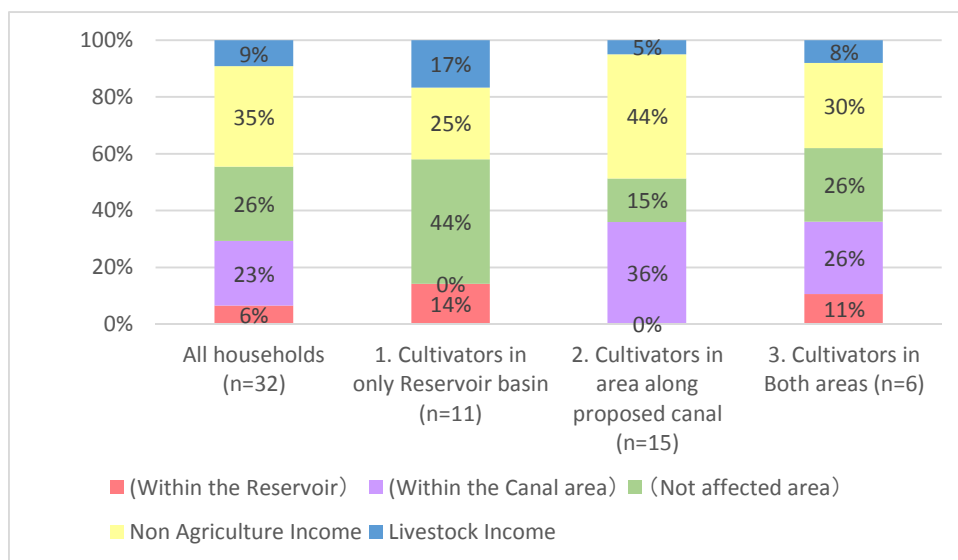


Figure 5-2-3.2 Annual Gross Income

3) Non-farm income

Expect for a household, PAHs have non-farm income and their main source is “Salary.” Other large shares are pension, income from work abroad, and livestock. The similar trend in the three categories is observed. However, the largest share of “1. Cultivators in only Reservoir basin” is “Pension,” not “Salary,” as shown in Table 5-2-3.18.

5-2-3.18 Non-farm Income

Item	Total (n=32)	1. Cultivators in only Reservoir basin (n=11)	2. Cultivators in area along proposed canal (n=15)	3. Cultivators in Both area (n=6)
None	1	1	0	0
Income from work abroad	4	0	4	0
Salary	12	2	6	4
Pension	9	3	4	2
Livestock	3	2	1	0
Poverty benefits	2	2	0	0
Others (pension and salary)	1	1	0	0
Total	32	11	15	6

Source) JICA Survey Team, March-April of 2016

4) Land size of Project affected area and average farm-income

As shown in Table 5-2-3.19, the average land size of cultivated area within the Reservoir is 1.89 ha/household. In addition, the average farm-income from this activity is 272,200 AMD/household. On

the other hand, the average land size of cultivated area within the Canal area is 0.25 ha/household. Then, the average farm-income from this activity is 973,700 AMD/household. From the comparison between “Within the Reservoir basin” and “Within the Canal area,” the profitability of farm crops of the former is much lower than latter.

Table 5-2-3.19 Average Land Size of Affected Cultivated Area and Farm-income

Item		Total (n=31)	1. Cultivators in only Reservoir basin (n=11)	2. Cultivators in area along proposed canal (n=15)	3. Cultivators in Both area (n=6)
Within the Reservoir basin	Land size (ha)	1.89	1.46	0.00	8.47**
	Farm-income (AMD)	272,200	527,100	0	528,000
Within the Canal area	Land size (ha)	0.25	0.00	0.30	0.65
	Farm-income (AMD)	973,700	0	1,586,000	1,280,000

Source) JICA Survey Team, March-April of 2016

Remarks) * It was excluded one household, which get huge amount of farm-income compared with the other households, as the outlier.

** It was included the household, which has fallow of 35 ha within the Reservoir basin.

(3) Living Conditions of PAHs

1) Cultivation years in the past

All PAHs have cultivated crops in their lands for 18.5 years in average. About “1. Cultivators in only Reservoir basin”, 55% of PAHs have cultivated for over 16 years, since the immediately before or after independence of RA. On the other hand, 45% of PAHs have cultivated there for less than 10 years. About “2. Cultivator in only area along the proposed canal”, all PAHs have cultivated over 6 years. Furthermore, 80% of them have used their lands over 16 years. About “3. Cultivators in Both areas,” the clear trend is not observed, as shown in Table 5-2-3.20.

Table 5-2-3.20 Period of Cultivation (years)

Item	Total (n=32)	1. Cultivators in only Reservoir basin (n=11)	2. Cultivators in area along proposed canal (n=15)	3. Cultivators in Both areas (n=6)
Average of total PAHs	18.5	14.9	22.6	14
1~5	4	3	-	1
6~10	5	2	2	1
11~15	-	-	-	-
16~20	4	2	1	1
21~25	13	4	8	1
<25	3	-	3	-
N/A	3	-	1	2

Source) JICA Survey Team, March-April of 2016

2) Legal status of land use

Table 5-2-3.21 shows the legal status for land use of PAHs. There are 11 PAHs of “1. Cultivators in only Reservoir basin” and 3 PAHs of “3. Cultivators in Both area”, who cultivate within the Reservoir basin. In addition, there are 6 PAHs of “2. Cultivators in area along proposed canal.” Thus, there are 20 PAHs who have cultivated the Project affected area without legal status.

Table 5-2-3.21 Legal Status of Land Use

Item	1. Cultivators in only Reservoir basin (n=11)	2. Cultivators in area along proposed canal (n=15)	3. Cultivators in Both areas (n=6)*
1. Within the Reservoir basin	11	-	6
Legal	-	-	3
Illegal	11	-	3
2. Within Canal area	-	15	6
Legal	-	9	6
Illegal	-	6	-

Source) JICA Survey Team, March- April of 2016

Remarks) The total of "3. Cultivator in Both areas" is 12 PAHs, since 6PAHs have cultivated in the both area.

(4) Others

1) Expectation to the Project

As shown in Table 5-2-3.22, 25 PAPs (78%) anticipate that the Job opportunity will be increased during the construction period. Especially, the most APs of "1. Only Reservoir basin" anticipated it.

Table 5-2-3-3.22 Anticipated Impacts by the Project

Item	Total (n=32)	1. Cultivators in only Reservoir basin (n=11)	2. Cultivators in area along proposed canal (n=15)	3. Cultivator in Both area (n=6)
1) Water quality in the Community will be damaged	6	4	1	1
2) Nothing	1	0	1	0
3) Job opportunity will be increased during the construction period.	25	10	11	4
7) Others (promotion of tourism, etc.)	7	4	2	1

Source) JICA Survey Team, March – April of 2016

Remarks) This question applied plural answered.

2) Expected Benefits by the Project

As shown in Table 5-2-3.23, the most of PAPs expect to access to stable water in the community more easily than before. In addition, PAPs hope the development of some industries around the Reservoir area.

Table 5-2-3.23 Expected Benefits by the Project

Item	Total (n=32)	1. Cultivators in only Reservoir basin (n=11)	2. Cultivators in area along proposed canal (n=15)	3. Cultivator in Both area (n=6)
1) Stable water using in the Community	15	6	4	5
2) Solution for lack of agricultural water	15	7	6	2
3) Improvement of irrigation system	9	5	2	2
4) Promotion of industry	11	7	2	2
5) Reduction of water fee	6	3	3	0
6) None	6	1	4	1
7) Others (promotion of tourism, etc.)	4	2	1	1

Source) JICA Survey Team, March – April of 2016

Remarks) This question applied plural answered.

3) Concerns on the Project

As shown in Table 5-2-3.24, the most of PAPs have concerns about risk on safety/ seismicity by the Project. Then, PAPs, who have cultivated in the Project affected area are worry about compensation

for land loss.

Table 5-2-3.24 Concerns on the Project

Item	Total (n=32)	1. Cultivators in only Reservoir basin (n=11)	2. Cultivators in area along proposed canal (n=15)	3. Cultivator in Both area (n=6)
1) Risk on Safety/ Seismicity	17	6	7	4
2) Financial damage due to land loss	13	5	5	3
3) Implementation of compensation	15	5	7	3
4) Increasing of water price	1	1	0	0
5) Others	1	0	0	1

Source) JICA Survey Team, March – April of 2016
Remarks) This question applied plural answered.

4) Understanding on the Project

As shown in Table 5-2-3.25, 24 PAPs (75 %) understand that they should stop cultivation within the Reservoir basin, when the Project is re-stated.

Table 5-2-3.25 Understanding on the Project

Item	Total (n=32)	1. Cultivators in only Reservoir basin (n=11)	2. Cultivators in area along proposed canal (n=15)	3. Cultivator in Both area (n=6)
Already known	24	8	11	5
Not Known	8	3	4	1

Source) JICA Survey Team, March – April of 2016

5-2-3-4 Social and Cultural Characteristics

(1) Transition of land ownership within the Yeghvard Reservoir basin

1) Period of Soviet Union

In the period of Soviet Union, all of the lands belonged to the State. Before the Yeghvard Reservoir construction project (1970's), collective farming, called as Kolkhoz, had been operated in the farmlands of Yeghvard city, including Yeghvard Reservoir basin (see, figure right (1)). In the farmlands, grape had been cultivated and the farmers had gotten fixed monthly salary by works. The farmers had been engaged in farming activities in rotation within the grape garden.

In 1980's, due to the plan of the construction of the Yeghvard Reservoir, cultivation within the Reservoir basin was suspended (see, figure right (2)). On the other hand, the farmers had continued cultivations outside of the range of the Reservoir basin. In addition, their salary was not changed, since it was fixed by the State. Therefore, the impacts on the surrounding households were not serious.

In 1984, because of the financial problems, the Government of Soviet Union stopped the construction of the Yeghvard Reservoir.

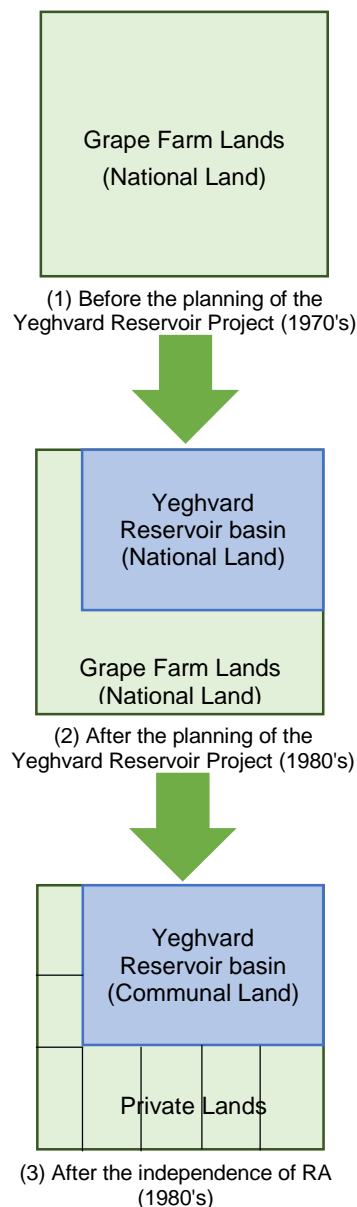
2) After independence of Armenia

In 1991, the Armenia gained independence from the Soviet Union. After that, the Government of Armenia distributed the lands of outside of the Yeghvard Reservoir basin to the people as the private lands (see figure right (3)). The average land distribution was 0.5 ha per household, if the number of family members was 3 or less, while the numbers of household members was 4 or more, they could get 1.0 ha or more. On the other hand, the lands for the Yeghvard Reservoir became communal lands which belong to Yeghvard city.

Since the construction of the Yeghvard Reservoir has been suspended even after the independence, the surrounding people re-started crop cultivation within the Reservoir basin, considering the soil within the Reservoir is fertile. They do not have the legal rights to cultivate there. However, Yeghvard city has given silent consent to them until now, since it is not sure whether the construction of the Reservoir will be re-started or not. According to Yeghvard city, approximately 30~40 farmers have cultivated, as of June in 2015.

3) Current farming conditions

As of April in 2016, land ownerships within the Reservoir basin are categorized into 3 types, namely, a) State Lands⁷, b) Communal Lands of Yeghvard city, and c) Private Lands. Most of the lands are communal lands (see, Figure 5-3-3.3). In addition to that, there are some private lands (four plots),



⁷ The current State lands belonged to Nor-Yerznka village before, however, it became state lands for construction of the Reservoir.

which were sold by the Yeghvard city to individuals by auctions.

The farmers who cultivate within the Reservoir basin has been changed so often, since some of them have handed over or have leased lands to others, or stopped cultivation.

(2) Identification of farmers of the Reservoir basin

Yeghvard city, Nor-Yerznka village, and Yeghvard WUA do not have information about the farmers who have cultivated within the Reservoir basin. As well as, the farmers in the Reservoir don't communicate with

neighbor farmers well, since they don't go to the field every day. It means that there is no data/information related to the actual cultivators and the number of them within the Reservoir basin. Therefore, a site survey to identify the number of farming plots in the Reservoir was implemented by JICA Survey Team. As a result, as of April in 2016, 53 farming plots covering 80ha were identified. It could be assumed that there are maximally 53 farmers, if one farmer cultivates each plot. In the survey process, 14 illegal cultivators within the Reservoir basin were identified.

In the Project, the Stakeholder meetings and public seminar are noticed in the newspapers, web-site and on the board of communities concerned and Yeghvard WUA. The purpose is to enhance understanding of the persons concerned about the Project.

(3) Current situation within the Reservoir basin

Basically, the cultivated lands those are located on where it can access to water resource easily. In particular, the most of cultivated lands are located in the northeastern part of the Reservoir where it is close to the Arzni-Shamiram canal. On the other hand, there are few cultivated lands in the central part of the Reservoir basin, because the fertile top soil in the part has been already excavated in the period of Soviet Union. In the same period, ditches were constructed for water distribution to grape all over the Reservoir basin. Presently, the farmers use the existing ditch or construct new one by themselves for their cultivation (see, Figure 5-2-3.4).

As mentioned above clause (2), 53 plots are cultivated. And the area is 80 ha (see, Figure 5-2-3.5). There is a big plot whose area is 17 ha in the western part of the Reservoir basin and the plot is managed by one household. Except for the big plot, the average of cultivated lands area of 52 plots in the Reservoir basin is estimated at approximately 1.2 ha per household.

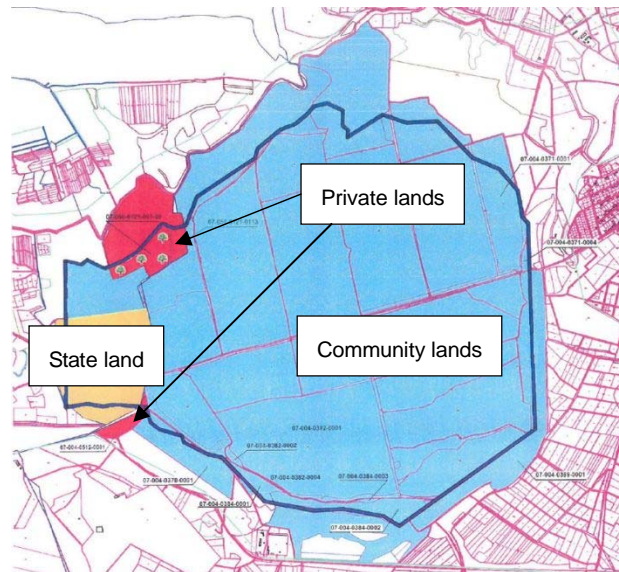


Figure 5-2-3.3 Current Land Ownership within the Reservoir Basin

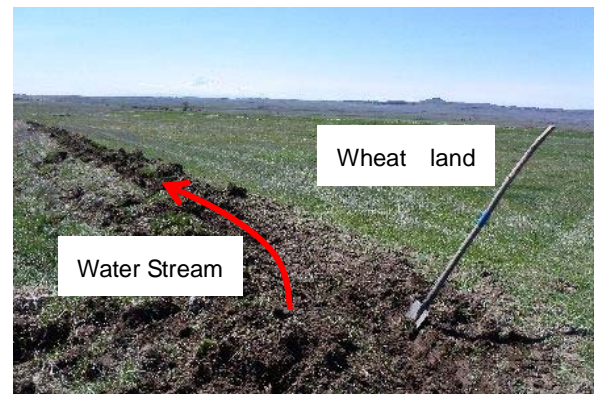
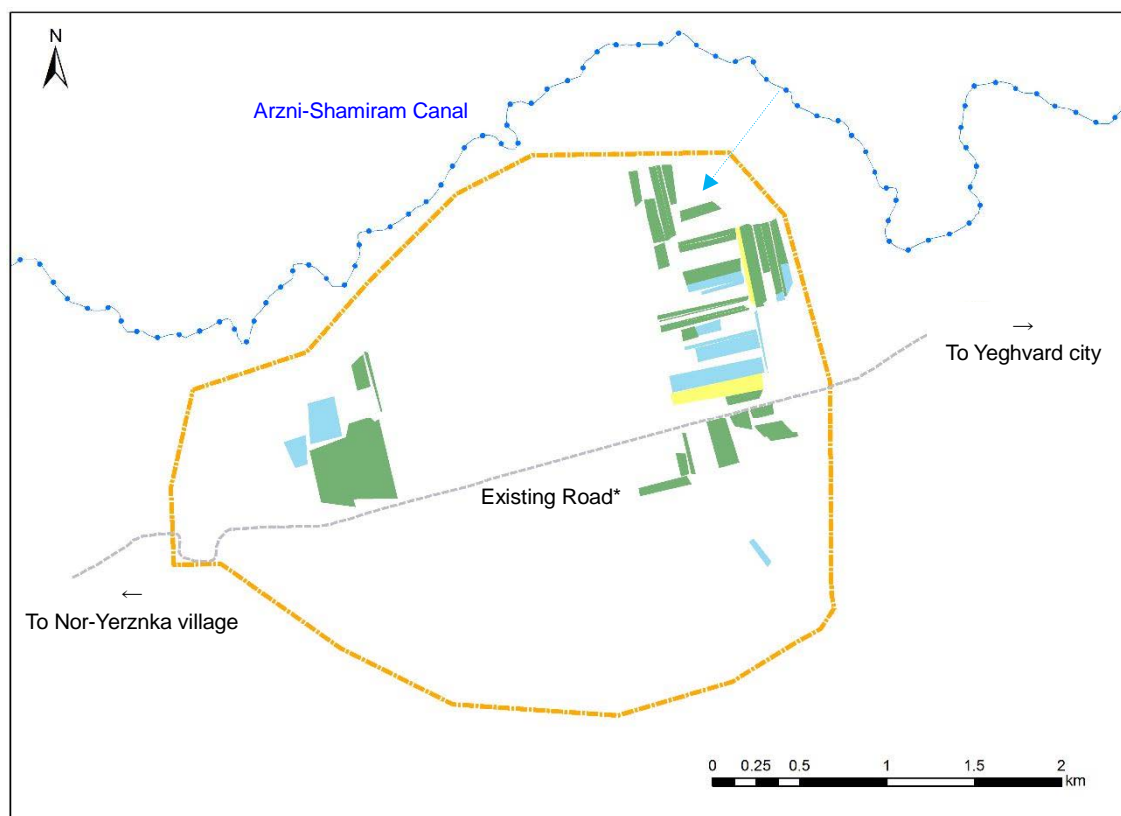


Figure 5-2-3.4 Maintained Ditch and Wheat Land



Crops	Plots	ha
Barley, Wheat	36	54
Alfalfa, Sainfoin	15	20
Plow ed lands	2	5
Total	53	79

Figure 5-2-3.5 Cultivated Lands within the Reservoir Basin

*It was maintained for construction of Yeghvard Reservoir in the Soviet Union Period.

(4) Cultivated crops within the Reservoir basin

Main cultivated crops in the Reservoir are wheat, barley, alfalfa and sainfoin (legume pasture), the cultivation areas of wheat and barley accounts for around 70% of the whole farmland area in the Reservoir basin. Alfalfa and sainfoin are perennial crops which can be harvested for 4-6 years, while wheat and barley are one-year crops. The profits from those crop productions are very low compared with those of vegetables and orchard, only 5%-20%. The reasons why such low profitable crops are cultivated is the area that 1) Yeghvard City gave an instruction to the farmers not to plant perennial crops such as fruit trees in case of re-start of the Yeghvard Reservoir Construction, and 2) water resources in the Reservoir are not sufficient.

5-2-3-5 Vulnerable People

Armenia has a social welfare program for the poor, namely, “Family Benefits System (FBS)”. According to the socioeconomic survey, there are two households, which get FBS. Each of them cultivated 1 ha and 0.6 ha, respectively within the Reservoir basin for their self-consumption, and they do not own their private farmlands outside of the Reservoir. If the Project is started, they will lose their measures to gain their daily food. Hence, it is proposed to hire them with high priority as the construction labors. Apart from them, there are elder households who get pension and disabled households who get disability benefits. In addition, there are some women headed households. Those

of them are also categorized into the vulnerable people, and they also will have high priority to be employed as workers by the Project. Moreover, as the ADB construction has done, allowance to them will be provided. On the other hand, there are no ethnic minority people in the affected area. Therefore, it is not necessary to consider such people.

5-2-4 Compensation Measures

5-2-4-1 Compensation for Loss

(1) Contents of compensation

In the Project, while physical relocation is not required, the land acquisition is needed. Based on the meetings with the implementation agency, namely, PIU/ SCWE, the basic compensation measures were drafted to provide compensation/ consideration. In addition, as described in “5-2-10 Public Consultation,” the contents on drafted compensation measures was presented to PAPs at Public Seminars, and it was basically accepted by the participants. The detailed contents are mentioned below;

1) Land loss

Compensation for land loss will be done to the PAPs who have legal status. In the Project affected area, it was identified three (3) categories of land, such “agricultural”, “residential”, and “industrial⁸.” Based on those categories, the market prices are evaluated by the evaluator who has the license from the Government of Armenia. Furthermore, the market price is fixed based the accessibility and productivity. This market price can cover the amount that PAPs to purchase the new lands which have equal values as previous lands. After comparing between the market and official prices (see, Table 5-2-4.1), the higher price, namely, market price is adopted.

Table 5-2-4.1 Comparison of Official Price and Market Price

	Official price (AMD/m ²)	Market price (AMD/m ²)
Agriculture (crop)	36.5-118.5	460
Agriculture (pasture)	6.75	460
Orchard	43.5-180	880
Residential area	2,940	3,800-8,700

Source) 1. Official price of lands: State Committee of Real Estate Cadaster,
2. Market price of lands: JICA Survey Team, 2016 (estimated by the licensed land evaluator)

The amount for compensation, including 15 % plus of the market price is applied and the amount of compensation can be thought as full replacement cost.

While there are some illegal land users in the Project affected area, all of illegal land users within the Reservoir basin have not been identified. Also, since the illegal land users are changing by years, it is very difficult to compensate to actual PAPs who cultivate in the Reservoir basin.

According to the PIU member, the Vedi project founded by AFD, didn't need to compensate to the illegal land users, since the project announced to PAPs in advance that they cannot use within the project affected area after implementation of the project, and the PAPs understood the area is for the Vedi project from the beginning. On the other hand, the road construction project founded by ADB, compensated to the illegal land users, since the project area was not decided in early stage and the illegal PAPs were not aware the project.

In case of the Yeghvard Reservoir Project, while it was stopped in the Soviet Union period, Yeghvard

⁸ The buildings will be demolished, however, the area will be affected by the Project.

city has instructed the illegal land users not to cultivate perennial crops. Furthermore, it is known that the cultivation in state or communal land is illegal, generally. As the result of socioeconomic survey, 76 % of illegal land users within the Reservoir area have already know that they should stop cultivation within the Reservoir area, when the Project is restarted. From these reasons, it will not be difficult to gain consensus from the PAPs. Hence, though the Project will not compensate to the illegal land users within the Reservoir basin, it is recommended to employ the illegal land users as workers during construction stage with priority.

Regarding the illegal land users who have cultivated trees in area along the proposed canal, they do not have any rights nor permission for cultivation in the communal lands, as same as illegal land users within the Reservoir basin. Hence, they will not be compensated for affected land by the Project.

2) Crop loss

Compensation for perennial crop loss will be paid to the PAPs, who have legal status to be affected by the Project. In case of annual crop, the cultivator can stop cultivation based on the announcement about construction schedule. Hence, the compensation for annual crop loss will not be provided to PAPs.

The amount is calculated for expected harvest at market price by crop. Regardless of whether land is affected permanently or temporary, loss of perennial crop is compensated to PAPs who have the legal status. On the other hand, crop compensation will not be provided to the illegal land users. In the Project affected area for irrigation canal, there is no crop of illegal land users, while there are crops within the Reservoir basin. However, according to the socioeconomic survey, they have cultivated unprofitable crops, as barley or wheat.

Furthermore, if they cultivate annual crops within the Reservoir basin, the Project will not affect their cultivation, since the Project will announce at least before construction starts one year. In case of perennial crops, while the Project will affect their cultivation, according to the officer of Yeghvard city, they have instructed PAPs not to cultivate perennial crops within the Reservoir area with considering restarting its construction. Somebodies followed the instruction, while others did not. Hence, it is suggested not to compensate for the crop loss to avoid any conflicts among those legal and illegal land users.

3) Tree loss

Compensation for tree loss will be paid to the all PAPs, who will be affected by construction of the Reservoir and/ or irrigation canals. Regardless of whether the land is affected permanently or temporary, loss of tree is compensated.

Within the Reservoir area, while there is no trees which belong to illegal PAPs, in the area for irrigation canals, there are orchards of illegal land users. The profitability of trees are higher than crops, and the impact of tree loss will be significant. Therefore, regardless of legal status, all PAPs should be compensated.

4) Loss of livelihood means

Since there is no regulation regarding compensation for illegal land users in the law of Armenia, illegal land users will lose the parts of their livelihood means by the Project. Thus, it is proposed the employment for construction works should be given to the illegal land users in the Project. The detailed methodology is discussed in section 5-2-4-2.

5) Special attention for vulnerable people

In the Project, all PAPs which get FBS, disabled benefits or headed by female or eldered people are regarded as the vulnerable people. According to ADB project, the vulnerable people can get allowance as same as amount of 6 months of minimum salary and be hired with high priority as a labor for the construction works. The same approach is proposed in the Project.

6) Temporary land loss

While temporary land acquisition for pipeline and stockyard is needed, there is no specific regulation for temporary land loss in Armenia. Generally, since compensation rates for temporary land loss are fixed based on the negotiations with the land owners before making compensation agreement, the rate cannot be set at least in this F/S stage. Therefore at present, it is proposed to apply the same compensation rate for temporary land loss as the permanent land loss. It means that sum of the higher amount of market price and official price for land, and 15 % of the land price is proposed as compensation rate.

(2) Cut-off date

While at this F/S stage, the cut-off date has not been established, it should be established at D/D stage, before implementation of final census survey. In addition, at least one year before from starting construction, it is needed to announce PAPs not to cultivate in the Project affected area, for the next year. It is proposed that the announcement is done as soon as possible, after exchange of the Loan Agreement.

5-2-4-2 Methods for Recovering Livelihood Means

As mentioned section 5-2-4-1 (1) (4) and 5)), the vulnerable people and the illegal land users will lose the parts of their livelihood means. Hence, it is necessary to provide some supports. In the Project, it is proposed to hire them with high priority during the construction period.

As the result of socioeconomic survey, 11 PAHS of “1. Only Reservoir basin,” have 1.46 ha cultivated lands (see, Table 5-2-3.19) on average. Two households which get FBS are classified into this category. When the construction of Reservoir is started, those PAHs will lose the income from cultivation within the Reservoir. Then, the scale of their remaining lands will be less than 1.0 ha, namely, 0.28 ha as shown in Table 5-2-4.2.

Table 5-2-4.2 Average Cultivated Land Size of PAHs within the Reservoir Basin

Item	Total (n=31)	1. Cultivators in only Reservoir basin (n=11)	2. Cultivators in area along proposed canal (n=15)	3. Cultivator in Both area (n=6)
Within the Reservoir basin	1.89	1.46	-	8.47**
Within the Canal area	0.25	-	0.30	0.65
Outside the Project affected area	0.58	0.28	0.15	2.52

Source) JICA Survey Team, March-April of 2016

Remarks) * It was excluded one household, which get huge amount of farm-income compared with the other households, as the outlier.

** It was included the household, which has fallow of 35 ha within the Reservoir basin.

On the other hand, Table 5-2-4.3 shows that the most of farmers in Armenia have small scale farmlands which are less than 1.0 ha. In Kotayk Marz⁹, 46.3% of the households have cultivated lands which are less than 1.0 ha. That is to say, the scale of their remaining land become close to the general trend of Kotayk Marz.

⁹ Yeghvard city and Nor-Yerznka village belong to Kotayk Marz.

Table 5-2-4.3 Cultivated Land Size by Marz

Marz	Less than 1.0 ha		1.0ha-5.0 ha		More than 5.0 ha		Total
	No. of Households (1,000HH)	Share (%)	No. of Households (1,000HH)	Share (%)	No. of Households (1,000HH)	Share (%)	No. of Households (1,000HH)
Yerevan	5.4	79.4	1.4	20.6	0.0	0.0	6.8
Aragatsotn	17.2	46.4	17.9	48.2	2.0	5.4	37.1
Ararat	21.4	43.2	25.3	51.1	2.8	5.7	49.5
Armavir	23.3	46.3	24.3	48.3	2.7	5.4	50.3
Gegharkunik	21.4	46.4	22.3	48.4	2.4	5.2	46.1
Lori	15.0	47.0	15.1	47.3	1.8	5.6	31.9
Kotayk	17.4	46.3	18.2	48.4	2.0	5.3	37.6
Shirak	13.0	46.3	13.6	48.4	1.5	5.3	28.1
Syunik	5.9	46.5	6.1	48.0	0.7	5.5	12.7
Vayots Dzor	5.1	46.4	5.3	48.2	0.6	5.5	11.0
Tabush	11.4	46.5	11.8	48.2	1.3	5.3	24.5
Total	156.5	46.6	161.3	48.1	17.8	5.3	335.6

Source) JICA Report, 2008 (original data from Ministry of Agriculture)

If the PAPs will continue their farming after the Project implementation, they have to purchase new lands, since their farmlands outside of the Reservoir are very small. At this moment, the average cultivation area within the Reservoir is 1.46ha as shown in Table 5-4-2.2. It is noted that the cultivated crops in the Reservoir basin are wheat, barley, alfalfa and so on, which produce low profits. The benefit per unit area is 5-20% of those of vegetables and fruit trees as shown Table 5-2-4.4. It means that current benefits from the 1.46ha in the Reservoir basin are low. Therefore, if the PAPs can purchase 1.0ha new farmland and they harvest vegetables and fruit trees, it can compensate for the loss of land within in the Reservoir and 1.0 ha of new land can be regarded as sufficient.

Table 5-2-4.4 Profit by Crop

Crop	Net profit (AMD/ha/year)
Wheat	96,520
Barley	102,900
Tomato	2,009,000
Cucumber	2,777,000
Eggplant	2,625,000
Bell pepper	2,645,000
Cabbage	3,125,000
Onion	2,152,000
Watermelon	2,310,000
Potato	1,263,000
Alfalfa (1st year)	△ 81,528
Alfalfa (after 2nd cropping year)	494,000
Alfalfa (7 years cropping)	411,782
Grape (adult tree)	514,000
Apricot	803,000
Apple	951,000

Source) JICA Survey Team (based on the data from MOA)

Except for one household¹⁰, all PAPs hope to continue their agricultural activities after the starting construction of the Project. If vulnerable people and illegal land users are hired as labor in the Project, it is supposed that they can get 216,573 AMD/ month (see, Table 5-2-4.5)

¹⁰ The household answered "cannot answer" to this question.

Table 5-2-4.5 Average Monthly Nominal Salary of Workers (AMD)

Marz	Combined work	Worker with contract or civil-law agreement	
		included income tax	excluded income tax*
Total	135,764	127,858	95,894
Agriculture, forestry and fishery	81,250	-	-
Mining industry and exploitation of open mines	219,700	119,897	89,923
Processing industry	167,548	172,941	129,706
Supply of electricity, gas, steam and high quality air	1,902,754	171,906	128,930
Water supply, sewerage, waste management and recycle	151,400	141,051	105,788
Construction	339,439	216,573	162,430
Wholesale and retail trade, repair of vehicles and motorcycles	184,689	158,223	118,667
Transportation and storage economy	217,433	174,794	131,096
Organization of accommodation and public food	134,309	87,866	65,900
Information and communication	147,888	131,587	98,690
Financial and insurance activity	420,211	130,809	98,107
Activity related to real estate	394,076	120,498	90,374
Specialty, scientific and technical activity	89,391	93,360	70,020
Administrative and supportive activity	143,403	48,964	36,723
State governing and defense, obligatory social safety	95,361	108,638	81,479
Education	99,367	99,007	74,255
Healthcare and social service of population	120,332	169,020	126,765
Culture, entertainment, recreation	141,601	135,275	101,456
Other services	166,669	115,340	86,505

Source) National Statistical Service of the RA, "Socioeconomic Situation of the RA, January-February 2016"

Remarks) The income tax is around 25%.

It is assumed that the term of construction stage is for four years. Thus, the amount of income by construction is as following;

$$162,430 \text{ AMD/month} * 12 \text{ months} * 4 \text{ years} = \underline{\underline{7,796,640 \text{ AMD}}} \text{ — (1)}$$

Average farm-income in non-affected area of "cultivators in only Reservoir basin" is estimated at 1,622,900 AMD/HH/year as shown in Table 5-2-3.15. Thus, the amount of income by agriculture in the periods is as following;

$$1,622,900 \text{ AMD/HH/year} * 4 \text{ years} = \underline{\underline{6,491,600 \text{ AMD}}} \text{ — (2)}$$

The market price of agricultural land, which is adopted in this RAP, is **4,600,000 AMD/ha** – (3).

The cost for property registration is **23,500 AMD**¹¹ — (4)

Table 5-2-4.6 shows consumer expenditure of monthly average per capita, namely, 34.742 AMD.

Table 5-2-4.6 Monthly Average Consumer Expenditures per Capita (AMD)

	2010	2011	2012	2013	2014	Average
On food goods	16,125	18,552	18,500	19,146	20,283	18,521
On non-food goods	4,439	5,022	6,159	6,568	7,442	5,926
On service	8,082	9,011	10,262	11,073	13,045	10,295
Total	28,646	32,585	34,921	36,787	40,770	34,742

Source) National Statistical Service of Armenia, "Statistical Yearbook of Armenia, 2015"

The annual average of consumer expenditure per capita is as following;

$$34,742 \text{ AMD/month/capita} * 12 \text{ months} = 416,904 \text{ AMD/year/capita}$$

In the project affected area, the average of PAH family members is 5.59 persons (see, Table 3-3.2). Then the average per household for four (4) years is as following;

$$416,904 \text{ AMD/year/capita} * 4 \text{ year} * 5.59 \text{ persons} = \underline{\underline{9,321,973 \text{ AMD/year/household}}} \text{ — (5)}$$

¹¹ The details mentioned latter.

Table 4-2.7 shows the calculation of household's balance sheet in case of purchase of new agricultural land. If the PAPs work as labor in the Project for four years, the income can cover their livelihood means, including purchasing new agricultural land. In addition, the remaining income after purchasing new agricultural lands is assumed 342,767 AMD. This amount is approximately 15 % of average gross income of all PAPs, referring to the socioeconomic survey. Hence, this methods for recovering livelihood means is proper.

Table 5-2.4.7 Estimated Household's Balance (for 4 years)

Item	AMD
1. Incomes	
Construction (1)	7,796,640
Agriculture in non-affected Area (2)	6,491,600
Sub-total (1)~(2)	14,288,240
2. Expenditures	
New land (3)	Δ4,600,000
Property Registration Fee (4)	Δ23,500
Expenditures (5)	Δ9,321,973
Sub-total (3)~(5)	Δ13,945,473
Total	<u>342,767</u>

It is noted that any farmers can find out new farmlands by themselves through intermediaries, acquaintances, or internet, if necessary, and it is not very difficult for them. However, when those people ask some advices for new land purchase, PIU/ SCWE could provide necessary information, through cooperation with communities or regional branch of State Committee of Real Estate Cadaster which have information on new farmlands.

According to the socioeconomic survey result, most of the affected farmers want to continue farming activities, and the consideration to employ them during the construction works with high priority, which enables them to purchase new farmland, can be judged as reasonable.

5-2-4-3 Resettlement Sites

It is not necessary to prepare resettlement sites, since the relocation is not assumed in the Project.

5-2-4-4 Entitlement Matrix

Taking consideration into the JICA Guideline and Armenian regulations, entitlement matrix of the Project is shown in Table 5-2-4.8.

Table 5-2-4.8 Entitlement Matrix

Type of loss	Entitled Persons (Beneficiaries)	Entitlement (Compensation Package)	Implementation issues/ Guideline	Responsible Organization
1. Loss of land				
Loss of agricultural land	Legal land owners	Cash compensation at the market price (or official rate, higher of them) +15 %	1) Identification of land owners by State Committee of Real Estate Cadastral 2) Land evaluation and cost estimation by evaluators with license 3) Explanation of payment procedure for the PAPs (Project Affected Persons) and negotiation with the PAPs 4) Payment of cash compensation under the Law	PIU/SCWE
2. Loss of income sources				
2.1 Crop loss ¹²	Legal land owners	Perennial Crop compensation for expected harvest in cash at market rate	1) Identification of land owners by State Committee of Real Estate Cadastral 2) Evaluation and cost estimation by	PIU/SCWE

¹² Since it is planned to notice of the timing the construction start to the PAPs and request them to stop the cultivation as soon as possible after the concluding loan agreement, it is not needed to compensate for annual crop. .

Type of loss	Entitled Persons (Beneficiaries)	Entitlement (Compensation Package)	Implementation issues/ Guideline	Responsible Organization
			3) evaluator with license Explanation of payment procedure for the PAPs and negotiation with the PAPs 4) Payment of cash compensation under the law	
2.2 Tree Loss	All PAPs regardless of legal status	Cash compensation at market rate based on type, age and productive value of the trees	1) Identification of land owners by State Committee of Real Estate Cadastral 2) Evaluation and cost estimation by evaluator with license 3) Explanation of payment procedure for the PAPs and negotiation with the PAPs 4) Payment of cash compensation under the law	PIU/SCWE
3. Loss of livelihood means				
loss of livelihood means (agriculture)	Illegal land users	Employment priority in project-related jobs	1) Identification of land users by WUA and communities concerned 2) PIU/SCWE is to push the contractor to employ the identified cultivators as workers with high priority 3) Employment by contractor	PIU/SCWE, WUA, Communities concerned
4. Special attention				
Vulnerable people*	1) Recipient PAHs of poverty benefits, disabled benefits, or 2) PAHs headed by Female or Elder people	1. Allowance equivalent to 6 months of minimum salary ¹³ 2. Employment priority in project-related jobs	1) Identification of vulnerable people by communities concerned 2) Explanation of payment procedure for the PAPs and negotiation with the PAPs 3) Payment of allowance under the law 4) PIU/SCWE is to push the contractor to employ the vulnerable people as works with high priority 5) Employment by contractor	PIU/SCWE, Communities concerned
5. Others				
Temporary land loss	Legal land owners	1. For land; Cash compensation at the market price (or official rate, higher of them) + 15% 2. For crop; Crop compensation for expected harvest in cash at market rate. 3. For tree; Cash compensation at market rate based on type, age and productive value of the trees	1) Identification of land owners by State Committee of Real Estate Cadastral 2) Evaluation and cost estimation by evaluator with license 3) Explanation of payment procedure for the PAPs and negotiation with the PAPs 4) Payment of cash compensation under the law	PIU/SCWE

Remarks) Category for Vulnerable people will be re-considered at D/D stage, with Ministry of Labor and Social Affairs.

5-2-5 Grievance Redress Mechanism

While there is no provision about grievance redress mechanism on the law of Armenia, it should be established in order to deal with the discontent or disapproval to the proposed compensation measures. International donors such as WB and ADB have already implemented some projects in Armenia, and they proposed new grievance redress mechanism by project, for instance, establishment of Grievance Redress Committee. However, such committees did not function well so far, since it was not close to the PAPs physically and mentally. On the other hand, although the most accessible organizations for PAPs are communities and WUAs in the Project, they do not have function to settle down issues related to land acquisition. Thus, it is not practical to establish the new committee within those

¹³ It is regulated on the "Law on minimum monthly salary". As of April in 2016, it is fixed at 55,000 AMD.

organizations for grievance redress, and it is recommended to use existing system for the Project.

The most practical way is that PIU handles grievances, since PIU has some experts who are in charge of environmental and social consideration, including the matters on resettlement and land acquisition. Those experts can receive grievances from the PAPs, and solve the matters. However, PIU is not very accessible for the PAPs, since it does not have the field office near by the Project affected area. On the other hand, considering that communities and WUAs are the most accessible for the PAPs, they can play role as liaison between PIU staff and the PAPs. Thus, it is proposed to involve them in addition to PIU for the grievance redress mechanism in the Project. Apart from that, it is possible for the PAPs to take grievances into the court, since Armenian people know how they can apply to the court, in general. It is noted that if a complainant goes to the court directly, it will not take time for the settlement, however, it is needed to pay commission charge. On the other hand, if a complainant gets consultation with the communities, WUAs and/ or PIU, it is free of charge but will take time to settle the issues.

Considering necessary cost, time and accessibility, three patterns for the grievance redress mechanism can be applied in the Project as illustrated in Figure 5-1-5.1. The PAPs will choose the most convenient and accessible way for them. The implementation agency, namely, PIU/ SCWE, and PAPs have already basically accepted the proposed system for grievance redress at the meetings including Public Seminars. In addition, at the final Public Consultation, which is planned to be held, such information would be announced to the participants again.

(1) Pattern 1

The PAP can lodge his/ her grievance to the community or WUA which is the most accessible for him/ her. Within 7 working days after the community or WUA receives grievance, the officer must submit the complaint to the PIU.

After PIU receives the grievance, PIU must respond to the PAPs within 15 working days. If PIU cannot solve the issue or the PAP doesn't accept the PIU's response, the PAP can proceed to the court. If he/ she wins at the court, the commission fee will be refunded. However, if he/she loses at the court, commission fee will be shouldered by the complainant.

After grievance lodging, the court should review the expropriation cases, carry out

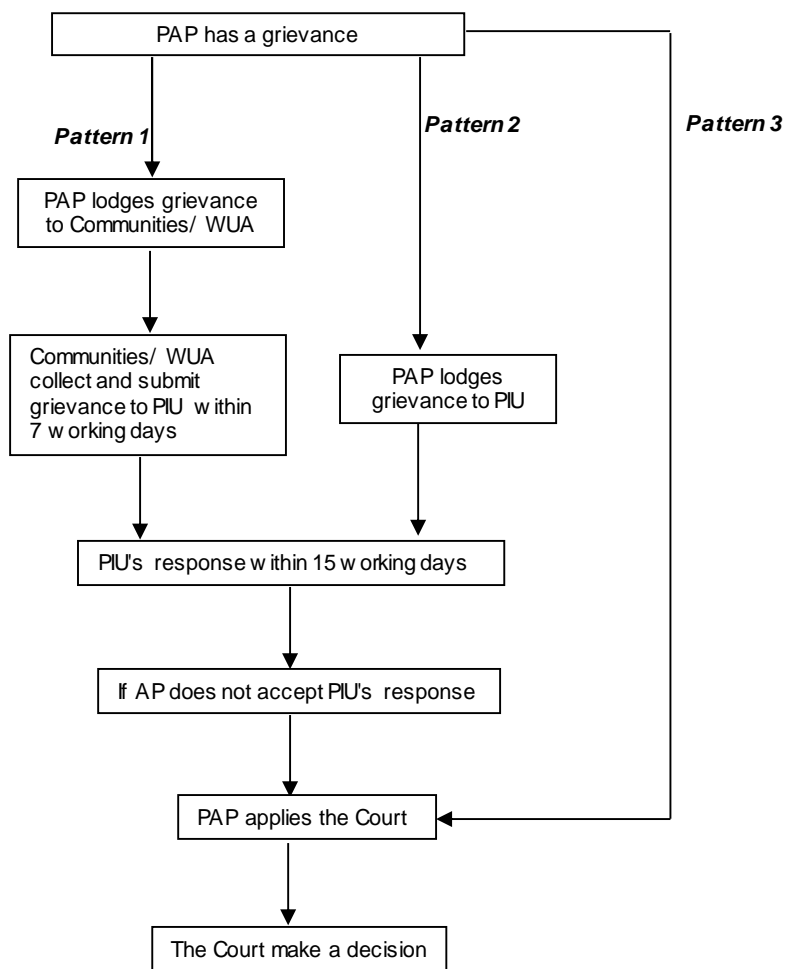


Figure 5-2-5.1 Grievance Redress Mechanism

the hearing and make decision whether the land can be acquired or not. In addition, the court also should decide how much the fair price for compensation is. Then, the Project and the PAP need to follow the decision of the court.

(2) Pattern 2

The PAP can lodge his/ her grievance to the PIU directly. The process for the grievance redress by PIU will be same as that in Pattern 1. If the PAP does not accept PIU’s response, he/ she can proceed to the court. The process for the grievance redress by the court will be same as that in Pattern 1.

(3) Pattern 3

The PAP can lodge his/ her grievance to the court directly. After grievance lodging to the court, the process for the grievance redress by the court will be same as in that Pattern 1.

5-2-6 Implementation Structure

Figure 5-2-6.1 shows the implementation structure for RAP of the Project.

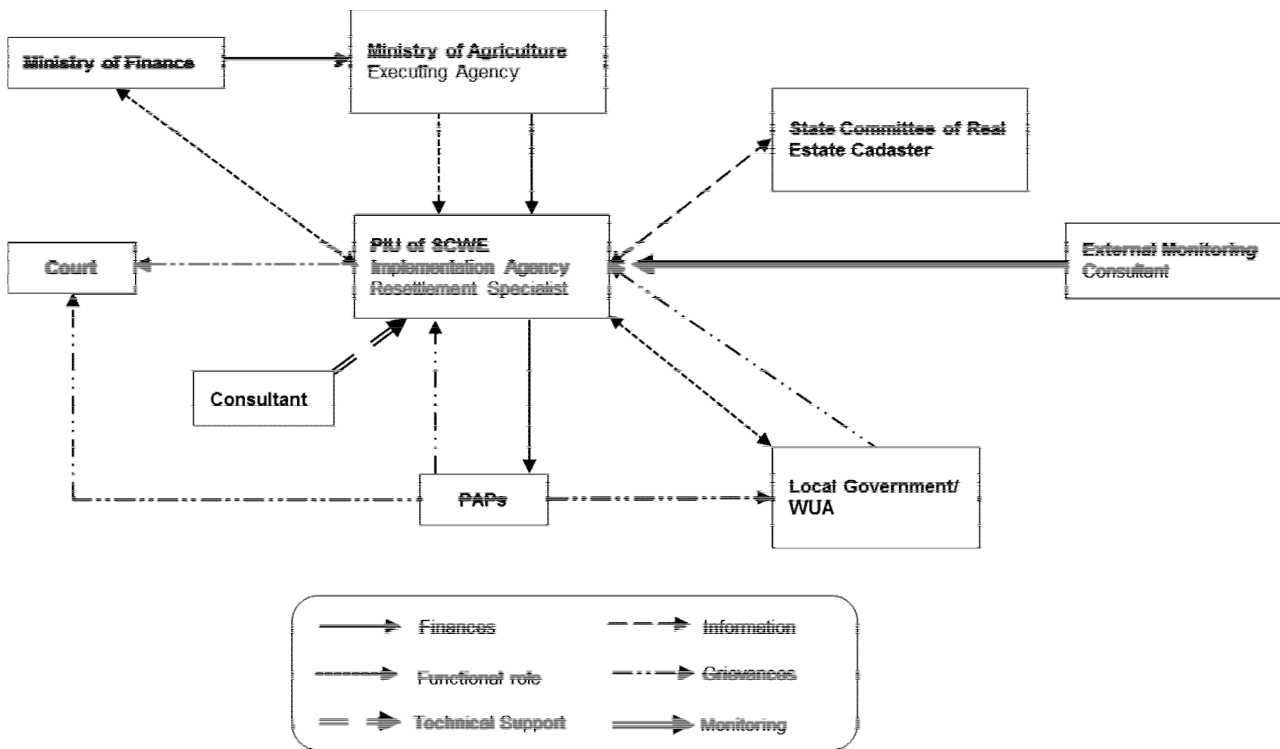


Figure 5-2-6.1 Implementation Structure

(1) Ministry of Agriculture (MOA)

MOA is the Executing Agency for the Project. It implements general functions for the Project including coordination with the concerned organizations.

(2) PIU of SCWE

PIU of SCWE is the organization which is in charge of implementation of the proposed RAP in the Project. Especially, PIU is requested to cover the final RAP preparation, implementation of the RAP, coordination with concerned organizations. Based on the proposed cost for compensation and support to the PAPs, PIU will apply the necessary budget allocation to the Government. The social expert of PIU is responsible for the general management of the planning and implementation of the RAP.

(3) Local organizations

Yeghvard city, Nor-Yerznka village, Ashtarak city, Yeghvard WUA, and Ashtarak WUA are concerned, they are expected to support the PIU for identification of PAPs and payment of compensation to the PAPs. And if the PAPs needs, the organizations are expected to give advices PAPs to solve issues. When the local government/ WUA cannot solve those issues by themselves, they are needed to report it to PIU.

(4) Consultants

At the D/D stage, the consultant is required to implement the updating/ finalizing of this RAP and he/ she provides technical support for RAP implementation of PIU, based on the results of census, assets, and socioeconomic surveys.

(5) External monitoring consultant

After D/D completion, it is required to confirm the progress of compensation payment, living conditions of PAPs by interview to representative of the PAPs by the external monitoring consultant.

(6) Other organization concerned**1) Ministry of Finance (MOF)**

The budget for the implementation of the RAP will be allocated to the PIU by the MOF after the approval of the final RAP by the Government of RA.

2) State Committee of Real Estate Cadastral

To identification of PAPs, the information of cadastral map is provided by the State Committee of Real Estate Cadastral.

3) Court

According to the Law in RA, all PAPs can lodge their grievance, if they need. The court is required to review the acquisition cases, carries out a hearing and judges about the land acquisition and compensation.

4) PAPs

Representative of the PAPs, are requested to participate into the monitoring system. To be concrete, when the consultant take interviews, the representative of the PAPs will provide the information of the progress of compensation payment, living condition of PAPs, and so on.

5-2-7 Implementation Schedule

While implementation schedule has not been fixed yet at this moment, after the Loan Agreement between Government of RA and Government of Japan, the Project will be started soon. There will be several steps to be followed during the preparation and construction. The proposed implementation schedule of the RAP after the Loan Agreement is as shown in Figure 5-2-7.1.

Activities / Month	D/D Period (14 months)														Construction (4 years)	
	Facility Design							RAP preparation								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14		
Loan Agreement of the Project	x															
Facility design	x	x	x	x	x	x	x	x	x	x	x	x	x	x		
Cut-off date									x							
Final census									x	x						
Disclosure of final census result											x					
Compensation agreement												x				
Compensation													x			
Land expropriation														x		
Monitoring and grievance redress																

Figure 5-2-7.1 Implementation Schedule

5-2-8 Cost and Financial Resources

This chapter presents the estimated compensation cost. The compensation cost shall be shouldered by the Government of RA. Table 5-2-8.1 shows the compensation cost for private land loss. 15% plus of market price is applied for the compensation cost estimation. In the Project, the following market price were estimated by the evaluator who has the license.

Table 5-2-8.1 Cost Estimation for Private Land Loss

Community	Land Use	Affected area (m ²) (1)	Market Price (AMD/m ²) (2)	Applied Value (AMD/m ²) (3)=(2)*115%	Compensation Cost (AMD) (4)=(1)*(3)
Yeghvard	Crop	100,496.59	460	529	53,162,696
Nor-Yerznka	Crop	14,588.27	440	506	7,381,665
Nor-Yerznka	Orchard	102,773.53	880	1,012	104,006,812
Nor-Yerznka	Pasture land	25,000.00	460	529	13,225,000
Nor-Yerznka	Residential area	2,021.21	3,800	4,370	8,832,688
Ashtarak	Industrial area	9,014.43	7,000	8,050	72,566,162
Ashtarak	Residential area	5,370.00	8,700	10,005	53,726,850
Total (AMD)					312,901,892
<i>Total (USD)</i> 1 USD = 486.99 AMD					64,253

Source) 1. Market price of lands: JICA Survey Team, 2016 (estimated by the licensed land evaluator)

2. Area to be affected: JICA Survey Team, 2016 (estimated by the licensed land evaluator)

In addition, Table 5-2-8.2 shows the fee for property registration.

Table 5-2-8.2 Cost Estimation for Property Registration

Community	Land Use	No. of Plot (1)	Fee for Property Registration (2)	Total Cost (AMD) (3)=(1)*(2)
Private Land				
Yeghvard	Crop	7	23,500	164,500
Nor-Yerznka	Crop	8	23,500	188,000
Nor-Yerznka	Orchard	3	23,500	70,500
Nor-Yerznka	Pasture land	1	23,500	23,500
Nor-Yerznka	Residential area	2	75,000	150,000
Ashtarak	Industrial area	2	95,000	190,000

Community	Land Use	No. of Plot (1)	Fee for Property Registration (2)	Total Cost (AMD) (3)=(1)*(2)
Ashtarak	Residential area	2	75,000	150,000
Yeghvard	Crop (partly acquired)	1	3,000	3,000
Ashtarak	Residential area (partly acquired)	2	26,000	52,000
Ashtarak	Industrial area (partly acquired)	1	26,000	26,000
Communal and State Land				
Yeghvard (community)	Farmland	54	3,500	189,000
Yeghvard (community)	Farmland (partly affected)	6	3,000	18,000
Nor-Yerznka (community)	Farmland	5	3,500	17,500
Nor-Yerznka (community)	Farmland (partly affected)	1	3,000	3,000
Nor-Yerznka (State)	Residential area	1	2,500	2,500
Nor-Yerznka (community)	Residential area	11	36,000	396,000
Ashtarak (community)	Residential area	5	36,000	180,000
Ashtarak (community)	Residential area (partly affected)	5	26,000	130,000
Ashtarak (State)	Residential area	1	35,000	35,000
Ashtarak (State)	Residential area (partly affected)	1	26,000	26,000
Total (AMD)				2,014,500
<i>Total (USD)</i> <i>1 USD=486.99AMD</i>				<i>4,137</i>

Source) 1. Law on state Registration of Property Rights

2. Law on the State Duties

Table 5-2-8.3 (1), (2) and (3) show unit cost of tree, number of affected trees, and cost for tree loss, respectively. Since it takes 2 to 6 years for the fruit trees to grow to produce fruits, considering tree species and ages, the unit price were determined by the calculation of evaluator who has the official license (see, Table 5-2-8.3 (1)).

Table 5-2-8.3 (1) Unit Price of Seeding

Type of Tree	1 st year	2 nd year	3 rd Year	4 th year	5 th year	6 th year	Years to produce fruit*
Apricot	2,260	3,930	5,600	7,270	8,940	10,610	6
Pear	1,760	3,210	4,660	6,110	7,560	9,010	6
Nutwood	2,396	4,896	7,396	9,896	12,396	14,896	4
Plum	1,760	3,210	4,660	6,110	-	-	4
Cherry	1,260	2,710	4,160	5,610	-	-	4
Oleaster	2,760	4,430	6,100	7,770	9,440	-	-
Hazel nuts	2,396	4,896	7,396	9,896	12,396	14,896	6
Mulberry	2,260	3,930	5,600	7,270	-	-	4
Apple	1,260	2,710	4,160	5,610	7,060	8,510	6
Bird cherry	1,600	2,137	2,674	3,211	-	-	4
Peach	1,600	2,137	2,674	-	-	-	3
Grape	1,010	2,680	4,350	6,020	-	-	4

Source) JICA Survey Team, 2016 (estimated by the licensed land evaluator)

Remarks) Years to produce fruit depend on tree species.

Table 5-2-8.3 (2) Number of Affected Trees

Type of Tree	1 st year	2 nd year	3 rd Year	4 th year	5 th year	6 th year
Apricot	0	6	0	0	0	65
Pear	0	0	0	4	0	3,011
Nutwood	0	0	2	0	0	138
Plum	0	0	4	161	-	-
Cherry	0	0	0	75	-	-
Oleaster	0	0	0	0	1	-

Type of Tree	1 st year	2 nd year	3 rd Year	4 th year	5 th year	6 th year
Hazel nuts	0	0	0	4	0	6
Mulberry	0	0	3	2	-	-
Apple	0	350	0	0	0	819
Bird cherry	0	0	0	40	-	-
Peach	0	0	74	-	-	-
Grape*	0	12	0	78	-	-

Source) JICA Survey Team, 2016 (estimated by the licensed land evaluator)

Table 5-2-8.3 (3) Cost Estimation for Tree loss

Type of Tree	1 st year	2 nd year	3 rd Year	4 th year	5 th year	6 th year	Total
Apricot	0	23,580	0	0	0	689,650	713,230
Pear	0	0	0	24,440	0	27,129,110	27,153,550
Nutswood	0	0	14,792	0	0	2,055,648	2,070,440
Plum	0	0	18,640	983,710	-	-	1,002,350
Cherry	0	0	0	420,750	-	-	420,750
Oleaster	0	0	0	0	9,440	-	9,440
Hazel nuts	0	0	0	39,584	0	89,376	128,960
Mulberry	0	0	16,800	14,540	-	-	31,340
Apple	0	948,500	0	0	0	6,969,690	7,918,190
Bird cherry	0	0	0	128,440	-	-	128,440
Peach	0	0	197,876	-	-	-	197,876
Grape*	0	32,160	0	469,560	-	-	501,720
Total (AMD)							40,276,286
<i>USD</i> 1 USD = 486.99 AMD							82,705

Source) JICA Survey Team, 2016 (estimated by the licensed land evaluator)

The cost for crop loss is as shown in Table 5-2-8.4.

Table 5-2-8.4 Cost Estimation for Crop Loss

	Area (m ²) (1)	Yield (kg/m ²) (2)	Unit price (AMD/kg)* (3)	Compensation cost (AMD) (4)=(1)*(2)*(3)
Alfalfa	25,700	0.73	53	994,333
Total (AMD)				994,333
<i>USD</i> 1 USD = 486.99 AMD				2,042

Source) 1. Yield; JICA Survey Team, 2016 (estimated by the licensed land evaluator)

2. Unit price; Farmer's costs of agricultural products as given by the National Statistical Service of the Republic of Armenia for 2010-2014

If all of the communities concerned agree at the voluntary provision of the communal land (including Reservoir basin) for the Project, compensation to them will not be necessary. On the other hand, if the communities do not agree at the proposal, it is needed to provide compensation for the communal land loss (Reservoir basin and area along the proposed Outlet Canal-3). In case of compensation to the communities, the cost can be estimated as shown in Table 5-2-8.5.

Table 5-2-8.5 Cost Estimation for Communal Land Loss

Community	Land Use	Affected Area (ha) (1)	Unit Price (AMD/m ²) (2)	Applied Value (AMD/m ²) (3)=(2)*115%	Compensation Cost (AMD) (4)=(1)*(3)*10,000
Yeghvard	Agriculture (crop)	705.66	460	529	3,732,941,400
Nor-Yerznka	Agriculture (orchard)	27.88	880	1,012	282,145,600
	Residential Area	3.47	3,800	4,370	151,639,000
Ashtarak	Residential Area	1.92	8,700	10,005	192,096,000
Total (AMD)		738.93			4,358,822,000
<i>Total (USD)</i> 1 USD = 486.99 AMD					8,950,537

It is necessary to provide special consideration to the vulnerable persons who are affected by the Project. Table 5-2-8.6 shows the number and percentage of vulnerable people out of the 32 PAHs, which are targeted of socioeconomic survey.

Table 5-2-8.6 Number and Percentage of Vulnerable PAHs which are Targeted of Socioeconomic Survey

Item	No. of household	Share in total PAHs (%)
1) Recipient household of "poverty benefits"	2	6.25
2) Recipient household of "disability benefits"	3	9.38
3) Headed by female	3	9.38
4) Headed by elderly person	3	9.38

Source) JICA Survey Team, March-April of 2016

The actual number of the cultivators in the Reservoir basin is unknown, however, it can be estimated at 53 households, considering there are 53 plots at most. Therefore, the total number of project affected households can be thought as 75 (=53+22¹⁴).

Table 5-2-8.7 shows the results of calculation for potential vulnerable PAHs in the Project affected area by using the result of the socioeconomic survey.

Table 5-2-8.7 Potential Vulnerable PAHs within the Reservoir Basin

Item	Total no. of PAHs (1)	Share in total PAHs (%) (2)	Vulnerable PAHs within the Reservoir Basin (3)=(1)*(2)
1) Recipient household of "poverty benefits"	75	6.25	4.68
2) Recipient household of "disability benefits"	75	9.38	7.04
3) Headed by elderly person	75	9.38	7.04
4) Headed by female	75	9.38	7.04
Total			Approximately 26

Source) JICA Survey Team, March-April of 2016

The vulnerable persons is calculated as shown in Table 5-2-8.8.

Table 5-2-8.8 Allowance to the Vulnerable Persons

Item	No. of household	Unit Price (AMD/month)	Payment Period	Total (AMD)
Allowance to the vulnerable person	26HHs	55,000*	6 month	8,580,000

Source) Law on minimum monthly salary

Remarks) Since ADB project provided minimum monthly salary for 6 months to the vulnerable persons, the Project follows the same methodology.

Based on the cost estimation mentioned above, total compensation cost is as shown in Table 5-2-8.9.

Table 5-2-8.9 (1) Total Compensation Cost of the Project (Excluding the Communal Land Loss)

Item	Compensation Cost (AMD)
Private Land Loss	312,901,873
Property Registration	2,014,500
Tree Loss	40,276,286
Crop Loss	994,333
Allowance to the vulnerable persons	8,580,000
Total (1)	364,766,992
Contingency* (2)=(1)*0.20	72,953,398
Grand Total (AMD) (3)=(1)+(2)	437,720,390
<i>Grand Total (USD)</i> 1 USD = 486.99 AMD	898,828

¹⁴ There are 15 PAHs with legal status and 7 PAHs which have cultivated within canal area without legal status.

Table 5-2-8.9 (2) Total Compensation Cost of the Project (Including the Communal Land Loss)

Item	Compensation Cost (AMD)
Private Land Loss	312,901,873
Property Registration	2,014,500
Tree Loss	40,276,286
Crop Loss	994,333
Allowance to the vulnerable persons	8,580,000
Communal Land Loss	4,358,822,000
Total (1)	4,723,588,992
Contingency* (2)=(1)*0.20	944,717,798
Grand Total (AMD) (3)=(1)+(2)	5,668,306,790
<i>Grand Total (USD)</i> <i>1 USD = 486.99 AMD</i>	11,639,473

Remarks) Based on the Resettlement Action Plan of Sustainable Urban Development Investment Program–Tranche 2 (ADB, 2015), contingency of the compensation cost of the Project is set at 20%.

5-2-9 Monitoring Structure and Monitoring Form

For carrying out of the RAP, it is required the internal and external monitoring by different organizations, as shown below;

(1) Internal Monitoring

The internal monitoring is carried out by PIU and private consultants for RAP implementation. In the internal monitoring process, following indicators could be proposed:

- Number of people raising grievances in relation to the Project and number of unresolved grievances;
- Progress of compensation payment;
- Whether the payment is properly done; and
- Change of the living conditions of PAPs.

(2) External Monitoring

The purpose of the external monitoring is examine the impacts on the PAPs objectively. The external monitoring is carried out by private consultants hired by the PIU/SCWE, who are independent from internal monitoring, to confirm whether the compensation, considerations, grievance redress and so on are properly implemented in accordance with the RAP.

(3) Monitoring Form

It is needed to confirm whether the proposed RAP is implemented as planned through the monitoring. Verification of payment, grievance handling, and conflict settlement have to be managed. During the compensation and construction stage, the monitoring will be practiced on monthly basis and it is implemented by the PIU/SCWE in collaboration with the private consultants. The consultants must provide technical advices to the PIU/SCWE, and the result should be complied as a monitoring report. After the construction completion, i.e., in the operation stage, the living conditions of the PAPs should be monitored bi-annually by PIU/SCWE by using format shown in Table 5-2-9.1.

Table 5-2-9.1 Sample of Format for Monitoring**Public Consultation**

No.	Date	Place	Contents of the consultation/ main comments and answers
1			
2			

Resettlement Activities	Planned Total	Unit	Progress in Quantity			Progress in %		Expected Date of Completion	Responsible Organization
			During the Quarter	Till the Last Quarter	Up to the Quarter	Till the Last Quarter	Up to the Quarter		
Preparation RAP									PIU/ SCWE
Employment of Consultants		Man-month							
Implementation of Census Survey (including socioeconomic survey)									
Approval of RAP			Date of Approval:						
Finalization of PAPs List		No. of PAPs							
Progress of Compensation Payment		No. of PAHs							
Lot 1		No. of PAHs							
Lot 2		No. of PAHs							
Lot 3		No. of PAHs							
Lot 4		No. of PAHs							
Progress of Land Acquisition (all lots)		ha							
Lot 1		ha							
Lot 2		ha							
Lot 3		ha							
Lot 4		ha							
Progress Asset Replacement		No. of PAHs							
Lot 1		No. of PAHs							
Lot 2		No. of PAHs							
Lot 3		No. of PAHs							
Lot 4		ha							
Progress of Relocation of People (all lots)		No. of PAHs							
Lot 1		No. of PAHs							
Lot 2		No. of PAHs							
Lot 3		No. of PAHs							
Lot 4		ha							

5-2-10 Public Consultation

It was decided to hold the series of stakeholder meetings on ESIA and RAP at the same time. The venues to hold the Stakeholder Meetings are Yeghvard city and Nor-Yerznka village, since their get impacts by the Project mostly.

Following the Armenian law on Environmental Impact Assessment and Expertise, public consultation shall be organized at two stages. Before the start of the environmental impact assessment survey (Scoping Stage), the first Public Consultation should be organized, and the project outline and environmental expected impacts would be presented. In addition, before the submission the draft of ESIA Report, the second Public Consultation would be organized to share the environmental impact assessment results and gain comments from the participants. At the same time, it is needed to get feedback from the participants about socioeconomic survey results and compensation policy.

5-2-10-1 Arrangement of Public Consultation

(1) Public Notice for Public Consultation on the Initial Environmental Impact Assessment

Armenia has been a member country of the Aarhus Convention which has regulated the access-ability to the environmental information, since 2002. In Armenia, there are 15 Aarhus Centers, which was founded by Organization for Security and Cooperation in Europe (hereinafter, "OSCE"), in each Marzs. Especially, Ministry of Territorial Administration and Emergency Situations and MNP had been involved with their establishments. And Aarhus Center has promoted information disclosure and public involvement, with supporting of the Armenian Governmental organizations, including SCWE. Moreover, the centers have taken charge of arrangement for Public Consultation. Actually, SCWE requested Aarhus Center of Yeghvard city to support for holding of the first Public Consultation. SCWE, the Survey Team, and Aarhus Center of Yeghvard city worked together.

According to the Law on Environmental Impact Assessment and Expertise, seven working days before of Public Consultation, information of public consultation shall be noticed. On 8th October 2015, public notice for the Public Consultation on 20th October 2015, was presented at the newspaper (see, Appendix K-12) and website of Aarhus center. And Table 5-2-10.1 shows the contents of the Public Notice which would be organized on 20th October 2015. And the same contents were published on the website of Aarhus Center.

Table 5-2-10.1 Contents of the Public Notice on the Project Outline

A Public Hearing (consultation) about the document of "Application of the Initial Assessment of Environmental Impact of the Yeghvard Irrigation System Improvement Project" will be held on 20th October, 2015, at 15.00 - 18.00 at the Yeghvard Municipality Conference hall (address: Yeghvard, 1Yerevanyan street) as follows:	
Undertaker	State Committee of Water Economy, MOA, Armenia
Venue of the public Consultation	1 Yerevanyan str., Yeghvard, Conference Hall of the Municipality
Possible environmental impact	Some environmental impacts due to the project are expected.
Time, date, location and method to learn about the application mentioned above	The initial assessment application is uploaded in website of following addresses: <ul style="list-style-type: none"> · State Committee of Water Economy (Yerevan, Vardanants deadlock 13A) – www.scws.am · Yeghvard city info@yeghvard.am, and · Yeghvard Aarhus Center - www.aarhus. Furthermore, you can contact the offices mentioned above every day at 14.00-18.00 from the day of public notice to the deadline mentioned below, if you want to make the comments and suggestions on the application.
The deadline for submitting comments and suggestions on the application	7 working days after, counting from the date of public notice.
Responsible officer for discussions	Yeghvard Municipality

E-mail address and telephone number of Responsible Officer	E-mail address info@yeghvard.am Tel. (0224) 2 11 10
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(2) Public Notice for Public Consultation on the Draft ESIA Report

On 28th September 2016, the Public Notice for the Public Consultation on the Draft ESIA Report was presented at the newspaper (see Appendix K-22). Table 5-2-10.2 shows the contents of the Public Notice for the Public Consultation on 10th October 2016 at Yeghvard city and Nor-Yerznka village. And the same contents were published on the website of SCWE.

Table 5-2-10.2 Contents of the Public Notice on the Draft ESIA Report

A public hearing (consultation) about the ESIA Report of the "Yeghvard Irrigation System Improvement Project" will be held on 10th October, 2016, at 11.00 at the Yeghvard City Conference hall and at 14:00 at the Nor-Yerznka Village Office.	
Undertaker	State Committee of Water Economy, MOA, RA
Possible environmental impact	Some environmental impacts due to the project are expected.
Time, date, location and method to learn about the application mentioned above	The documents are uploaded in the website of State Committee of Water Economy (Yerevan, Vardanants deadlock 13A) – www.scws.am and in the website of Yeghvard Aarhus center (1 Yerevan str., Yeghvard city) - www.aarhus. Furthermore, you can contact the offices mentioned above every day at 14.00-18.00 from the day of public notice until the deadline for making comments and suggestions.
The deadline for submitting comments and suggestions on the application	7 working days after, counting from the date of public notice.
Responsible officer for discussions	Yeghvard Municipality Nor-Yerznka community office
E-mail address and telephone number of Responsible Officer	Yeghvard Municipality (info@yeghvard.am, Tel. (+374224) 2-11-10) Nor Yerznka community office (norerznka-village@mail.ru, Tel. (+374232) 3-67-91)

5-2-10-2 Public Consultation on the Project Outline by SCWE

On 20th October 2015, the Public Consultation on the Project Outline was organized at Yeghvard city office. This Public Consultation was organized by the Project, and general project outlines were explained to the participants.

Table 5-2-10.3 shows the comments and questions from the attendances. Seemingly, the attendants do not oppose to the Project.

Table 5-2-10.3 Discussion at the Public Consultation on the Project Outline (20th October 2015)

No.	Speakers	Questions/ Comments	Respondents	Answers
1.	Director of Vagharshapat WUA	How is the stakeholder territory of the project distributed among WUA? How much territory will be served by each of 4 WUAs?	Hydro-technical Engineer of PIU	Mentioned that the studies are still being carried out, but the areas being served are known. The biggest areas are in Khoy and Vagharshapat WUAs.
2.	Director of Yeghvard WUA	How about the progress and results of geological survey for determination of water permeability of the bottom of Yeghvard reservoir?	Team leader of the Survey Team	We started the investigations in June. The geological survey and the ground water survey were implemented. The preliminary data show that the permeability coefficient is high and the water may easily infiltrate through the existing layer. Therefore, it is necessary to take anti-filtration measures. The type of impervious material and the method of application will be determined as a result of survey. The expenses related to reservoir construction are mostly dependent on the type of impervious layer.
3.	Mayor of Ashtarak City	How much is the approximate budget for Yeghvard irrigation system improvement project and is it planned	Hydro-technical Engineer of PIU	As it was mentioned by Mr. Tsumura, the project budget depends on the method and material of impervious layer. The budget will be calculated after selection of the abovementioned. Regarding the creation of recreation zone near

No.	Speakers	Questions/ Comments	Respondents	Answers
		to create a recreation zone near the reservoir?		the reservoir, it is not a subject of this project and is not being considered by the survey team.
4.	Director of Ashtarak WUA	Some areas of the 27 communities are located on higher altitude than Yeghvard reservoir. How will the irrigation be done for them? Do you plan to construct new canals?	Hydro-technical Engineer of PIU	New canals will not be constructed. The water from Yeghvard reservoir will flow to Arzni-Branch canal and Kasakh river, and will be guided to stakeholder communities by the use of existing system.
5.	Social Expert of PIU	How is the status and ownership of the lands of the territory of reservoir?	Social Specialist of ATMS Solutions LLC	Mentioned that the issues of alienation and compensation of the lands are being considered in the frames of F/S of Yeghvard irrigation system improvement project. At this moment the studies are still being carried out and there are no final results. However, there will be several explanations. Particularly, the actual reservoir is located on community lands that belong to Yeghvard and Nor-Yerznka communities. This means that large scale resettlement is not envisaged. However, in case of feeder and intake canals, resettlement issue may arise. However, the canal routes have not been determined yet. Detail information will be provided to the Client soon.
6.	Mayor of Ashtarak City	Is there an issue of transportation of topsoil? Is it completely transported? If there is such an issue, then you have to consider it.	Hydro-technical Engineer of PIU	Most part is transported to Ashtarak to establish gardens. There is a few humus in the territory.
7.	Deputy Mayor of Yeghvard City	As I know the Japanese company is mainly implementing technical surveys. Do you have any preliminary data on the possible impact on the environment?	Environmental Consideration of the JICA Survey Team	The environmental impact assessment of Yeghvard irrigation system improvement project is on-going. Impacts on ecosystem, especially to the fishes of Hrazdan and Kasakh rivers, are examined. Besides, underground water and soil contamination by pesticides/fertilizer in the beneficial areas are studied.
8.	Director of Vagharshapat WUA	If the water of Kasakh river will flow to Yeghvard reservoir, is there a possibility, that the irrigation of the territories served by "Khoy" and "Vagharshapat" WUAs will depend on reservoir?	Hydro-technical Engineer of PIU	Water of Kasakh river will not be used. Only the additional surplus water will be directed to the reservoir. The reservoir will store 90 MCM of water, which will be used by WUAs (Khoi, Vagharshapat, Yeghvard and Ashtarak). The water will be stored in the reservoir during non-irrigation season, mainly during spring floods.
9.	Deputy Chairman of SCWE	What are possible social and environmental risks during construction of reservoirs and if they are typical for Yeghvard reservoir?	Environmental Consideration of the JICA Survey Team	Regarding the social impact, in case of construction of canals, the issue of alienation and compensation will arise. The lands in the actual reservoir area are not private. However, the people who cultivate there will have to leave their lands. As for natural environmental impact, there will be air pollution because of large-scale construction works with various types of machines and vehicles. As the reservoir will be filled by the water from Hrazdan river, which will then flow to Kasakh river, the ecosystems of Hrazdan and Kasakh rivers will possibly mix with each other. In case of such projects, it is very difficult to avoid environmental impact completely, however, our goal is to minimize it.
10.	Resident of Yeghvard City	How many years will the construction of Yeghvard reservoir last?	Hydro-technical Engineer of PIU	The F/S stage of Yeghvard irrigation system improvement project will be finished in May 2016. 1-1.5 years will be required for agreement of it. After that, 4-5 years will be required for construction of the reservoir.
11.	Resident of Yeghvard City	Is there any initial calculation of minimum and maximum depths of the reservoir to be constructed?	Hydro-technical Engineer of PIU	According to the initial calculations the maximum depth is going to be 15 m. The minimum depth is going to be 1.5 meters. It means that 6 MCM will always remain in the reservoir.

As Table 5-2-10.4 shows attendants, the total numbers of the attendants was 35. 17 persons out of 35 are from SCWE, PIU, JICA Survey team member, Aarhus Center staff and the environmental consultants for ESIA and RAP preparation, while 18 persons out of 35 are from beneficial communities, 4 WUAs concerned to the Project, and additional 2 WUAs.

Table 5-2-10.4 Participant List of the Public Consultation on the Project Outline (20th October 2015)

No.	Name	Position	Organization
1.	Volodya Narimanyan	Deputy Chairman	SCWE, MOA
2.	Viktor Martirosyan	Advisor of Chairman	
3.	Khoren Tsarukyan	Hydro-technical Engineer	PIU, SCWE, MOA
4.	Marina Vardanyan	Social Expert	
5.	Martiros Nalbandyan	Environmental Expert	
6.	Kazumitsu Tsumura	Team Leader	The Survey Team of JICA
7.	Rie Kitao	Environmental Consideration	
8.	Shohey Natsuda	Social Consideration (1)	
9.	Ayumi Shiga	Social Consideration (2)	
10.	Gevorg Gevorgyan	Assistant/ Interpreter	
11.	Luiza Manyan	Assistant/ Interpreter	
12.	Khristine Goroyan	Assistant/ Interpreter	
13.	Ruzanna Manyan	Head Officer	Aarhus Center
14.	Anush Beybutyan	Coordinator	
15.	Artak Ter-Terosyan	Environmental Specialist, Director	ATMS Solutions LLC, Local ESIA Consultant
16.	Suren Gyunjinyan	Social Specialist	
17.	G.Sahakyan	Cameraman	
18.	Karen Harutyunyan	Deputy Mayor	Yeghvard city
19.	----	Resident (Head of Library)	
20.	----	Resident (Librarian)	
21.	----	Resident (Librarian)	
22.	----	Resident	
23.	Armen Antonyan	Mayor	Ashtarak city
24.	Armen Sargsyan	Head of Community	Hovtamej Community
25.	Suren Baghdasaryan	Deputy Head of Community	Zovuni Community
26.	Sedrak Khachatryan	Head of Community	Kashakh Community
27.	V.Mkhitaryan	Representative	Sasunik Community
28.	G.Shahgeldyan	Representative	Arshaluys Community
29.	A.Movsesyan	Representative	Aragats Community
30.	Mihran Hovhannisyan	Director	Yeghvard WUA
31.	Sedrakyan Sedrakyan	Director	Vagharshapat WUA
32.	Arsen.Khachatryan	Director	Ashtarak WUA
33.	Sargyan Sargsyan	Director	Khoy WUA
34.	Hovik Gevorgyan	Director	Parpi WUA*
35.	Armen Karapetyan	Director	Nairi WUA*

Remarks: 1. Parpi WUA and Nairi WUA are outside of project beneficiary and affected areas.

2. In Armenia, generally, there are one or plural communities under one community. Both Yeghvard and Ashtarak are categorized into city, those cities have one community each, Yeghvard City is sometimes called as Yeghvard Community. Communities are politically managed by "Head", while City is headed by "Mayor".

5-2-10-3 Public Seminar on the Project Outline in Nor-Yerznka Village

Given that the number of participants from the communities, namely, general residents, at the public consultation is limited, a seminar was organized to promote the local residents to attend more to supplement the public consultation on 5th November, 2015 in Nor-Yerznka village.

Nor-Yerznka village is located on west of the Yeghvard Reservoir, and parts of the village could be affected by the Project. At the arrangement of the seminar, the Project side tries to enhance women's participation in the seminar in terms of gender balance, since women's participation rate in the Public Consultation was low. On the other hand, it is noted that Head of Nor-Yerznka village is female.

At the seminar, the project outlines and expected impact by the Project were explained by the Project Coordinator of PIU/SCWE, Mr. K.Tsarukyan, using the same presentation material as the one at the Public Consultation was used. Moreover, the location map illustrating the affected area in the village was also presented to the participants. It is noted that two routes for Outlet Canal-2, namely, 1)

northern route which passes through orchard and houses and 2) southern route passes through natural stream, were proposed at that time, both route on the map were presented¹⁵. The participants made some questions and comments as shown in following table. As a whole, no objection against the Project was presented, however, some issues to be examined were raised.

Table 5-2-10.5 Discussion at the Public Seminar in Nor-Yerznka Village (5th November 2015)

No.	Speaker	Question and Comment	Answer
1.	Head of the village	Proposed northern route for Outlet Canal passes through the graveyard, and it is very difficult to expropriate the lands around the route. On the other hand, another option, namely, southern route passes through natural stream, which results in small impacts on the residents. The community supports the Project, if southern route is selected.	-
2.	Resident	My concerns are counteraction of the Reservoir and earthquake proof.	Japan has experienced many natural disasters, Japanese engineer's design is reliable. It is planned to implement quake-resistance study during the survey. (Mr. Khoren Tsarukyan, PIU)
3.	Resident	Impact on the community by water leakage from the Reservoir is also a concern.	After the completion of the reservoir construction, it is planned to maintain the Reservoir continuously and take measures against any problems. The Project is not first reservoir construction project. Your concern has been already examined in other reservoir construction projects so far, and you do not have to be worry about the issue. Safe reservoir construction is examined. (Mr. Khoren Tsarukyan, PIU)
4.	Resident	What is the reason for intake from the Arzni-Shamiram Canal? Do you have a plan to use the irrigation water of the canal?	It is planned to use free water of the Hrazdan River through the Arzni-Shamiram Canal, and to store the water at the Yeghvard Reservoir. (Mr. Khoren Tsarukyan, PIU)
5.	Resident	I think the free-water is only one million tons.	According to current estimation, amount of the free water is 90 million tons and the water will be stored during 2-3 months. (Mr. Khoren Tsarukyan, PIU).
6.	Head of the Village	Nor-Yerznka village uses Aparam Canal and Arzni-Shamiram Canal for irrigation. Is it possible for the community to use the store water at the Yeghvard Reservoir?	The Project plans to divert the stored water at the Reservoir to the Kasakh River for irrigation of Ararat Plain. Beneficial communities are Kasakh, Zovuni, Proshyan and so on. (Mr. Khoren Tsarukyan, PIU)
7.	Resident	Is it planned to use canals to discharge the Reservoir water to the Ararat Plain?	Kasakh River will be used for water distribution to the Ararat Plain. (Mr. Khoren Tsarukyan, PIU)
8.	Resident	When river water is used, around 20% of the water will be lost?	In general, water loss in river is observed even in natural conditions. However, free water, which is planned to be diverted to the Kasakh, can be used without loss. Mr. Khoren Tsarukyan, PIU)
9.	Resident	Existing roads are included in the affected areas, and how the roads will be changed after the construction works?	After the pipelines are buried, the roads will be restored to the original conditions. (PIU, Mr. Khoren Tsarukyan, Mr. Khoren Tsarukyan, PIU)
10.	Resident	I think that capacity of the Reservoir becomes smaller than that before.	Original plan of reservoir capacity was 230 MCM, while current planned capacity is around 90 MCM. (Mr. Khoren Tsarukyan, PIU)
11.	Head of the Village	How do you evaluate the compensation rate? Is it based on the market price or official price?	Based on the law/regulation, land evaluation and compensation will be implemented. (Mr. Artak Ter-Torosyan, ATMS Solutions LLC) The Reservoir basin is owned by State/Community, therefore, compensation for the loss in the reservoir will not be a big issue. Regarding temporary land acquisition, compensation for the loss during the construction period will be provided. (Mr. Khoren Tsarukyan, PIU)
12.	Resident	Which place is the highest point of water pressure by the Reservoir?	Nor-Yerznka village side in the Reservoir is relatively higher. (Mr. Khoren Tsarukyan, PIU)
13.	Resident	If the Reservoir capacity is 90 MCM, how deep in the reservoir?	Around 15-16m depth. Since the reservoir area is wide, water depth is not very huge. It is noted that the standard of quake-resistant during Soviet Union period was not very strict, however, new standard becomes strict than before. The quake-resistant design/measure is examined in collaboration with the Academy at this moment. (Mr. Khoren Tsarukyan, PIU)
14.	Resident	When will the construction works start?	It is F/S stage at this moment and after the F/S completion, Loan Agreement (L/A) will be exchanged. After the L/A, it

¹⁵ Ultimately, the northern route was not proposed as the Project component.

No.	Speaker	Question and Comment	Answer
			will take 1.5 years for Detailed Design (D/D). After the D/D completion, the construction works will be started. (Mr. Khoren Tsarukyan, PIU)
15.	Resident	Climate change due to the construction works is expected?	It is recommended to ask the environmental expert for the issue. (Mr. Khoren Tsarukyan, PIU)
16.	Head of the Village	Are there any environmental impacts on Nor-Yerznka village?	During construction stage, heavy construction vehicles will be used, which can cause air pollution. (Mr. Khoren Tsarukyan, PIU)
17.	Resident	What kinds of materials will be used during construction stage? Do you have a plan to use oil?	It is planned to reduce the impacts on natural environment by the construction materials as much as possible. (Mr. Khoren Tsarukyan, PIU)
18.	Head of the Village	There can be some dangerous situations by the Project. However, due to the increase of soil moisture, I think that Nor-Yerznka village can be rich.	Indirect impact such as increase of agricultural application amount will be examined. (Mr. Khoren Tsarukyan, PIU)
19.	Resident	The most important matter for the Community is safety, namely, quake-resistant measures of the Reservoir. Permeability examination during the construction stage is necessary.	If no measure is taken, all of the 90MCM water for the Reservoir will be infiltrated into the soil. Therefore, any measures have to be done. At this moment, anti-infiltration works are examined, and main construction cost will be for the works. In the Reservoir basin, most of area consists of sand and clay, while only a part of northern part of the Reservoir basin is rock. (Mr. Khoren Tsarukyan, PIU)
20.	Resident	Do you have a plan to transport of the fertile top-soil within in the Reservoir basin to other areas?	Some parts of top-soil in the Reservoir basin had been already transported during the Soviet Union period. If necessary, before the construction works, transportation of the top-soil will be examined. (Mr. Khoren Tsarukyan, PIU)
21.	Resident	The most important matter for the Community is safety. If safety is considered and secured, we will support the Project.	—
22.	Resident	Water leakage will give damage to not only Nor-Yerznka village, but also Zovuni Community.	—
23.	JICA Survey Team	We would like to some female participants to express their opinions.	It seems that everybody regards the Project as very good one. However, there can be a possibility that dangerous situations in the Community will be caused by the Project, and I cannot support the Project completely. (a female resident)

At the seminar, official personnel of the PIU, the Survey team members, private environment experts (ATMS Solutions LLC), staff of Aarhus Center, the Community Head, and fifteen (15) residents including WUA Deputy Head participated. Attendant list of the seminar is as shown in Table 5-2-10.6.

Table5-2-10.6 Participant List of the Public Seminar in Nor-Yerznka Village (5th November 2015)

No.	Name	Position	Organization
1.	Alina Sahakyan	Head of the Community	Nor-Yerznka Village
2.	Haikush Nazaryan	Community office worker	Nor-Yerznka Village
3.	Lolita Tonotyan	Community office worker	Nor-Yerznka Village
4.	Artur Tonyan	Deputy Head	Ashtarak WUA
5.	-----	Resident	
6.	-----	Resident	
7.	-----	Resident (a vehicle Operator)	
8.	-----	Resident (Director of Culture House)	
9.	-----	Resident (School Director)	
10.	-----	Resident (Librarian)	
11.	-----	Resident	
12.	-----	Resident	
13.	-----	Resident (Farmer)	
14.	-----	Resident	
15.	-----	Resident	
16.	-----	Resident	
17.	Khoren Tsarukyan	Hydro-technical engineer	PIU, SCWE, MOA
18.	Kazumitsu TSUMURA	Team Leader	JICA Survey Team
19.	Ayumi SHIGA	Environmental and Social Consideration	JICA Survey Team
20.	Gevorg GEVORGYAN	Interpreter	JICA Survey Team
21.	Ruzanna Manyan	Coordinator	Aarhus Center
22.	Artak Ter-Torosyan	Director	ATMS Solutions LLC

5-2-10-4 Public Consultation on the Project Outline by the MNP

Based on the law in Armenia, the Public Consultation by the MNP on application of the Initial Environmental was held in Yeghvard municipality on 23rd December 2015. The Public Consultation was organized under the responsibility of the MNP, for the purpose of confirmation of the result of the Public Consultation, which had been already done by the Project. The opening remarks were done by Mr. K. Harutyunyan, Deputy Mayor of Yeghvard city and Ms. A. Drnoyan, the specialist of “Environmental Impact Expertise Center” SNCO. The discussion at the Public Consultation by the MNP is as shown below:

Table 5-2-10.7 Discussion at the Public Consultation on the Project Outline by MNP (23rd December 2015)

No	Speaker	Question and Comment	Answer
1.	Resident	What water will be used to fill the reservoir? Will the water of Sevan Lake be used? Is there enough water reserve, which will ensure irrigation of agricultural lands during irrigation period?	Water of Hrazdan river will be used to fill the reservoir through Arzni-Shamiram canal during springtime before irrigation season. Regarding the irrigation water reserves, 90MCM water will be reserved annually, which is quite huge amount for irrigation of lands. (Mr. Khoren Tsarukyan, PIU)
2.	Resident	You mentioned during presentation that the construction of reservoir will solve social issues. What kind of labor issues will be solved and is a fishing industry planned?	Currently our task is to construct the reservoir for the purpose of irrigation of lands. Regarding the recreation zone, maybe in the future fishing industry and recreation zone will also be considered, but such works are not envisaged in current project. (Mr. Khoren Tsarukyan, PIU)
3.	Resident	Is there a possibility to create a recreational zone around the reservoir?	
4.	Resident	What will happen to the humus (top soil) after removal during reservoir construction works? Will it be provided to land users of that territory?	The removed humus will be used for agriculture. (Mr. A. Ter-Torosyan, Environmental expert of ATMS Solutions LLC) Answers of such questions related to humus will be given in the main stage of environmental impact assessment and alternative options for solution of those issues may be proposed. All the proposals and remarks will be taken into consideration. (Ms. A. Drnoyan)
5.	Resident	What kind of compensations will be provided to the owners of lands in the territory of reservoir?	Beside the laws of the Republic of Armenia there are international regulations, according to which, the land user, who has no ownership of the land, will not receive compensation as a land owner, but investments he made for cultivation of the land will be compensated. (Mr. M. Vardanyan, Chief accountant of “Welfare and housing fund” office)
6.	Resident	Will there be independent experts in the stage of assessment of environmental impact?	Independent experts are also being involved during the main stage of expertise, but this is still an initial stage and no independent expert is involved. (Ms. A. Drnoyan)

Table 5-2-10.8 Participant List of the Public Consultation by MNP (23rd December 2015)

No.	Name	Position	Organization
1.	K.Harutyunyan	Deputy-Mayor	Yeghvard city
2.	A.Drnoyan	Specialist	“Environmental Impact Expertise Center” SNCO, MNP
3.	N.Karapetyan	Leading specialist of Yeghvard City	Yeghvard City
4.	R.Manyan	Coordinator	Yeghvard Aarhus center
5.	M.Vardanyan	Specialist of social affairs	PIU, SCWE, MOA
6.	D.Zakaryan	Hydrologist	PIU, SCWE, MOA
7.	K.Tsarukyan	Hydro-technical engineer	PIU, SCWE, MOA
8.	A.Ter-Torosyan	Director	ATMS Solutions LLC
9.	A.Vardanyan	Chief accountant	“Welfare and Housing Fund” office
10.	A.Aleksanyan	Clerk	“Welfare and housing fund” office
11.	-----	Resident of Yeghvard city	
12.	-----	Resident of Yeghvard city	
13.	-----	Resident of Yeghvard city	
14.	-----	Resident of Yeghvard city	
15.	-----	Resident of Yeghvard city	
16.	-----	Resident of Yeghvard city	
17.	-----	Resident of Yeghvard city	
18.	-----	Resident of Yeghvard city	
19.	-----	Resident of Yeghvard city	
20.	-----	Resident of Yeghvard city	
21.	-----	Resident of Yeghvard city	
22.	-----	Resident of Yeghvard city	

5-2-10-5 Public Seminars on Environmental and Social Impacts by the Project

It is not a duty for any project undertakers to organize public consultations for Category A projects more than twice. However, the Project could cause land acquisition and several dozen people will be affected, and expected impacts by the Project should be presented to the people at early stage, so that, the Project can be implemented smoothly. Based on the concept, the public seminars to explain about anticipated impacts were organized on 31st May 2016 prior to the official public consultation on the ESIA report. The most affected areas by the Project are Yeghvard city and Nor-Yerznka village, and the seminars were held at those municipality offices. Public notice were presented at two (2) community offices mentioned above and four (4) WUA offices concerned (see the photos of public notice in Appendix 15) to encourage the people concerned to participate in the seminar as much as possible.

At the seminars, as a whole, there were no objection against the Project, and the participants are interested in compensation policy, transportation of fertile top-soil in the Reservoir basin, anti-infiltration works and involuntary communal land provision. It is noted that both heads of communities hope governmental support, e.g. small scale of project, in case of voluntary communal land provision. The discussions and participant lists at Nor-Yerznka village and Yeghvard city are shown in Table 5-2-10.9, Table 5-2-10.10, Table 5-2-10.11, and Table 5-2-10.12, respectively.

Table 5-2-10.9 Discussion at the Public Seminar in Nor-Yerznka Village on Environmental and Social Impacts (31st May 2016)

No.	Speaker	Question and Comment	Answer
1.	Resident	What benefit will Nor-Yerznka village receive from the reservoir? I think we have a privileged use of water, however, people don't get water even now.	If you have water shortage issue, please apply to PIU and explain your problem, they will record it. At this moment, we are in the F/S stage. We will implement further study in next stage (D/D). (Khoren Tsarukyan / PIU)
2.	Alina Harutyunyan/ Head of Community	We have gathered today in order to discuss issues related to the reservoir. If you have some other issues related to PIU, we will discuss it later.	Today's topic of discussion is environmental and social impacts by the Project, in terms of positive and negative impact. (Khoren Tsarukyan / PIU)
3.	Resident	How long does it take for the construction works?	Around 4 years (Khoren Tsarukyan / PIU)
4.	Resident	What if I do not agree with the compensation amount? (*1)	It is today's main subject to be discussed. If you do not agree, we may decide not to pass the pipeline through your land (Khoren Tsarukyan / PIU)
5.	Alina Harutyunyan/ Head of Community	How many meters of width is necessary for burying the pipeline (ø1,600mm) which will pass through the community?	In general, 15m width for one-side (excluding canal) is secured for the proposed pipeline, still, in this Project, more than 15 m width for the pipeline is secured for safety side. It is noted that this is F/S stage and it will be finally decided during D/D stage. Everything will be done in accordance with the law. (Khoren Tsarukyan / PIU)
6.	Alina Harutyunyan/ Head of Community	Are you going to use existing dam or implement some additional works related to the dam?	Yes. It will be a high quality dam by using existing dam and additional works. The specialists from Japan have a rich related experience. We will take all the possible measures to ensure the safety of the dam. (Khoren Tsarukyan / PIU)
7.	Resident	There are many sandy areas in the reservoir basin. According to my experience, sprayed water is immediately absorbed into the soil. So, there will be a problem of infiltration.	We have carried out many surveys. The most severe issue is the anti-infiltration works. We have planned to implement anti-infiltration works to solve the issue. (Khoren Tsarukyan / PIU)
8.	Resident	Do you have a plan to construct a spill way?	No, the water is going to be discharged into Kasakh river through Outlet canal pipeline. In case of Yeghvard reservoir, we do not have the issue of catastrophic discharge facilities, because it is not going to be constructed on the river. In case of river, it is necessary to construct spill way.(Khoren Tsarukyan / PIU)
9.	Resident	But what if we have an earthquake?	We are going to design an emergency action plan where all the issues and scenarios will be considered. (Khoren Tsarukyan / PIU)
10.	Resident	How deep will the reservoir be?	10-15m (Khoren Tsarukyan / PIU)
11.	Alina	Why does the section related to fertile soil	It is possible to discuss the matter, if you have the land

No.	Speaker	Question and Comment	Answer
	Harutyunyan/ Head Community of	contain only the name of Yeghvard city?	within the Reservoir. (Artak Ter-Torosyan / ATMS Solutions) There is not going to be any biased towards any of the communities. There will be multi-party supervision not only by PIU, SCWE, Ministry of Agriculture (Suren Gyurjinyan / ATMS Solutions)
12.	Resident	You said that it will take 4 years for the construction works. Have you considered that we have very strong wind from end of May to end of June? And all the construction dust will be blown away to Nor-Yerznka village. So, it can be a kind of environmental impact on the village by the Project.	We will certainly take it into account (*2) (Artak Ter-Torosyan / ATMS Solutions)
13.	Alina Harutyunyan/ Head Community of	I have a concern related to donation of the community lands to the state. If the land is taken from the community, at least some investments should be made in the community by the state. We do not want money. If the state can implement some small scale project for the community, it is OK. We need improved irrigation systems. Please mention this issue in your minutes of meeting because we have made some investments in many lands and donated them to the state.(*4)	The law is on your side. According to law, you can receive compensation.(*3) (Suren Gyurjinyan / ATMS Solutions) The community should defend your own interests. You can demand any supports from the state. (Suren Gyurjinyan / ATMS Solutions) I think this should be mentioned in the minutes of meeting and it can be taken into account later (Marine Vardanyan / PIU)
14.	Resident	In the presentation, construction of a new pipeline which will pass through the community is proposed. Is it possible to connect the new pipeline with an existing pipeline which provides water to Ashtarak canal?	Yes, it is planned in the Project. If your land is located under this pipeline, you will get water. (Khoren Tsarukyan / PIU)

*1: The question No.4 mentioned above was made before explanation of compensation policy, and the speaker understand the policy after the explanation.

*2: It is possible to minimize dust generation by water spray at the construction site.

*3: There is a case that the State provided compensation for communal land loss in Armenia (RAP for Construction of Road Links of Yerevan Western Ring Road, ADB, 2015). However, in the Project, it has yet to be decided whether the communities concerned to the Project will provide the communal land to the State voluntarily. This issue will be discussed after the Loan Agreement.

*4: It is possible to request to the Government to provide some small scale projects for the community. However, it is not fixed whether the Project will be implemented, therefore, after the loan agreement, such negotiation will be done between the community and the government.

Table 5-2-10.10 Participant List of the Public Seminar in Nor-Yerznka Village (31st May 2016)

No.	Full Name	Position	Organization
1	Alina Harutyunyan	Head of Community	Nor-Yerznka village
2	Lolita Tonoyan	Chief Specialist	Nor-Yerznka village
3	Yupik Rzgoyan	Chief Specialist	Proshyan Community
4	-----	Resident, Nor Yerznka village	
5	-----	Resident, Nor Yerznka village	
6	-----	Resident, Nor Yerznka village	
7	-----	Resident, Nor Yerznka village	
8	-----	Resident, Nor Yerznka village	
9	-----	Resident, Nor Yerznka village	
10	-----	Resident, Nor Yerznka village	
11	-----	Resident, Nor Yerznka village	
12	-----	Resident, Nor Yerznka village	
13	-----	Resident, Nor Yerznka village	
14	Artur Tonyan	Deputy Head	Ashtarak WUA
15	Khoren Tsarukyan	Hydro-technical Engineer	PIU
16	David Zakaryan	Hydrologist	PIU
17	Marine Vardanyan	Social Expert	PIU
18	Ruzan Khojikyanyan	Program Coordinator in Armenia	JICA Armenia Liaison Office
20	Ayumi Shiga	Social Consideration	JICA Survey Team
21	Gevorg Gevorgyan	Assistant	JICA Survey Team
22	Kristine Goroyan	Assistant	JICA Survey Team
23	Luiza Ohanian	Assistant	JICA Survey Team
24	Artak Ter-Torosyan	Environmental Specialist	ATMS Solutions LLC

25	Suren Gyurjinyan	Resettlement Specialist	ATMS Solutions LLC
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Table 5-2-10.11 Discussion at the Public Seminar in Yeghvard City on Environmental and Social Impacts**(31st May 2016)**

No.	Speaker	Question and Comment	Answer
1.	Karen Harutyunyan / Deputy Mayor	There are many poisonous snakes in the Reservoir basin. When the construction works are started, they will escape to outside of the Reservoir. We should not allow them to hurt people. The reservoir is surrounded by communities. Wherever the snakes go, we will face danger. Please consider the countermeasure against the issue.	At the moment, we do not have any ready-made solutions. We will try to find an optimal solution to the issue. (Artak Ter-Torosyan / ATMS Solutions)
2.	Karen Harutyunyan / Deputy Mayor	Currently, Hrazdan River and Kasakh River are not connected each other. If fish from the Hrazdan River are flushed to the Kasakh River through Yeghvard Reservoir, fish in both rivers can be mixed. Any ecological problems will be caused?	We are going to take the water at Arzni-Shamiram intake from the Hrazdan River. Around the intake point in Hrazdan River, 6 fish species are identified, and 5 species out of them are also identified in Kasakh River. Hence, it will not be a big issue. (Rie Kitao / JICA Survey Team)
3.	Karen Harutyunyan / Deputy Mayor	What if only a part of the land is to be alienated?	If the owner of the alienated land can prove that the remaining part of land (not to be alienated) also cannot be used any more since it is useless, he/she can demand compensation for whole land. In case of large lands, there is a principle of partial alienation. But in case of small lands, we have adopted the principle of alienating the whole area of the land. (Suren Gyurjinyan / ATMS Solutions)
4.	Garush Simonyan / Kasakh Community	We also have a problem of the difference of market price of the lands before and after construction of the reservoir.	Armenian legislation stipulates a very clear price determination methodology. Unit price of land is market price plus 15%. The land price should be determined before the construction. According to the regulation, a professional land evaluator with license makes measurement of the affected area, and set the market price. A notification is sent to the owner. If the owner does not agree the price, he/she can appeal to the court. Governmental decree simply states which area of land should be alienated for public interest, however, there is no provision of market price in case of alienation. (Suren Gyurjinyan / ATMS Solutions)
5.	Karen Harutyunyan / Deputy Mayor	Isn't the Government responsible for determining the market price?	No. Government will not determine the land price. Land evaluators will do that. (Suren Gyurjinyan / ATMS Solutions)
6.	Garush Simonyan / Kasakh Community	Can the resident insist on getting land as compensation instead of money?	He can negotiate and come to an agreement. He cannot take the case to the court. Experience shows that the amount of compensation is almost always acceptable for the land owner. (Suren Gyurjinyan / ATMS Solutions)
7.	Garush Simonyan / Kasakh Community	When the Reservoir is constructed, the land price will be increased. If compensation is done before construction, the land price can be lower than that after the project completion.	We have to follow the law for land price estimation regardless of land price increase or decrease. (Suren Gyurjinyan / ATMS Solutions)
8.	Sargis Hovhannisyan / land owner /officer of community	I have two pieces of lands in the affected area, in one land, 2 year-old apple trees are planted, while 8 years apple trees are planted in another land. How the compensation will be done?	One of the lands (8-year-old trees) is out of the affected area. Regarding the other one, you will get compensation for the land, as well as for your expenses made for the apple trees. (Suren Gyurjinyan / ATMS Solutions)
9.	Karen Harutyunyan / Deputy Mayor	Which company will construct the reservoir? Is there going to be an international or a local tender?	Irrespective of international or local contractor, we will suggest the contractor to hire the local population as much as possible. We will also suggest the contractor to provide job opportunity for local women, for instance, to employ women as cook for

No.	Speaker	Question and Comment	Answer
			labors. (Marine Vardanyan / PIU)
10.	Karen Harutyunyan / Deputy Mayor	Those who get a pension at this moment can receive allowance by the Project. It means that they receive both the pension and allowance.	That is why we have introduced some additional criteria, namely families headed by single mothers, old people and families that have disabled members. If you can suggest any other criteria, we are ready to discuss it. (Suren Gyurjinyan / ATMS Solutions)
11.	Karen Harutyunyan / Deputy Mayor	We provide community lands to the state but don't get anything in return. So, we would like to get some benefits. For instance, we could have free irrigation system for 10-15 years. (*1)	I would suggest that you negotiate on some social projects, for instance, construction of a school (Suren Gyurjinyan / ATMS Solutions)
12	Karen Harutyunyan / Deputy Mayor	Are you going to completely use the stored water at the reservoir during the irrigation period?	No, it is going to keep a "dead" water level. In the area close to Nor Yerznka, the water depth will be 2-3m, while it will be around 0.5m near Yeghvard city. (Khoren Tsarukyan / PIU)
13.	Karen Harutyunyan / Deputy Mayor	In such case, a swamp can be formed?	No, because the water will flow all the time. The water is continually stored and discharged for irrigation. Therefore, water will not be stagnant and no swamp will be formed. (Khoren Tsarukyan / PIU)
14.	Karen Harutyunyan / Deputy Mayor	What kind of anti-infiltration measure do you plan to use?	We plan to use bentonite sheet and soil-cement. This soil-cement will be kind of a weak concrete. And the slopes will be protected from wave action and infiltration. (Khoren Tsarukyan / PIU)
15.	Garush Simonyan / Kasakh Community	Are the ground waters affected by the Project?	The ground waters range in very deep layer, at around 120-130m, the water is filtrating into the ground, finally to the Kasakh River. After anti-infiltration works by the Project, stored water at the Reservoir almost will not permeate into the soil. Thus, no impact on the ground water by the Project is expected. (Khoren Tsarukyan / PIU)
16.	Karen Harutyunyan / Deputy Mayor	How the fertile top soil of the Reservoir basin will be managed by the Project?	We should have a discussion with the communities and decide the method of fertile layer transportation and the destination. (*2) (Khoren Tsarukyan / PIU)
17.	Garush Simonyan / Kasakh Community	What if, for instance, my land is evaluated and given a lower price than my neighbor's land?	If you do not agree with the price determined for your land, you have some options, and finally you can take the case to court. (*3) (Suren Gyurjinyan / ATMS Solutions)

*1: Whether the communal land will provided voluntarily cannot be determined at F/S stage. After the loan agreement, it will be discussed between community concerned and the Government.

*2: In case of any projects which would disturb fertile top-soil, it is needed to transport the soil to outside of the area based on decrees in Armenia. However, there is no mention who is requested to transport the fertile soil and how the soil is distributed among the stakeholders in the decrees.

*3: Three patterns for lodging of complaints are proposed in the Project, it is possible to consult with the communities concerned and PIU prior to court.

Table 5-2-10.12 Participant List of the Public Seminar in Yeghvard City (31st May 2016)

No.	Name	Position	Organization
1	Karen Harutyunyan	Deputy Head	Yeghvard City
2	Lilit Harutyunyan	Officer	Yeghvard City
3	Narine Karapetyan	Officer	Yeghvard City
4	Sona Karapetyan	Officer	Yeghvard City
5	Narine Harutyunyan	Officer	Yeghvard City
6	-----	Resident, Kasakh Community	
7	-----	Resident of Yeghvard city	
8	-----	Resident of Yeghvard city	
9	Khoren Tsarukyan	Hydro-technical Engineer	PIU
10	Marine Vardanyan	Social Expert	PIU
11	David Zakaryan	Hydrologist	PIU
12	Ruzanna Manyan	Coordinator	Aarhus Center, Yeghvard City
13	Anush Beybutyan	Coordinator	Aarhus Center, Yeghvard City
14	Ayumi Shiga	Social Consideration	JICA Survey Team
15	Rie Kitao	Environmental Consideration	JICA Survey Team

No.	Name	Position	Organization
16	Gevorg Gevorgyan	Assistant	JICA Survey Team
17	Kristine Goroyan	Assistant	JICA Survey Team
18	Luiza Ohanian	Assistant	JICA Survey Team
19	Artak Ter-Torosyan	Environmental Specialist	ATMS Solutions LLC
20	Suren Gyurjinyan	Resettlement Specialist	ATMS Solutions LLC

Since the number of farmers who participated in the public seminar in Yeghvard city on 31st May was limited, additional seminar in Yeghvard WUA office to get feedback from the PAPs was organized. The discussion at the seminar and participant list are as shown in Table 5-2-10.13 and Table 5-2-10.14.

Table 5-2-10.13 Discussion on the Draft ESIA Report at the Public Seminar in Yeghvard WUA (3rd June 2016)

No.	Speaker	Question and Comment	Answer
1.	Resident	How large was the Reservoir area during the Soviet Union period and how large is current proposed area of Reservoir?	During the Soviet Union period, it was around 1,000 ha, at this moment, the planned area is around 800 ha. (Khoren Tsarukyan / PIU).
2.	Resident	Are only cereal crops cultivated in the reservoir area?	Both cereal and fodder crops are cultivated. (Suren Gyurjinyan / ATMS Solutions)
3.	Resident	How much is the minimum monthly salary rate in Armenia?	Currently, it is 55,000 AMD per month (Suren Gyurjinyan / ATMS Solutions)
4.	Resident	In case we need to apply to the court for solution of some issues, who is going to pay for court expenses?	The person who applies to the court should pay when he/she applies. But if the applier wins the case, the expenses will be reimbursed to him/her. (Suren Gyurjinyan / ATMS Solutions)
5.	Resident	Is the community land compensated by the State? If there are any vulnerable people (regardless of directly affected or not affected by the Project), what kind of compensation can be provided to them?	This issue should be solved through negotiations between the State and the community. If the State provides compensation for communal land loss, it will be provided to the community, not to vulnerable people in the community, In general, vulnerable people are provided by social support program, like renovation of schools, some cultural houses, etc. It means that the State already has special supporting to such kind of people. (Suren Gyurjinyan / ATMS Solutions)
6.	Resident	When will the Project be officially launched?	It will take one year for negotiation between Government of Japan and Government of Armenia for signing the loan agreement. After that, D/D and construction works will be started. The construction stage will last 4-5 years. (Khoren Tsarukyan / PIU)
7.	Resident	What do you mean by saying partial alienation of land?	After completion of the design, the land size to be alienated will be decided based on the inventory survey. For example, if you have a land with 50 m width and only 15 m width of that will be alienated by the Project, the amount of compensation will be calculated only for the part of 15 m width. (Suren Gyurjinyan / ATMS Solutions)
8.	Resident	What type of canal will be constructed?	It is going to be a pipe with 1,600 mm diameter, buried at 2-2.5 m depth (Khoren Tsarukyan / PIU)
9.	Resident	Will the compensation be provided equal to market price or cadastral price?	Higher price between them will be applied. However, usually market price is higher than the cadastral one. (Suren Gyurjinyan / ATMS Solutions)
10.	Resident	I expect that tourism around the Reservoir will be developed after construction.	-
11.	Resident	My private land will be affected by canal construction. However, I support the Project, since I know its importance.	-

Table 5-2-10.14 Participant List of the Public Seminar in Yeghvard WUA (3rd June 2016)

No.	Name	Position	Organization
1.	-----	Resident	
2.	-----	Resident	
3.	-----	Resident	
4.	-----	Resident	
5.	-----	Resident	
6.	-----	Resident	

7.	----	Resident	
8.	----	Resident	
9.	----	Resident	
10.	----	Resident	
11.	----	Resident	
12.	----	Resident	
13.	----	Resident	
14.	----	Resident	
15.	----	Resident	
16.	Gayane Karapetyan	WUA officer	Yeghvard WUA
17.	Aida Hovhannissyan	WUA officer	Yeghvard WUA
18.	Gyurjinyan Suren	Resettlement expert	ATMS Solutions
19.	Ayumi Shiga	Social Consideration	JICA Survey Team
20.	Rie Kitao	Environmental Consideration	JICA Survey Team
21.	Gevorg Gevorgyan	Assistant	JICA Survey Team
22.	Tatevik Minasyan	Assistant	JICA Survey Team
23.	Luiza Ohanyan	Assistant	JICA Survey Team

5-2-10-6 Public Consultation on Draft ESIA Report by the SCWE

After the preparation of the Draft ESIA Report, in accordance with the Law on ESIA and Expertise, the Public Consultation under the name the SCWE was organized at Yeghvard city and Nor-Yerznka village to explain the Draft ESIA Report and RAP.

As mentioned in 10-5, a series of Public Seminar to explain expected environmental impacts by the Project has been already organized. The newly explained contents at the Public Consultations are the proposed anti-infiltration works of the Reservoir, namely, soil cement with a sandwiched by bentonite sheet. The participants did not present concern about the proposed structure of Reservoir. Furthermore, since the participants are aware of the general project outline, expected environmental impacts, compensation measures and so on through the Public Seminars from May to June 2016, there were no objection against the Project. The deputy Mayor of Yeghvard city asked about poisonous snake again, and it was answered that further ecological survey to prevent from any dangerous situations would be implemented during the detailed design stage.

At the previous Public Seminar on 31st May 2016, the both heads of communities requested top-soil transportation and small scale of project for voluntary communal land provision. Therefore, it was explained that, the both community councils are expected to discuss about the top-soil storage point and equal distribution after the Loan Agreement, and the communities and the PIU/SCWE will make a final decision based on the discussion result in collaboration with the MNP. Regarding small scale project requested by the communities, it was explained that the communities can propose some projects based on their idea to the SCWE. According to the SCWE staff, it is difficult to make a final decision at this moment whether such small scale projects can be implemented, however, it is possible for the SCWE to propose the requested projects from the communities to the Government of RA, after the Project implementation is officially determined.

The discussions and participant lists at Nor-Yerznka village and Yeghvard city are shown in Table 5-2-10.15, Table 5-2-10.16, Table 5-2-10.17, and Table 5-2-10.178 respectively.

Table 5-2-10.15 Discussion on the Draft ESIA Report at the Public Consultation in Yeghvard City (10th October 2016)

No.	Speaker	Question and Comment	Answer
1.	Mr. Harutyunyan/ Deputy Mayor	How are you going to solve the problem with the snakes? The necessity of relocation is high, because the number of snakes is big. If measures are not taken, they will get into the neighbor residential areas.	This question was raised at the last public seminar also. We have a plan to implement further ecological study about the snake to prevent damages. (Suren Gyurjinyan/ ATMS Solutions)

No.	Speaker	Question and Comment	Answer
2.	Mr. Harutyunyan/ Deputy Mayor	I think that it is not needed to transport fertile topsoil to Nor-Yerznka village, since there is no fertile top-soil in Nor-Yerznka village within the Reservoir.	If there is no fertile topsoil in the communal land of Nor-Yerznka any more, we do not have to transport the soil. However, it is needed to confirm the detail situation again. (Suren Gyurjinyan/ ATMS Solutions)
3.	Mr. Harutyunyan/ Deputy Mayor	How much is the amount of loan? How much is the capacity of the Reservoir?	The loan amount is about 200 million USD. The capacity of the Reservoir is about 90 MCM with 800 ha area. (Khoren Tsarukyan/ PIU)
4.	Mr. Harutyunyan/ Deputy Mayor	I am worry about that the cost is high and amount of water infiltration at the Reservoir is big. How can we evaluate the feasibility of the project?	This issue of cost should be solved between the governments. The Project is very effective. The Project has many positive impacts: use of snow melted water, conservation of the Lake Sevan, energy saving. However, at this moment, we cannot say whether the Project will be implemented or not. (Khoren Tsarukyan/ PIU)
5.	Mr. Harutyunyan/ Deputy Mayor	I want to know further schedule of the Project.	Negotiations will be started between the Government of RA and the Government of Japan after the Survey. (Khoren Tsarukyan/ PIU)

Table 5-2-10.16 Participant List at the Public Consultation in Yeghvard City (10th October 2016)

No.	Full name	Position	Organization
1	Karen Harutyunyan	Deputy Mayor	Yeghvard city Office
2	Benjamin Tadevosyan	Head of Agricultural Department	Yeghvard city Office
3	Vardan Muradkhanyan	Chief of staff	Yeghvard city Office
4	Lilit Harutyunyan	Leading specialist	Yeghvard city Office
5	Christine Petrosyan	Leading specialist	Yeghvard city Office
6	Ruzanna Manyan	Coordinator	Yeghvard Arhus Center
7	-----	Resident	
8	Samvel Zakoyan	Deputy Head of Department	SCWE Irrigation Collector-Drainage Systems Department
9	Marine Vardanyan	Social Specialist	PIU
10	Khoren Tsarukyan	Hydro-technical Engineer	PIU
11	Toru Nakagawa	JICA Survey Team	Earthquake-Resistant/Design/Civil Design
12	Rie Kitao	JICA Survey Team	Environmental Consideration
13	Ayumi Shiga	JICA Survey Team	Project Coordinator/Social Consideration 2,3
14	Gevorg Gevorgyan	JICA Survey Team	Assistant/Interpreter
15	Christine Goroyan	JICA Survey Team	Assistant/Interpreter
16	Tatevik Minasyan	JICA Survey Team	Assistant/Interpreter
17	Luiza Ohanyan	JICA Survey Team	Assistant/Interpreter
18	Suren Gyurjinyan	Resettlement specialist	ATMS Solutions
19	Artak Ter-Torosyan	Environmental specialist	ATMS Solutions

Table 5-2-10.17 Discussion on the Draft ESIA Report at the Public Consultation in Nor-Yerznka village (10th October 2016)

No.	Speaker	Question and Comment	Answer
1.	Employee of Community Office	How much is the dead water level in the Reservoir?*	There are some places with high infiltration rate and the Reservoir is designed to minimize them. (Suren Gyurjinyan/ATMS Solutions).
		Do you have a plan to start aquaculture at the Reservoir?	At least 5MCM of water will remain in the Reservoir (when the water is at the low water level, stored water quantity at the reservoir is 5MCM). During the winter season, a small amount of water will remain in the Reservoir, and the rest will be used. (Khoren Tsarukyan/ PIU)
			We do not have such an aquaculture plan. The Project aims at promotion of irrigation. (Khoren Tsarukyan/ PIU)

After the Q&A discussion, it was confirmed that the speaker wanted to ask whether eutrophication in the Reservoir would be caused by the Project. The Team explained that due to water flow within the Reservoir, such possibility will be low.

Table 5-2-10.18 Participant List at the Public Consultation in Nor-Yerznka village (10th October 2016)

No.	Full name	Position	Organization
1	Vram Mardoyan	Village council member	Nor-Yerznka village
2	Artur Tonyan	Inspector	Ashtarak WUA
3	-----	Resident	

No.	Full name	Position	Organization
4	-----	Resident	
5	-----	Resident	
6	-----	Resident	
7	-----	Resident	
8	-----	Resident	
9	-----	Resident	
10	-----	Resident	
11	-----	Resident	
12	Samvel Zakoyan	Deputy Head of Department	SCWE / Irrigation Collector-Drainage Systems Department
13	Khoren Tsarukyan	Hydro-technical Engineer	PIU
14	Marine Vardanyan	Social specialist	PIU
15	Toru Nakagawa	JICA Survey Team	Earthquake-Resistant/Design/Civil Design
16	Rie Kitao	JICA Survey Team	Environmental Consideration
17	Ayumi Shiga	JICA Survey Team	Project Coordinator/Social Consideration 2,3
18	Gevorg Gevorgyan	JICA Survey Team	Assistant/Interpreter
19	Christine Goroyan	JICA Survey Team	Assistant/Interpreter
20	Tatevik Minasyan	JICA Survey Team	Assistant/Interpreter
21	Luiza Ohanyan	JICA Survey Team	Assistant/Interpreter
22	Suren Gyurjinyan	Resettlement specialist	ATMS Solutions
23	Artak Ter-Torosyan	Environmental specialist	ATMS Solutions

5-3 Climate Changes

5-3-1 Review of Current Perspective on Climate Change

According to WB, Armenia is highly vulnerable country against climate change compared to other countries in the South Caucasus region (WB 2014)¹. The impact of climate change will be in various sectors. The total future loss to the agricultural sector is estimated at around 75 billion to 170 billion Armenian Drams, which equivalent to a loss of 2-5 % of GDP in 2009. Moreover, it will be worse if indirect losses (e.g. food processing industries, input markets) are also included. Temperature increase and intensification of evaporation of moisture from the soil surface imply additional demands of irrigation water for agricultural land. On the other hand, in the water resource sector, future streamflow is assessed to decrease by 45-56 % in the Khami-Debed basin (Armenia/Georgia) and by 59-72 % in the Agstev basin (Armenia/Azerbaijan) by the end of the century. Reduced river flows coupled with an increased demand for irrigation water may be future risks not only of agriculture but also of other sensitive sectors such as hydropower development.



Source World Bank (2014)

Figure 5-3-1.1 Map of Armenia by River Basin

The RA has cooperated with international climate change frameworks for a long time. The government ratified the United Nations Framework Convention on Climate Change (UNFCCC) in May 1993 as Non-Annex I party and the Kyoto Protocol in December 2002. MNP has been appointed as the Designated National Authority (DNA) for the Clean Development Mechanism (CDM) of the Kyoto Protocol by a decree of Government of Armenia. One of the main functions is to approve the compliance Kyoto Protocol, as well as to ensure effective participation of Armenia in international CDM processes. In 2010, the Republic of Armenia submitted a statement to the Convention Secretariat for association with the Copenhagen Accords. This statement presents the position of the Republic of Armenia on the continuation of the Kyoto Protocol and the limitation of greenhouse gas (GHG) emissions. In September 2015, the RA approved the Intended Nationally Determined Contribution (INDC) under the UNFCCC. According to this, the climate change mitigation actions should not reverse the social and economic trends, but contribute to the socioeconomic development of the RA. The adaptation activities, on the other hand, has not been yet submitted, but it is mentioned that the submission will be prioritized based on the most vulnerable sectors to climate change i.e. a. Natural ecosystems (aquatic and terrestrial, including forest ecosystems, biodiversity and land cover), b. Human health, c. Water resource management, d. Agriculture including fishery and forests, e. Energy, f. Human settlements and infrastructures, and e.g. Tourism.

All of climate change adaptation activities will have to be based on appropriate future forecasting with some GHG emission scenarios. Perhaps, the most comprehensive reports about climate change

¹ WB (2014) "Towards Integrated Water Resource Management: Revised"

forecasts in Armenia are the series of national communication papers prepared by MNP in accordance with Article 4.1 and 12.1 of the UNFCCC and the guidelines for national communication of non-Annex I parties to the Convention. The latest paper; “*the Third National Communication on Climate Change (TNC)*”, was submitted in 2015 following “*the First National Communication on Climate Change (FNC)*” and “*the Second National Communication on Climate Change (SNC)*” submitted in 1998 and 2010, respectively. They have been widely utilized by major international donor organizations. Although some of them have recommended to commission additional studies, these reports are based on Global Climate Model and there is no reliable Regional Climate Model in Armenia so far. In this respect, the Survey Team has employed results from TNC for climate change adaptation strategies in spite of the data limitation of Global Climate Model. It is noted that TNC made corrections from SNC in climate change scenarios. Although it shows very similar tendency as the previous two reports, some of forecasts dramatically are changed due to some modifications. For example, annual precipitation in the territory of Armenia has forecasted an increase by 2.9% in TNC, according to the RCP8.5 (equivalent to A2, See Table 5-3-1.1) scenario by 2100, while it was estimated 8-24% decrease in SNC. One of the reasons for this is to uniform with the other climate change scenarios provided by neighboring countries and international organizations. Therefore, it is noted that the future forecasts discussed in the following sub-chapters might have certain limitations.

Table 5-3-1.1 IPCC Recommended Scenarios and Their Explanations

Scenario	Explanation
SRES A2 (Equivalent to RCP 8.5 scenario)	The A2 storyline and scenario family describes a very heterogeneous world. The underlying theme is self-reliance and preservation of local identities. Fertility patterns across regions converge very slowly, which results in continuously increasing population. Economic development is primarily regionally oriented and per capita economic growth and technological change more fragmented and slower than other storylines.
SRES B2 (Equivalent to RCP 6.0 scenario)	The B2 storyline and scenario family describes a world in which the emphasis is on local solutions to economic, social and environmental sustainability. It is a world with continuously increasing global population, at a rate lower than A2, intermediate levels of economic development, and less rapid and more diverse technological change than in the B1 and A1 storylines. While the scenario is also oriented towards environmental protection and social equity, it focuses on local and regional levels.

Source) IPCC (2007)²

5-3-2 Trends in Annual Temperature and Precipitation in Armenia

According to the TNC, there has been a significant temperature increase in recent decades. When baseline period is set 1961-1990, temperature and precipitation in following years have been changed drastically. Table 5-3-2.1 shows the changes in temperature and precipitation in 1929-2012 and 1935-2012, respectively, compared with those of baseline. The annual mean temperature increased by 0.4 °C in 1929-1996, 0.85 °C in 1929-2007, and 1.03 °C in 1929-2012. Annual precipitation was 6% decrease in 1935-1996, and it was close to 10% decrease in 1935-2012. Over the last 80 years, the climate in the northeastern and central (Ararat Valley) region of the country has turned arid, while precipitation has increased in the southern and northwestern region, as well as in the western part of the Lake Sevan basin.

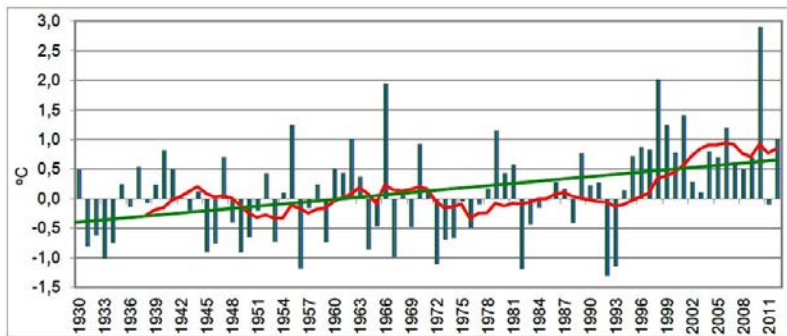
Table 5-3-2.1. Annual Mean Temperature and Precipitation Changes in 1929-2012 Compared with the Baseline

Time Period	Air Temperature (°C) and Changes Compared with the Baseline	Time Period	Precipitation, mm (%) and Changes compared with the Baseline
1961-1990 (Baseline)	5.5	1961-1990 (Baseline)	592
1929-1996	+0.40	1935-1996	-35(-6%)
1929-2007	+0.85	1935-2007	-41(-7%)
1929-2012	+1.03	1935-2012	-59(-10)

Source) MNP (2015)

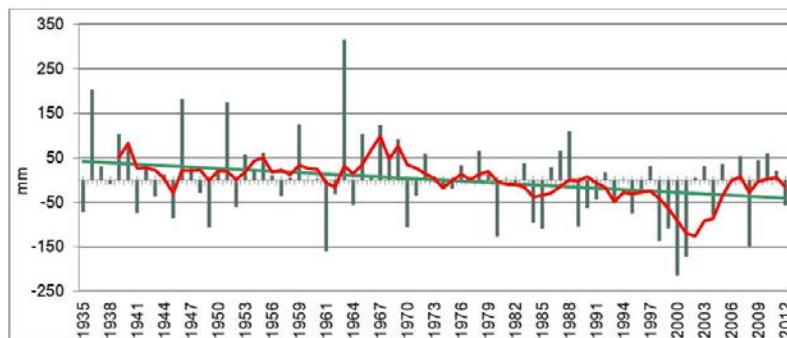
² IPCC, 2007: Summary for Policymakers. In: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Figure 5-3-2.1 and Figure 5-3-2.2 show the trend of air temperature and precipitation, respectively provided that those in 1961-1990 are baseline (=0).



Source) MNP (2015)

Figure 5-3-2.1. Deviation of Annual Average Air Temperature in Armenia from the Baseline



Source) MNP (2015)

Figure 5-3-2.2. Deviation of Annual Average Precipitation in the Territory of Armenia from the Baseline

5-3-3 Climate Change Projection in Armenia

In order to forecast the future climate change and its ecological impacts in Armenia, the Third National Communication on Climate Change (TNC) has adopted CCSM4 model in accordance with IPCC recommended RCP 6.0 (equivalent to the SRES B2 scenario) and RCP 8.5 (equivalent to the SRES A2 scenario) scenarios for CO₂ emission. As per the RCP 6.0 scenario, CO₂ concentration will be 670 ppm by 2100, while it will be 936 ppm according to the RCP 8.5 scenarios. Future changes are forecasted in the period of 2011-2040, 2041-2070, and 2071-2100.

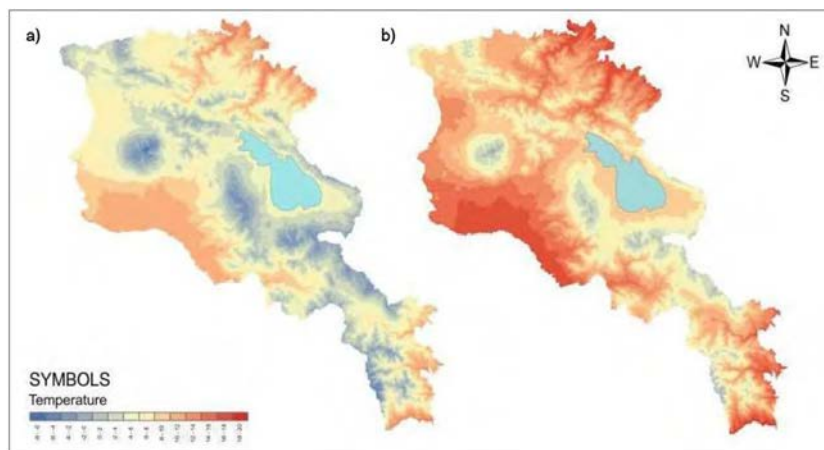
Table 5-3-3.1 indicates that the temperature will be continuously increased in all seasons of the year. It will be accelerated since 2041 under RCP 8.5 scenario. Given that the baseline through the year is 5.5 °C, and it is simulated that 4.7 °C will be increased under RCP 8.5 scenario in 2071-2100, the average annual temperature in Armenia could be 10.2 °C in 2100 (=4.7+5.5). Figure 5-3-3.1 represents spatial distribution maps for annual mean temperature for the 1961-1990 baseline (a) and projections for 2071-2100 under RCP8.5 scenario (b). It is expected that temperature will be increased in most of the regions of Armenia by 2100. The annual average temperature in the beneficial area is expected to reach to around 16-20 °C in 2100 under RCP 8.5 scenario.

Table 5-3-3.1 Projected Changes in Annual and Seasonal Average Temperatures in Armenia

Seasons	Baseline (1961-1990 average)	Scenarios	2011-2040	2041-2070	2071-2100
Winter	-5.3	RCP, 6.0	1.4	2.6	3.6
		RCP, 8.5	1.7	2.8	4.4
Spring	4.3	RCP, 6.0	1.3	2.4	2.7
		RCP, 8.5	1.4	2.7	3.9
Summer	15.7	RCP, 6.0	1.9	3.0	3.8
		RCP, 8.5	2.1	4.0	6.0

Seasons	Baseline (1961-1990 average)	Scenarios	2011-2040	2041-2070	2071-2100
Autumn	7.2	RCP, 6.0	0.8	2.3	3.0
		RCP, 8.5	1.4	3.2	4.4
Year	5.5	RCP, 6.0	1.3	2.6	3.3
		RCP, 8.5	1.7	3.2	4.7

Source) MNP (2015)



Source) MNP (2015)

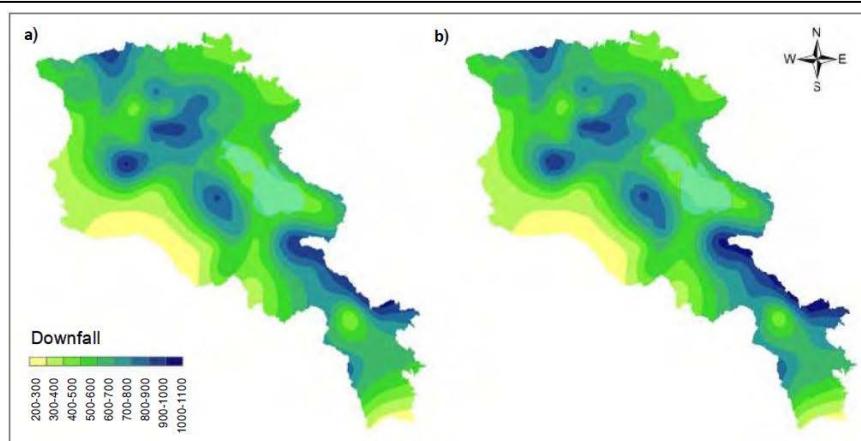
Figure 5-3-3.1. Distribution of Annual Average Temperature in Armenia in (a) 1961-1990 and (b) in 2071-2100, RCP 8.5

Table 5-3-3.2 shows that annual precipitation might be 2.9% increase in the long run (in 2071- 2100) under the RCP8.5 scenario, while there might be also 6.2% increase under the RCP6.0 scenario. However, it should be noted that there are much more uncertainties in future precipitation than that of temperature. The distribution of annual precipitation is expected to insignificant change. The amount of annual average precipitation in the beneficial area was around 200-400 mm in 1961-1990 and it has almost unchanged in 2071 – 2100 (see Figure 5-3-3.2).

Table 5-3-3.2 Projected Changes in Annual and Seasonal Precipitation in Armenia, %

Seasons	1961-1990 average	Scenarios	2011-2040	2041-2070	2071-2100
Winter	114	RCP, 6.0	5.3	5.8	6.2
		RCP, 8.5	-5.7	16.3	2.9
Spring	211	RCP, 6.0	1.2	4.2	2.6
		RCP, 8.5	4.2	-8.0	2.4
Summer	148	RCP, 6.0	-10.1	-10.8	12.8
		RCP, 8.5	-23.0	-3.4	-13.0
Autumn	119	RCP, 6.0	5.0	3.2	1.2
		RCP, 8.5	2.5	8.6	13.6
Year	592	RCP, 6.0	5.3	5.8	6.2
		RCP, 8.5	-5.7	16.3	2.9

Source) MNP (2015)



Source) MNP (2015)

Figure 5-3-3.2 Distribution of Annual Average Precipitation in Armenia in (a) 1961-1990 and (b) in 2071-2100, RCP 8.5

5-3-4 Expected Climate Change Impacts by Sensitive Sectors

a) Agriculture

Agriculture sector is one of the most climate sensitive sectors in the economy. Even in the current conditions, the sector is affected by adverse weather phenomena such as drought, hail, early frost, spring floods, and landslides. In recent decades, extreme weather events have been becoming more frequent and lasting longer. Agriculture accounts for about 20% of the country's total GDP, and the sector has a role of ensuring food security, targeting 75-80% of self-produced basic foods. Therefore, the TNC notes that the strategy for this sector should be aimed at enhancing competitiveness and sustainable development, and at implementing preventive adaptation measures.

The impact of climate change in agriculture is not uniform by agro-climatic zone, crops, and land types. However, there are some major negative consequences such as;

- Shift of agro-climatic zones 100 m upward by mountain slopes by 2030, and 200-400m by 2100;
 - Reduced crop yields as a result of temperature increases, reduced rainfall, and increasing evaporation from soil surface;
- Reduction of fertility and deterioration of agricultural land;
- Increased negative impact of extreme weather events due to expected increases in their frequency and intensity;
- Expansion of irrigated lands and the need for additional irrigation water; and
- More intensive degradation of land, including natural grazing land.

b) Water Resources

Needless to say, water resources are important for the social and economic development of the country. According to WB (2014), Armenia has sufficient water to supply approximately 3,100 cubic meters per capita per year well above the typically cited Falkenmark water stress indicator of 1,700 cubic meters per capita per year, which is one of the most commonly used indicators when one is describing water availability in a country. It means that Armenia has sufficient water resource "on average". However, the spatial and seasonal distribution of water resources in Armenia is extremely uneven. In particular, the Hrazdan River has significant seasonal fluctuations. In a normal year, about 55% of the total river flow is fed by melting snow in spring and rainfall; the maximum and minimum flow ratio can be in the range of 10:1 (MNP, 2015).

As it is mentioned above, even if climate change will not be realized as forecasted, the needs for stabilizing the uneven seasonal water supply is still high. On the other hand, if the climate change will be realized as forecasted, the water instability becomes a critical issue as water scarcity would become worse. For example, in upper stream of the Hrazdan River, there are estimated to be a reduction of 2-3 % of river flows by 2040; of 6-7% by 2014-2070; and of 15-20% by 2100 under the scenario of A2 according to the TNC.

c) Lake Sevan

During 1933-1981, the water level of Lake Sevan dropped by 18.5 m due to excessive discharge of water for irrigation and power generation purposes. Thanks to diversion of water from River Arpa through a newly built tunnel designed to supply annually around 250 MCM water to the lake, the water level recovered by 0.9 m in 1981-1990. However, in 1991-2005, during the energy crisis, the level turned to a decreasing trend by 1.60 m for the sake of power generation. In 2004, the second tunnel Vorotan-Sevan was built to replenish water resources of the river and in 2006, the water level increased by 1.93m.

The historical experiences indicate how the water level of Lake Sevan has fluctuated reflecting the socio-economic circumstances at the time. So far, the water level shows an increasing trend since 2003, but if climate change will be realized as forecasted, Lake Sevan's inflow might decrease again by 53.0 million m³ against baseline (787 million m³) in 2030; by 114.0 million m³ in 2070; and by 192.0 million m³ in 2,100, according to TNC (Table 5-3-4.1). It means that the water level might have been going down by about 16cm per year. By the way, it is expected that after the project implementation, irrigation water conveyance from Lake Sevan, with the amount of 50 MCM, will not be needed any more. It could partially offset the impact of climate change.

Table 5-3-4.1 Projection of Inflows in Lake Sevan. A2 Scenario. million m³

variables	1961-1990	2030	2070	2100
Inflow	787.0	734.0	673.0	595.0
difference from 1961-1990	-	-53.0	-114.0	-192.0

Source) MNP (2015)

5-3-5 Mitigation Strategy

In this chapter, the project benefit for climate change mitigation will be estimated. In the Protocol Decision No.41, 10 September 2015, “*On approving the Intended Nationally Determined Contribution of the Republic of Armenia under the UN Framework Convention on Climate Change*”, it is mentioned that the total aggregate quantitative contributions of the Republic of Armenia under INDC equal to 633 million tons carbon dioxide equivalent (189 tons per capita × 3.35 million people) in the period of 2015-2050 or an annual average of 5.4 ton per capita. Currently, the total GHG emission in Armenia in 2010 made up 7,463.6 Giga grams (Gg) CO_{2eq}. Most of CO₂ emissions are generated by the energy sector that account for 5,008.6 Gg CO_{2eq} or 67.1% of total emission in 2010.

In the project, it is expected that existing deep wells and pump stations will be converted to gravity irrigation systems. The abolishment of them may reduce GHG emission through saving in energy use. Although the impact may not be large, the project possibly contributes to climate change mitigation to some extent. The contribution of the project is quantitatively evaluated using a tool “*JICA climate-FIT version2.0*”.

For the calculation of the net reduction of CO₂ emission, following formula has been applied;

$$ER_y = (BE_y - PE_y)$$

ER_y : Emission reduction in year “y” comparing with-without project (unit: tCO₂/year)

BE_y : Baseline emission in year “y” without the project implementation (unit: tCO₂/year)

PE_y : Project emission in year “y” with the project implementation (unit: tCO₂/year)

Current total amount of energy use for the operation of deep wells and pump stations in our beneficial areas was collected from related WSA and WUA, is estimated at 31,856.9 MWh/year. The impact calculation is standardized in year “y”, then, baseline emission should be evaluated under the water demand in year “y” by multiplying the ratio P_{PJ} / P_{BL} . It should be noted that there is no diesel pump station in the beneficial area so that baseline and project consumption of fuels are regarded as “zero”.

$$BE_y = BE_{elec} \times P_{PJ} / P_{BL} = (EC_{BL} \times EF_{elec}) \times P_{PJ} / P_{BL}$$

BE_{elec} : Baseline (current) emission due to energy consumption (unit: t-CO₂/year)

P_{BL} : Production Capacity (Water demands for irrigation) in the baseline (unit: MCM)

P_{PJ} : Production Capacity (Water demands for irrigation) in the project (unit: MCM)

EC_{BL} : Electricity consumption in the baseline in year “y” (MWh/year)

EF_{elec} : CO₂ emission factor of the grid electricity (t-CO₂/MWh)

Project emission in year “y” (PE_y) is expected to be “zero” because all of deep wells and pump stations will be abolished after the project implementation, namely; $PE_y = 0$ is assumed. The estimated GHG emission reduction of the project is 16,575.02 t-CO₂/year as shown in Table 5-3-5.1.

Table 5-3-5.1 Calculation of Energy Saving in Industrial Facilities (Pump Stations)

	Value	Unit
Emission reduction	16,575.02	tCO₂/year
Baseline emission	16,575.02	tCO ₂ /year
Production capacity (or other appropriate factors) in the baseline	104.0	MCM
Production capacity (or other appropriate factors) in the project	154.2	MCM
Electricity consumption in the baseline in year y	27,772.8	MWh/year
Consumption of the fuel in the baseline in year y	0.0	t/year
CO ₂ emission factor of the grid electricity	0.40250	t-CO ₂ /MWh
Net calorific value of fuel	0.0	TJ/t
CO ₂ emission factor of fuel	0.0	t-CO ₂ /TJ
Project emission	0.0	tCO ₂ /year
Electricity consumption in the project in year y	0.0	MWh/year
Consumption of the fuel in the project in year y	0.0	t/year
CO ₂ emission factor of the grid electricity	0.40250	t-CO ₂ /MWh
Net calorific value of fuel	0.0	TJ/t
CO ₂ emission factor of fuel	0.0	t-CO ₂ /TJ

Source) Output from JICA Climate-FIT ver.2.0.

5-3-6 Adaptation Strategy

The Project aims at the production increase through irrigation system improvement, and it is not a project focusing on the adaptation of climate change. On the other hand, there is possibility that existing water resources for farming will be decreased according to the simulation results mentioned above. Therefore, the Project is categorized into the “general development +adaptation option” based on the JICA Climate FIT Version 1.0 (June, 2010).

In Armenia, it is discussed to introduce a weather index insurance system to minimize damages by natural disasters to farmers. MNP and UNDP have prepared some reports altogether, however, it will take time for introduction of the system. Regarding international donors, WB has not implemented large-scale projects, which require considering the climate change, and the WB has not taken adaptation measures. Out of donors in Armenia, KfW is the most advanced in terms of examination of

impacts by the climate change. However, according to the staff of KfW, the Regional Climate Model covering Caucasus countries i.e. Armenia, Georgia, and Azerbaijan has not been established, and the existing Global Climate Model cannot cover data for small spatial resolution. Therefore, KfW has not implemented any projects which focus on climate change specifically in Armenia.

KfW involved the climate change specialist at F/S stage of the Kaps project, and it was estimated that impacts on the Kaps project by the climate change will be minor. However, warming, precipitation decrease, increase of disaster frequency could be caused in the future, therefore, following measures are proposed by the Kaps project:

- Prevention of water losses by improving water supply system;
- Introduction of drip irrigation system: training of WUA and provision of financial incentive to the farmers; and
- Organization of a forum with other water users, e.g. WSA, WUA, hydropower plants, national parks and so on.

It can be said that the Kaps project proposes to take adaptation measure against the climate change through technical training, awareness and introduction of water-saving irrigation system. Given that other donors have not taken countermeasures against the climate change in Armenia, it seems reasonable to follow the methodology taken by the KfW.

Water loss due to wasting of water resource has not been observed in the Project area so far, however, deterioration of the existing irrigation facilities cause water loss, e.g. water leaking from the canals. It is necessary to rehabilitate those facilities and the proposed project components include the rehabilitation works. In the future, it is possible to introduce water saving irrigation system such as drip irrigation and sprinkler irrigation. During the Project implementation, a pilot project to verify the water saving irrigation system can be implemented in collaboration with the MOA.

Concerning evaluation indicator for climate change adaptation, four (4) indicators; namely, 1) irrigable planted area, 2) agricultural production for main crops, 3) use of electricity for irrigation purpose, and 4) volume of water conveyance from the Lake Sevan to the beneficiary area, are proposed. The indicators are consistent with ones of project evaluation.