ANNEX V

AGRICULTURAL AND RURAL INFRASTRUCTURE

The Feasibility Study
on
Integrated Agricultural and Rural Development
in
Highland Area in the Republic of Indonesia

ANNEX-V AGRICULTURAL AND RURAL INFRASTRUCTURE

Table of Contents

Page

List of Tables

List of Figures

CHAPTER 1 PRESENT CONDITIONS OF THE MODEL AREAS

1.1 Location

Geographical locations of the model areas are given in the following table:

Location of Model Areas

Model Area	District	Sub-district	Location by Coordinate (Village Office or Center of the Area)		Distance from Bandung Km (driving hour by car)
			Latitude	Longitude	
Mekarjaya	Bandung	Arjasari	7º04’11”S	107o37’34”E	24 (1.5)
Langensari	Bandung	Lembang	6º48’52”S	107o38’41”E	12 (1.0)
Tugumukti	Bandung	Cisarua	6º48’32”S	107o32’37”E	14 (1.0)
Gekbrong	Cianjur	Warungkondang	6º51’25”S	106o01’30”E	70 (3.0)
Cisurupan	Garut	Cisurupan	7º19’14”S	107o47’27”E	80 (2.5)
Tanjungkarya	Garut	Samarang	7º11’38”S	107o49’25”E	70 (2.0)
Mekarmukti	Sumedang	Buadua	6º42’15”S	107o54’53”E	65 (2.5)
Cisantana	Kuningan	Cigugur	6º57’41”S	108o27’04”E	120 (5.0)

Major locations in the Study area are given in coordinates in Table V-1.

1.2 Natural Conditions

1.2.1 Topography and River System

Topography and river system of the model areas are given in the following table:

Topography and River System of Model Areas

Area	Altitude (m AMSL)	Slope of farm fields	River/Spring system
Mekarjaya	850 - 1200	13 % (average)	Ciremes spring, Cikuya spring, Citiis river (spring), Ciengan ruver
Langensari	1100 - 1200	5 – 40 %	Cikukang river, Cipogo river, Cikareo spring
Tugumukti	1100 - 1200	5 % (dominant area)	Kali Cimahi river, Cilayung river, Cipogor river

Gekbrong	1150 - 1250	10 % (average)	Cibeleng river (water from spring)
Cisurupan	950 - 1250	10 – 30 %	Cihareumas spring, Cigambira spring, Cibrial spring, Cimanuk river
Tanjungkarya	1100 - 1250	5 % (average)	Cisaat stream (spring), Cidadalilebak spring, Cilembang spring, Tanjungpura spring, Cilutung spring, Ciroyom river
Mekarmukti	150 - 250	10 % (average)	Ciliang spring, Ciaka river, Cisaat river, Cimanut river
Cisantana	750 - 1200	5 – 15 %	Cipager river (water from spring)

1.2.2 Climate

Climatic characteristics of the model areas are as follows:

- Wet season which has about twenty (20) rain days per month begins in October and ends in April.
- Annual rainfall amounts from 1,800 to 3,000 mm
- Average minimum air temperature is between 15 and 20 oC

Five meteorological stations, which observe climatic factors of temperature, relative humidity, sunshine hours and wind speed, are selected for representing climatic conditions of the model areas. They are Lembang (Bandung) for Langensari and Tugumukti, Bandung (Bandung) for Mekarjaya, Cisurupan and Tanjungkarya, Jatiwangi (Kuningan) for Mekarmukti, and Kuningan (Kuningan) for Cisantana.

The climatic data are shown in Table V-2 and Fig. V-1.

1.2.3 Water Resources

There are three (3) types of water sources in the Study area. They are rivers, springs, and groundwater. Water resources are evaluated by the model area in the following.

(1) Mekarjaya (Fig.V-2)

1) River

The Citiis river which flows northward to the east of the area originates from springs halfway up the Mt. Marabar (2,350m), having a catchment area of 4.6 km^2 at the proposed intake site. According to the estimation of monthly average discharge mentioned in Annex-I, the lowest flow is estimated at about 0.075 m^3/s or 75 lit/s. The discharge in the downstream (behind the

Village Office) is estimated to be more than double of the upstream contributed by several streams such as the one from the Cikuya spring.

Taking into account the estimated discharge of the river, it is considered possible to irrigate vegetable areas of 100 ha (proposed study area) even during the driest season. However, the river water is also used on the right bank (opposite side) of the river (Baros Village). Moreover, in the downstream of the Citiis river, there are several intake structures mainly for paddy rice cultivation.

The estimated flow is given below:

Estimated Discharge at Citiis River

(m^3/s)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.258	0.254	0.236	0.303	0.249	0.171	0.102	0.076	0.096	0.102	0.147	0.289

Ref.: Annex-I

The Ciremes stream to the west of the area also originates from springs, having a catchment area of 0.4 km^2 at the proposed intake site. According to the estimation of monthly average discharge mentioned in Annex-I, the lowest flow is estimated at about 0.007 m^3/s or 7 lit./s. There is no major river water user.

The estimated flow is shown below:

Estimated Discharge at Ciremes Stream

(m^3/s)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.020	0.022	0.026	0.022	0.014	0.009	0.007	0.008	0.009	0.012	0.026	0.022

Ref.: Annex-I

2) Spring

The Cikuya spring is situated right upstream of the proposed irrigation area between the Citiis river and Ciremes stream. Assumed that its catchment area coincides with surface catchment, it has a catchment of 0.8 km^2 at the spring. According to the estimation of monthly average discharge, the lowest flow is estimated at about 0.013 m^3/s or 13 lit /s. The spring water is being used for irrigating upper part of the area with simple earthen channels. Its irrigation area is roughly estimated at five (5) to ten (10) hectares. The spring is the only water source that can be captured at the spring itself, so it is recommended to utilize the spring water for drinking purpose. Being located on the upstream of the area, the spring water can be distributed to the whole area.

The estimated flow is shown below:

Estimated Discharge at Cikuya Spring

(m^3/s)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.045	0.044	0.041	0.053	0.043	0.030	0.018	0.013	0.017	0.018	0.026	0.050

Ref.: Annex-I

The Cibruey spring is located in the midst of the area at RW06. The spring water is being utilized as the water source of an existing drinking water supply system, which was constructed in 1995 funded by UNICEF. Its catchment area can not be specified on the topographic map, but the dependable flow is estimated at 3 lit/s on the basis of field observation and interview to residents there.

(2) Langensari (Fig. V-3)

1) River

The Cikukang river which originates from the east mountain side of Mt. Tangkubanperahu flows southward in the eastern part of the area having a catchment area of 6.1 km^2 at the up most location in the area. The lowest flow of the Cikukang river is estimated at 0.092 m^3/s or 92 lit./s according to the low flow estimation. There are two intake weirs on the upstream of the area (Cikidang Village) for irrigating paddy rice and vegetables on the left bank. Despite that quantity is sufficient for irrigating vegetables in the proposed Study area of 72 ha, the water is not being used due to higher elevation of cultivated area. The estimated flow is shown below:

Estimated Discharge at Cikukang River

(m^3/s)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.317	0.352	0.247	0.401	0.277	0.173	0.118	0.094	0.092	0.111	0.157	0.319

Ref.: Annex-I

The Cipogo stream, which flows to the west of the area, originates from springs. The water is presently used for irrigating farmlands totaling 8 ha (15 ha in the plan). A non-technical irrigation system with a weir named “Pemandian Kuda” is located on the upstream in the area. The lowest flow is estimated at 15 lit./s, which can accommodate nearly 20 ha of vegetable field. The discharge increases to a large extent even in the area getting contribution from springs and small streams. The estimated flow is shown below:

Estimated Discharge at Cibogo River

(m^3/s)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.052	0.058	0.040	0.066	0.045	0.028	0.019	0.015	0.015	0.018	0.026	0.052

Ref.: Annex-I

2) Spring Water

Spring waters are coming out from certain strata or elevation around the rivers. The waters are being used for irrigation and domestic purposes. Discharges by spring are not exactly measured, but it is estimated at not more than five (5) liters per second at one location. Since the springs are generally situated below residential areas near the streams or rivers, it is difficult to extract the waters by gravity. The largest spring in the area is Cikareo spring which is situated at the top of the second valley to the east of Dusun III. The discharge is estimated at 50 to 100 lit./s.

3) Groundwater (dug well)

In Langensari area, people depend on the groundwater at dug wells for domestic purposes. In Dusun III, which is located in the northern part of the area, the water levels in the dug wells are about 15 to 20 m from the ground level fluctuating by season. It is considered that the water levels in the dug wells are at similar level of the river waters and the groundwater originates from infiltrated water in/around the area.

According to the results of water quality test as given in Table V-3, the water in the dug wells might be contaminated to some extent.

However, in the area, they practice “boiling of waters” for 20 to 30 minutes before drinking, so the above mentioned contamination is considered to be resolved.

(3) Tugumukti (Fig. V-4)

There are two (2) types of water sources in the area. They are rivers and spring water.

1) River

Two rivers flow westward in the north and south of the Area. They are the

Cilayung river (north) and the Cipogor river (south).

The lowest flow of the Cilayung river is estimated at 50 to 100 lit/s taking into account the field observation during the Study period and interview survey to residents. However, the Cilayung river flows about 100 m below the area, and its water can hardly be used.

Waters of the Kali Cimahi river are conveyed through pipelines of PDAM (Cimahi) and PAM (Pasirharang), and through an existing irrigation (open) canal to the downstream areas including Tugumukti. The river originates from the Lake Situ Lembang, which supplies stable flow throughout the year. Based on actual measurement of the river discharge at the intake, monthly discharges of 80 % probability are estimated as follows:

Dependable Discharge at Kali Cimahi River

(m^3/s)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.94	1.16	1.04	1.10	1.00	0.93	0.71	0.49	0.47	0.26	0.41	0.59

Source: Provincial Irrigation Services (PU Pengairan), Bandung District Office, Soreang.

2) Spring Water

Waters from the Cipogor stream which originates from springs on the upstream end of the area are presently used for irrigation for vegetable and paddy rice along the stream. Some waters are extracted through an earthen channel to the downstream part of the Area for irrigating more or less five (5) hectares. The total discharge of the spring water is estimated at about 10 to 30 lit/s.

Spring waters come out from certain strata or elevation between the area and the Cilayung river, of which total discharge is estimated at 10 to 30 lit/s. The water is pumped up with hydraulic pumps by 20 m for drinking purpose.

(4) Gekbrong (Fig. V-5)

The Cibeleng river is the sole water source for Gekbrong model area not only for irrigation but also for drinking purpose.

The Cibeleng river originates from halfway up the Mt. Gede (2,968m) and flows eastward to the north of the area, having a catchment area of 3.1 km^2 at the proposed intake site. According to the estimation of monthly discharge mentioned in Annex-I, the lowest flow at the intake site is estimated at about 0.068 m^3/s or 68 lit/s. The discharge on the downstream

(Loji) is estimated more than double of upstream contributed by several streams. Compared with rivers in other model areas, sediment loads for similar discharges seem to be higher. It explains “rapid runoff”, “low base flow” and/or “less contribution of spring waters”.

According to the previous study the discharge of the river is reported at 0.006 m^3/s in September 1996. On the other hand, during the Study period (October to November, 1999), the Study Team observed river discharges of more than 100 lit/s, and also a flood of more than 10 m^3/s after intensive rainfall. It also explains the runoff characteristics, namely unstableness of runoff. This should be carefully taken into account in irrigation planning by applying a kind of safety coefficient[1].

The estimated flow is given below:

Estimated Discharge at Cibeleng River

(m^3/s)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.239	0.256	0.174	0.193	0.201	0.142	0.088	0.068	0.079	0.096	0.173	0.259

Ref.: Annex-I

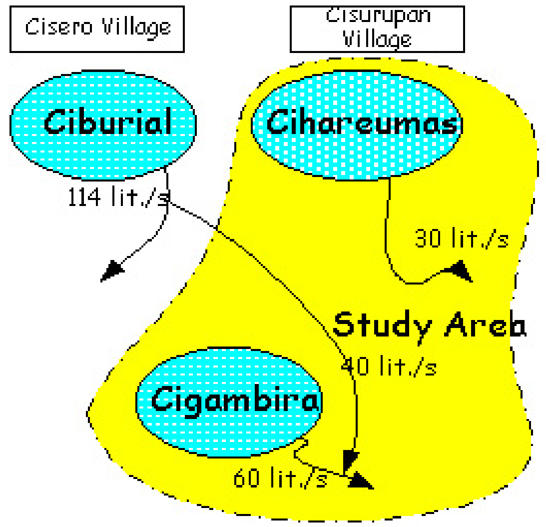
(5) Cisurupan (Fig. V-6)

The main river system of the area is the Cimanuk river which flows in the center of the area. Since the river flows below the proposed irrigation area, the river water can not be used for the area by gravity system.

Main water sources of the area are spring waters. There exist three (3) major springs/ponds in the area, namely the Cihareumas, Ciburial and Cigambira springs. According to the field measurement during the Study period (November 1999), the discharges from the ponds are 30 lit/s for the Cihareumas, 114 lit/s for Ciburial and 60 lit/s for Cigambira.

The Ciburial spring/pond is situated in Cisero Village and the land itself is possessed by a few private owners. They made a kind of contract with certain users and gave right to extract the water to their lands, for instance fish ponds in Cisero Village. About 65 % or two thirds of the waters in the Ciburial pond is conveyed to outside the Area. The water flows from the ponds are shown in the following figure:

[1] A safety factor of 50 % is adopted for estimation.



Water Flow from the Springs as of November 1st, 1999

Judging from the geographical conditions such as location, elevation, topography, etc., contributing strata for the spring water are considered common for three ponds, of which catchment area is 4.5 km^2 on the surface.

The estimated total flow from three ponds are given below:

Estimated Discharge from Springs

(m^3/s)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.253	0.249	0.231	0.297	0.245	0.168	0.100	0.075	0.095	0.101	0.144	0.283

Ref.: Annex-I

(6) Tanjungkarya (Fig. V-7)

Tanjungkarya is a characteristic model area having a number of spring waters. There are at least 12 major springs in the Area. Out of these, the following springs have more discharges than 10 lit/s even during the driest month.

- Cisaat Spring/Stream
- Cidadalilebak Spring
- Tanjungpura Spring
- Cilembang Spring
- Cilatung Spring

1) Cisaat Spring/River

The Cisaat Spring is situated at the up-most location of the Area having a larger surface catchment area of 4.5 km^2 at proposed intake site on the southern slope of Mt. Cakra (1922 m). The stream from the spring flows at the northern edge of the area and becomes the Ciroyom river running at eastern end of the area. The discharge measured in November 1999 was 120 lit/s, which is sufficient to irrigate all the proposed area (80 ha) even for paddy rice cultivation. According to the interview survey to resident farmers, the discharge is more or less same as those of the driest period.

The estimated flow by month is given below:

Estimated Discharge at Cisaat Stream

(m^3/s)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.312	0.307	0.285	0.365	0.302	0.208	0.125	0.095	0.119	0.126	0.179	0.349

Ref.: Annex-I

2) Cidadalilebak Spring

The Cidadalilebak Spring is situated at the northwestern end of the area having a surface catchment area of 0.95 km^2. Spring water is directly taken by a structure, so-called "capturing[2]" and used for drinking and irrigation purposes. The stream from the spring flows through cultivated area of Cidadalilebak up to the western end of the area. The discharge itself is not big, but the water would be suitably utilized for drinking purpose due to the following reasons:

- Discharge is stable though the year,
- water can be directly captured by "caftering", and
- located on the upstream, it is easy to distribute by gravity system.

The discharge during the Study period (November 1999) was nearly 60 lit./s.

The estimated flow by month is given below:

Estimated Discharge from Cidadalilebak Spring

(m^3/s)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.052	0.051	0.045	0.046	0.053	0.048	0.037	0.029	0.026	0.028	0.029	0.034

Ref.: Annex-I

[2] In Indonesian drawings, it is written "caftering".

3) Tanjungpura Spring

The Tanjungpura Spring is situated to the east of the Cidadalilebak spring. The surface catchment area is estimated at 0.45 km^2. The water flows southward and join the stream from the Cidadalilebak spring.

The estimated flow by month is given below:

Estimated Discharge from Tanjungpura Spring

(m^3/s)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.025	0.024	0.021	0.022	0.025	0.023	0.018	0.014	0.012	0.013	0.014	0.016

Ref.: Annex-I

4) Cilembang Spring

The Cilembang Spring[3] is situated to the north of Tanjung in which the village office is located. Its surface catchment area is 3.0 km^2 located on the southern side of Mt. Cakra. There are two outlets at the pond, both of which flow down to the Ciroyom river. The discharge measured in November 1999 was 110 lit/s in total. According to the interview survey to resident farmers, the discharge is more or less same as those of the driest period. The spring water has a sufficient potential as the main irrigation water source for the downstream reach of the model area.

The estimated flow by month is given below:

Estimated Discharge at Cilembang Stream

(m^3/s)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.164	0.162	0.142	0.146	0.166	0.152	0.117	0.091	0.082	0.088	0.093	0.108

Ref.: Annex-I

5) Cilatung Spring

The Cilatung Spring is situated at the western end of the Study area. Having a surface catchement area of 11 km^2, the spring provides the biggest discharge to the downstream area. Certain amount of drinking water is brought from here to Garut, the capital city of the District by PDAM. The water is also used for irrigation mainly for paddy rice cultivation. The discharge measured at one of the outlets was 234 lit./s in November 1999.

[3] The Cilembang spring is specified as “Situ Tanjung” on the topographic map of 1:25,000.

The estimated flow by month is given below:

Estimated Discharge at Cilatung Stream

(m^3/s)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.603	0.594	0.522	0.537	0.610	0.557	0.428	0.335	0.301	0.324	0.339	0.394

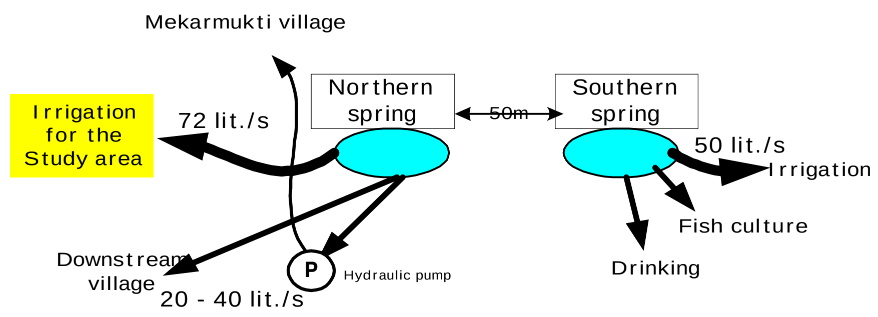
(7) Mekarmukti (Fig. V-8)

The Ciliang springs, which consist of two springs separately situated by 50 m, are the main water sources for the model area.

The springs are situated halfway at the river terrace of the Cimanuk river. Located below the residential area of the village, they lift up the water with a hydraulic pump for drinking purpose. The water is also utilized for drinking purpose in a downstream village (Karangbungur), fishpond, irrigation, etc. During the Study period, water distribution practice for the springs was observed. Out of two springs, the water from the southern one is distributed southward for fish culture, drinking and irrigation at the foot of the river terrace.

The hydraulic pump and the intake of the drinking water supply for the downstream village are installed at the northern spring. An irrigation channel, which has already deteriorated and malfunctioned, runs northward along the steep river terrace for irrigating a part of the model area.

Observed discharges at the springs were 50 lit/s for the southern spring, while 72 lit./s for the northern one. The waters used and distributed by the hydraulic pump and for the downstream village could not be measured, but they were roughly estimated by diameter of the pipes at 20 to 40 lit/s. Thus the water available at the spring is estimated at about 150 lit/s. It should be noted that only half of the available water is used for the northern part, namely the Study area regardless to the volume.



Present Water Distribution Practice

Judging from the residents' information on the discharge, and little surface runoff at the springs, the discharges are likely to be stable throughout the year.

The estimated flow is given below:

Estimated Discharge at Ciliang Spring

(m^3/s)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.175	0.203	0.206	0.196	0.192	0.176	0.140	0.134	0.126	0.128	0.128	0.140

Ref.: Annex-I

(8) Cisantana (Fig. V-9)

The main water source of the model area is the Cipager river, which flows eastward to the south of the area. The Cipager river originates from springs halfway up Mt. Ciremai (3,078 m) having a catchment area of 14.6 km^2 at the proposed intake site. The river water is used not only for irrigation but also for drinking purpose. Water quality of the water is good enough, and a factory of a mineral water supplier is being operated on the upstream of the area. River discharge was 225 lit./s in October 1999.

The estimated flow is given below:

Estimated Discharge at Cipager River

(m^3/s)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.479	0.886	0.646	0.792	0.734	0.544	0.527	0.295	0.298	0.242	0.211	0.277

Ref.: Annex-I

(9) Water Quality

The following items were checked with a "test kit" for water samples taken at drinking water sources in the model areas.

- Turbidity
- Discoloulation
- Odors
- pH
- COD (Potassium permanganate consumed)
- Nitrate nitrogene (NO2-N)
- Nitrate nitrogene (NO3-N)
- Cyanogen (Cn)

- Iron (total as Fe)
- Copper (Cu)
- Zinc (Zn)
- Residual chlorine
- Hexavalent chromium
- Bacteria coli (nos/ml)
- Colon bacillus (nos/ml)

Most of the waters have Bacteria and/or bacillus coliform over permissible ranges. However, people generally practice treatment of the drinking water by boiling for at least 20 to 30 minutes, which is the most practical and reasonable solution for the rural water sources.

The results of the water quality test are given in Table V-3 along with drinking water standards adopted in Indonesia.

1.2.4 Geological Condition

Geological and hydrogeological conditions are mentioned below:

Geological and Hydrogeological Conditions of Model Areas

Area	Geology	Hydrogeology
Mekarjaya	Young volcanic deposits, composed of tuffs, lahars, breccias and andesitic to basaltic lavas. Moderate to high permeability, especially high in lahar deposits and vesicular lava flows.	Extensive moderately productive aquifers (Aquifers of largely varying transmissivity depth to groundwater generally great; wells generally yields less than 5 lit/s)
Langensari		Locally productive aquifers (Aquifers of largely varying transmissivity; generally no groundwater exploitation by drilling due to great depth to the groundwater table; locally, springs can be captured.)
Tugumukti		
Gekbrong		Extensive moderately productive aquifers (Aquifers of moderate transmissivity; water table or piezometric head of groundwater near or above land surface. Well yields generally less than 5 lit/s
Cisurupan	Young volcanic deposits, composed of tuffs, lahars, breccias and andesitic to basaltic lavas. Moderate to high permeability, especially high in lahar deposits and vesicular lava flows.	Locally productive aquifers (Aquifers of largely varying transmissivity; generally no groundwater exploitation by drilling due to great depth to the groundwater table; locally, springs can be captured.
Tanjungkarya		
Mekarmukti	Alluvial river deposits, mostly fine grained materials (clay, silts with sandy intercalations). Generally moderate to low permeability.	Extensive moderately productive aquifers (Aquifers of moderate transmissivity; water table or piezometric head of groundwater near or above land surface. Well yields generally less than 5 lit/s

Cisantana	Undifferenciated volcanic deposits. Mixture of unconsolidated and consolidated volcanic products. Moderate to low permeability.	

Source: Hydrogeological Map of Indonesia, Directorate of Environmental Geology.

1.3 Agricultural and Rural Infrastructures

1.3.1 Irrigation and Drainage Systems

(1) Mekarjaya

DI[4]. Campaka is a semi-technical irrigation system in/around the model area. The system has been constructed on the Citiis river recently for irrigating lower reach of the area, in which paddy rice is cultivated.

Some non-technical irrigation systems (free intake) exist on the upstream of the Citiis river and irrigates several hectares of paddy rice fields. Waters from the Cikuya spring and the Ciremes stream are also extracted by simple earthen channels which are managed by farmers themselves. These irrigation systems cover only the areas adjacent to the water sources. areas which are situated upper or far from the water sources suffer from chronic water shortage during dry season.

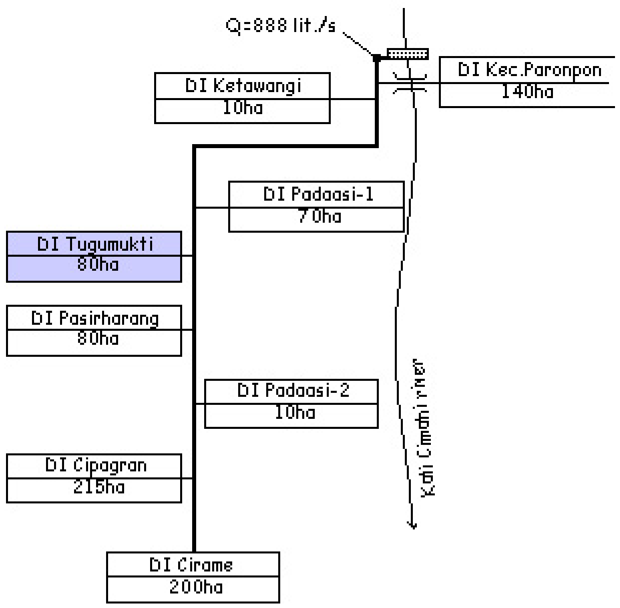
(2) Langensari

A semi-technical weir (Pemandian Kuda) is located on the Cipogo stream irrigating about 8 ha. On the Cikukang river in Langensari village, there exists no irrigation system. A semi-technical irrigation system is located in Cikidang village at one kilometer upstream of the model area irrigating some 10 ha of vegetable area on the left bank. Another irrigation system (village irrigation) is located at one kilometer upstream of the above-mentioned weir irrigating some 5 ha of paddy field on the left bank. Some pieces of farmlands are irrigated by using spring waters with simple earth channels. Even having these irrigation systems on the upstream, the water volume of the Cikukang river in the area seems sufficient for irrigating the proposed area. Due to topographic conditions, it is difficult to irrigate the whole area by gravity irrigation. Since the river or other water sources are located comparatively closer to the farmland, farmers seem to manage the irrigation manually by themselves.

(3) Tugumukti

[4] Daerah Irigasi, irrigation area or irrigation scheme.

Tugumukti Area is included in an irrigation scheme, DI Cijanggel. The total irrigation area is 740 ha (net). There exist eight irrigation blocks as shown on the right, and each block has been improved by village irrigation scheme. The main system is maintained by Subdistrict Irrigation Office of Public Works (Cabang DPU Pengairan). According to the DPU staff, irrigation water reaches only up to Tugumukti block during the driest season due to shortage of water at the river. However, farmers in Tugumukti are suffering from both unstable water supply and shortage during the dry season.



Remarks: Gross area

Fig. DI Cijanggel (Existing)

During the period in which the available water does not meet the demand, they practice rotational irrigation. In this case, Tugumukti block can get the water together with Pasirharang block only for 24 hours a week.[5]

Since the system was planned for paddy rice irrigation, field channels are insufficient, and tertiary canal itself has already deteriorated. Number of control structures such as gates and diversion boxes are not sufficient for precise water management for vegetable cultivation. For eight irrigation blocks, water users associations (Perkumpulan Petani Pemakai Air, P3A) have been established, and water management practices are being discussed in case of water shortage.[6]

A few hectares of vegetable area on the downstream part of the model area is irrigated by extracting spring water from the Cipogor stream.

(4) Gekbrong

There exist two pipelines in the area. One was constructed by a private owner and has been used for drinking and irrigation purposes. Galvanized iron pipes (5 inch) are used. The conveyance pipeline is connected to a diversion or desilting

[5] From 6 a.m. of Tuesday until 6 a.m. of Wednesday.
[6] Mr. H. Sobana is the chief of P3A for Tugumukti block.

box which is located at 1.0 km from the intake at the up most part of the irrigation area. A distribution pipeline runs to downstream by one kilometer to several distribution boxes, from which the water is extracted to houses and farm lands.

Another pipeline (3 inch, galvanized iron pipe) has been constructed by the village, but has not started functioning yet. Galvanized iron pipes are generally expensive compared with PVC pipes, but they install the iron pipes almost on the ground surface for easier maintenance.

The intake at the Cibeleng river was improved when the new pipeline was constructed. However, because of its "open structure", the intake box is often buried with debris and sediments after floods.

(5) Cisurupan

Three spring/ponds, namely Ciburial, Cihareumas, and Cigambira have been widely utilized in the area for irrigation, mainly for paddy rice cultivation. Out of three springs/ponds, Ciburial and Cigambira are presently involved in an irrigation program[7], namely "Java Irrigation Water Management Project" funded by IBRD (3762-IND 1998/99). Designed irrigation area for Ciburial is 133 ha (designed discharge is 0.22 m^3/s) in Cisero and Cisurupan Villages, while that of Cigambira is 124.5 ha (ditto, 0.164 m^3/s) in Cisurupan and Tambakbaya Villages. The target crops are paddy rice and palawija. The design works have been completed and the construction works are going to be started.

An earth channel is being used for irrigation of vegetables, extracting water from the Cihareumas spring. The channel has deteriorated due to sediments and sliding of the channel itself. The irrigation area is registered as 49 ha for the system.

(6) Tanjungkarya

There exists no major irrigation scheme in the model area except the Cilatung system which irrigates mainly paddy rice fields in five villages including Tanjungkarya. The irrigated area by the system occupies few hectares in the model area.

Farmers utilize waters from springs in the area by storing the waters in small ponds which are formed in natural depressions or artificially constructed. Although the area is blessed with abundant water for irrigation, present problems or constraints for vegetable cultivation here are "lack of proper irrigation

[7] Penyerahan Irigasi Ketil, PIK (Handover of Small Irrigation Scheme)

facilities".

(7) Mekarmukti

There is no systematic irrigation facilities in the model area. A line of simple canal was constructed by farmers but deteriorated. because of no irrigation facilities, cropping intensity of the area is low. Farmers are likely to plant paddy rice if they have irrigation water. Pre-coordination on water management is prerequisite for planning of an irrigation project.

Sub-district office of Provincial Irrigation Services, Sumedang has an irrigation plan utilizing the Ciliang spring. The plan, DI Ciliang (282 ha) consists of two systems, namely Ciliang (182.5 ha) and Cijambe (99.5 ha). The design discharge of the Ciliang system is 262.8 lit/s for paddy rice cultivation, but it will not be acquired at the Ciliang spring taking into account the water potential and present water distribution practices as mentioned above. The construction cost is estimated at 900 million Rp. The proposed system diagram is shown below:

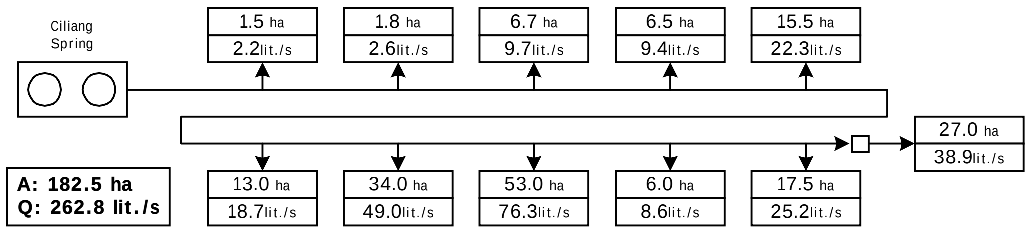


Fig. DI Ciliang (Plan)

(8) Cisantana

There exists an irrigation system named DI Cipager in the model area. Five intakes are diverting water to both banks of the river. According to the field observation during the Study period, the intakes are functioning well.

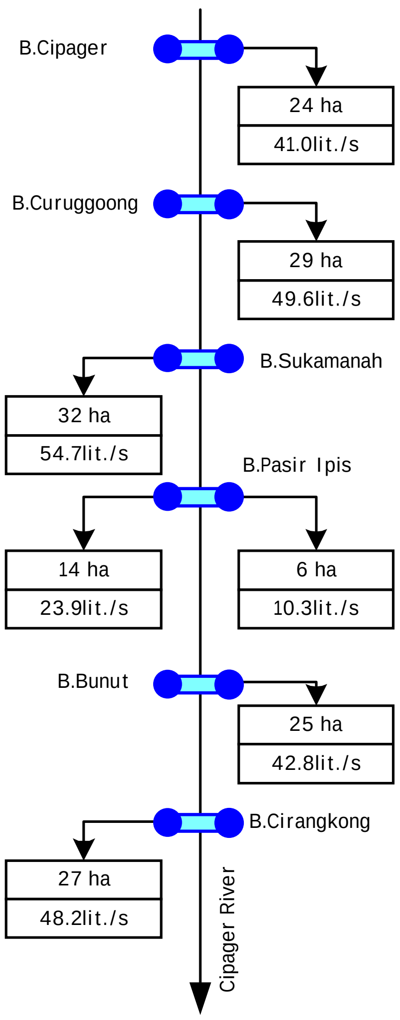


Fig. DI Cipager (Detail Design)

The irrigation system is being improved under the same program of PIK as Cisurupan, namely Java Irrigation Water Management Project handled by DPU Pengairan. Five existing weirs are rehabilitated or replaced and a new intake is being constructed. The project itself is for paddy rice irrigation, and the dimensions of facilities are bigger than those for vegetable irrigation. The diversion water requirement is set at 1.7 lit/s/ha, which is twice as big as the requirement for vegetables. Unlike Cisurupan, vegetables are cultivated in the area and the forthcoming irrigation system, which was designed for paddy, should be carefully managed for vegetable cultivation. In particular, the present system does not have field channels due to its steep topography, and lateral distribution system along with field storage facilities will be required.

1.3.2 Road Networks

(1) Mekarjaya

Deterioration of roads is one of the biggest problems in the area. Access road from the District road (Banjaran – Arjasari) to Mekarjaya Village is seriously damaged for 2.3 km. The road being the "main market road" of the area, the present poor condition greatly hampers the agricultural activities there.

Within the model area, the main village road has deteriorated at the upper part of the area for 1.0 km.

Some road improvement programs are being planned under P3DT in the village.

(2) Langensari

The model area is situated close to the provincial road, which connects Lembang and Subang. There are two lines of main village road in the model area. One starts at the provincial road at Cibogo Village, and runs through the area to Cikidang Village. The road has deteriorated partly by 300 m at the village boundary to Cikidang.

Another line of main road connecting the area and village center has also deteriorated. Due to the deterioration of road sub-base (900 m) and a bridge over the Cibogo river, vehicles can not access the area through this route. The route being the main track connecting the area and markets, farmers hire labor transporters to forward their products or to bring agricultural inputs.

(3) Tugumukti

Main road to the area starts at the provincial road at the National Police Training Center (SPN). The road condition is generally good at this moment, but its road surface should be improved in several locations. Roads in the village are also kept in good condition mainly because of moderate topography in the area.

(4) Gekbrong

Main road of the area starts at the national road and ends at Tabrik totaling 3.4 km. Due to lack of proper drains, the road is seriously eroded and damaged during the wet season. Trucks for shipping tomatoes use the road as production road, and the poor condition causes certain losses. The road is being improved by a project named "Infrastructure Improvement Project for Developing Villages (Proyek Peningkatan Pelaksana Daerah Tertinggal, P3DT)" funded by the World Bank and executed by Village Society Strengthening Institution (Lembaga Ketahanan Masyarakat Desa, LKMD).

(5) Cisurupan

The model area is located close to the provincial road, and there is few problems in the model area on road network except low density of collection roads which connect the farm lands to the main roads.

(6) Tanjungkarya

Main village road is being improved by LKMD for 1.6 km. Due to lack of production and collection road network, farmers have to hire labor for shipping agricultural products and bringing inputs. Development of new collection road network was suggested by the farmers. Roads in forest area are also being improved under a program of land conservation (Proyek Konservasi Tanah, PKT) for 3.0 km.

(7) Mekarmukti

Main road in the model area is well maintained. It might be pointed out that lack of proper production and collection road networks are one of the constraints for further development of vegetable cultivation along with water shortage in the downstream area.

(8) Cisantana

Access road (District road) to the model area from Kuningan, the district capital is in poor condition for 1 km at Cigugur village. Main village road which is used as production road is poorly maintained for 2 km in total on the upstream of the model area. The main village road being located far from the irrigated area, collection roads are required for shipping products and inputs. Farmers in the model area have a number of milk cows, and shipping of the milk to the KUD or collection places is one of the important routine works. For this purpose, farm roads, even for motor cycle, are supposed to support farmers' activities to the great extent.

1.3.3 Rural Water Supply

(1) Mekarjaya

There is a drinking water supply system in the village. The water source is the Cibruey spring. The system was constructed in 1995 by UNICEF having four diversion boxes or public watering stands in four village societies (Rukun Warga, RW) in the area. They are RW02 (Cirateun), RW05 (Ciburuy), RW06 (Ciburuy) and RW09 (Pasirkadu). Assuming 150 households per RW, 600 households or 2,400 people are supposed to get drinking water with the system, but it has already deteriorated and malfunctioned. As for other RWs, they carry drinking water from springs, small streams, or the Cienggang river.

(2) Langensari

Out of six RWs in the area, four RWs in Dusun III (RW06, RW07, RW08, RW14) are located on the hill top between the two rivers, and depend on dug wells for drinking water. A large part of the remaining two RWs (RW02, RW11) receive waters through distribution system of Regional Drinking Water Company (Perusahaan Daerah Air Minum, PDAM) and others are taking spring waters or groundwater in dug wells.

Some dug wells are dried up during the dry season and they share limited water. Most of the dug wells are not provided with pumps and they lift up the water by nearly 20 m. It should be a tough job for women and children, but power-driven pumping from the dug wells might cause rapid dry-up of the wells.

According to the Village Office, development cost of a dug well (30 m deep) is approximately 1.5 million Rp.

(3) Tugumukti

Major drinking water sources for Tugumukti are; i) spring water on the northern slope to the Cilayung river, and ii) distributed water through the National Police Training Center (SPN Cisarua) which is located on the upstream of the area. The spring water is pumped up by a series of hydraulic pumps as mentioned above, distributing the water to about 300 households or 15 user groups (Kelompok). The upstream part of the area receives water from the Police Training Center (Sekolah Kepolisian Negara Cisarua), of which the water is taken from the Cijanggel river through a pipeline. The pipeline is connected to diversion boxes at several locations, from which rubber or polyethylene hoses are used to distribute the water to each household. Anyhow, they are suffering from shortage of domestic water, particularly during the dry season.

(4) Gekbrong

As mentioned in the sub-section 1.3.1 “Irrigation and Drainage Systems”, people in the village depend on the Cibeleng river for irrigation and drinking purposes. The new pipeline constructed by the village has not yet functioned, but already deteriorated due to poor construction works without proper technical guidance and funding. The pipes are connected without sockets or joints, which causes extensive leakages throughout the line. The intake structure is disposed to the floods, which allows sediments flowing into the pipeline and finally causes choking.

Irrigated lands by the same pipeline being located on the upstream of the residential area, village people are always suffering from drinking water shortage.

It is strongly recommended to develop an independent system for the drinking water supply. A new intake should be installed on the upstream of that for the irrigation.

(5) Cisurupan

As the capital of Sub-district Cisurupan, the village is facilitated with a drinking water supply system (Ibu Kota Kecamatan, IKK system) managed by PDAM. The water source of the IKK system is the Cihareumas spring. Residents living outside the service area depend on other spring waters or dug wells. Extension of the IKK system will be one of promising development alternatives for the area.

The area is located comparatively close to the water sources, so simple pipeline system would also be a suitable development alternative for the residential areas which are scatteringly distributed in the area.

(6) Tanjungkarya

Having abundant spring water, people in the model area enjoy better condition on drinking water. They extract water through pipes and/or manually from the nearest spring. However, certain possibility of pollution by agro-chemicals and/or fertilizers is pointed out taking into consideration that cultivated area is spread widely between the springs and residential areas. It is recommended to develop a drinking water supply system with capturing structures at the springs and pipelines. The Cidadalilebak spring and the spring below the Cilembang pond will provide a good drinking water for the area.

(7) Mekarmukti

The Ciliang spring being situated below the village, they can take only a small amount of the spring water by a hydraulic pump. Out of 600 households in the village, nearly 80 % have direct access to the drinking water. Out of the 80 %, 30 % get waters via the hydraulic pump, and others get through a pipeline from Cikurubuk Village on the upstream or other small streams such as Citaleus, Cisitu, Cikanangan, etc. The pipeline was constructed in 1970’s by foreign aid, with a design capacity of 240 lit/day/household. Taking into consideration the operation and maintenance, the best alternative for drinking water supply improvement would be extension and improvement of the existing system by optimizing the water from Cikurubuk.

(8) Cisantana

The drinking water source of the area is the Cipager river, same as that of irrigation. Having comparatively abundant water adjacently, they extract the water by pipeline from the existing intakes on the river. Distribution boxes are installed extensively in the residential areas, and the people extract the water to their houses by rubber or plastic pipes and/or hoses. The water distribution system of Cisantana seems to be the best one among the model areas.

Present problems, constraints on rural and agricultural infrastructures and countermeasures are summarized by model area in Table V-4.

Photo Distribution box

CHAPTER 2 IRRIGATION WATER REQUIREMENT

Irrigation water requirements for the Study are estimated conformed to the design standard of PU Pengairan, "Irrigation Planning" (KP-1). Parameters used in the Study are described in the following:

(1) Compilation of climatic data

Monthly average values of the following meteorological factors are required for calculation of evapotranspiration (Eto) which is the essential parameter in calculation of crop water requirements;

- Average air temperature,
- Average relative humidity,
- Average wind speed, and
- Average sunshine hours.

Fluctuation of climatic conditions is not very big by year like precipitation, but preferably, average values of five years are to be used.

In this study, five (5) meteorological stations are chosen for representing the climate conditions in the model areas. They are *Lembang* for Langensari and Tugumukti, *Bandung* for Mekarjaya, Cisurupan and Tanjungkarya, *Pacet* for Gekbrong, *Jatiwangi* for Mekarmukti, and *Kuningan* for Cisantana. Records of the wind speed are available only at Bandung, and the records are used for other areas.

(2) Calculation of evapotranspiration

The evapotranspiration is estimated according to the procedure introduced in the FAO Irrigation and Drainage Paper No. 24, "Crop Water Requirement" (hereinafter referred to as "FAO IDP No.24"), which is also adopted in the design standard of PU.

The calculation processes and the results for five stations are given in Table V-2.

(3) Setting of cropping pattern

The proposed cropping patterns are determined taking into consideration the general characteristics of cultivation practices in the model areas. It is important here that the cropping pattern should represent not only the proposed development area but also adjacent areas in which the proposed water sources are utilized, because the cropping pattern is used for the water balance estimation for the water sources. The starting time is set at mid-November as the initial stage of the wet season. Basically, the cropping intensity of the pattern which includes paddy rice, is set at 200 % at the maximum. The intensity of the pattern of vegetables is set 300 % at the maximum. The assumed cropping patterns by model area are described below:

1) Mekarjaya

The water sources are supposed to accommodate some 115 ha of cultivated field, out of which 10 % is paddy rice field in the downstream. The paddy field is not included in the Study area, but the irrigation water should be allocated from the proposed water sources. The target irrigation area is 100 ha.

2) Langensari, Tugumukti, Gekbrong, Cisantana

In these areas, only vegetables are cultivated, and the cropping pattern for the water balance calculation is also set for vegetables with a cropping intensity of 300 %. The target irrigation areas are 72 ha for Langensari, 50 ha for Tugumukti, 50 ha for Gekbrong and 120 ha for Cisantana.

3) Cisurupan

The proposed water sources of the area (springs of Cihareumas, Cigambira, and Ciburial) accommodate some 140 ha of farm fields, out of which 100 ha is the paddy rice area covered by IBRD project, so excluded from the target area. Thus the cropping pattern for Cisurupan area is set for vegetables with a cropping intensity of 300 %. The target irrigation area is 40 ha.

4) Tanjungkarya

The target irrigation area covered by the proposed water sources (Cidadalilebak spring, Tanjungpura spring, Citiis river, and Cilembang spring) is 80 ha, out of which 30 ha is used for cultivating paddy rice in the wet season, while the other 50 ha is used for vegetable cultivation. Thus the cropping patterns consist of; i) vegetables with a cropping intensity of 300 % and ii) wet season paddy rice and vegetables in the dry seasons with a cropping intensity of 200 %.

5) Mekarmukti

The target irrigation area covered by the proposed water sources (Ciliang spring) is 167 ha, which is totally used for cultivating paddy rice in the wet season. Thus the proposed cropping pattern is set as “wet season paddy rice and vegetables in the dry seasons” with a cropping intensity of 200 %.

(4) Crop coefficient (Kc)

The crop water requirement is calculated by multiplying the evapotranspiration

(Eto) by crop coefficient (Kc) for each growing stage. The crop coefficient (Kc) varies by crop as given in the FAO IDP No.24.

In the model areas, a number of kinds of vegetables are being cultivated. The growing periods, water requirements, and durability to drought differ by crop. It is very difficult and unpractical to represent the actual cropping pattern which will be applied in the areas. Thus, taking into account the allowance on the safe side of the range, a longer growing period of 3.5 months and higher crop coefficients are applied for the calculation.

The cropping coefficients for paddy rice are chosen from the FAO IDP No.24 which is also used in the design standard of PU (KP-1).

(5) Assumptions for calculation of water requirements of paddy rice

As for the calculation of the water requirements of the paddy rice cultivation, several parameters are used. Settings of each parameter are described below:

1) Land preparation

A land preparation period is set for one month taking farming practices in the areas[8] into account. The total requirement for the land preparation is set at 300 mm for the first planting, while 250 mm is adopted for the second paddy rice because of usage of residual moisture of the previous cultivation.

2) Deep percolation rate

Deep percolation rate is set at 3 mm which stands for moderate percolation.

3) Intermediate watering

Intermediate ploughing and watering are carried out for fertilization and/or improving of physical conditions of soils. The intermediate watering of 50 mm is planned twice in a growing period, namely half month after transplanting and 1.5 months after transplanting.

(6) Effective rainfall

Effective rainfall is estimated based on the rainfall of 80 % probability (once out of 5-year drought). In FAO IDP No.24, the effective rainfall for upland crops is calculated with the probable rainfall and evapotranspiration. However, in this study, a similar estimation procedure is applied following the planning procedure undertaken in Indonesia.

1) Paddy rice

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[8] The land preparation is generally conducted by manpower without machines or draft animals.

Effective rainfall for paddy rice is considered as 70 % of the rainfall of 80 % probability. During the land preparation period, rate of the effective rainfall is reduced to 60 % (from 70 %) because of standing water in the paddy fields.

2) Vegetables (upland crops)

Effective rainfall for non-paddy crop irrigation is set at 70 % of the rainfall of 80 % probability throughout the growing period.

(7) Irrigation Efficiency

Irrigation efficiencies, which would be improved by the proposed irrigation system are set by type of irrigation system as follows:

Irrigation Efficiency

Type of irrigation	Irrigation efficiency by system			Overall irrigation efficiency
	Conveyance	Distribution	Application	
Type A (paddy/vegetables	Open channel	Open channel	Field ditch	0.64
	0.80		0.80	
Type B (vegetables)	Open channel	Open channel	Hose/pipe/bucket	0.72
	0.80		0.90	
Type C (vegetables)	Open channel	Pipeline	Hose/pipe/bucket	0.77
	0.85		0.90	
Type D (vegetables)	Pipeline	Pipeline	Hose/pipe/bucket	0.81
	0.90		0.90	

In this Study, an irrigation efficiency of 0.64 is used for paddy rice irrigation, and 0.77 for vegetable irrigation, for preliminary water balance.

The irrigation water requirements are calculated using the above mentioned parameters and procedures. The results are given in Table V-5.

CHAPTER 3 WATER BALANCE

According to the dependable flow estimated in ANNEX I, the amount or percentage of water which can be used for the proposed irrigation area is determined. Then, irrigable area is estimated balancing the available water and the water requirement.

(1) Allocation of Available Water

Water availability for each model area is mentioned in "1.2.3 Water Resources" as total potential of the water resources. However, all the available water cannot always be used for one project. Coordination and allocation of the available water should be done in advance of planning as illustrated in Fig. V-10.

According to the present conditions, the basic concept and the development approach as mentioned in the following Chapter, percentage of the available water is determined for each model area by certain reasons. The available water is assumed as 80 % of the estimated amount of available water to ensure the plan (safety factor). The percentage of the available water is summarized below:

Percentage of Available Water to be Used for Model Area

Model Area	Pecentage	Reasons
Mekarjaya	Citiis 40 %	Safety factor (80%), Other water users (50%)
	Ciremes 80%	Safety factor (80%)
Langensari	Cikukang 80%	Safety factor (80%)
	Cipogo 80%	Safety factor (80%)
Tugumukti	Kali Cimahi 10.8%	Percentage of irrigation area in DI Cijanggel
Gekbrong	Cibeleng (50%-5lit/s)	Safety factor (50%) 5 lit./s is deducted for drinking water.
Cisurupan	Cihareumas, Ciburial, Cigambira (52%)	Safety factor (80%), Present water allocation (65%) to the proposed area.
Tanjungkarya	Cisaat river (80%)	Safety factor (80%)
	Cidadalilebak spring (80%-5lit/s)	Safety factor (80%) 5 lit./s is deducted for drinking water.
	Tanjungpura spring (80%)	Safety factor (80%)
	Cilembang spring (80%-5lit/s)	Safety factor (80%) 5 lit./s is deducted for drinking water.
Mekarmukti	Ciliang spring (40%)	Safety factor (80%), Other water users (50%)
Cisantana	Cipager river (80%)	Safety factor (80%)

(2) Irrigable Area

According to the usable water and water requirements, water balance is examined. The results are shown in Table V-6 and the irrigable areas by season are summarized below:

Irrigable Area by Model Area

Model Area	Cropping Pattern and Irrigable Area (ha)					
	1st crop (Wet season)		2nd crop (Dry season)		3rd crop (Dry season)	
Mekarjaya	Paddy (10%) Vegetable(90%)	313	Paddy (10%) Vegetable(90%)	132	Vegetable(90%)	59
Langensari	Vegetable(100%)	Over 1000	Vegetable(100%)	338	Vegetable(100%)	121
Tugumukti	Vegetable(100%)	422	Vegetable(100%)	193	Vegetable(100%)	61
Gekbrong	Vegetable(100%)	326	Vegetable(100%)	148	Vegetable(100%)	42
Cisurupan	Vegetable(50%)	631	Vegetable(100%)	205	Vegetable(100%)	77
Tanjungkarya	Paddy (50%) Vegetable(50%)	572	Vegetable(100%)	583	Vegetable(100%)	345
Mekarmukti	Paddy(100%)	44	Vegetable(100%)	88	-	-
Cisantana	Vegetable(100%)	Over 1000	Vegetable(100%)	676	Vegetable(100%)	197

CHAPTER 4 AGRICULTURAL AND RURAL INFRASTRUCTURE DEVELOPMENT PLAN

4.1 Water Resources Development Plan

(1) General

In general, vegetable cultivation requires intensive crop management, which is supported by more sophisticated infrastructures and operation than those of paddy cultivation. Moreover, average land holding size in the vegetable area is very small, and the project scale also becomes smaller than that of paddy cultivation for the same number of beneficiary farmers. For these small areas, water resources themselves should also be small, such as springs, groundwater, or small streams. It is rather difficult for evaluating potential or dependable volume of these small water resources having few hydrological data and records available. Water resources development plan should thus be prepared paying special attention to the local conditions, which can be grasped at the location itself.

Three types of water sources exist in the model areas. They are, river (surface) water, spring water and groundwater. In the highland area of West Java Province, groundwater and spring water potential are comparatively high due to abundant rainfall having a long wet season which lasts six to seven months from October, and also due to geological formation having thick volcanic deposits widely spread in the area.

The main purposes of the water use in the rural area are; irrigation, fish culture, other agricultural activities, and domestic use. Out of these, irrigation requires the largest amount of water, which often causes conflict or troubles between drinking water use.

On the other hand, possibility of pollution of the drinking water by agro-chemicals and fertilizers is pointed out due to intensive agricultural practices in the area. Thus, due consideration should also be taken on the water quality management in the course of the water resources development.

(2) Basic Concept

Taking into consideration the present conditions as mentioned in Chapter 3 of the main text, the following concept and approach should be undertaken for the water resources development for agriculture and rural development in the model areas.

- Drinking water should be given the first priority and should have independent water sources as far as possible,

- Present water distribution practices (water right, regulation, volume, etc) should be respected,
- The primary target of the water resources development is not “to increase the diversion volume of water” but “to enhance efficiency of water use”.

Development approach and respective plans by model area are described in the following section.

4.2 Irrigation System Development Plan

(1) General

According to the basic concept of the water resources development, irrigation methods are considered primarily aiming at improvement of the irrigation efficiency. So far, processes and procedures for the vegetable irrigation development such as survey, planning, design, construction and O&M have not been established in Indonesia, special attention should be paid in selecting the best approach or modifying them for the model areas.

(2) Basic Concept

Considering the present conditions and constraints of the model areas, basic concept and approach to the irrigation development are as follows:

1) Improvement of irrigation efficiency

In the model areas, most agricultural fields depend on limited and small water sources which are often used conjunctively for drinking purposes. Losses in using the limited water can be reduced by applying of pipelines, storage facilities (farm pond, on-farm pond, etc) and pin-point application of the water to crops.

2) Irrigation system for vegetable cultivation

Vegetable cultivation requires irrigation facilities which are densely distributed compared with paddy rice cultivation. The pipeline will be buried under the ground, which does not bother farmers about losing of their lands by the irrigation canals.

Traditional paddy irrigation system which applies “flood irrigation” cannot be applied for the vegetable irrigation. “24-hours irrigation” is acceptable for the paddy irrigation, but it is not applicable for the vegetables cultivation. In this case, the farm ponds are necessary as “night storage”. Only few areas which have sufficient water sources can do without the farm ponds. For easy O&M and risk management, the command area of one farm pond should be 50 to 60 ha at the maximum.

3) Easy O&M

Since the proposed irrigation system includes several facilities of "new-concept" such as the pipelines and the farm ponds, "easy operation and maintenance" should always be considered at the planning stage. Following points should be noted;

- to use materials which are supplied in the local market,
- to provide low-pressured distribution system,
- field application will be done by manual irrigation with hose, bucket, etc.
- to keep personnel or functions under Provincial Agricultural Services, for consultation and guidance from/to farmers on engineering aspect of the proposed irrigation system.

4) Low O&M cost

The irrigation facilities will be handed over and maintained by farmers themselves. It is quite necessary to establish "facilities with low O&M cost" even the initial investment cost is high. Systems which require power-driven machines such as pumps, motors, etc. will not basically be proposed. Expensive parts such as pressure-control valves of big diameter will not also be used. For easier procurement of spare materials and/or risk dispersion, one irrigation unit should be smaller than 50 or 60 ha so that the diameter of the main pipeline be smaller than 200 mm.

5) Participation of farmers

Since the vegetable irrigation system is also new for farmers, it is very important to involve them from the initial stage of the project. Farmers will know the system when they participate in the construction works. Intensive training for the water users should also be carried out.

6) Even distribution of limited water

Taking into account the small development scale and limited water resources, the command area of the irrigation system should be determined paying due consideration not only on irrigable area but also on social impact which will be brought into the local society by the development. The extent of the development should be determined so that such negative social impact be reduced.

(3) Development Approach

According to the above basic concept, irrigation development is planned. In order to clarify the present problems and countermeasures, or to realize sustainability and equitability in development activities, the following approach is recommended for the irrigation development:

- Step-1 : To secure stable drinking water source
- Step-2 : Determination of appropriate development size on the basis of water balance study,
- Step-3 : Coordination on water use with other users,
- Step-4 : Development, improvement, rehabilitation of irrigation facilities,
- Step-5 : Institution building and revitalization (water users association, supporting organization on technical aspects),
- Step-6 : Guidance and training to the above institutions

The above approach is illustrated in Fig. V-10.

(4) Development Plan

The irrigation area of Mekarmukti is reduced to 80 ha for applying rotational irrigation. The proposed irrigation area of Cisantana is 120 ha excluding the irrigated area by DI. Cipager, of which improvement project is being undertaken by PIK (IBRD) program. The irrigation development plans by model area are summarized in the following table:

Irrigation Development Plans

Study area	Physical development plan	
	Water resources and intake facilities	Conveyance and distribution system
Mekarjaya 100 ha (Fig. V-11)	• Construction of an intake weir at the Citiis river. • Construction of an intake weir at the Ciremes river.	• Conveyance pipelines from the intakes(1,500m). • Farm pond for downstream block of Citiis system (about 1,500 m^3 for 8 hours) • Main distribution pipelines with open stands for Citiis upper block (1,500m), Citiis lower block (2,000m) and Ciremes block (650m). • Diversion boxes and lateral pipelines (10,000m) at every 100m on the main pipelines. • Field outlet boxes at every 50m on the lateral lines • Pipe (hose) or bucket field application from the diversion boxes.
Langensari 72 ha (Fig. V-12)	• Intake box with a pump stand at every 100 m on the Cikukang river and on the stream from the Cikareo spring.. • Removable or portable pumps (Head 35m x 8 nos, Head 50m x 13 nos.) • Rehabilitation of Pemandian Kuda Weir on the Cipogo river.	• Diversion boxes on the top of the slope of the farm fields. • Removable pipes to connect the pump and the diversion box. • Pipe (hose) for field application. • Field outlet box at every 20 m along the connecting pipe. • Rehabilitation of open channel (lining) from Pemandian Kuda Weir on the Cipogo river with diversion boxes and field storage for bucket application.

Tugumukti 50 ha (Fig. V-13)	• Rehabilitation of diversion facilities at BCL6 of Cijanggel system (provision of diversion box, check gate,etc)	• Conveyance pipeline (1,310m) from the diversion point (BCL6). • Farm pond (about 1,500 m^3 for 8 hours). • Main pipeline from the farm pond (1,100m) • Diversion boxes and lateral pipe lines at every 100 m on the main pipe lines (5,000m). • Field outlet boxes at every 50 m on the lateral lines • Pipe (hose) or bucket field application from the diversion boxes.
Gekbrong 50 ha (Fig. V-14)	• One intake weir on the Cibeleng river.	• Conveyance pipe line (1,000m). • Farm pond (about 1,500 m^3 for 8 hours). • Main pipe line from the farm pond (1,600m). • Diversion boxes and lateral pipe line at every 100 m on the main pipe line. • Field outlet boxes at every 50 m on the lateral pipe line. • Pipe (hose) or bucket field application from the diversion boxes.
Cisurupan 40 ha (Fig. V-15)	• Improvement of intake facilities at Cihareumas spring/pond.	• Two lines of main pipelines (1,900m). • Diversion boxes along the pipeline. • Lateral pipe line at every 100 m on the main pipe line (4,000m). • Field outlet boxes at every 50 m on the lateral lines • Pipe (hose) or bucket field application from the diversion boxes.
Tanjungkarya 80 ha (Fig. V-16)	• Intake facilities (intake box) at streams from Cisaat River (three locations). • Intake box at the pond on the downstream of Cilembang springs. • Intake facilities at Cidadalilebak and Tanjungpura	• Three lines of main pipeline from the Cisaat stream (2,700m). • Diversion boxes and lateral pipelines at every 100 m along the main pipelines • Main pipeline from the Cidadalilebak and Tanjungpura springs (900 m). • Main open canal (wet masonry) from the intake at the pond. (Cilembang system, 1,200m) • Lateral pipelines of 8,650 m. • Field outlet boxes at every 50 m on the lateral lines. • Pipe (hose) or bucket field application from the diversion boxes.
Mekaramukti 80 ha (Fig. V-17)	• Intake facilities at Ciliang spring (capturing)	• Main canal cum conveyance canal (open structure by wet masonry) for 1,970 m. • Farm pond for downstream area (40 ha) (about 1,500 m^3 for 8 hours). • Main pipeline for the lower block (600m, 40ha). • Lateral pipe lines at every 100 m on the main canal and pipeline (8,000m). • Field outlet boxes at every 50 m on the lateral lines • Pipe (hose) or bucket field application from the diversion boxes.

Cisantana 120 ha (Fig. V-18)	・Enhancement of intake capacity at the up-most weir.	・Two lines of conveyance pipeline (2,000m in total). ・Two farm pond. Farm pond (about 1,500 m^3 each for 8 hours). ・Two lines of main pipe line from the farm ponds (4,400m). ・Diversion boxes and lateral pipelines at every 100 m on the main pipe lines. ・Field outlet boxes at every 50 m on the lateral pipe line. ・Pipe (hose) or bucket field application from the diversion boxes.

4.3 Rural Road Development Plan

(1) General

In the model areas, the public roads (village road) play a role of “production road”. In many areas, the public roads in adjacent villages have a function of “access road” to the village. If the irrigation facility is the key infrastructure for production, the rural road network is the one for marketing. In some areas, poor capacity of the roads becomes the main constraint for increasing of production and value of the products. In this context, the road network is regarded as one of “marketing facilities” in the Study.

(2) Basic Concept and Approach

The rural road development in the Study will be proposed with the following basic concept:

- As the marketing facilities, the roads should connect the market and the model area. Extent of road improvement should be determined conformed to this concept,
- Taking into consideration the small land holding size, O&M roads of the proposed irrigation system will take a part of the roles of the marketing road.

(3) Development Plan

Dimensions and structures of the roads should be conformed to the standard given by Road Services of Ministry of Public Works (PU Bina Marga). The design parameters of roads are given below:

Specification of Rural Roads

	Village/Access Road	Production Road	Collection Road	Foot Path
Speed	40 km/hr	20-25 km/hr	15-20 km/hr	-
Paved width	Paved	Paved	Non-paved	Non-paved

(effective width)	3.0 m	2.0 m	(2.0 m)	(1.0 m)
Road shoulder	1.0 m	1.0 m	0.5 m	-
Total width	8.0 m	7.0 m	5.0 m	2.0 m
Load capacity	5 ton	5 ton	1.0 – 1.5 ton	-
Type	ATB&AC [1)]	AWCAS[2)]	NACAS [3)]	NACAS
Construction Cost (mil.Rp./km)	220	150	75	30
Improvement Cost (mil.Rp./km)	155	90	45	18
Periodical Maintenance Cost (mil.Rp./km)	55	30	20	-
Routine Maintenance Cost (mil.Rp./km)	5	3	2	-

Source: Bina Marga (PU), Bandung District Office (Village road), IHDUA (other roads)

Remarks: 1) Asphalt Treatment Base + Hot Mix

2) All Weather Compacted Aggregate Sub-grade

3) Non Asphaltic Compacted Aggregate Sub-grade

According to the basic concept and development approach, the road development is proposed by model area as summarized in the following table:

Rural Road Development Plans

Model Area	Physical development plan
Mekarjaya	• Access road from the District road (Banjaran – Arjasari) to Mekarjaya (2,300 m) • Upper village road (1,000 m)
Langensari	• Improvement of village road to Cikidang Village as “production road”. (200 m) • Improvement of village road to the village center as “production road” (900 m) • Replacement of a road bridge over the Cibogo river (B=3m, L=5m).
Tugumukti	• O&M roads for the irrigation system will be utilized.
Gekbrong	• Village road to Tabrik as “production road”. (1,750 m) which is partly being improved by P3DT (IBRD).
Cisurupan	• O&M roads for the irrigation system will be utilized.
Tanjungkarya	• Improvement of village road from Tanjung to Makam (400 m) • Construction of new village road from Makam to Engkol (800 m)
Mekaramukti	• O&M roads for the irrigation system will be utilized.
Cisantana	• Access road from the District road (Kuningan) to Cisantana (1,000 m) • Village road through the Study area (2,000 m)

4.4 Rural Water Supply Development Plan

(1) General

Rural water used for domestic purposes (including drinking purposes) is the basic needs to support and maintain agricultural activities. In this Study, the domestic and drinking water development is considered as "primary need" among the purposes of water use in the rural area. Main problems on the domestic water in the model areas are;

- Shortage of water sources in terms of "small volume" and "unstableness",
- Concurrence on water use with irrigation, which requires much more water than domestic purposes, and
- Lack of proper water supply facilities for providing safe drinking water.

Development of the rural water supply should be planned paying due consideration to the above problems.

(2) Basic Concept and Approach

According to the Planning Criteria for Rural Water Supply prepared by Cipta Karya of PU (Diretorate General of Housing, Planning and Urban Development, Ministry of Public Works), the rural water supply by pipeline system is adopted for the villages or resident areas, of which population density is over 20 persons/ha with total poplulation of more than 3,000. As for O&M cost, it is mentioned that tariff for the water supply should be 3,000 to 5,000 Rp./month[9].

In view of present conditions in the model areas and the above criteria, the rural water supply in this Study would cover the following manner:

- Pipeline water supply system for the model area which has more than 3,000 beneficiary users [None of the model areas],
- Model area of which drinking water sources are conjunctively proposed for irrigation water sources [Gekbrong, Cisantana], and
- Model areas which use dug wells for drinking purposes [Langensari, Cisurupan].

For the above target areas, rural water supply systems are proposed in accordance with the following concept:

1) Independent water source

Water sources for the drinking purpose should be independent from irrigation. In case that no water source is available, the intake facility should be installed separately.

[9] The actual water fee collected at present is higher of 5,000 Rp to 8,000 Rp.

2) Suitable water sources

Available water sources in the model areas are river, spring, groundwater and rainfall. Certain treatment is necessary for drinking of the river water, which requires high O&M cost. Rain water is not stable throughout the year, and quality of stored rain water is not suitable for drinking. Thus, the water sources are to be limited to the spring water and the groundwater. Power-driven machines or equipment will not be used not only because of their high O&M costs but also of avoiding over exploitation of the groundwater, which would cause “dry-up” of the dug wells.

3) O&M by users

Development works are planned under a precondition that operation and maintenance would be done by water users themselves. The total O&M costs will be shared by the users themselves.

4) Distribution system

Distribution system (SR or TA/HU[10]) will be determined according to the present systems and/or availability of water, but SR will be primarily considered.

(3) Development Plan

1) Design standard for pipeline system in Indonesia

The design water duty for drinking water supply being adopted is 90 /person/day for SR, and 30 /person/day for HU for IKK[11] system, which are applied for capital towns of Sub-districts. Replacement period is set at five (5) years. PVC pipe is used for supply and distribution system except for aqueduct, road crossing and rock zone.

2) Proposed system for the model areas

Judging from the present condition of the model areas, the water supply systems for the area were recommended in the Stage-1 as follows:

Proposed Rural Water Supply System

	Type A	Type B
Water source	Groundwater	spring water
Intake facilities	Tubewell (50m) with hand pump and public water space	Capturing at spring

[10] SR=”Sambungan Rumah” (distribution to household), TA/HU=”Terminal Air/Hidran Umum”(water station/public water place).
[11] IKK=Ibu Kota Kecamatan (Capital City of Sub-district)

Design supply	90 /person/day (for SR)	
Capacity per Unit	15 m^3/day	-
Distribution system	Public watering place	Pipeline/water stand (SR)
Expected cost per unit	0.7 mil.Rp./household	0.5 mil.Rp./household
Model Area	Langensari, Cisurupan	Gekbrong, Cisantana

However, in the course of technical discussions made in the Stage-2 Study with Cipta Karya, PU, difficulty in O&M of the hand pump was pointed out. Then, further discussion and investigation were made, and came to a conclusion that a pipe line distribution system with an electric pump is suitable for Langensari model area, taking into consideration the following conditions:

- Abundant water source (Cikole spring) is situated near the area, and
- A similar system with the pipe line and the electric pump is being operated in Langensari Village

4.5 Collection Center Development Plan

Losses of products in marketing channel are caused in harvesting, collecting, packing, shipping by trucks, motorcycles, etc. By improving of marketing roads, certain part of losses are reduced. On the other hand, on-farm losses caused by rainfall, sunshine, etc. can be reduced by handling at certain facilities adjacent to the farm fields, for collecting and packing before shipping or loading on the trucks of traders.

In Tugumukuti, some farmers built a small hut with bamboo piles and simple roof with a floor area of 4 x 4 m. The construction cost of the hut is reported approximately Rp 5,000,000 /unit. Functions of the hut are well recognized among the farmers, and extensive development of the hut might be a promising alternative for reducing the handling losses. However, it will be difficult to connect these small structures in the farm fields with the market roads.

In this Study, a “field collection center” is proposed for each farmers’ group (Kelompok Tani), which will operate, maintain and manage the center. The center will have a capacity for storing the products from the farm fields for two days before shipping. The center building is proposed to have a floor area of 30 to 60 m^2 for handling works, with scales for the products, furniture, watering and sanitation facilities.

CHAPTER 5 DESIGN OF PIPELINE IRRIGATION SYSTEM IN THE MODEL AREAS

5.1 General

In the study, agricultural and rural infrastructures, namely, irrigation, rural market road, collection center and rural water supply, were proposed to be constructed, improved, and rehabilitated.

Irrigation development has been generally handled by the Directorate General of Water Resources Development of Ministry of Public Works (PU Pengairan) and its connected organizations in the Province, District and Sub-district. Irrigation projects handled by PU Pengairan are mostly for paddy rice irrigation even the size is big or small. Upland irrigation is generally planned for secondary crops so called “palawija”. Even for the irrigation systems that are proposed exclusively for the upland crops, there systems have been similar to that for the paddy rice.

In the Highland Area, natural conditions, namely; i) limited water source, and ii) steep topography, force the farmers to cultivate on the steep and undulating farm field in water shortage. In the location that the water is available and can be extracted, they convey the water by small channels to their farm fields mainly for paddy rice cultivation.

However, the proposed irrigation areas in the Study all have difficulties in getting water for the farm fields by using such a procedure, because sometimes the land is too steep and undulating, or the water sources are located far below the farm land. In that case, what the farmers can do is just to plant crops, which can be cultivated with less water, and even without fertilizers be harvested. The poor farmers forced to cultivate under such condition have also difficulties to purchase “rice” for their consumption.

In order to overcome such situations, the irrigation procedures should also be selected paying due attention to the specific development constraints in the Highland Areas. The pipeline system, with gravity or pump system, is suitable or sometimes the only alternative to irrigate such areas.

Preliminary design of the pipeline irrigation systems proposed in the Study is described in the following, taking into consideration that no sufficient experts on the pipeline irrigation systems are available neither in DGFCH, PU Pengairan nor PU Cipta Karya. Design of rural market roads, rural water supply and open type irrigation system were conducted conformed to the design and planning criteria of

PU Bina Marga, PU Cipta Karya and PU Pengairan, respectively.

5.2 Mekarjaya Model Area

Proposed irrigation system of Mekarjaya consists of three systems as follows:

Name of System	Irrigation Area (ha)	Water sourse	Conveyance system	Distribution system
Citiis-A	40.9	Citiis river	Pipeline + farm pond	Pipeline, hose or bucket
Citiis-B	33.5	Same as A	Pipeline + farm pond	Pipeline, hose or bucket
Ciremes	8.4	Ciremes river	Pipeline	Pipeline, hose or bucket
Total	82.8			

5.2.1 Diversion Water Requirement and Watering Schedule

(1) Diversion Requirement

According to the Stage-1 study, a peak unit water requirement for Mekarjaya Model Area is 0.67 lit/s/ha for the following cropping pattern:

Wet season: paddy rice (10 %) + vegetables (90 %)

Dry season: paddy rice (10 %) + vegetables (180 %)

Assuming the same condition, the diversion requirement (Q_d) for the Citiis-A and Citiis-B block is estimated at;

$$Q_d = 0.67 \times (40.9 + 33.5) = 49.8\ lit/s.$$

The diversion requirement for Ciremes is

$$Q_d = 0.67 \times 8.4 = 5.6\ lit/s$$

Watering Schedule and Quantity

Rotational irrigation is proposed with an interval of three (3) days. Irrigating hour per day is assumed to be 12 hours. Thus, for one irrigation block, water duty per day (12 hours) (Q_r)should be;

$$Q_r = 0.67 \times 3 \times (24 \div 12) \cong 4.0 lit/s/ha.$$

Irrigation diagram with rotational water demands are given in the Drawing MJ/2.

5.2.2 Intake Weir

(1) Citiis Weir

An wet masonry fixed weir is proposed on the Citiis river. The weir width is proposed to be 10 m and the water is diverted to the left bank. A manual gate will be used for controlling the inflow to the conveyance pipeline. The more important function of the weir is "control of sediment inflow" to the pipeline. Certain stretch of open channel is required to refrain sediments from entering the pipeline. Since the proposed weir site is located in the forest-reserve area, due discussion and arrangement are required at design stage.

(2) Ciremes Intake

The intake structure of Ciremes irrigation system is proposed on the Ciremes stream, which originates from springs upstream and the discharge is unstable especially in the dry season. Runoff of the stream after certain rainfall is rapid, and brings large debris and sediments from time to time. In this situation, it is not recommended to construct an ordinary fixed weir, which would be filled up by the sediments soon. Thus an intake facilities with an infiltration drain is proposed. The water is extracted through the drain to the inlet box, then to the conveyance pipe line. The intake facilities are shown in the Drawing MJ7.

5.2.3 Conveyance system

(1) Conveyance pipe line

Conveyance pipe line for the Citiis-B block starts at the farm pond for Citiis-B. For determining of the pipe dimensions, hydraulic analysis is conducted. For determination of the diameter, the hydraulic analysis is conducted by Hazen-Williams Formula as follows:

$$V = 0.35464 C D^{0.63} I^{0.54}$$

$$Q = 0.27853 C D^{2.63} I^{0.54}$$

$$D = 1.6258 C^{-0.38} Q^{0.38} I^{-0.205}$$

$$I = h / L = 10.666 C^{-1.85} D^{-4.87} Q^{1.85}$$

$$h = 10.666 C^{-1.85} D^{-4.87} Q^{1.85} L$$

$$Q = AV = \frac{\pi D^2}{4} \cdot V$$

where,
- V: average velocity (m/s)
- D: diameter of pipe (m)
- I=h/L: hydraulic gradient
- L: pipe length (m)
- Q: discharge (m^3/s)
- h: head loss by friction (m)
- g: gravity acceleration (m/s^2)

C: current velocity coefficient (150 for PVC)

For the conveyance pipelines, the following conditions are used:

- Pipe to be used: PVC pipe (velocity coefficient C=150)
- Discharge: 49.8 lit/s for Citiis-A
  22.4 lit/s for Citiis-B
  5.6 lit/s for Ciremes

Design water speed of the pipeline is determined so that the pipe is not damaged by the water hammer pressure. The design speed by diameter is given below:

Diameter (mm)	Design velocity (m/s)
50 - 150	0.7 – 1.0
200 - 400	0.9 – 1.6

On the other hand, the maximum allowable velocity for PVC pipe is set at 5.0 m/s. In case the estimated velocity in the pipeline is over the design velocity, certain countermeasures against the water hammer (pressure control stand, safety valve, etc) are to be considered.

For the upland irrigation system, it is often difficult to control the velocity below the design velocity due to topographic condition. Taking into account available PVC pipes in the local market (up to 12.5 kgf/cm^2 of internal pressure), design speed is determined with reference to static water pressure. Primarily, the pipe diameter is determined so that the velocity should not exceed 2.0 m/s.

The results of longitudinal hydraulic analysis are given in Table V-7. The diameters for Citiis-A, Citiis-B and Ciremes are thus determined to be 200 mm,150 mm and 75 mm, respectively.

Then, type of the pipe is to be determined according to the designed pressure of the pipe line. The design pressure is estimated by the maximum static water pressure and water hammer pressure of the system.

The water hammer pressure is estimated using the transmission speed (α) of shock wave of the water hammer. The speed is calculated in the following formula:

$$\alpha = \sqrt{\frac{1}{\frac{W}{g}\left(\frac{1}{K} + \frac{D \cdot C_1}{E \cdot b}\right)}}$$

where, g: gravity acceleration (9.8 m/s^2)

W: weight of water per unit volume (1000 kg/m^3)

D: pipe diameter (indside) (m)

b: thickness of the pipe (m)

E: Elasticity coefficient of pipe (0.03 for PVC)

K: Volume elasticity of water (2.07 x 10^8 kgf/cm^2)

C_1: Coefficient by pipe support (normally 1.0)

The transmission speed is determined by pipe characteristic, and the α for the PVC pipe is approximately 300 m/s.

The water hammer pressure by sudden close of the downstream valve (t=0) is estimated by the Joukowsky's formula:

$$h_{max} = \frac{\alpha}{g} V_0 \text{ (meter in water head)}$$

where, α: shock wave speed of water hammer (m/s) (about 300 m/s for PVC pipe)

V_0: current speed of steady flow (m/s)

According to the results of hydraulic analysis, the current speeds of the conveyance pipeline are 1.6 m/s between the intake and Citiis-A farm pond, and 1.3 m/s between the farm ponds of Citiis-A and Citiis-B. Thus the maximum water hammer pressures for the sections are 49 m and 40 m, respectively.

Ciremes block, having design water velocity of 1.3 m/s, the water hammer pressure is estimated at 40 m.

Normally, a valve is closed in certain seconds. The longer the time for closing the valve is, the smaller the water hammer pressure becomes. At this stage, the maximum water hammer pressure caused by the sudden close of valve estimated above is used for keeping safe side of the design.

Thus the design pressure of the conveyance pipeline is determined as follows:

Section	Discharge (lit/s)	Water hammer pressure (m)	Static water pressure (m)	Total design pressure (m)	Diameter (mm)	Type
Intake – Citiis-A FP	49.8	49 m	13 m	62 m	200	S16
Citiis A – B FP	22.4	40 m	59 m	99 m	150	S10
Ciremes	12.4	40 m	26 m	66 m	75	S12.5

Note: FP= farm pond

(a) Blow off

A scouring valve is to be installed at the lowest point of the conveyance pipeline so that the sediment in the pipeline is eliminated.

(c) Pressure Control Stand

A pressure control stand is to be installed between the Citiie-A FP and the blow off structure in order to control the pressure below the permissible range of the pipes. The design capacity of the float valve is assumed at 75 m or 7.5 kgf/cm^2.

5.2.4 Farm Pond

(1) Citiis-A block

The design capacity of the farm pond (V) is determined as follows:

$$V = U_{req.} \times 86.4 \times A \times (24 - t) \div 24$$

where, V: required volume of farm pond,

U_{req}: unit water requirement (0.67 lit/ha/s)

A: irrigation area (ha) (41 ha for Citiis-A block)

t: irrigation hours per day (12 hours per day)

Thus, the farm pond volume for Citiis-A block is estimated at 1186 m^3. The dimensions of the farm ponds (net) is determined as follows:

Farm pond Citiis-A: 20 m (width) x 30 m (length) x 2 m (depth) = 1200 m^3.

The farm pond type is proposed to be open type reinforced concrete structure. The farm pond is designed to have the following facilities:

- control valve at inlet pipe
- inlet chamber with float valve to control the water level in the pond
- spillway pipe
- outlet chamber
- outlet pipe with control valve
- desilting pipe

Dimension of the spill way pipe is determined by the following formula:

$$Q = C \cdot B \cdot H^{3/2}$$

where, Q: required discharging capacity (m^3/s),

B: width or length of overflow (m)

For pipes, $\pi \cdot D \cdot$

D: diameter of pipe

H: overflowing depth (m)

C: discharge coefficient,

$$C = 1.838\left(1 + \frac{0.0012}{H}\right)\left(1 - \frac{\sqrt{H/B}}{10}\right)$$

The overflow discharge by diameter (D) and design overflow depth (H) is given below:

Table Overflow discharge of spillway pipe (m^3/s)

D(m) \ H(m)	0.05	0.10	0.15	0.20	0.25	0.30
0.10	0.007	0.018	0.033	0.050	0.068	0.087
0.15	0.010	0.028	0.050	0.077	0.106	0.137
0.20	0.013	0.037	0.067	0.103	0.143	0.186
0.25	0.017	0.046	0.084	0.129	0.179	0.235
0.30	0.020	0.055	0.101	0.155	0.216	0.283

The diameter is to be determined so that the water can be smoothly discharged. Consequently, the dimension of the spillway pipe is determined as follows:

Farm pond	Diameter (m)	Overflow depth (m)	Discharge (m^3/s)
Citiis-A	0.25	0.107	0.0498
Citiis-B	0.15	0.087	0.0224
Ciremes	0.10	0.049	0.0056

(2) Citiis-B block

The farm pond volume for Citiis-B block is estimated following the same procedure as Citiis-A at 970 m^3. The dimensions of the farm ponds (net) is determined as follows:

Farm pond Citiis-B: 20 m (width) x 25 m (length) x 2 m (depth) = 1000 m^3.

(3) Ciremes block

The farm pond volume for Ciremes block is estimated at 243 m^3. The dimensions of the farm ponds (net) is determined as follows:

Farm pond Ciremes: 5 m (width) x 25 m (length) x 2 m (depth) = 250 m^3.

5.2.5 Main Pipeline

The main pipeline is designed according to the same procedure as the conveyance pipeline. The pipe is selected considering discharge, velocity, static water pressure, water hammer pressure, etc. The result of the hydraulic analysis along with selected pipe type is given in Table V-7, V-8 and V-9.

5.2.6 Lateral Pipeline

According to the irrigation plan, design discharge of lateral pipeline ranges from 3 lit/s to 21 lit/s. The pipe for the lateral line is selected based on the matrix, which is derived from Hazen-Williams' formula. Pressure control structures are considered depending on the estimated water speed and the static water pressure. .

5.2.7 Pressure Control Stand

Pressure control stands are provided so that the total internal pressure to the pipe be controlled below the permissible range. The pressure control stand for the conveyance or main pipeline is proposed to have floating valve so that the water flow in the pipe be controlled from the downstream. The pressure stand on the lateral pipeline would be "open type" without the valve because the water application by the lateral line, which is used only for daytime, can all the time be monitored.

Dimensions of the stand are determined taking into account surging (fluctuation of the water level) in the stand, and space for O&M activity.

5.2.8 Field Distribution Stand

Field distribution stand is proposed that be installed at every 50 m along the lateral pipeline on the average. The field distribution stand consists of i) valve, ii) stand pipe, and iii) concrete booth with lid as shown in Drawing CI/3

5.3 Gekbrong Model Area

5.3.1 Diversion Water Requirement and Watering Schedule

(1) Diversion Requirement

According to the Stage-1 study, peak unit water requirement for Gekbrong Model Area is 0.82 lit/s/ha for the following cropping pattern:

Wet season: vegetables (100 %) + vegetables (100 %) + vegetables (100 %)

Dry season: vegetables (100 %) + vegetables (100 %) + vegetables (100 %)

The diversion requirement (Q_d) for the system is estimated at;

$$Q_d = 0.82 \times (49.8) = 40.8\ lit/s.$$

(2) Watering Schedule and Quantity

Rotational irrigation is proposed with an interval of three (3) days. Irrigating hour per day is assumed to be 12 hours. Thus, for one irrigation block, water duty per day (12 hours) (Q_r) should be;

$Q_r = 0.82 \times 3 \times (24 \div 12) \cong 4.9 lit/s/ha$.

Irrigation diagram with rotational water demands are given in the Drawing GK/2.

5.3.2 Intake Weir

An wet masonry fixed weir is proposed on the Cibeleng river. (Drawing GK/4) The weir width is proposed to be 7 m and the water is diverted to the right bank, while the existing weir diverts to the left bank and the pipeline pass across the river. The existing intake facilities will be replaced by the new weir and the existing pipeline will be connected to the new weir.

A manual gate will be used for controlling the inflow to the conveyance pipeline. The more important function of the weir is "control of sediment inflow" to the pipeline. Certain stretch of open channel is required to refrain sediments from entering the pipeline. The discharge control to the pipelines will be done by the valves installed at the intake box. Since the proposed weir site is located in the forest-reserve area, due discussion and arrangement is required at the design stage.

5.3.3 Farm Pond

The design capacity of the farm pond (V) is determined as follows:

$$V = U_{req.} \times 86.4 \times A \times (24 - t) \div 24$$

where, V: required volume of farm pond,

U_{req}: unit water requirement (0.82 lit/ha/s)

A: irrigation area (ha) (49.8 ha)

t: irrigation hours per day (12 hours per day)

Thus, the farm pond volume is estimated at 1764 m^3. The dimensions of the farm ponds (net) is determined as follows:

Farm pond: 30 m (width) x 30 m (length) x 2 m (depth) = 1800 m^3.

The farm pond type is proposed to be open type reinforced concrete structure. The farm pond is designed to have the following facilities:

- control valve at inlet pipe
- inlet chamber with float valve to control the water level in the pond
- spillway pipe
- outlet chamber
- outlet pipe with control valve

- blow off pipe

5.3.4 Main Pipeline

The main pipeline is designed according to the same procedure as Mekarjaya. The pipe is selected considering discharge, velocity, static water pressure, water hammer pressure, etc. The result of the hydraulic analysis is given in Table V-10.

5.3.5 Lateral Pipeline

According to the irrigation plan, design discharge of lateral pipeline ranges from 4 lit/s to 22 lit/s. The pipe for the lateral line is selected based on the matrix, which is derived from Hazen-Williams' formula. Pressure control structures are considered depending on the estimated water speed and the static water pressure. .

5.4 Langensari Model Area

5.4.1 Pump

(1) Cikukang and Ciputri Portable Pump Irrigation System

Capacity of portable pump is determined through the following condition and estimation:

Item	Value		Remarks
Unit irrigation water requirement	0.71	lit/s/ha	Results of Stage-1 study
Daily requirement	61.34	m^3	$0.71 \times 86400 \div 1000$
Irrigation interval	3	days	
Operation hour per block	4	hours	
Water duty per operation	184.02	m^3	61.34×3
Water duty per second	12.8	lit/s	$184.02 \div (4 \times 3600) = 0.0128\ m^3/s$

Thus, the portable pump capacity is determined to be 12.8 lit/s/ha. Maximum pumping head is 35 m. The following portable engine pump is proposed for the above requirements:

- Maximum head: 35 m
- Discharge: 1000 lit/min (16.7 lit/s)
- Coverage area for three days: 3.9 ha

(2) Electric pump for the System LPA and LPB

The capacity of the pump will be determined so that the daily requirements for the proposed irrigation areas (8.2 ha and 10.2 ha) could be pumped up within proposed daily operating hours, which is assumed to be 20 hours considering necessary time for maintenance. The capacity is estimated as follows:

$$Qp = V \div t_p \div 3.6$$

where, Qp: required discharge of pump (lit/s),

V: Farm pond volume (288 m^3, 338 m^3, mentioned in the following sub-section)

t_p: pumping hours per day (20 hours)

Thus, the pumping capacities for LPA and LPB are determined to be 4.6 lit/s and 6.3 lit/s.

The specifications of the pumps will be as follows:

Electric pump type-A (PP type-A):

- type: submersible pump
- power: electricity
- discharge 240 lit/min (4 lit/s)
- outlet pipe diameter: 25 - 40 mm
- maximum head: 60 m

Electric pump type-B (PP type-B):

- type: submersible pump
- power: electricity
- discharge 282 lit/min (4.7 lit/s)
- outlet pipe diameter: 25 - 40 mm
- maximum head: 60 m

The electric submersible pump is generally imported. In Bandung, several suppliers deal with the pump from Japan, USA, etc. which are mostly used for the domestic water supply system. Pumps which satisfy the above requirements will be selected from the ones available in Bandung.

5.4.2 Farm Pond

The irrigation systems of LPA and LPB have farm ponds. The design capacity of the farm ponds(V) are determined in the following:

$$V = U_{req.} \times 86.4 \times A \times (24 - t) \div 24$$

where, V: required volume of farm pond,

U_{req}: unit water requirement (0.71 lit/ha/s for Langensari)

A: irrigation area (ha) (8.2 ha for LPA, 10.2 ha for LPB)

t: irrigation hours per day (12 hours per day)

Thus, the farm pond volumes for LPA and LPB are estimated at 252 m^3 and 313 m^3, respectively. The dimensions of the farm ponds (net) are determined as follows:

Farm pond LPA: 12 m (width) x 12 m (length) x 2 m (depth) = 288 m^3

Farm pond LPB: 13 m (width) x 13 m (length) x 2 m (depth) = 338 m^3

CHAPTER 6 PROJECT COST ESTIMATE

6.1 General

The project cost is composed of the following items:

(1) Construction cost of model area

(2) Training and extension cost for model area

(3) Common project cost

(4) Price contingency

(5) Related cost

The project is assumed to be commenced in the year 2001, and the project cost is estimated by using unit prices of the fiscal year of February 2000. The unit prices and costs are determined referring to the project costs and/or unit cost and prices, which are used by related organizations such as “PU Pengairan”, “PU Cipta Karya”, PU Bina Marga”, etc. As for other related projects, the costs and prices used by IHDUA were also referred to. Prices of imported materials and equipment were estimated on the basis of prices of “delivery in Bandung”.

6.2 Initial Investment Cost

(1) Construction cost

The construction cost consists of direct construction cost including the physical contingency (10 %), and value added tax (PPN) which is 10 % of the direct construction cost.

(2) Training and Extension Cost

The training and extension costs consist of; i) arrangement of village coordinators, ii) training of farmers and/or farmers’ groups, and iii) training of the village coordinators.

(3) Common Project Cost

Costs on implementation of the project over highland area, which consist of i) arrangement of external experts, construction cost of the adaptive trial farm, machine and equipment cost, and training cost for the task team.

(4) Price Contingency

The price contingency for compensating price escalation by completion of the project implementation is accounted for the local currency portion at a rate of 8 % per annum.

(5) Related cost

(a) Administration Cost

The administration cost consists of wages, allowances for staffs who will work exclusively for the project, operational costs for project offices, and other related costs for the project. The administration cost will be prepared by the local currency.

(b) Land acquisition cost

Land acquisition is conducted for the land which will be occupied permanently for the project. The necessary arrangement for land acquisition will be made by using the local currency.

(c) Pre-construction Arrangement Cost

Cost for the pre-construction arrangement beside the land acquisition consists of i) survey and investigation such as EIA, and ii) civil works such as electrification, public access road construction, etc. The cost will be allocated by the local currency.

The project cost is summarized in Table V-12, while the break down of the construction cost by model area is given in Table V-13 to 17.

6.3 Operation and Maintenance Cost

The operation and maintenance cost consists of; i) maintenance costs such as repair cost for facilities, and ii) operational costs such as fuel, electricity, wages, etc. The operation and maintenance cost by model area is as follows:

Operation and Maintenance Cost

Unit : million Rupiah

Item	Mekarjaya	Tanjungkarya	Gegbrong	Langensari	ATF	Tital
Maintenance	99.2	47.9	64.9	54	8.4	274.4
Operation	15.9	23.7	17.4	104.9	11.2	173.1
Total	115.1	71.6	82.3	158.9	19.6	447.5

Note: ATF; adaptive trial farm at Margahayu BBU

6.4 Replacement Cost

The replacement cost is estimated conformed to the following concept:

Every 15 years : pump and related accessories, steel tools (gates, screens, fences, etc), pipes, housing utilities (water and/or electric facilities), etc.

Every 10 years : wooden structures excluding housing materials, bamboo, valves of pipelines, etc.

The pipes are not generally replaced at a time, but replaced for damaged portion as required. The O&M costs for the facilities which are composed of the pipes are estimated higher including occasional replacement of the damaged pipes, and the replacement cost itself is assumed at every 15 years.

The replacement cost is shown below:

Replacement Cost

Unit : million Rupiah

Item	Mekarjaya	Tanjungkarya	Gegbrong	Langensari	ATF	Tital
15years	925.2	54.2	639.3	383.9	50.6	2,053.2
10years	154.0	53.2	80.9	27.7	171.4	487.2
total	1,079.2	107.4	720.2	411.6	222.0	2,540.4

Note: ATF; adaptive trial farm at Margahayu BBU

CHAPTER 7 OPERATION AND MAINTENANCE PLAN

7.1 Irrigation Facilities

In this Study, irrigation system development is proposed paying special attention to vegetable cultivation in the highland area. Operation and maintenance should also be planned paying due attention to the following issues.

(1) Strengthening of Organizations and Specialists on Upland Irrigation Technology

The development plan of irrigation facilities which are introduced in the project is prepared assuming the O&M works to be undertaken by beneficiaries themselves. However, certain technical guidance is required for beneficiary farmers in operating such facilities of "new concept" as "farm pond", "pipelines", etc.

It will be an important role of the project implementation officials to support beneficiary farmers in solving technical problems, which they are supposed to face, and certain amount of such technical specialist should be allocated and technically strengthened for that purpose.

(2) O&M Support at Field Level

The existing water users' association (P3A) in the model areas will be strengthened through the project. In case that no P3A exists, new P3As will be organized at the initial stage of the project implementation. P3As are normally organized by tertiary block for paddy rice irrigation system. As for the proposed vegetable irrigation system, it is preferable to form sub-unit of P3A by rotation block.

One of the primary targets should be set at training of "village craftsman" for physical maintenance of the irrigation system. Candidates of the village craftsman will be nominated, and the nominee will be trained through all the stages of the project, namely, construction and operation during the project period. Wages will be paid to the craftsman as an "incentive" from the stock fund, which originates from water charges collected from the beneficiaries.

The craftsman will manage routine and periodical maintenance works by himself by procuring necessary parts and materials using the fund. In case that significant troubles occur to the system, and the craftsman cannot dissolve them, he would consult Sub-district engineer or the District Task Team.

7.2 Rural Market Road

Public roads are maintained by related local government getting technical guidance by Bina Marga, PU. The maintenance works consist of; routine maintenance, periodical maintenance, betterment, upgrade, and replacement or new construction. The budget is partly allocated by PU Bina Marga, and the LKMD executes the maintenance works of the village roads by using the budget allocated to the local government. However, in fact, they are suffering from budget limitation and deterioration of village roads.

It is difficult to specify individual beneficiary of the rural road, so the routine maintenance work is conducted by village people themselves, while the periodical or heavier maintenance works are carried out by using the revenue budget.

As for rural market roads, which are mainly used for agricultural activities, it might also be possible; i) to collect certain margin of profits from the beneficiaries (who get tangible benefit by using the road) or farmers' cooperatives as "stock-fund" for the maintenance work, or ii) to collect a part of improvement cost from the beneficiaries as the need arises.

7.3 Rural Water Supply

Operation of the facilities will be carried out by the rural water users' association consisting of beneficiaries.

"Rural water users' association" should be organized at the same level of "village office" so that the leaders of the village would directly be involved in the daily operation and management. It is proposed to conduct training and guidance for the users and the members in the course of the project so that they should be motivated for the development plan.

The domestic water users association appoints several representatives for the training course on operation, management and maintenance of the whole system, which will be conducted in the course of the project implementation and/or by the Sub-district Health Center (Pusat Kesehataan Masyarakat) under the Ministry of Health. After all, all the facilities including new facilities such as pumps, storage tanks, pipelines and control structures, will be maintained by users themselves. It is proposed to pay wages from the water charges for their maintenance works. The appointed, so called "village plumbers" will take the responsibility on the maintenance works. In case that significant damages or troubles occurred to the system, the "village plumbers" would procure necessary parts at the Sub-district Health Center or consult the infrastructure engineer of the Sub-district under the District Task Team.

7.4 Collection Center

Operation and maintenance of the collection center is conducted by the owner of the center, namely farmers' cooperatives. O&M cost consisting of personnel expenditure, expenses for electricity, water, communication, etc) will be borne by the cooperatives by using a part of handling charge collected from the users. A responsible person in charge will be appointed among the staffs of farmers' cooperative as "collection center manager".

Tables

Table V-1 Location of Important Sites

Location	Geodetic Coordinate		Universal Transverse Mercator (UTM)		Remarks
	Latitude (South)	Longitude (East)	Easting	Northing	
(1) Mekarjaya, Bandung					
Village office	7o04’10”	107o37’40”	48 7 90 094	92 17 797	
Ciburuy spring	7o04’48”	107o37’57”	48 7 90 637	92 16 643	
Cikuya spring	7o05’48”	107o37’57”	48 7 90 625	92 14 793	
Citiis (end of road)	7o05’39”	107o38’21”	48 7 91 541	92 15 069	
Village Master’s house	7o04’25”	107o37’54”	48 7 90 523	92 17 332	
DI Canpaka, Weir	7o04’35”	107o38’00”	48 7 90 722	92 17 040	
(2) Langensari, Bandung					
Village office					
Village Master’s house	6o48’51”	107o38’46”	48 7 92 308	92 46 047	
Bridge at Cipogo (Sukaraja)	6o49’15”	107o38’52”	48 7 92 464	92 45 317	
Weir, Pemandian Kuda, Cipogo	6o48’47”	107o38’38”	48 7 92 033	92 46 152	
(3) Tugumukti, Bandung					
Village office					
Hydraulic pumps	6o48’17”	107o33’11”	48 7 82 000	92 47 146	
Spring at Cipogor	6o48’32”	107o33’22”	48 7 82 341	92 46 667	
(4) Gekbrong, Cianjur					
Village office					
Village Master’s house	6o51’27”	107o01’31”	48 7 23 632	92 41 587	
(5) Cisurupan, Garut					
Village office (Cisero)	7º19’13”	107o47’32”	48 8 08 134	91 89 949	
House of Village Master (Cisero)	7º19’21”	107o46’54”	48 8 07 101	91 89 736	
Ciburial spring	7º19’06”	107o47’39”	48 8 08 331	91 90 161	
(6) Tanjungkarya, Garut					
Village office	7º11’37”	107o49’30”	48 8 11 823	92 03 920	
Masjid, Tanjungpura	7º11’18”	107o49’16”	48 8 11 403	92 04 507	
(7) Mekarmukti, Sumedang					
Village office					
Ciliang spring	6º42’13”	107o54’58”	48 8 22 226	92 58 098	
Proposed canal road crossing	6º41’24”	107o55’17”	48 8 22 830	92 59 595	
(8) Cisantana, Kuningan					
Village office	6º57’40”	108o27’01”	49 2 18 145	92 29 847	
Downstream end of Village	6º57’48”	108o27’08”	49 2 18 378	92 29 588	
No.1 Intake (B. Cipager)	6º56’39”	108o25’58”	49 2 16 216	92 31 711	
No.2 Intake	6º57’14”	108o26’49”	49 2 17 786	92 30 641	
No.3 Intake	6º57’27”	108o26’53”	49 2 17 902	92 30 230	
No.4 Intake	6º57’37”	108o26’54”	49 2 17 950	92 29 920	

Table V-2 Evapotranspiration (ETo) by FAO Procedures (1/3)

Station : LEMBANG Latitude: -6.8 Altitude : 1241 m

	Item	Unit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann	
(1)	Temperature (T)	C	19.3	19.6	19.7	20.1	20.1	19.6	19.1	19.5	20.3	20.7	20.5	20.4		
(2)	Relative humidity (RH)	%	88.4	87.3	87.0	86.9	87.0	84.5	83.6	80.9	79.5	73.9	84.7	87.5		
(3)	Wind speed at 2 m high	km/day	137.8	128.9	115.6	102.2	97.8	97.8	111.1	124.5	146.7	128.9	120.0	133.3		
(4)	Sunshine hours (n/N)	%	35.3	39.6	49.8	49.5	59.5	63.1	70.2	71.8	71.1	60.2	44.3	39.9		
(5)	ea (Table5)	mbar	22.4	22.8	23.0	23.5	23.6	22.9	22.2	22.7	23.9	24.4	24.1	23.9		
(6)	ed (5)x(2)/100	mbar	19.8	19.9	20.0	20.4	20.5	19.3	18.5	18.4	19.0	18.0	20.4	20.9		
(7)	f(U) 0.27(1+U_2/100)		0.64	0.62	0.58	0.55	0.53	0.53	0.57	0.61	0.67	0.62	0.59	0.63		
(8)	(1-W) (Table 8)		0.31	0.30	0.30	0.31	0.31	0.30	0.31	0.31	0.31	0.30	0.31	0.31		
(9)	(1-W)f(U)(ea-ed)	mm	0.52	0.54	0.52	0.53	0.51	0.57	0.65	0.80	1.01	1.19	0.67	0.58		
(10)	Ra (Table 10)	mm	15.9	16.0	15.6	14.6	13.3	12.6	12.9	13.9	15.0	15.7	15.9	15.8		
(11)	(0.25+0.50n/N)		0.43	0.45	0.50	0.50	0.55	0.57	0.60	0.61	0.61	0.55	0.47	0.45		
(12)	Rs (10)x(11)	mm	6.8	7.2	7.8	7.3	7.3	7.1	7.8	8.5	9.1	8.7	7.5	7.1		
(13)	Rns Rs x (1-0.25)	mm	5.1	5.4	5.8	5.4	5.5	5.4	5.8	6.3	6.8	6.5	5.6	5.3		
(14)	f(T) (Table 13)		14.5	14.5	14.5	14.6	14.6	14.5	14.4	14.5	14.7	14.7	14.7	14.7		
(15)	f(ed) 0.34 - 0.044 x $ed^{1/2}$		0.14	0.14	0.14	0.14	0.14	0.15	0.15	0.15	0.15	0.15	0.14	0.14		
(16)	f(n/N) 0.1 + 0.9 n/N		0.42	0.46	0.55	0.55	0.64	0.67	0.73	0.75	0.74	0.64	0.50	0.46		
(17)	Rnl (14)x(15)x(16)	mm	0.9	1.0	1.1	1.1	1.3	1.4	1.6	1.6	1.6	1.4	1.0	0.9		
(18)	Rn (13)-(17)	mm	4.2	4.4	4.7	4.3	4.1	3.9	4.2	4.7	5.2	5.1	4.6	4.4		
(19)	W Rn	mm	2.9	3.1	3.3	3.0	2.8	2.7	2.9	3.3	3.6	3.5	3.2	3.0		
(19)	W Rn +(1-W)f(U)(ea-ed)	mm	3.4	3.6	3.8	3.5	3.4	3.3	3.6	4.1	4.6	4.7	3.9	3.6		
(20)	c		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
(21)	ETo	mm	3.4	3.6	3.8	3.5	3.4	3.3	3.6	4.1	4.6	4.7	3.9	3.6	3.8	1382

Source: Badan Meteorologi dan Geofisika, Bandung, 1989 - 1998

Station : BANDUNG Latitude: -6.9 Altitude : 791 m

	Item	Unit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann	
(1)	Temperature (T)	C	22.9	22.9	23.0	23.1	23.3	22.9	22.6	22.8	23.3	23.6	23.3	23.1		
(2)	Relative humidity (RH)	%	82.3	81.7	81.6	82.2	79.9	77.2	74.2	71.8	70.6	75.3	70.8	81.2		
(3)	Wind speed at 2 m high	km/day	137.8	128.9	115.6	102.2	97.8	97.8	111.1	124.5	146.7	128.9	120.0	133.3		
(4)	Sunshine hours (n/N)	%	44.9	50.4	57.3	58.7	64.5	69.6	77.0	78.5	77.3	63.1	49.4	49.2		
(5)	ea (Table5)	mbar	27.8	27.9	28.1	28.3	28.6	27.8	27.4	27.7	28.7	29.1	28.5	28.3		
(6)	ed (5)x(2)/100	mbar	22.9	22.8	22.9	23.3	22.8	21.5	20.3	19.9	20.2	21.9	20.2	23.0		
(7)	f(U) 0.27(1+U2/100)		0.64	0.62	0.58	0.55	0.53	0.53	0.57	0.61	0.67	0.62	0.59	0.63		
(8)	(1-W) (Table 8)		0.27	0.27	0.27	0.27	0.26	0.27	0.28	0.27	0.26	0.26	0.27	0.27		
(9)	(1-W)f(U)(ea-ed)	mm	0.86	0.85	0.81	0.74	0.81	0.92	1.11	1.29	1.48	1.16	1.31	0.90		
(10)	Ra (Table 10)	mm	15.9	16.0	15.6	14.6	13.3	12.6	12.9	13.9	15.0	15.7	15.9	15.8		
(11)	(0.25+0.50n/N)		0.47	0.50	0.54	0.54	0.57	0.60	0.64	0.64	0.64	0.57	0.50	0.50		
(12)	Rs (10)x(11)	mm	7.6	8.1	8.3	7.9	7.6	7.5	8.2	8.9	9.5	8.9	7.9	7.9		
(13)	Rns Rs x (1-0.25)	mm	5.7	6.0	6.3	5.9	5.7	5.7	6.2	6.7	7.1	6.7	5.9	5.9		
(14)	f(T) (Table 13)		15.2	15.2	15.2	15.2	15.3	15.2	15.1	15.2	15.3	15.3	15.3	15.2		
(15)	f(ed) 0.34 - 0.044 x ed1/2		0.13	0.13	0.13	0.13	0.13	0.14	0.14	0.14	0.14	0.13	0.14	0.13		
(16)	f(n/N) 0.1 + 0.9 n/N		0.50	0.55	0.62	0.63	0.68	0.73	0.79	0.81	0.80	0.67	0.54	0.54		
(17)	Rnl (14)x(15)x(16)	mm	1.0	1.1	1.2	1.2	1.3	1.5	1.7	1.8	1.7	1.4	1.2	1.1		
(18)	Rn (13)-(17)	mm	4.7	4.9	5.0	4.7	4.3	4.2	4.5	4.9	5.4	5.3	4.7	4.8		
(19)	W Rn	mm	3.4	3.6	3.7	3.5	3.2	3.0	3.2	3.6	4.0	3.9	3.5	3.5		
(19)	W Rn +(1-W)f(U)(ea-ed)	mm	4.3	4.5	4.5	4.2	4.0	4.0	4.3	4.9	5.5	5.1	4.8	4.4		
(20)	c		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
(21)	ETo	mm	4.3	4.5	4.5	4.2	4.0	4.0	4.3	4.9	5.5	5.1	4.8	4.4	4.5	1654

Source: Badan Meteorologi dan Geofisika, Bandung, 1989 - 1998

Table V-2 Evapotranspiration (ETo) by FAO Procedures (2/3)

Station : Pacet — Latitude: -6.8 — Altitude : 1500 m

	Item	Unit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann	
(1)	Temperature (T)	C	19.8	20.0	20.3	20.8	20.9	20.5	20.0	20.5	20.6	21.3	21.2	20.5		
(2)	Relative humidity (RH)	%	88.6	88.1	87.9	87.6	88.3	86.6	75.0	82.6	82.3	84.8	86.1	88.5		
(3)	Wind speed at 2 m high	km/day	137.8	128.9	115.6	102.2	97.8	97.8	111.1	124.5	146.7	128.9	120.0	133.3		
(4)	Sunshine hours (n/N)	%	20.0	20.9	36.0	44.1	55.8	61.4	62.4	63.9	60.4	58.6	44.6	29.7		
(5)	ea (Table5)	mbar	23.2	23.3	23.9	24.6	24.8	24.1	23.3	24.1	24.3	25.3	25.3	24.2		
(6)	ed (5)x(2)/100	mbar	20.5	20.6	21.0	21.6	21.9	20.9	17.5	19.9	20.0	21.4	21.8	21.4		
(7)	f(U) 0.27(1+U2/100)		0.64	0.62	0.58	0.55	0.53	0.53	0.57	0.61	0.67	0.62	0.59	0.63		
(8)	(1-W) (Table 8)		0.29	0.29	0.30	0.30	0.29	0.30	0.29	0.30	0.30	0.29	0.29	0.30		
(9)	(1-W)f(U)(ea-ed)	mm	0.50	0.50	0.51	0.49	0.46	0.52	0.97	0.77	0.86	0.69	0.60	0.53		
(10)	Ra (Table 10)	mm	15.9	16.0	15.6	14.6	13.3	12.7	13.0	13.9	15.0	15.7	15.9	15.8		
(11)	(0.25+0.50n/N)		0.35	0.35	0.43	0.47	0.53	0.56	0.56	0.57	0.55	0.54	0.47	0.40		
(12)	Rs (10)x(11)	mm	5.6	5.7	6.7	6.9	7.0	7.0	7.3	7.9	8.3	8.5	7.5	6.3		
(13)	Rns Rs x (1-0.25)	mm	4.2	4.3	5.0	5.1	5.3	5.3	5.5	5.9	6.2	6.4	5.6	4.7		
(14)	f(T) (Table 13)		14.6	14.6	14.7	14.8	14.8	14.7	14.6	14.7	14.7	14.9	14.8	14.7		
(15)	f(ed) 0.34 - 0.044 x ed1/2		0.14	0.14	0.14	0.14	0.13	0.14	0.16	0.14	0.14	0.14	0.13	0.14		
(16)	f(n/N) 0.1 + 0.9 n/N		0.28	0.29	0.42	0.50	0.60	0.65	0.66	0.67	0.64	0.63	0.50	0.37		
(17)	Rnl (14)x(15)x(16)	mm	0.6	0.6	0.9	1.0	1.2	1.3	1.5	1.4	1.4	1.3	1.0	0.7		
(18)	Rn (13)-(17)	mm	3.6	3.7	4.2	4.2	4.1	4.0	4.0	4.5	4.8	5.1	4.6	4.0		
(19)	W Rn	mm	2.5	2.6	2.9	2.9	2.9	2.8	2.8	3.1	3.4	3.7	3.3	2.8		
(19)	W Rn +(1-W)f(U)(ea-ed)	mm	3.0	3.1	3.4	3.4	3.3	3.3	3.8	3.9	4.2	4.3	3.9	3.3		
(20)	c		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
(21)	ETo	mm	3.0	3.1	3.4	3.4	3.3	3.3	3.8	3.9	4.2	4.3	3.9	3.3	3.6	1310

Source: Badan Meteorologi dan Geofisika, Bandung, 1987,89,92-98, Wind speeds are for Bandung

Station : JATIWANGI — Latitude: -6.8 — Altitude : 50 m

	Item	Unit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann	
(1)	Temperature (T)	C	26.1	26.1	26.6	27.0	27.3	26.8	26.6	27.0	27.7	28.4	27.6	26.7		
(2)	Relative humidity (RH)	%	87.8	87.3	85.3	84.1	80.4	79.1	74.1	69.8	67.3	68.6	77.9	84.8		
(3)	Wind speed at 2 m high	km/day	133.3	158.0	138.3	138.3	143.2	153.1	163.0	192.6	177.8	167.9	128.4	133.3		
(4)	Sunshine hours (n/N)	%	50.8	51.7	65.3	70.9	79.8	78.8	80.2	88.4	85.2	76.7	61.7	55.2		
(5)	ea (Table5)	mbar	33.7	33.9	34.8	35.7	36.3	35.3	34.8	35.7	37.1	38.7	37.0	35.0		
(6)	ed (5)x(2)/100	mbar	29.6	29.6	29.7	30.0	29.2	27.9	25.8	24.9	25.0	26.6	28.8	29.7		
(7)	f(U) 0.27(1+U2/100)		0.63	0.70	0.64	0.64	0.66	0.68	0.71	0.79	0.75	0.72	0.62	0.63		
(8)	(1-W) (Table 8)		0.25	0.25	0.24	0.24	0.24	0.24	0.24	0.24	0.23	0.23	0.23	0.24		
(9)	(1-W)f(U)(ea-ed)	mm	0.65	0.74	0.80	0.87	1.10	1.21	1.56	2.04	2.11	2.00	1.17	0.81		
(10)	Ra (Table 10)	mm	15.9	16.0	15.6	14.6	13.3	12.7	13.0	13.9	15.0	15.7	15.9	15.8		
(11)	(0.25+0.50n/N)		0.50	0.51	0.58	0.60	0.65	0.64	0.65	0.69	0.68	0.63	0.56	0.53		
(12)	Rs (10)x(11)	mm	8.0	8.2	9.0	8.8	8.6	8.1	8.4	9.6	10.1	10.0	8.9	8.3		
(13)	Rns Rs x (1-0.25)	mm	6.0	6.1	6.7	6.6	6.5	6.1	6.3	7.2	7.6	7.5	6.6	6.2		
(14)	f(T) (Table 13)		15.9	15.9	16.0	16.1	16.2	16.1	16.0	16.1	16.2	16.4	16.2	16.0		
(15)	f(ed) 0.34 - 0.044 x ed1/2		0.10	0.10	0.10	0.10	0.10	0.11	0.12	0.12	0.12	0.11	0.10	0.10		
(16)	f(n/N) 0.1 + 0.9 n/N		0.56	0.57	0.69	0.74	0.82	0.81	0.82	0.90	0.87	0.79	0.66	0.60		
(17)	Rnl (14)x(15)x(16)	mm	0.9	0.9	1.1	1.2	1.4	1.4	1.5	1.7	1.7	1.5	1.1	1.0		
(18)	Rn (13)-(17)	mm	5.1	5.2	5.6	5.4	5.1	4.7	4.8	5.5	5.9	6.0	5.5	5.3		
(19)	W Rn	mm	3.8	3.9	4.3	4.1	3.9	3.6	3.6	4.2	4.5	4.6	4.3	4.0		
(19)	W Rn +(1-W)f(U)(ea-ed)	mm	4.5	4.7	5.1	5.0	5.0	4.8	5.2	6.2	6.6	6.6	5.4	4.8		
(20)	c		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
(21)	ETo	mm	4.5	4.7	5.1	5.0	5.0	4.8	5.2	6.2	6.6	6.6	5.4	4.8	5.3	1944

Source: Badan Meteorologi dan Geofisika, Bandung, 1990 - 1998

Table V-2 Evapotranspiration (ETo) by FAO Procedures (3/3)

Station : KUNINGAN Latitude: -7 Altitude : 545 m

	Item	Unit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann	
(1)	Temperature (T)	C	24.0	24.0	24.8	24.9	24.8	24.6	24.2	23.7	24.2	25.1	24.9	24.7		
(2)	Relative humidity (RH)	%	84.4	85.4	82.0	81.0	80.3	78.8	79.8	81.6	79.2	77.5	79.3	82.3		
(3)	Wind speed at 2 m high 1	km/day	133.3	158.0	138.3	138.3	143.2	153.1	163.0	192.6	177.8	167.9	128.4	133.3		
(4)	Sunshine hours (n/N) 2)	%	35.3	39.0	53.5	48.0	62.0	71.5	79.0	70.0	52.0	76.7	61.7	55.2		
(5)	ea (Table5)	mbar	29.8	29.8	31.2	31.5	31.3	31.0	30.2	29.2	30.2	31.8	31.4	31.1		
(6)	ed (5)x(2)/100	mbar	25.1	25.4	25.6	25.5	25.1	24.4	24.1	23.8	23.9	24.7	24.9	25.6		
(7)	f(U) 0.27(1+U2/100)		0.63	0.70	0.64	0.64	0.66	0.68	0.71	0.79	0.75	0.72	0.62	0.63		
(8)	(1-W) (Table 8)		0.26	0.27	0.26	0.26	0.26	0.26	0.27	0.26	0.27	0.25	0.26	0.26		
(9)	(1-W)f(U)(ea-ed)	mm	0.76	0.82	0.93	0.98	1.04	1.17	1.15	1.12	1.25	1.31	1.03	0.90		
(10)	Ra (Table 10)	mm	15.9	16.0	15.6	14.6	13.3	12.6	12.9	13.9	15.0	15.7	15.9	15.8		
(11)	(0.25+0.50n/N)		0.43	0.45	0.52	0.49	0.56	0.61	0.65	0.60	0.51	0.63	0.56	0.53		
(12)	Rs (10)x(11)	mm	6.8	7.1	8.0	7.1	7.4	7.7	8.3	8.3	7.6	10.0	8.9	8.3		
(13)	Rns Rs x (1-0.25)	mm	5.1	5.4	6.0	5.3	5.6	5.7	6.2	6.2	5.7	7.5	6.7	6.3		
(14)	f(T) (Table 13)		15.4	15.4	15.6	15.6	15.6	15.6	15.5	15.3	15.5	15.7	15.6	15.6		
(15)	f(ed) 0.34 - 0.044 x ed1/2		0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.13	0.12	0.12	0.12	0.12		
(16)	f(n/N) 0.1 + 0.9 n/N		0.42	0.45	0.58	0.53	0.66	0.74	0.81	0.73	0.57	0.79	0.66	0.60		
(17)	Rnl (14)x(15)x(16)	mm	0.8	0.8	1.1	1.0	1.2	1.4	1.6	1.4	1.1	1.5	1.2	1.1		
(18)	Rn (13)-(17)	mm	4.3	4.5	5.0	4.4	4.3	4.3	4.7	4.8	4.6	6.0	5.4	5.2		
(19)	W Rn	mm	3.2	3.3	3.7	3.3	3.2	3.2	3.4	3.6	3.4	4.5	4.0	3.8		
(19)	W Rn +(1-W)f(U)(ea-ed)	mm	4.0	4.1	4.6	4.2	4.3	4.4	4.6	4.7	4.6	5.8	5.1	4.7		
(20)	c		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
(21)	ETo	mm	4.0	4.1	4.6	4.2	4.3	4.4	4.6	4.7	4.6	5.8	5.1	4.7	4.6	1676

Source: Badan Meteorologi dan Geofisika, Bandung, 1980-1984

Note; 1) Mean wind speed at Jatiwangi for 1989-1997

2) Mean sunshine hours (October to December) at Jatiwangi for 1989 -1997

Table V-3 Results of Water Quality Test (1/4)

Test items \ Sample number	LS1	LS2	CS1	CS2	MJ1	Remarks
Study area	Langensari	Langensari	Cisantana	Cisantana	Mekarjaya	
Type of water source	open dug well	springwater	river (spring)	river (2nd intake)	springwater	
Sampling location	near KADES's house	beside Cikukang stream	at the 1st intake	Village office	Ciburuy (spring)	
Sampling date	Oct-14 '99	Oct-14 '99	Oct-16 '99	Oct-16 '99	Oct-20 '99	
Weather	cloudy	cloudy	cloudy	cloudy	cloudy	
Person in charge	Sambe	Sambe	Mizuguchi / Sambe	Mizuguchi / Sambe	Sambe	
Organization	JICA	JICA	JICA	JICA	JICA	
Air temperature (^{o}C)	28	28	28	28	26	
Water temperature (^{o}C)	27	25	25	25	25	

Test items \ Sample number	LS1	LS2	CS1	CS2	MJ1	Standard(Maximum)
Turbidity (degree)	1	<1	<1	1	<1	(5, Japanese)
Discoloulation (degree)	ND	ND	ND	ND	ND	15
Odours (type)	waterweed	none	none	waterweed	none	no odour
Taste (type)	NA	NA	NA	NA	NA	no taste
pH range	6.0	7.0	7.5	7.0	6.0	7.5
COD (Potassium permanganate consu	5	10	10	10	0	
Nitrate nitrogene (NO_2-N, mg/l)	0.006	ND	ND	ND	ND	1.0
Nitrate nitrogene (NO_3-N, mg/l)	2.3	1.15	0.46	0.23	0.46	10.0
Total hardness (mg/l)	100-150	50-100	100-150	100-150	<50	300(Japanese)
Residual chlorine (ClO, mg/l)	ND	ND	ND	ND	ND	0.1 (Japanese)
Chloride (Cl, mg/l)	<100	<25	<100	<25	<25	250
Cyanogen (CN, mg/l)	ND	ND	ND	ND	ND	0.1
Hexavalent chromium (Cr^{6+}, mg/l)	ND	ND	ND	ND	ND	0.05
Iron (total as Fe, mg/l)	<0.2	<0.2	0.2	0.2	<0.2	0.3
Copper (Cu, mg/l)	<0.5	<0.5	<0.5	<0.5	<0.5	1.0
Zinc (Zn, mg/l)	ND	ND	ND	ND	ND	5
Bacteria coliform (nos/ml)	100<	100<	100<	100<	<50	3
Bacillus coliform (nos/ml)	7	10	10	2	7	0

Note: NA=not available, ND=not detective

Judgment: [grey] unsuitable for drinking [hatched] merginally suitable for drinking

Table V-3 Results of Water Quality Test (2/4)

Test items \ Sample number	MJ2	MJ3	CP1	CP2	TM1	Remarks
Study area	Mekarjaya	Mekarjaya	Cisurupan	Cisurupan	Tugumukti	
Type of water source	springwater	springwater	dug well	dug well	distribution pipe	
Sampling location	Ciremes stream	KADES's house	dug well in front of station	dugwell down-stream CP1	Mr.Syahid's House	
Sampling date	Oct-20 '99	Oct-20 '99	Oct-19 '99	Oct-19 '99	Oct-21 '99	
Weather	cloudy	cloudy	cloudy	cloudy	rain	
Person in charge	Sambe / Dadeng	Sambe / Dadeng	Mizuguchi / Sambe	Mizuguchi / Sambe	Sambe	
Organization	JICA/ DP Bandung	JICA/ DP Bandung	JICA	JICA	JICA	
Air temperature (^{o}C)	26	26	-	-	25	
Water temperature (^{o}C)	25	25	25	25	25	

Test items \ Sample number	MJ2	MJ3	CP1	CP2	TM1	Standard(Maximum)
Turbidity (degree)	<1	<2	1	1	<1	(5, Japanese)
Discoloulation (degree)	ND	ND	ND	ND	ND	15
Odours (type)	none	fish	none	none	none	no odour
Taste (type)	NA	NA	NA	NA	NA	no taste
pH range	7.0	5.5	7.0	6.5	7.0	7.5
COD (Potassium permanganate consu	0	0	<5	0	5	
Nitrate nitrogene (NO_2-N, mg/l)	ND	ND	0.015	ND	0.006	1.0
Nitrate nitrogene (NO_3-N, mg/l)	0.23	0.46	0.46	0.46	1.15	10.0
Total hardness (mg/l)	<50	<50	50-100	200-250	100-150	300(Japanese)
Residual chlorine (ClO, mg/l)	ND	ND	ND	ND	ND	0.1 (Japanese)
Chloride (Cl, mg/l)	<25	<25	<25	<25	<25	250
Cyanogen (CN, mg/l)	ND	ND	ND	ND	ND	0.1
Hexavalent chromium (Cr^{6+}, mg/l)	ND	ND	ND	ND	ND	0.05
Iron (total as Fe, mg/l)	<0.2	<0.2	<0.2	<0.2	<0.2	0.3
Copper (Cu, mg/l)	<0.5	<0.5	<0.5	<0.5	<0.5	1.0
Zinc (Zn, mg/l)	0	0	0	0	0	5
Bacteria coliform (nos/ml)	<10	<10	100<	100<	100<	3
Bacillus coliform (nos/ml)	10<	5<	18	2	3	0

Note: NA=not available, ND=not detective

Judgment: [shaded] unsuitable for drinking [hatched] merginally suitable for drinking

Table V-3 Results of Water Quality Test (3/4)

Test items \ Sample number	TM2	TM3	TM4	GK1	GK2	Remarks
Study area	Tugumukti	Tugumukti	Tugumukti	Gekbrong	Gekbrong	
Type of water source	Distribution pipe (SPN)	Distribution pipe (HP)	ground-water	river (spring)	Distibution pipe (GK1)	
Sampling location	RW07 (SPN)	RW07(hydraulic pump)	tubewell (60m)	Intake	Kp. Loji	
Sampling date	Oct-20 '99	Oct-21 '99	Oct-21 '99	Oct-22 '99	Oct-22 '99	
Weather	cloudy	cloudy	cloudy	cloudy	cloudy	
Person in charge	Sambe	Sambe	Sambe	Sambe	Sambe	
Organization	JICA	JICA	JICA	JICA	JICA	
Air temperature (^{o}C)	26	26	26	27	27	
Water temperature (^{o}C)	25	25	25	25	25	

Test items \ Sample number	TM2	TM3	TM4	GK1	GK2	Standard(Maximum)
Turbidity (degree)	2<	5<	5<	<1	1	(5, Japanese)
Discoloulation (degree)	ND	ND	ND	ND	ND	15
Odours (type)	none	none	none	none	ND	no odour
Taste (type)	NA	NA	NA	NA	NA	no taste
pH range	7.0	9.5	6.5	7.5	7.5	7.5
COD (Potassium permanganate consu	5	<5	5	<5	5	
Nitrate nitrogene (NO_2-N, mg/l)	ND	ND	0.006	ND	ND	1.0
Nitrate nitrogene (NO_3-N, mg/l)	0.23<	1.15	1.15	0.23	0.23	10.0
Total hardness (mg/l)	50-100	50-100	100-150	<50	<25	300(Japanese)
Residual chlorine (ClO, mg/l)	ND	ND	ND	ND	ND	0.1 (Japanese)
Chloride (Cl, mg/l)	100-200	<25	<25	<25	<25	250
Cyanogen (CN, mg/l)	ND	ND	ND	ND	ND	0.1
Hexavalent chromium (Cr^{6+}, mg/l)	ND	ND	ND	ND	ND	0.05
Iron (total as Fe, mg/l)	<0.2	<0.2	<0.2	<0.2	<0.2	0.3
Copper (Cu, mg/l)	<0.5	<0.5	<0.5	<0.5	<0.5	1.0
Zinc (Zn, mg/l)	0	0	10	0	0	5
Bacteria coliform (nos/ml)	2	100<	100<			3
Bacillus coliform (nos/ml)	ND	5<	10<			0

Note: NA=not available, ND=not detective

Judgment: [shaded] unsuitable for drinking [hatched] merginally suitable for drinking

Table V-3 Results of Water Quality Test (4/4)

Test items \ Sample number	TK1	CS3	MM1	TK2	GK3	Remarks
Study area	Tanjung-karya	Cisantana	Mekarmukti	Tanjung-karya	Gekbrong	
Type of water source	dug well	river (spring)	spring	spring	river	
Sampling location	Sukalasa KADES's house	at the 1st intake	Ciliang	downstream of Cilembang	Intake site	
Sampling date	Oct-20 '99	Oct-27 '99	Oct-28 '99	No-2 '99	Nov-3 '99	
Weather	cloudy	cloudy	cloudy	cloudy	rain	
Person in charge	Mizuguchi /Sambe	Sambe / Umen	Sambe / Umen	Sambe / Umen	Sambe	
Organization	JICA	JICA	JICA	JICA	JICA	
Air temperature (^oC)	-	27	30	26	25	
Water temperature (^oC)	25	25	25	23	25	

Test items \ Sample number	TK1	CS3	MM1	TK2	GK3	Standard(Maximum)
Turbidity (degree)	<1	<1	<1	<1	5<	(5, Japanese)
Discoloulation (degree)	ND	ND	ND	ND	ND	15
Odours (type)	none	none	none	none	none	no odour
Taste (type)	NA	NA	NA	NA	NA	no taste
pH range	7.0	7.5	6.5	6.5	7.0	7.5
COD (Potassium permanganate consu	5	5	<5	<5	10	
Nitrite nitrogene (NO_2-N, mg/l)	ND	ND	ND	ND	ND	1.0
Nitrate nitrogene (NO_3-N, mg/l)	0.46	<0.23	0.46	0.23	0.23	10.0
Total hardness (mg/l)	100-150	100-150	50-100	100-150	50-100	300(Japanese)
Residual chlorine (ClO, mg/l)	ND	ND	ND	ND	ND	0.1 (Japanese)
Chloride (Cl, mg/l)	<25	25-50	<25	<25	<25	250
Cyanogen (CN, mg/l)	ND	ND	ND	ND	ND	0.1
Hexavalent chromium (Cr^{6+}, mg/l)	ND	ND	ND	ND	ND	0.05
Iron (total as Fe, mg/l)	<0.2	<0.2	<0.2	<0.2	<0.2	0.3
Copper (Cu, mg/l)	<0.5	<0.5	<0.5	<0.5	<0.5	1.0
Zinc (Zn, mg/l)	0	0	0	0	0.5	5
Bacteria coliform (nos/ml)	NA	1	2	NA	NA	3
Bacillus coliform (nos/ml)	NA	100<	<50	NA	NA	0

Note: NA=not available, ND=not detective

Judgment: [grey] unsuitable for drinking [hatched] merginally suitable for drinking

Table V-4 Present Problems, Constraints and Countermeasures by Model Area (1/3)

Area	Present problems and constraints	Considered countermeasures
Mekarjaya	Irrigation	
	① Irrigation water sources are located below or far from the area.	① Construction of new intakes and a conveyance canal on/from the upstream of the Citiis river.
	② Water shortage during the dry season.	② Practice of rotational and supplemental irrigation. Improvement of irrigation efficiency.
	③ Other water users on the same water source.	③ Coordination with other users to set up watering schedule and volume allocation for each area.
	④ No irrigation facilities.	④ Construct a new irrigation system.
	⑤ Steep topography	⑤ Adopt pipe distribution system.
	⑥ Paddy rice is planted under irrigated condition.	⑥ Involvement of water users from the initial stage of implementation in order to get consensus on the proposed cropping patterns.
	Rural road	
	① Village road to the area (2.3 km) has deteriorated.	① Improvement works with the collaboration of villages along the road.
	② The main village road has deteriorated partly (1.0 km).	② Improvement of deteriorated portion.
	Drinking water	
	① No water source is located nearby.	① Construction of a new intake at the Cikuya spring and a water supply pipeline.
	② Existing water supply system has deteriorated.	② Rehabilitation and upgrading of the Cibruey water supply and distribution system.
	③ Same water sources with irrigation.	③ Irrigation area by the Cikuya spring will be covered by the new irrigation system of the Citiis river.
	④ Increasing water use (demand).	④ The Cikuya water supply system will satisfy the increasing demands.
Langensari	Irrigation	
	① Irrigation water sources are located below the area.	① Water quantity is sufficient. Low head pumping irrigation is considered most effective.
	② No irrigation facilities	② Low running cost portable pump and pipes
	Rural road	
	① The main village road has deteriorated partly (1.2 km in total).	① Upgrading or rehabilitation
	Drinking water	
	① Water sources are located below or far from the area. ② Some of dug-wells are dried up. ③ Water in the dug-wells is polluted to some extent.	① ② ③ Construction of shallow tubewells (30~50m) with hand pumps.

Table V-4 Present Problems, Constraints and Countermeasures by Model Area (2/3)

Area	Present problems and constraints	Considered countermeasures
Tugumukti	Irrigation	
	① Irrigation water sources are located below or very far from the area.	① The available discharge does not meet the irrigation demand. Better to improve the present gravity irrigation system (DI.Cijanggel)
	② Other water users on the same water source.	② Coordination on watering schedule (DI. Cijanggel) with other tertiary blocks.
	③ Water shortage during the dry season.	③ Practice of rotational and supplemental irrigation. Improvement of irrigation efficiency.
	④ Existing irrigation facilities have deteriorated.	④ Upgrade to a system with higher efficiency
	⑤ Existing irrigation facilities do not cover the whole area.	⑤ Provision of new irrigation blocks and field irrigation network.
	Rural road	
	① Connection roads to the main village road are not facilitated well.	① Utilization of operation and maintenance roads of the proposed irrigation system
	Drinking water	
	① Existing water supply system has deteriorated.	① Replacement of hydraulic pumps.
	② Presently utilized water sources do not meet the demands.	② Development of new water supply system.
	③ Water sources are located below or very far from the area.	③ Construction of new water supply system by gravity pipeline (5 km).
Gekbrong	Irrigation	
	① Shortage of water (water source itself is in short for irrigating the proposed area)	① Priority will be given to drinking water supply. Practice of rotational and supplemental irrigation. Improvement of irrigation efficiency.
	② The area depends on a private-owned irrigation system.	② Construction of a new intake and conveyance pipeline.
	Rural road	
	① The main village road has deteriorated. (1.75 km)	① Rehabilitation or upgrading of the existing road.
	Drinking water	
	① Existing water supply system has deteriorated.	① Construction of a new system.
	② Poor distribution system.	② Construction of distribution pipelines and distribution stands.
	③ The area depends on a private-owned water supply system.	③ Construction of a new system.
	③ Same water source with irrigation.	③ Provision of independent intake and conveyance pipeline.
Cisurupan	Irrigation	
	① Shortage of water (water source itself is in short for irrigating the whole area)	① Practice of rotational and supplemental irrigation. Improvement of irrigation efficiency.
	② Paddy rice is planted under irrigated condition	② Involvement of water users from the initial stage of implementation in order to get consensus on the proposed cropping patterns or Allocation of an independent irrigation system for vegetable cultivation.
	③ Existing irrigation facilities have deteriorated.	③ Construction of a new irrigation system with high efficiency particularly for vegetable cropping.
	④ Existing irrigation facilities do not cover the whole area.	④ Provision of new irrigation blocks and field irrigation network.
	Rural road	
	① Connecting roads are poorly distributed.	① Utilization of operation and maintenance roads of the proposed irrigation system
	Drinking water	
	① Water sources are located far from the area.	① Upgrading and extension of the existing PDAM pipeline system.
	② Some of dug-wells are dried up.	② Construction of shallow tubewells (30~50m) with hand pumps.

Table V-4 Present Problems, Constraints and Countermeasures by Model Area (3/3)

Area	Present problems and constraints	Considered countermeasures
Tanjungkarya	<u>Irrigation</u>	
	① Existing irrigation facilities do not cover the whole area.	① Provision of new irrigation blocks and field irrigation network.
	② Paddy rice is planted under irrigated condition	② Involvement of water users from the initial stage of implementation in order to get consensus on the proposed cropping patterns.
	<u>Rural road</u>	
	① The main village road has deteriorated. (1.6 km)	① Rehabilitation or upgrading of the existing road.
	② Connection roads to the main village road are not sufficiently distributed.	② Utilization of operation and maintenance roads of the proposed irrigation system
	<u>Drinking water</u>	
	① Water sources are possibly polluted by agro-chemicals.	① Construction of intake facilities at springs.
	② Lack of proper water supply and distribution system.	② Provision of conveyance and distribution system
Mekarmukti	<u>Irrigation</u>	
	① Irrigation water sources are located far from the area.	① Reduction of losses by lined main canal. Provision of night storage.
	② Paddy rice is planted under irrigated condition	② Involvement of water users from the initial stage of implementation in order to get consensus on the proposed cropping patterns.
	<u>Rural road</u>	
	① Lack of access roads to the proposed irrigation area on the downstream.	① Utilization of operation and maintenance roads of the proposed irrigation system
	<u>Drinking water</u>	
	① Water sources are located below the area.	① Provision of a new gravity pipeline from Cikurubuk village (spring).
	② Existing water supply system has deteriorated.	② Replacement of existing hydraulic pumps and distribution system.
	③ Existing water supply system do not satisfy the demands at present.	③ Same as ①
Cisantana	<u>Irrigation</u>	
	① Existing irrigation facilities do not cover the whole area.	① Provision of another irrigation system and field irrigation network.
	② Existing irrigation facilities have deteriorated.	② Rehabilitation and upgrading of existing facilities.
	③ Steep topography	③ Upgrading to a pipeline system with farm ponds.
	④ Other water users on the same water source.	④ Coordination with other users to set up watering schedule and volume allocation for each area.
	<u>Rural road</u>	
	① Village road to the area (1.0 km) has deteriorated.	① Improvement works with the collaboration of villages along the road.
	② The main village road has deteriorated partly (2.0 km in total).	② Improvement of deteriorated portion.
	③ Connection roads to the main village road are not sufficiently distributed	③ Utilization of operation and maintenance roads of the proposed irrigation system
	<u>Drinking water</u>	
	① Same water source with irrigation.	① Provision of independent intake and conveyance pipeline.
	② Existing water supply system has deteriorated.	② Rehabilitaion

Table V-5 Irrigation Water Requirements (1/8)

Project : **Mekarjaya**
Year: **Mean**

Name	Pattern(intensity)	Area(%)
Cropping pattern -1(P1)	paddy-paddy (200%)	10%
Cropping pattern -2(P2)	vegetable-vegetable-vegetable (300%	90%
Cropping pattern -3(P3)		

No.	Item	Unit		Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
(1)	ETo (Bandung)	mm		4.3	4.3	4.5	4.5	4.5	4.5	4.2	4.2	4.0	4.0	4.0	4.0	4.3	4.3	4.9	4.9	5.5	5.5	5.1	5.1	4.8	4.8	4.4	4.4
(2)	Crop coeff, Kc	P1	1	1.10	1.05	1.05	0.95						1.10	1.10	1.05	1.05	0.95										1.10
	(FAO IDP No.24)		2	1.10	1.10	1.05	1.05	0.95						1.10	1.10	1.05	1.05	0.95									
		P2	3	1.00	1.00	0.95	0.90		0.70	0.85	1.00	1.00	1.00	0.95	0.90		0.70	0.85	1.00	1.00	1.00	0.95	0.90		0.70	0.85	1.00
			4	1.00	1.00	1.00	0.95	0.90		0.70	0.85	1.00	1.00	1.00	0.95	0.90		0.70	0.85	1.00	1.00	1.00	0.95	0.90		0.70	0.85
		P3																									
(3)	ETcrop/day	mm	1	4.7	4.5	4.7	4.2						4.4	4.3	4.1	4.6	4.1										4.9
		mm	2	4.7	4.7	4.7	4.7	4.3						4.3	4.3	4.6	4.6	4.6									
		mm	3	4.3	4.3	4.2	4.0		3.1	3.6	4.2	4.0	4.0	3.8	3.6		3.0	4.1	4.9	5.5	5.5	4.8	4.6		3.4	3.8	4.4
		mm	4	4.3	4.3	4.5	4.2	4.0		2.9	3.6	4.0	4.0	4.0	3.8	3.9		3.4	4.1	5.5	5.5	5.1	4.8	4.3		3.1	3.8
		mm	5																								
		mm	6																								
(4)	ET crop 1/2 month	mm	1	70.5	71.7	65.6	59.4						70.6	65.2	62.2	68.3	65.9										78.0
		mm	2	70.5	75.2	65.6	65.6	64.1						65.2	65.2	68.3	72.9	69.5									
		mm	3	64.1	68.3	59.4	56.2		50.4	53.4	62.8	60.1	64.1	56.3	53.3		48.6	62.1	78.0	82.1	82.1	72.5	73.2		50.4	56.5	70.9
		mm	4	64.1	68.3	62.5	59.4	60.7		44.0	53.4	60.1	64.1	59.3	56.3	58.6		51.2	66.3	82.1	82.1	76.3	77.3	64.8		46.6	60.3
		mm	5																								
		mm	6																								
(5)	Land Preparation	mm	1								190.6	188.7													220.5	216.8	
	(KP-01)	mm	2									188.7	201.3													216.8	231.2
		mm	3																								
		mm	4																								
		mm	5																								
		mm	6																								
(6)	Deep percolation	mm	1	45	48	42	42						48	45	45	45	48										48
	3.0 mm/day	mm	2		48	42	42	45						45	45	45	48	45									
		mm	3																								
		mm	4																								
		mm	5																								
		mm	6																								
(7)	Water layer replacement	mm	1	50		50								50		50											
	(KP-01)		2		50		50								50		50										
			3																								
			4																								
			5																								
		mm	6																								
(8)	Field water requirement	mm	1	165.5	119.7	157.6	101.4				190.6	188.7	118.6	160.2	107.2	163.3	113.9								220.5	216.8	126.0
			2	70.5	173.2	107.6	157.6	109.1				188.7	201.3	110.2	160.2	113.3	170.9	114.5								216.8	231.2
			3	64.1	68.3	59.4	56.2		50.4	53.4	62.8	60.1	64.1	56.3	53.3		48.6	62.1	78.0	82.1	82.1	72.5	73.2		50.4	56.5	70.9
			4	64.1	68.3	62.5	59.4	60.7		44.0	53.4	60.1	64.1	59.3	56.3	58.6		51.2	66.3	82.1	82.1	76.3	77.3	64.8		46.6	60.3
			5																								
			6																								
(9)	Effc rainfall	mm																									
	Rain (80% reliable)			69.6	69.6	50.8	50.8	92.3	92.3	84.5	84.5	42.7	42.7	2.0	2.0	3.4	3.4			11.1	11.1	18.5	18.5	55.7	55.7	62.5	62.5
	0.70 x R		1	41.7	41.7	30.5	30.5				59.2	29.9	25.6	1.2	1.2	2.0	2.0								39.0	43.8	37.5
	0.60 x R		2	41.7	41.7	30.5	30.5	55.4				29.9	29.9	1.2	1.2	2.0	2.0									43.8	43.8
			3	48.7	48.7	35.6	35.6		64.6	59.2	59.2	29.9	29.9	1.4	1.4		2.3			7.8	7.8	13.0	13.0		39.0	43.8	43.8
			4	48.7	48.7	35.6	35.6	64.6		59.2	59.2	29.9	29.9	1.4	1.4	2.3				7.8	7.8	13.0	13.0	39.0		43.8	43.8
			5																								
			6																								
(10)	Net Water Requirement	mm	1	123.7	78.0	127.1	70.9				131.5	158.8	92.9	159.0	106.0	161.3	111.9								181.6	173.0	88.5
			2	28.7	131.4	77.1	127.1	53.7				158.8	171.4	109.0	159.0	111.3	168.9	114.5								173.0	187.5
			3	15.4	19.6	23.8	20.7				3.7	30.2	34.3	54.9	51.9		46.2	62.1	78.0	74.3	74.3	59.5	60.3		11.4	12.8	27.2
			4	15.4	19.6	26.9	23.8					30.2	34.3	57.9	54.9	56.2		51.2	66.3	74.3	74.3	63.3	64.3	25.8		2.8	16.5
			5																								
			6																								
(11)	Net Water Requirement		1	0.95	0.56	1.05	0.59				1.01	1.23	0.67	1.23	0.82	1.24	0.81								1.40	1.33	0.64
	l/sec/ha		2	0.22	0.95	0.64	1.05	0.41				1.23	1.24	0.84	1.23	0.86	1.22	0.88								1.33	1.36
			3	0.12	0.14	0.20	0.17				0.03	0.23	0.25	0.42	0.40		0.33	0.48	0.56	0.57	0.57	0.46	0.44		0.09	0.10	0.20
			4	0.12	0.14	0.22	0.20					0.23	0.25	0.45	0.42	0.43		0.39	0.48	0.57	0.57	0.49	0.47	0.20		0.02	0.12
			5																								
			6																								
	Mean total			0.35	0.45	0.53	0.50	0.10			0.26	0.73	0.60	0.73	0.72	0.63	0.59	0.44	0.26	0.29	0.29	0.24	0.23	0.05	0.37	0.70	0.58
(12)	Gross Water Requirement																										
	l/sec/ha			0.23	0.29	0.38	0.35	0.03			0.08	0.43	0.42	0.65	0.62	0.39	0.33	0.57	0.61	0.67	0.67	0.56	0.53	0.12	0.16	0.28	0.34
	Pattern-1			0.93	1.20	1.34	1.30	0.33			0.66	1.60	1.25	1.35	1.34	1.37	1.33	0.58							1.11	2.12	1.58
	Pattern-2			0.16	0.19	0.27	0.24				0.02	0.31	0.32	0.57	0.54	0.28	0.22	0.57	0.68	0.75	0.75	0.62	0.59	0.13	0.06	0.08	0.21

Table V-5 Irrigation Water Requirements (2/8)

Project : **Langensari**
Year: **Mean**

Name	Pattern(intensity)	Area(%)
Cropping pattern -1(P1)	paddy-vegetable (200%)	
Cropping pattern -2(P2)	vegetable-vegetable-vegetable (300%	100%
Cropping pattern -3(P3)		

No.	Item	Unit		Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
(1)	ETo (Lembang)	mm		3.4	3.4	3.6	3.6	3.8	3.8	3.5	3.5	3.4	3.4	3.3	3.3	3.6	3.6	4.1	4.1	5.5	5.5	4.7	4.7	3.9	3.9	3.6	3.6
(2)	Crop coeff, Kc	P1	1	1.10	1.05	1.05	0.95				0.70	0.85	1.00	1.00	1.00	0.95	0.90										1.10
	(FAO IDP No.24)		2	1.10	1.10	1.05	1.05	0.95				0.70	0.85	1.00	1.00	1.00	0.95	0.90									
		P2	3	1.00	1.00	0.95	0.90		0.70	0.85	1.00	1.00	1.00	0.95	0.90		0.70	0.85	1.00	1.00	1.00	0.95	0.90		0.70	0.85	1.00
			4	1.00	1.00	1.00	0.95	0.90		0.70	0.85	1.00	1.00	1.00	0.95	0.90		0.70	0.85	1.00	1.00	1.00	0.95	0.90		0.70	0.85
		P3																									
(3)	ETcrop/day	mm	1	3.8	3.6	3.8	3.5				2.4	2.9	3.4	3.3	3.3	3.4	3.2										4.0
		mm	2	3.8	3.8	3.8	3.8	3.6				2.4	2.9	3.3	3.3	3.6	3.4	3.7									
		mm	3	3.4	3.4	3.5	3.3		2.7	3.0	3.5	3.4	3.4	3.2	3.0		2.5	3.5	4.1	5.5	5.5	4.5	4.2		2.7	3.1	3.6
		mm	4	3.4	3.4	3.6	3.5	3.4		2.4	3.0	3.4	3.4	3.3	3.2	3.2		2.8	3.5	5.5	5.5	4.7	4.5	3.5		2.5	3.1
		mm	5																								
		mm	6																								
(4)	ET crop 1/2 month	mm	1	56.6	57.6	53.4	48.3				36.6	42.8	53.8	49.8	49.8	50.7	51.3										63.8
		mm	2	56.6	60.4	53.4	53.4	54.1				35.3	45.7	49.8	49.8	53.4	54.1	54.9									
		mm	3	51.5	54.9	48.3	45.8		42.5	44.5	52.3	50.4	53.8	47.3	44.8		39.9	51.9	65.1	82.1	82.1	67.2	67.9		40.4	46.2	58.0
		mm	4	51.5	54.9	50.9	48.3	51.2		36.6	44.5	50.4	53.8	49.8	47.3	48.1		42.7	55.3	82.1	82.1	70.8	71.7	52.0		38.1	49.3
		mm	5																								
		mm	6																								
(5)	Land Preparation	mm	1																						210.8	208.5	
	(KP-01)	mm	2																							208.5	222.3
		mm	3																								
		mm	4																								
		mm	5																								
		mm	6																								
(6)	Deep percolation	mm	1	45	48	42	42																				48
	3.0 mm/day	mm	2		48	42	42	45																			
		mm	3																								
		mm	4																								
		mm	5																								
		mm	6																								
(7)	Water layer replacement	mm	1	50		50																					
	(KP-01)		2		50		50																				
			3																								
			4																								
			5																								
		mm	6																								
(8)	Field water requirement	mm	1	151.6	105.6	145.4	90.3				36.6	42.8	53.8	49.8	49.8	50.7	51.3								210.8	208.5	111.8
			2	56.6	158.4	95.4	145.4	99.1				35.3	45.7	49.8	49.8	53.4	54.1	54.9								208.5	222.3
			3	51.5	54.9	48.3	45.8		42.5	44.5	52.3	50.4	53.8	47.3	44.8		39.9	51.9	65.1	82.1	82.1	67.2	67.9		40.4	46.2	58.0
			4	51.5	54.9	50.9	48.3	51.2		36.6	44.5	50.4	53.8	49.8	47.3	48.1		42.7	55.3	82.1	82.1	70.8	71.7	52.0		38.1	49.3
			5																								
			6																								
(9)	Effc rainfall	mm																									
	Rain (80% reliable)			69.6	69.6	51.8	51.8	94.5	94.5	71.6	71.6	9.8	9.8	2.0	2.0	1.9	1.9			17.1	17.1	12.3	12.3	59.6	59.6	56.0	56.0
	0.70 x R		1	41.7	41.7	31.1	31.1				50.1	6.9	6.9	1.4	1.4	1.3	1.3								41.7	39.2	33.6
	0.60 x R		2	41.7	41.7	31.1	31.1	56.7				6.9	5.9	1.2	1.2	1.1	1.1									39.2	39.2
			3	48.7	48.7	36.2	36.2		66.2	50.1	50.1	6.9	6.9	1.4	1.4		1.3			12.0	12.0	8.6	8.6		41.7	39.2	39.2
			4	48.7	48.7	36.2	36.2	66.2		50.1	50.1	6.9	6.9	1.4	1.4	1.3				12.0	12.0	8.6	8.6	41.7		39.2	39.2
			5																								
			6																								
(10)	Net Water Requirement	mm	1	109.9	63.9	114.4	59.3					36.0	46.9	48.4	48.4	49.5	50.0								169.1	169.3	78.2
			2	14.9	116.6	64.4	114.4	42.4				28.4	39.8	48.6	48.6	52.3	53.0	54.9								169.3	183.2
			3	2.8	6.2	12.1	9.6				2.2	43.5	46.9	45.9	43.4		38.6	51.9	65.1	70.1	70.1	58.6	59.3			7.0	18.8
			4	2.8	6.2	14.7	12.1					43.5	46.9	48.4	45.9	46.8		42.7	55.3	70.1	70.1	62.2	63.1	10.3			10.1
			5																								
			6																								
(11)	Net Water Requirement		1	0.85	0.46	0.95	0.49					0.28	0.34	0.37	0.37	0.38	0.36								1.30	1.31	0.57
	l/sec/ha		2	0.11	0.84	0.53	0.95	0.33				0.22	0.29	0.37	0.37	0.40	0.38	0.42								1.31	1.33
			3	0.02	0.04	0.10	0.08				0.02	0.34	0.34	0.35	0.33		0.28	0.40	0.47	0.54	0.54	0.45	0.43			0.05	0.14
			4	0.02	0.04	0.12	0.10					0.34	0.34	0.37	0.35	0.36		0.33	0.40	0.54	0.54	0.48	0.46	0.08			0.07
			5																								
			6																								
	Mean total			0.25	0.35	0.42	0.40	0.08			0.00	0.29	0.33	0.37	0.36	0.29	0.26	0.29	0.22	0.27	0.27	0.23	0.22	0.02	0.33	0.67	0.53
(12)	Gross Water Requirement																										
	l/sec/ha			0.03	0.06	0.14	0.12				0.01	0.44	0.44	0.48	0.45	0.24	0.18	0.48	0.57	0.71	0.71	0.61	0.58	0.05		0.04	0.14
	Pattern-1			0.76	1.04	1.17	1.14	0.26				0.32	0.41	0.49	0.49	0.51	0.49	0.28							1.04	2.07	1.50
	Pattern-2			0.03	0.06	0.14	0.12				0.01	0.44	0.44	0.48	0.45	0.24	0.18	0.48	0.57	0.71	0.71	0.61	0.58	0.05		0.04	0.14

Table V-5 Irrigation Water Requirements (3/8)

Project : **Tugumukti**
Year: **Mean**

Name	Pattern(intensity)	Area(%)
Cropping pattern -1(P1)	paddy-vegetable (200%)	
Cropping pattern -2(P2)	vegetable-vegetable-vegetable (300%	100%
Cropping pattern -3(P3)		

No.	Item	Unit		Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
(1)	ETo (Lembang)	mm		4.5	4.5	4.7	4.7	5.1	5.1	5.0	5.0	5.0	5.0	4.8	4.8	5.2	5.2	6.2	6.2	5.5	5.5	6.6	6.6	5.4	5.4	4.8	4.8
(2)	Crop coeff, Kc	P1	1	1.10	1.05	1.05	0.95				0.70	0.85	1.00	1.00	1.00	0.95	0.90										1.10
	(FAO IDP No.24)		2	1.10	1.10	1.05	1.05	0.95				0.70	0.85	1.00	1.00	1.00	0.95	0.90									
		P2	3	1.00	1.00	0.95	0.90		0.70	0.85	1.00	1.00	1.00	0.95	0.90		0.70	0.85	1.00	1.00	1.00	0.95	0.90		0.70	0.85	1.00
			4	1.00	1.00	1.00	0.95	0.90		0.70	0.85	1.00	1.00	1.00	0.95	0.90		0.70	0.85	1.00	1.00	1.00	0.95	0.90		0.70	0.85
		P3																									
(3)	ETcrop/day	mm	1	4.9	4.7	4.9	4.4				3.5	4.3	5.0	4.8	4.8	4.9	4.7										5.3
		mm	2	4.9	4.9	4.9	4.9	4.8				3.5	4.3	4.8	4.8	5.2	4.9	5.6									
		mm	3	4.5	4.5	4.4	4.2		3.5	4.3	5.0	5.0	5.0	4.5	4.3		3.6	5.3	6.2	5.5	5.5	6.3	6.0		3.8	4.1	4.8
		mm	4	4.5	4.5	4.7	4.4	4.6		3.5	4.3	5.0	5.0	4.8	4.5	4.7		4.3	5.3	5.5	5.5	6.6	6.3	4.9		3.4	4.1
		mm	5																								
		mm	6																								
(4)	ET crop 1/2 month	mm	1	74.2	75.5	68.5	62.0				52.6	63.8	80.1	71.8	71.8	73.8	74.6										84.7
		mm	2	74.2	79.1	68.5	68.5	72.1				52.6	68.1	71.8	71.8	77.7	78.7	83.7									
		mm	3	67.4	71.9	62.0	58.7		56.7	63.9	75.2	75.1	80.1	68.2	64.6		58.0	79.1	99.2	82.1	82.1	94.7	95.7		57.0	61.4	77.0
		mm	4	67.4	71.9	65.2	62.0	68.3		52.6	63.9	75.1	80.1	71.8	68.2	69.9		65.1	84.3	82.1	82.1	99.7	101.0	73.3		50.6	65.5
		mm	5																								
		mm	6																								
(5)	Land Preparation	mm	1																						227.2	220.7	
	(KP-01)	mm	2																							220.7	235.4
		mm	3																								
		mm	4																								
		mm	5																								
		mm	6																								
(6)	Deep percolation	mm	1	45	48	42	42																				48
	3.0 mm/day	mm	2		48	42	42	45																			
		mm	3																								
		mm	4																								
		mm	5																								
		mm	6																								
(7)	Water layer replacement	mm	1	50		50																					
	(KP-01)		2		50		50																				
			3																								
			4																								
			5																								
		mm	6																								
(8)	Field water requirement	mm	1	169.2	123.5	160.5	104.0				52.6	63.8	80.1	71.8	71.8	73.8	74.6								227.2	220.7	132.7
			2	74.2	177.1	110.5	160.5	117.1				52.6	68.1	71.8	71.8	77.7	78.7	83.7								220.7	235.4
			3	67.4	71.9	62.0	58.7		56.7	63.9	75.2	75.1	80.1	68.2	64.6		58.0	79.1	99.2	82.1	82.1	94.7	95.7		57.0	61.4	77.0
			4	67.4	71.9	65.2	62.0	68.3		52.6	63.9	75.1	80.1	71.8	68.2	69.9		65.1	84.3	82.1	82.1	99.7	101.0	73.3		50.6	65.5
			5																								
			6																								
(9)	Effc rainfall	mm																									
	Rain (80% reliable)			69.6	69.6	51.8	51.8	94.5	94.5	71.6	71.6	9.8	9.8	2.0	2.0	1.9	1.9			17.1	17.1	12.3	12.3	59.6	59.6	56.0	56.0
	0.70 x R		1	41.7	41.7	31.1	31.1				50.1	6.9	6.9	1.4	1.4	1.3	1.3								41.7	39.2	33.6
	0.60 x R		2	41.7	41.7	31.1	31.1	56.7				6.9	5.9	1.2	1.2	1.1	1.1									39.2	39.2
			3	48.7	48.7	36.2	36.2		66.2	50.1	50.1	6.9	6.9	1.4	1.4		1.3			12.0	12.0	8.6	8.6		41.7	39.2	39.2
			4	48.7	48.7	36.2	36.2	66.2		50.1	50.1	6.9	6.9	1.4	1.4	1.3				12.0	12.0	8.6	8.6	41.7		39.2	39.2
			5																								
			6																								
(10)	Net Water Requirement	mm	1	127.4	81.8	129.4	72.9				2.5	57.0	73.3	70.4	70.4	72.5	73.3								185.5	181.6	99.2
			2	32.4	135.4	79.4	129.4	60.4				45.7	62.2	70.6	70.6	76.6	77.6	83.7								181.6	196.3
			3	18.7	23.2	25.7	22.5			13.8	25.1	68.2	73.3	66.8	63.2		56.7	79.1	99.2	70.1	70.1	86.1	87.1		15.3	22.2	37.9
			4	18.7	23.2	29.0	25.7	2.1		2.5	13.8	68.2	73.3	70.4	66.8	68.6		65.1	84.3	70.1	70.1	91.1	92.4	31.6		11.4	26.3
			5																								
			6																								
(11)	Net Water Requirement		1	0.98	0.59	1.07	0.60				0.02	0.44	0.53	0.54	0.54	0.56	0.53								1.43	1.40	0.72
	l/sec/ha		2	0.25	0.98	0.66	1.07	0.47				0.35	0.45	0.54	0.54	0.59	0.56	0.65								1.40	1.42
			3	0.14	0.17	0.21	0.19			0.11	0.19	0.53	0.53	0.52	0.49		0.41	0.61	0.72	0.54	0.54	0.66	0.63		0.12	0.17	0.27
			4	0.14	0.17	0.24	0.21	0.02		0.02	0.11	0.53	0.53	0.54	0.52	0.53		0.50	0.61	0.54	0.54	0.70	0.67	0.24		0.09	0.19
			5																								
			6																								
	Mean total			0.38	0.48	0.54	0.52	0.12		0.03	0.08	0.46	0.51	0.54	0.52	0.42	0.38	0.44	0.33	0.27	0.27	0.34	0.32	0.06	0.39	0.77	0.65
(12)	Gross Water Requirement																										
	l/sec/ha			0.19	0.22	0.30	0.26	0.01		0.08	0.20	0.69	0.69	0.69	0.66	0.35	0.27	0.73	0.87	0.71	0.71	0.89	0.85	0.16	0.08	0.17	0.30
	Pattern-1			0.98	1.25	1.37	1.33	0.37			0.01	0.52	0.64	0.71	0.71	0.75	0.71	0.42							1.14	2.22	1.70
	Pattern-2			0.19	0.22	0.30	0.26	0.01		0.08	0.20	0.69	0.69	0.69	0.66	0.35	0.27	0.73	0.87	0.71	0.71	0.89	0.85	0.16	0.08	0.17	0.30

Table V-5 Irrigation Water Requirements (4/8)

Project : **Gekbrong(Cianjur)**
Year: **Mean**

Name	Pattern(intensity)	Area(%)
Cropping pattern -1(P1)	paddy-vegetable (200%)	
Cropping pattern -2(P2)	vegetable-vegetable-vegetable (300%	100%
Cropping pattern -3(P3)		

No.	Item	Unit		Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
(1)	ETo (Pacet)	mm		3.0	3.0	3.1	3.1	3.4	3.4	3.4	3.4	3.3	3.3	3.3	3.3	3.8	3.8	3.9	3.9	5.5	5.5	4.3	4.3	3.9	3.9	3.3	3.3
(2)	Crop coeff, Kc	P1	1	1.10	1.05	1.05	0.95				0.70	0.85	1.00	1.00	1.00	0.95	0.90										1.10
	(FAO IDP No.24)		2	1.10	1.10	1.05	1.05	0.95				0.70	0.85	1.00	1.00	1.00	0.95	0.90									
		P2	3	1.00	1.00	0.95	0.90		0.70	0.85	1.00	1.00	1.00	0.95	0.90		0.70	0.85	1.00	1.00	1.00	0.95	0.90		0.70	0.85	1.00
			4	1.00	1.00	1.00	0.95	0.90		0.70	0.85	1.00	1.00	1.00	0.95	0.90		0.70	0.85	1.00	1.00	1.00	0.95	0.90		0.70	0.85
		P3																									
(3)	ETcrop/day	mm	1	3.3	3.2	3.3	2.9				2.4	2.8	3.3	3.3	3.3	3.6	3.4										3.6
		mm	2	3.3	3.3	3.3	3.3	3.2				2.3	2.8	3.3	3.3	3.8	3.6	3.5									
		mm	3	3.0	3.0	2.9	2.8		2.4	2.9	3.4	3.3	3.3	3.1	2.9		2.6	3.3	3.9	5.5	5.5	4.1	3.9		2.7	2.8	3.3
		mm	4	3.0	3.0	3.1	2.9	3.1		2.4	2.9	3.3	3.3	3.3	3.1	3.4		2.7	3.3	5.5	5.5	4.3	4.1	3.5		2.3	2.8
		mm	5																								
		mm	6																								
(4)	ET crop 1/2 month	mm	1	50.2	51.1	45.6	41.3				35.9	42.5	53.4	49.2	49.2	53.7	54.3										58.4
		mm	2	50.2	53.5	45.6	45.6	48.6				35.0	45.4	49.2	49.2	56.6	57.3	52.8									
		mm	3	45.6	48.7	41.3	39.1		38.2	43.6	51.2	50.1	53.4	46.7	44.2		42.2	49.9	62.6	82.1	82.1	61.9	62.6		40.9	42.3	53.0
		mm	4	45.6	48.7	43.4	41.3	46.0		35.9	43.6	50.1	53.4	49.2	46.7	50.9		41.1	53.2	82.1	82.1	65.2	66.0	52.6		34.8	45.1
		mm	5																								
		mm	6																								
(5)	Land Preparation	mm	1																						211.2	205.3	
	(KP-01)	mm	2																							205.3	219.0
		mm	3																								
		mm	4																								
		mm	5																								
		mm	6																								
(6)	Deep percolation	mm	1	45	48	42	42																				48
	3.0 mm/day	mm	2		48	42	42	45																			
		mm	3																								
		mm	4																								
		mm	5																								
		mm	6																								
(7)	Water layer replacement	mm	1	50		50																					
	(KP-01)		2		50		50																				
			3																								
			4																								
			5																								
		mm	6																								
(8)	Field water requirement	mm	1	145.2	99.1	137.6	83.3				35.9	42.5	53.4	49.2	49.2	53.7	54.3								211.2	205.3	106.4
			2	50.2	151.5	87.6	137.6	93.6				35.0	45.4	49.2	49.2	56.6	57.3	52.8								205.3	219.0
			3	45.6	48.7	41.3	39.1		38.2	43.6	51.2	50.1	53.4	46.7	44.2		42.2	49.9	62.6	82.1	82.1	61.9	62.6		40.9	42.3	53.0
			4	45.6	48.7	43.4	41.3	46.0		35.9	43.6	50.1	53.4	49.2	46.7	50.9		41.1	53.2	82.1	82.1	65.2	66.0	52.6		34.8	45.1
			5																								
			6																								
(9)	Effc rainfall	mm																									
	Rain (80% reliable)			16.5	16.5	17.1	17.1	25.7	25.7	22.8	22.8	7.4	7.4	5.2	5.2	3.3	3.3	2.0	2.0	1.4	1.4	20.4	20.4	135.0	135.0	116.5	116.5
	0.70 x R		1	9.9	9.9	10.2	10.2				15.9	5.2	5.2	3.6	3.6	2.3	2.3		1.4						94.5	81.6	69.9
	0.60 x R		2	9.9	9.9	10.2	10.2	15.4				5.2	4.4	3.1	3.1	2.0	2.0	1.2								81.6	81.6
			3	11.5	11.5	11.9	11.9		18.0	15.9	15.9	5.2	5.2	3.6	3.6		2.3	1.4	1.4	0.9	0.9	14.3	14.3		94.5	81.6	81.6
			4	11.5	11.5	11.9	11.9	18.0		15.9	15.9	5.2	5.2	3.6	3.6	2.3		1.4	1.4	0.9	0.9	14.3	14.3	94.5		81.6	81.6
			5																								
			6																								
(10)	Net Water Requirement	mm	1	135.3	89.2	127.4	73.0				19.9	37.4	48.2	45.6	45.6	51.5	52.0								116.7	123.8	36.5
			2	40.3	141.7	77.4	127.4	78.1				29.9	40.9	46.1	46.1	54.6	55.4	51.6								123.8	137.5
			3	34.1	37.2	29.3	27.2		20.2	27.6	35.3	44.9	48.2	43.1	40.6		40.0	48.5	61.2	81.1	81.1	47.6	48.3				
			4	34.1	37.2	31.5	29.3	28.0		19.9	27.6	44.9	48.2	45.6	43.1	48.6		39.7	51.8	81.1	81.1	50.9	51.8				
			5																								
			6																								
(11)	Net Water Requirement		1	1.04	0.65	1.05	0.60				0.15	0.29	0.35	0.35	0.35	0.40	0.38								0.90	0.96	0.26
	l/sec/ha		2	0.31	1.02	0.64	1.05	0.60				0.23	0.30	0.36	0.36	0.42	0.40	0.40								0.96	0.99
			3	0.26	0.27	0.24	0.22		0.15	0.21	0.27	0.35	0.35	0.33	0.31		0.29	0.37	0.44	0.63	0.63	0.37	0.35				
			4	0.26	0.27	0.26	0.24	0.22		0.15	0.21	0.35	0.35	0.35	0.33	0.38		0.31	0.37	0.63	0.63	0.39	0.37				
			5																								
			6																								
	Mean total			0.47	0.55	0.55	0.53	0.20	0.04	0.09	0.16	0.30	0.34	0.35	0.34	0.30	0.27	0.27	0.20	0.31	0.31	0.19	0.18		0.23	0.48	0.31
(12)	Gross Water Requirement																										
	l/sec/ha			0.34	0.35	0.33	0.31	0.14	0.10	0.24	0.32	0.45	0.46	0.45	0.42	0.25	0.19	0.44	0.53	0.82	0.82	0.50	0.47				
	Pattern-1			1.08	1.33	1.34	1.31	0.48			0.10	0.34	0.42	0.46	0.46	0.53	0.51	0.26							0.71	1.52	1.00
	Pattern-2			0.34	0.35	0.33	0.31	0.14	0.10	0.24	0.32	0.45	0.46	0.45	0.42	0.25	0.19	0.44	0.53	0.82	0.82	0.50	0.47				

Table V-5 Irrigation Water Requirements (5/8)

Project : **Cisurupan (Garut)**
Year: **Mean**

Name	Pattern(intensity)	Area(%)
Cropping pattern -1(P1)	paddy-vegetable (200%)	
Cropping pattern -2(P2)	vegetable-vegetable-vegetable (300%	100%
Cropping pattern -3(P3)		

No.	Item	Unit		Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
(1)	ETo (Bandung)	mm		4.3	4.3	4.5	4.5	4.5	4.5	4.2	4.2	4.0	4.0	4.0	4.0	4.3	4.3	4.9	4.9	5.5	5.5	5.1	5.1	4.8	4.8	4.4	4.4
(2)	Crop coeff, Kc	P1	1	1.10	1.05	1.05	0.95				0.70	0.85	1.00	1.00	1.00	0.95	0.90										1.10
	(FAO IDP No.24)		2	1.10	1.10	1.05	1.05	0.95				0.70	0.85	1.00	1.00	1.00	0.95	0.90									
		P2	3	1.00	1.00	0.95	0.90		0.70	0.85	1.00	1.00	1.00	0.95	0.90		0.70	0.85	1.00	1.00	1.00	0.95	0.90		0.70	0.85	1.00
			4	1.00	1.00	1.00	0.95	0.90		0.70	0.85	1.00	1.00	1.00	0.95	0.90		0.70	0.85	1.00	1.00	1.00	0.95	0.90		0.70	0.85
		P3																									
(3)	ETcrop/day	mm	1	4.7	4.5	4.7	4.2				2.9	3.4	4.0	4.0	4.0	4.1	3.9										4.9
		mm	2	4.7	4.7	4.7	4.7	4.3				2.8	3.4	4.0	4.0	4.3	4.1	4.4									
		mm	3	4.3	4.3	4.2	4.0		3.1	3.6	4.2	4.0	4.0	3.8	3.6		3.0	4.1	4.9	5.5	5.5	4.8	4.6		3.4	3.8	4.4
		mm	4	4.3	4.3	4.5	4.2	4.0		2.9	3.6	4.0	4.0	4.0	3.8	3.9		3.4	4.1	5.5	5.5	5.1	4.8	4.3		3.1	3.8
		mm	5																								
		mm	6																								
(4)	ET crop 1/2 month	mm	1	70.5	71.7	65.6	59.4				44.0	51.1	64.1	59.3	59.3	61.8	62.5										78.0
		mm	2	70.5	75.2	65.6	65.6	64.1				42.1	54.5	59.3	59.3	65.1	65.9	65.8									
		mm	3	64.1	68.3	59.4	56.2		50.4	53.4	62.8	60.1	64.1	56.3	53.3		48.6	62.1	78.0	82.1	82.1	72.5	73.2		50.4	56.5	70.9
		mm	4	64.1	68.3	62.5	59.4	60.7		44.0	53.4	60.1	64.1	59.3	56.3	58.6		51.2	66.3	82.1	82.1	76.3	77.3	64.8		46.6	60.3
		mm	5																								
		mm	6																								
(5)	Land Preparation	mm	1																						220.5	216.8	
	(KP-01)	mm	2																							216.8	231.2
		mm	3																								
		mm	4																								
		mm	5																								
		mm	6																								
(6)	Deep percolation	mm	1	45	48	42	42																				48
	3.0 mm/day	mm	2		48	42	42	45																			
		mm	3																								
		mm	4																								
		mm	5																								
		mm	6																								
(7)	Water layer replacement	mm	1	50		50																					
	(KP-01)		2		50		50																				
			3																								
			4																								
			5																								
		mm	6																								
(8)	Field water requirement	mm	1	165.5	119.7	157.6	101.4				44.0	51.1	64.1	59.3	59.3	61.8	62.5								220.5	216.8	126.0
			2	70.5	173.2	107.6	157.6	109.1				42.1	54.5	59.3	59.3	65.1	65.9	65.8								216.8	231.2
			3	64.1	68.3	59.4	56.2		50.4	53.4	62.8	60.1	64.1	56.3	53.3		48.6	62.1	78.0	82.1	82.1	72.5	73.2		50.4	56.5	70.9
			4	64.1	68.3	62.5	59.4	60.7		44.0	53.4	60.1	64.1	59.3	56.3	58.6		51.2	66.3	82.1	82.1	76.3	77.3	64.8		46.6	60.3
			5																								
			6																								
(9)	Effc rainfall	mm																									
	Rain (80% reliable)			69.6	69.6	50.8	50.8	92.3	92.3	84.5	84.5	42.7	42.7	2.0	2.0	3.4	3.4			11.1	11.1	18.5	18.5	55.7	55.7	62.5	62.5
	0.70 x R		1	41.7	41.7	30.5	30.5				59.2	29.9	29.9	1.4	1.4	2.3	2.3								39.0	43.8	37.5
	0.60 x R		2	41.7	41.7	30.5	30.5	55.4				29.9	25.6	1.2	1.2	2.0	2.0									43.8	43.8
			3	48.7	48.7	35.6	35.6		64.6	59.2	59.2	29.9	29.9	1.4	1.4		2.3			7.8	7.8	13.0	13.0		39.0	43.8	43.8
			4	48.7	48.7	35.6	35.6	64.6		59.2	59.2	29.9	29.9	1.4	1.4	2.3				7.8	7.8	13.0	13.0	39.0		43.8	43.8
			5																								
			6																								
(10)	Net Water Requirement	mm	1	123.7	78.0	127.1	70.9					21.2	34.3	57.9	57.9	59.5	60.1								181.6	173.0	88.5
			2	28.7	131.4	77.1	127.1	53.7				12.2	28.9	58.1	58.1	63.0	63.9	65.8								173.0	187.5
			3	15.4	19.6	23.8	20.7				3.7	30.2	34.3	54.9	51.9		46.2	62.1	78.0	74.3	74.3	59.5	60.3		11.4	12.8	27.2
			4	15.4	19.6	26.9	23.8					30.2	34.3	57.9	54.9	56.2		51.2	66.3	74.3	74.3	63.3	64.3	25.8		2.8	16.5
			5																								
			6																								
(11)	Net Water Requirement		1	0.95	0.56	1.05	0.59					0.16	0.25	0.45	0.45	0.46	0.43								1.40	1.33	0.64
	l/sec/ha		2	0.22	0.95	0.64	1.05	0.41				0.09	0.21	0.45	0.45	0.49	0.46	0.51								1.33	1.36
			3	0.12	0.14	0.20	0.17				0.03	0.23	0.25	0.42	0.40		0.33	0.48	0.56	0.57	0.57	0.46	0.44		0.09	0.10	0.20
			4	0.12	0.14	0.22	0.20					0.23	0.25	0.45	0.42	0.43		0.39	0.48	0.57	0.57	0.49	0.47	0.20		0.02	0.12
			5																								
			6																								
	Mean total			0.35	0.45	0.53	0.50	0.10			0.01	0.18	0.24	0.44	0.43	0.34	0.31	0.35	0.26	0.29	0.29	0.24	0.23	0.05	0.37	0.70	0.58
(12)	Gross Water Requirement																										
	l/sec/ha			0.16	0.19	0.27	0.24				0.02	0.31	0.32	0.57	0.54	0.28	0.22	0.57	0.68	0.75	0.75	0.62	0.59	0.13	0.06	0.08	0.21
	Pattern-1			0.93	1.20	1.34	1.30	0.33				0.17	0.30	0.58	0.58	0.62	0.59	0.33							1.11	2.12	1.58
	Pattern-2			0.16	0.19	0.27	0.24				0.02	0.31	0.32	0.57	0.54	0.28	0.22	0.57	0.68	0.75	0.75	0.62	0.59	0.13	0.06	0.08	0.21

Table V-5 Irrigation Water Requirements (6/8)

Project : **Tanjungkarya (Gar**
Year: **Mean**

Name	Pattern(intensity)	Area(%)
Cropping pattern -1(P1)	paddy-vegetable (200%)	30%
Cropping pattern -2(P2)	vegetable-vegetable-vegetable (300%	70%
Cropping pattern -3(P3)		

No.	Item	Unit		Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
(1)	ETo (Bandung)	mm		4.3	4.3	4.5	4.5	4.5	4.5	4.2	4.2	4.0	4.0	4.0	4.0	4.3	4.3	4.9	4.9	5.5	5.5	5.1	5.1	4.8	4.8	4.4	4.4
(2)	Crop coeff, Kc	P1	1	1.10	1.05	1.05	0.95				0.70	0.85	1.00	1.00	1.00	0.95	0.90										1.10
	(FAO IDP No.24)		2	1.10	1.10	1.05	1.05	0.95				0.70	0.85	1.00	1.00	1.00	0.95	0.90									
		P2	3	1.00	1.00	0.95	0.90		0.70	0.85	1.00	1.00	1.00	0.95	0.90		0.70	0.85	1.00	1.00	1.00	0.95	0.90		0.70	0.85	1.00
			4	1.00	1.00	1.00	0.95	0.90		0.70	0.85	1.00	1.00	1.00	0.95	0.90		0.70	0.85	1.00	1.00	1.00	0.95	0.90		0.70	0.85
		P3																									
(3)	ETcrop/day	mm	1	4.7	4.5	4.7	4.2				2.9	3.4	4.0	4.0	4.0	4.1	3.9										4.9
		mm	2	4.7	4.7	4.7	4.7	4.3				2.8	3.4	4.0	4.0	4.3	4.1	4.4									
		mm	3	4.3	4.3	4.2	4.0		3.1	3.6	4.2	4.0	4.0	3.8	3.6		3.0	4.1	4.9	5.5	5.5	4.8	4.6		3.4	3.8	4.4
		mm	4	4.3	4.3	4.5	4.2	4.0		2.9	3.6	4.0	4.0	4.0	3.8	3.9		3.4	4.1	5.5	5.5	5.1	4.8	4.3		3.1	3.8
		mm	5																								
		mm	6																								
(4)	ET crop 1/2 month	mm	1	70.5	71.7	65.6	59.4				44.0	51.1	64.1	59.3	59.3	61.8	62.5										78.0
		mm	2	70.5	75.2	65.6	65.6	64.1				42.1	54.5	59.3	59.3	65.1	65.9	65.8									
		mm	3	64.1	68.3	59.4	56.2		50.4	53.4	62.8	60.1	64.1	56.3	53.3		48.6	62.1	78.0	82.1	82.1	72.5	73.2		50.4	56.5	70.9
		mm	4	64.1	68.3	62.5	59.4	60.7		44.0	53.4	60.1	64.1	59.3	56.3	58.6		51.2	66.3	82.1	82.1	76.3	77.3	64.8		46.6	60.3
		mm	5																								
		mm	6																								
(5)	Land Preparation	mm	1																						220.5	216.8	
	(KP-01)	mm	2																							216.8	231.2
		mm	3																								
		mm	4																								
		mm	5																								
		mm	6																								
(6)	Deep percolation	mm	1	45	48	42	42																				48
	3.0 mm/day	mm	2		48	42	42	45																			
		mm	3																								
		mm	4																								
		mm	5																								
		mm	6																								
(7)	Water layer replacement	mm	1	50		50																					
	(KP-01)		2		50		50																				
			3																								
			4																								
			5																								
		mm	6																								
(8)	Field water requirement	mm	1	165.5	119.7	157.6	101.4				44.0	51.1	64.1	59.3	59.3	61.8	62.5								220.5	216.8	126.0
			2	70.5	173.2	107.6	157.6	109.1				42.1	54.5	59.3	59.3	65.1	65.9	65.8								216.8	231.2
			3	64.1	68.3	59.4	56.2		50.4	53.4	62.8	60.1	64.1	56.3	53.3		48.6	62.1	78.0	82.1	82.1	72.5	73.2		50.4	56.5	70.9
			4	64.1	68.3	62.5	59.4	60.7		44.0	53.4	60.1	64.1	59.3	56.3	58.6		51.2	66.3	82.1	82.1	76.3	77.3	64.8		46.6	60.3
			5																								
			6																								
(9)	Effc rainfall	mm																									
	Rain (80% reliable)			69.6	69.6	50.8	50.8	92.3	92.3	84.5	84.5	42.7	42.7	2.0	2.0	3.4	3.4			11.1	11.1	18.5	18.5	55.7	55.7	62.5	62.5
	0.70 x R		1	41.7	41.7	30.5	30.5				59.2	29.9	29.9	1.4	1.4	2.3	2.3								39.0	43.8	37.5
	0.60 x R		2	41.7	41.7	30.5	30.5	55.4				29.9	25.6	1.2	1.2	2.0	2.0									43.8	43.8
			3	48.7	48.7	35.6	35.6		64.6	59.2	59.2	29.9	29.9	1.4	1.4		2.3			7.8	7.8	13.0	13.0		39.0	43.8	43.8
			4	48.7	48.7	35.6	35.6	64.6		59.2	59.2	29.9	29.9	1.4	1.4	2.3				7.8	7.8	13.0	13.0	39.0		43.8	43.8
			5																								
			6																								
(10)	Net Water Requirement	mm	1	123.7	78.0	127.1	70.9					21.2	34.3	57.9	57.9	59.5	60.1								181.6	173.0	88.5
			2	28.7	131.4	77.1	127.1	53.7				12.2	28.9	58.1	58.1	63.0	63.9	65.8								173.0	187.5
			3	15.4	19.6	23.8	20.7				3.7	30.2	34.3	54.9	51.9		46.2	62.1	78.0	74.3	74.3	59.5	60.3		11.4	12.8	27.2
			4	15.4	19.6	26.9	23.8					30.2	34.3	57.9	54.9	56.2		51.2	66.3	74.3	74.3	63.3	64.3	25.8		2.8	16.5
			5																								
			6																								
(11)	Net Water Requirement		1	0.95	0.56	1.05	0.59					0.16	0.25	0.45	0.45	0.46	0.43								1.40	1.33	0.64
	l/sec/ha		2	0.22	0.95	0.64	1.05	0.41				0.09	0.21	0.45	0.45	0.49	0.46	0.51								1.33	1.36
			3	0.12	0.14	0.20	0.17				0.03	0.23	0.25	0.42	0.40		0.33	0.48	0.56	0.57	0.57	0.46	0.44		0.09	0.10	0.20
			4	0.12	0.14	0.22	0.20					0.23	0.25	0.45	0.42	0.43		0.39	0.48	0.57	0.57	0.49	0.47	0.20		0.02	0.12
			5																								
			6																								
	Mean total			0.35	0.45	0.53	0.50	0.10			0.01	0.18	0.24	0.44	0.43	0.34	0.31	0.35	0.26	0.29	0.29	0.24	0.23	0.05	0.37	0.70	0.58
(12)	Gross Water Requirement																										
	l/sec/ha			0.39	0.49	0.59	0.56	0.10			0.01	0.26	0.32	0.57	0.55	0.38	0.33	0.50	0.48	0.52	0.52	0.43	0.41	0.09	0.37	0.69	0.62
	Pattern-1			0.93	1.20	1.34	1.30	0.33				0.17	0.30	0.58	0.58	0.62	0.59	0.33							1.11	2.12	1.58
	Pattern-2			0.16	0.19	0.27	0.24				0.02	0.31	0.32	0.57	0.54	0.28	0.22	0.57	0.68	0.75	0.75	0.62	0.59	0.13	0.06	0.08	0.21

Table V-5 Irrigation Water Requirements (7/8)

Project : **Mekarmukti(Sumed**
Year: **Mean**

Name	Pattern(intensity)	Area(%)
Cropping pattern -1(P1)	paddy-vegetable (200%)	100%
Cropping pattern -2(P2)	vegetable-vegetable-vegetable (300%	
Cropping pattern -3(P3)	paddy-vegetable-vegetable (300%)	

				Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
(1)	ETo (Jatiwangi)	mm		4.5	4.5	4.7	4.7	5.1	5.1	5.0	5.0	5.0	5.0	4.8	4.8	5.2	5.2	6.2	6.2	5.5	5.5	6.6	6.6	5.4	5.4	4.8	4.8
(2)	Crop coeff, Kc	P1	1	1.10	1.05	1.05	0.95				0.70	0.85	1.00	1.00	1.00	0.95	0.90										1.10
	(FAO IDP No.24)		2	1.10	1.10	1.05	1.05	0.95				0.70	0.85	1.00	1.00	1.00	0.95	0.90									
		P2	3	1.00	1.00	0.95	0.90		0.70	0.85	1.00	1.00	1.00	0.95	0.90		0.70	0.85	1.00	1.00	1.00	0.95	0.90		0.70	0.85	1.00
			4	1.00	1.00	1.00	0.95	0.90		0.70	0.85	1.00	1.00	1.00	0.95	0.90		0.70	0.85	1.00	1.00	1.00	0.95	0.90		0.70	0.85
		P3	5	1.10	1.05	1.05	0.95			0.70	0.85	1.00	1.00	1.00	0.95	0.90		0.70	0.85	1.00	1.00	0.95	0.90				1.10
			6	1.10	1.10	1.05	1.05	0.95			0.70	0.85	1.00	1.00	1.00	0.95	0.90		0.70	0.85	1.00	1.00	0.95	0.90			
(3)	ETcrop/day	mm	1	4.9	4.7	4.9	4.4				3.5	4.3	5.0	4.8	4.8	4.9	4.7										5.3
		mm	2	4.9	4.9	4.9	4.9	4.8				3.5	4.3	4.8	4.8	5.2	4.9	5.6									
		mm	3	4.5	4.5	4.4	4.2		3.5	4.3	5.0	5.0	5.0	4.5	4.3		3.6	5.3	6.2	5.5	5.5	6.3	6.0		3.8	4.1	4.8
		mm	4	4.5	4.5	4.7	4.4	4.6		3.5	4.3	5.0	5.0	4.8	4.5	4.7		4.3	5.3	5.5	5.5	6.6	6.3	4.9		3.4	4.1
		mm	5	4.9	4.7	4.9	4.4			3.5	4.3	5.0	5.0	4.8	4.5	4.7		4.3	5.3	5.5	5.5	6.3	6.0				5.3
		mm	6	4.9	4.9	4.9	4.9	4.8			3.5	4.3	5.0	4.8	4.8	4.9	4.7		4.3	4.6	5.5	6.6	6.3	4.9			
(4)	ET crop 1/2 month	mm	1	74.2	75.5	68.5	62.0				52.6	63.8	80.1	71.8	71.8	73.8	74.6										84.7
		mm	2	74.2	79.1	68.5	68.5	72.1				52.6	68.1	71.8	71.8	77.7	78.7	83.7									
		mm	3	67.4	71.9	62.0	58.7		56.7	63.9	75.2	75.1	80.1	68.2	64.6		58.0	79.1	99.2	82.1	82.1	94.7	95.7		57.0	61.4	77.0
		mm	4	67.4	71.9	65.2	62.0	68.3		52.6	63.9	75.1	80.1	71.8	68.2	69.9		65.1	84.3	82.1	82.1	99.7	101.0	73.3		50.6	65.5
		mm	5	74.2	75.5	68.5	62.0			52.6	63.9	75.1	80.1	71.8	68.2	69.9		65.1	84.3	82.1	82.1	94.7	95.7				84.7
		mm	6	74.2	79.1	68.5	68.5	72.1			52.6	63.8	80.1	71.8	71.8	73.8	74.6		69.4	69.7	82.1	99.7	101.0	73.3			
(5)	Land Preparation	mm	1																						227.2	220.7	
	(KP-01)	mm	2																							220.7	235.4
		mm	3																								
		mm	4																								
		mm	5																						227.2	220.7	
		mm	6																							220.7	235.4
(6)	Deep percolation	mm	1	45	48	42	42																				48
	3.0 mm/day	mm	2		48	42	42	45																			
		mm	3																								
		mm	4																								
		mm	5	45	48	42	42																				48
		mm	6		48	42	42	45																			
(7)	Water layer replacement	mm	1	50		50																					
	(KP-01)		2		50		50																				
			3																								
			4																								
			5	50		50																					
		mm	6		50		50																				
(8)	Field water requirement	mm	1	169.2	123.5	160.5	104.0				52.6	63.8	80.1	71.8	71.8	73.8	74.6								227.2	220.7	132.7
			2	74.2	177.1	110.5	160.5	117.1				52.6	68.1	71.8	71.8	77.7	78.7	83.7								220.7	235.4
			3	67.4	71.9	62.0	58.7		56.7	63.9	75.2	75.1	80.1	68.2	64.6		58.0	79.1	99.2	82.1	82.1	94.7	95.7		57.0	61.4	77.0
			4	67.4	71.9	65.2	62.0	68.3		52.6	63.9	75.1	80.1	71.8	68.2	69.9		65.1	84.3	82.1	82.1	99.7	101.0	73.3		50.6	65.5
			5	169.2	123.5	160.5	104.0			52.6	63.9	75.1	80.1	71.8	68.2	69.9		65.1	84.3	82.1	82.1	94.7	95.7		227.2	220.7	132.7
			6	74.2	177.1	110.5	160.5	117.1			52.6	63.8	80.1	71.8	71.8	73.8	74.6		69.4	69.7	82.1	99.7	101.0	73.3		220.7	235.4
(9)	Effc rainfall	mm																									
	Rain (80% reliable, Jatiwangi)			90.5	90.5	107.4	107.4	103.7	103.7	112.4	112.4	6.5	6.5	1.5	1.5							6.0	6.0	12.4	12.4	137.9	137.9
	0.70 x R		1	54.3	54.3	64.4	64.4				78.6	4.6	4.6	1.1	1.1										8.7	96.5	82.7
	0.60 x R		2	54.3	54.3	64.4	64.4	62.2				4.6	3.9	0.9	0.9											96.5	96.5
			3	63.4	63.4	75.1	75.1		72.6	78.6	78.6	4.6	4.6	1.1	1.1							4.2	4.2		8.7	96.5	96.5
			4	63.4	63.4	75.1	75.1	72.6		78.6	78.6	4.6	4.6	1.1	1.1							4.2	4.2	8.7		96.5	96.5
			5	54.3	54.3	64.4	64.4				78.6	4.6	4.6	1.1	1.1							4.2	4.2		8.7	96.5	82.7
			6	54.3	54.3	64.4	64.4	62.2				4.6	4.6	1.1	1.1							4.2	4.2	8.7		96.5	96.5
(10)	Net Water Requirement	mm	1	114.9	69.2	96.1	39.6					59.3	75.6	70.8	70.8	73.8	74.6								218.5	124.2	50.0
			2	19.9	122.8	46.1	96.1	54.9				48.0	64.2	70.9	70.9	77.7	78.7	83.7								124.2	138.9
			3	4.1	8.6							70.6	75.6	67.2	63.6		58.0	79.1	99.2	82.1	82.1	90.5	91.5		48.3		
			4	4.1	8.6							70.6	75.6	70.8	67.2	69.9		65.1	84.3	82.1	82.1	95.5	96.8	64.6			
			5	114.9	69.2	96.1	39.6			52.6		70.6	75.6	70.8	67.2	69.9		65.1	84.3	82.1	82.1	90.5	91.5		218.5	124.2	50.0
			6	19.9	122.8	46.1	96.1	54.9			52.6	59.3	75.6	70.8	70.8	73.8	74.6		69.4	69.7	82.1	95.5	96.8	64.6		124.2	138.9
(11)	Net Water Requirement		1	0.89	0.50	0.79	0.33					0.46	0.55	0.55	0.55	0.57	0.54								1.69	0.96	0.36
	l/sec/ha		2	0.15	0.89	0.38	0.79	0.42				0.37	0.46	0.55	0.55	0.60	0.57	0.65								0.96	1.01
			3	0.03	0.06							0.54	0.55	0.52	0.49		0.42	0.61	0.72	0.63	0.63	0.70	0.66		0.37		
			4	0.03	0.06							0.54	0.55	0.55	0.52	0.54		0.50	0.61	0.63	0.63	0.74	0.70	0.50			
			5	0.89	0.50	0.79	0.33			0.41		0.54	0.55	0.55	0.52	0.54		0.50	0.61	0.63	0.63	0.70	0.66		1.69	0.96	0.36
			6	0.15	0.89	0.38	0.79	0.42			0.41	0.46	0.55	0.55	0.55	0.57	0.54		0.50	0.54	0.63	0.74	0.70	0.50		0.96	1.01
	Mean total			0.36	0.48	0.39	0.37	0.14		0.07	0.07	0.49	0.53	0.54	0.53	0.47	0.34	0.38	0.41	0.41	0.42	0.48	0.45	0.17	0.62	0.64	0.46
(12)	Gross Water Requirement																										
	l/sec/ha			0.82	1.10	0.93	0.89	0.34				0.54	0.66	0.71	0.71	0.76	0.72	0.42							1.34	1.52	1.08
	Pattern-1			0.82	1.10	0.93	0.89	0.34				0.54	0.66	0.71	0.71	0.76	0.72	0.42							1.34	1.52	1.08
	Pattern-2			0.04	0.08							0.71	0.71	0.70	0.66	0.35	0.27	0.73	0.87	0.83	0.83	0.94	0.89	0.33	0.24		
	Pattern-3			0.82	1.10	0.93	0.89	0.34		0.32	0.32	0.80	0.87	0.87	0.84	0.88	0.43	0.40	0.88	0.93	1.00	1.14	1.08	0.40	1.34	1.52	1.08

Table V-5 Irrigation Water Requirements (8/8)

Project : **Cisantana(Kuninga**
Year: **Mean**

Name	Pattern(intensity)	Area(%)
Cropping pattern -1(P1)	paddy-vegetable (200%)	
Cropping pattern -2(P2)	vegetable-vegetable-vegetable (300%	100%
Cropping pattern -3(P3)		

No.	Item	Unit		Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
(1)	ETo (Kuningan)	mm		4.0	4.0	4.1	4.1	4.6	4.6	4.2	4.2	4.3	4.3	4.4	4.4	4.6	4.6	4.7	4.7	5.5	5.5	5.8	5.8	5.1	5.1	4.7	4.7
(2)	Crop coeff, Kc	P1	1	1.10	1.05	1.05	0.95				0.70	0.85	1.00	1.00	1.00	0.95	0.90										1.10
	(FAO IDP No.24)		2	1.10	1.10	1.05	1.05	0.95				0.70	0.85	1.00	1.00	1.00	0.95	0.90									
		P2	3	1.00	1.00	0.95	0.90		0.70	0.85	1.00	1.00	1.00	0.95	0.90		0.70	0.85	1.00	1.00	1.00	0.95	0.90		0.70	0.85	1.00
			4	1.00	1.00	1.00	0.95	0.90		0.70	0.85	1.00	1.00	1.00	0.95	0.90		0.70	0.85	1.00	1.00	1.00	0.95	0.90		0.70	0.85
		P3																									
(3)	ETcrop/day	mm	1	4.4	4.2	4.3	3.9				3.0	3.6	4.3	4.4	4.4	4.4	4.1										5.2
		mm	2	4.4	4.4	4.3	4.3	4.4				3.0	3.6	4.4	4.4	4.6	4.4	4.2									
		mm	3	4.0	4.0	3.9	3.7		3.2	3.6	4.2	4.3	4.3	4.2	3.9		3.2	4.0	4.7	5.5	5.5	5.5	5.2		3.5	4.0	4.7
		mm	4	4.0	4.0	4.1	3.9	4.2		3.0	3.6	4.3	4.3	4.4	4.2	4.1		3.3	4.0	5.5	5.5	5.8	5.5	4.6		3.3	4.0
		mm	5																								
		mm	6																								
(4)	ET crop 1/2 month	mm	1	65.5	66.7	60.7	54.9				44.5	54.4	68.3	65.6	65.6	65.5	66.2										83.2
		mm	2	65.5	69.8	60.7	60.7	65.9				44.8	58.0	65.6	65.6	68.9	69.9	63.2									
		mm	3	59.5	63.5	54.9	52.1		51.8	54.0	63.6	64.0	68.3	62.3	59.0		51.5	59.7	74.9	82.1	82.1	82.3	83.2		53.2	60.3	75.6
		mm	4	59.5	63.5	57.8	54.9	62.4		44.5	54.0	64.0	68.3	65.6	62.3	62.0		49.1	63.6	82.1	82.1	86.6	87.8	68.4		49.6	64.3
		mm	5																								
		mm	6																								
(5)	Land Preparation	mm	1																						223.4	219.8	
	(KP-01)	mm	2																							219.8	234.5
		mm	3																								
		mm	4																								
		mm	5																								
		mm	6																								
(6)	Deep percolation	mm	1	45	48	42	42																				48
	3.0 mm/day	mm	2		48	42	42	45																			
		mm	3																								
		mm	4																								
		mm	5																								
		mm	6																								
(7)	Water layer replacement	mm	1	50		50																					
	(KP-01)		2		50		50																				
			3																								
			4																								
			5																								
		mm	6																								
(8)	Field water requirement	mm	1	160.5	114.7	152.7	96.9				44.5	54.4	68.3	65.6	65.6	65.5	66.2								223.4	219.8	131.2
			2	65.5	167.8	102.7	152.7	110.9				44.8	58.0	65.6	65.6	68.9	69.9	63.2								219.8	234.5
			3	59.5	63.5	54.9	52.1		51.8	54.0	63.6	64.0	68.3	62.3	59.0		51.5	59.7	74.9	82.1	82.1	82.3	83.2		53.2	60.3	75.6
			4	59.5	63.5	57.8	54.9	62.4		44.5	54.0	64.0	68.3	65.6	62.3	62.0		49.1	63.6	82.1	82.1	86.6	87.8	68.4		49.6	64.3
			5																								
			6																								
(9)	Effc rainfall	mm																									
	Rain (80% reliable, Jatiwangi)			43.0	43.0	48.0	48.0	56.5	56.5	59.5	59.5	35.0	35.0	1.0	1.0	2.5	2.5							30.0	30.0	103.0	103.0
	0.70 x R		1	25.8	25.8	28.8	28.8				41.7	24.5	24.5	0.7	0.7	1.8	1.8								21.0	72.1	61.8
	0.60 x R		2	25.8	25.8	28.8	28.8	33.9				24.5	21.0	0.6	0.6	1.5	1.5									72.1	72.1
			3	30.1	30.1	33.6	33.6		39.6	41.7	41.7	24.5	24.5	0.7	0.7		1.8								21.0	72.1	72.1
			4	30.1	30.1	33.6	33.6	39.6		41.7	41.7	24.5	24.5	0.7	0.7	1.8								21.0		72.1	72.1
			5																								
			6																								
(10)	Net Water Requirement	mm	1	134.7	88.9	123.9	68.1				2.8	29.9	43.8	64.9	64.9	63.7	64.4								202.4	147.7	69.4
			2	39.7	142.0	73.9	123.9	77.0				20.3	37.0	65.0	65.0	67.4	68.4	63.2								147.7	162.4
			3	29.4	33.4	21.3	18.5		12.2	12.4	21.9	39.5	43.8	61.6	58.3		49.7	59.7	74.9	82.1	82.1	82.3	83.2		32.2		3.5
			4	29.4	33.4	24.2	21.3	22.9		2.8	12.4	39.5	43.8	64.9	61.6	60.3		49.1	63.6	82.1	82.1	86.6	87.8	47.4			
			5																								
			6																								
(11)	Net Water Requirement		1	1.04	0.64	1.02	0.56				0.02	0.23	0.32	0.50	0.50	0.49	0.47								1.56	1.14	0.50
	l/sec/ha		2	0.31	1.03	0.61	1.02	0.59				0.16	0.27	0.50	0.50	0.52	0.49	0.49								1.14	1.17
			3	0.23	0.24	0.18	0.15		0.09	0.10	0.17	0.30	0.32	0.48	0.45		0.36	0.46	0.54	0.63	0.63	0.64	0.60		0.25		0.03
			4	0.23	0.24	0.20	0.18	0.18		0.02	0.10	0.30	0.32	0.50	0.48	0.47		0.38	0.46	0.63	0.63	0.67	0.64	0.37			
			5																								
			6																								
	Mean total			0.45	0.54	0.50	0.48	0.19	0.02	0.03	0.07	0.25	0.30	0.49	0.48	0.37	0.33	0.33	0.25	0.32	0.32	0.33	0.31	0.09	0.45	0.57	0.43
(12)	Gross Water Requirement																								
	l/sec/ha			0.30	0.32	0.25	0.22	0.12	0.06	0.08	0.17	0.40	0.41	0.64	0.60	0.30	0.24	0.55	0.65	0.83	0.83	0.85	0.81	0.24	0.16		0.02
	Pattern-1			1.07	1.33	1.30	1.26	0.47			0.01	0.25	0.38	0.65	0.65	0.66	0.63	0.32							1.24	1.81	1.33
	Pattern-2			0.30	0.32	0.25	0.22	0.12	0.06	0.08	0.17	0.40	0.41	0.64	0.60	0.30	0.24	0.55	0.65	0.83	0.83	0.85	0.81	0.24	0.16		0.02

Table V-6 Irrigable Area by Model Area (1/2)

(1) Mekarjaya (Bandung)

Pattern-1 **Paddy rice + Paddy rice (10% of the total area), cultivated on the downstream using the water from the Citiis river.**

Pattern-2 **Vegetables + Vegetables + Vegetables (90% of the total area)**

		Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
Unit Diversion Req. in lit./sec/ha		0.23	0.29	0.38	0.35	0.03			0.08	0.43	0.42	0.65	0.62	0.39	0.33	0.57	0.61	0.67	0.67	0.56	0.53	0.12	0.16	0.28	0.34
Citiis (40% of estimated flow)	Available Water (m3/s)	0.10	0.10	0.10	0.10	0.09	0.09	0.12	0.12	0.10	0.10	0.07	0.07	0.04	0.04	0.03	0.03	0.04	0.04	0.04	0.04	0.06	0.06	0.12	0.12
	Irrigable area (ha)	443	359	267	294	'000<	'000<	'000<	'000<	229	240	106	111	104	124	53	50	57	57	74	77	503	361	409	335
Ciremes (80% of estimated flow)	Available Water (m3/s)	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02
	Irrigable area (ha)	77	62	46	51	498	'000<	'000<	253	40	42	18	19	18	22	9	9	10	10	13	13	87	63	71	58

Note : '000< = Irrigable area is more than 1,000 ha.

(2) Langensari and Tugumukti (Bandung)

Pattern-1 **Vegetables + Vegetables + Vegetables (100% of the total area)**

		Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
Unit Diversion Req. in lit./sec/ha		0.03	0.06	0.14	0.12				0.01	0.44	0.44	0.48	0.45	0.24	0.18	0.48	0.57	0.71	0.71	0.61	0.58	0.05		0.04	0.14
Cikoreo (80% of estimated flow)	Available Water (m3/s)	0.25	0.25	0.28	0.28	0.20	0.20	0.32	0.32	0.22	0.22	0.14	0.14	0.09	0.09	0.07	0.07	0.07	0.07	0.09	0.09	0.13	0.13	0.26	0.26
	Irrigable area (ha)	'000<	'000<	'000<	'000<	'000<	'000<	'000<	'000<	505	500	290	307	399	516	157	132	104	104	146	154	'000<	'000<	'000<	'000<
Cipogo (80% of estimated flow)	Available Water (m3/s)	0.04	0.04	0.05	0.05	0.03	0.03	0.05	0.05	0.04	0.04	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.04	0.04
	Irrigable area (ha)	'000<	709	319	393	'000<	'000<	'000<	'000<	83	82	48	50	65	85	26	22	17	17	24	25	396	'000<	'000<	306
Kali Cimahi (10.8% of dependable flow)	Available Water (m3/s)	0.10	0.10	0.11	0.11	0.10	0.10	0.08	0.08	0.12	0.12	0.09	0.09	0.06	0.06	0.05	0.05	0.04	0.04	0.04	0.04	0.05	0.05	0.06	0.06
	Irrigable area (ha)	'000<	'000<	745	920	'000<	'000<	'000<	'000<	270	268	193	204	261	338	102	85	61	61	68	72	914	'000<	'000<	422

Note : '000< = Irrigable area is more than 1,000 ha.

(3) Gekbrong (Cianjur)

Pattern-1 **Vegetables + Vegetables + Vegetables (100% of the total area)**

		Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
Unit Diversion Req. in lit./sec/ha		0.34	0.35	0.33	0.31	0.14	0.10	0.24	0.32	0.45	0.46	0.45	0.42	0.25	0.19	0.44	0.53	0.82	0.82	0.50	0.47				
Stream(50% of estimated flow - 5 lit/s for drinking water)	Available Water (m3/s)	0.11	0.11	0.12	0.12	0.08	0.08	0.09	0.09	0.10	0.10	0.07	0.07	0.04	0.04	0.03	0.03	0.03	0.03	0.04	0.04	0.08	0.08	0.12	0.12
	Irrigable area (ha)	333	326	374	403	581	860	381	288	211	209	148	157	159	207	65	54	42	42	86	91	'000<	'000<	'000<	'000<

Note : '000< = Irrigable area is more than 1,000 ha.

(4) Cisurupan (Garut)

Pattern-1 **Vegetables + Vegetables + Vegetables (100% of the total area)**

		Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
Unit Diversion Req. in lit./sec/ha		0.16	0.19	0.27	0.24				0.02	0.31	0.32	0.57	0.54	0.28	0.22	0.57	0.68	0.75	0.75	0.62	0.59	0.13	0.06	0.08	0.21
Cihaleumas, Cibrial, Cigambila (52% of estimated flow)	Available Water (m3/s)	0.18	0.18	0.17	0.17	0.16	0.16	0.21	0.21	0.17	0.17	0.12	0.12	0.07	0.07	0.05	0.05	0.07	0.07	0.07	0.07	0.10	0.10	0.20	0.20
	Irrigable area (ha)	'000<	944	631	719	'000<	'000<	'000<	'000<	556	524	205	216	246	318	91	77	88	88	113	119	770	'000<	'000<	949

Note : '000< = Irrigable area is more than 1,000 ha.

(5) Tanjungkarya (Garut)

Pattern-1 **Paddy rice + Vegetables (50% of the total area)**

Pattern-2 **Vegetables + Vegetables + Vegetables (50% of the total area)**

		Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
Unit Diversion Req. in lit./sec/ha		0.39	0.49	0.59	0.56	0.10			0.01	0.26	0.32	0.57	0.55	0.38	0.33	0.50	0.48	0.52	0.52	0.43	0.41	0.09	0.37	0.69	0.62
Cisaat River (80% of estimated flow)	Available Water (m3/s)	0.25	0.25	0.25	0.25	0.23	0.23	0.29	0.29	0.24	0.24	0.17	0.17	0.10	0.10	0.08	0.08	0.09	0.09	0.10	0.10	0.14	0.14	0.28	0.28
	Irrigable area (ha)	642	508	414	441	'000<	'000<	'000<	'000<	914	763	290	301	261	305	152	159	181	181	233	245	'000<	384	404	450
Cidadalilebak (80% of estimated flow - 5 lit/s for drinking water)	Available Water (m3/s)	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.04	0.04	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
	Irrigable area (ha)	94	75	61	65	315	'000<	'000<	'000<	141	117	58	61	64	75	36	38	30	30	40	42	202	49	32	36
Tanjungpura (80% of estimated flow)	Available Water (m3/s)	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	Irrigable area (ha)	51	40	33	35	173	'000<	'000<	'000<	76	63	32	33	37	43	22	23	19	19	24	26	122	30	19	21
Cilembang Spring (80% of estimated flow - 5 lit/s for drinking water)	Available Water (m3/s)	0.13	0.13	0.12	0.12	0.11	0.11	0.11	0.11	0.13	0.13	0.12	0.12	0.09	0.09	0.07	0.07	0.06	0.06	0.07	0.07	0.07	0.07	0.08	0.08
	Irrigable area (ha)	326	258	210	223	'000<	'000<	'000<	'000<	485	405	203	211	230	268	136	143	115	115	151	159	758	185	117	131

Note : '000< = Irrigable area is more than 1,000 ha.

Table V-6 Irrigable Area by Model Area (2/2)

(6) Mekarmukti (Sumedang)

Pattern-1 **Paddy rice + Vegetables (100% of the total area)**

		Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
Unit Diversion Req. in lit./sec/ha		0.82	1.10	0.93	0.89	0.34				0.54	0.66	0.71	0.71	0.76	0.72	0.42							1.34	1.52	1.08
Ciliang Spring (40% of estimated flow)	Available Water (m3/s)	0.08	0.08	0.10	0.10	0.10	0.10	0.09	0.09	0.09	0.09	0.08	0.08	0.07	0.07	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.07	0.07
	Irrigable area (ha)	102	76	105	110	294	'000<	'000<	'000<	170	139	118	118	88	93	152	'000<	'000<	'000<	'000<	'000<	'000<	46	44	62

Note : '000< = Irrigable area is more than 1,000 ha.

(7) Cisantana (Kuningan)

Pattern-1 **Vegetables + Vegetables + Vegetables (100% of the total area)**

		Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
Unit Diversion Req. in lit./sec/ha		0.30	0.32	0.25	0.22	0.12	0.06	0.08	0.17	0.40	0.41	0.64	0.60	0.30	0.24	0.55	0.65	0.83	0.83	0.85	0.81	0.24	0.16		0.02
Cipager River (80% of estimated flow)	Available Water (m3/s)	0.65	0.65	0.56	0.56	0.62	0.62	0.60	0.60	0.43	0.43	0.43	0.43	0.24	0.24	0.24	0.24	0.20	0.20	0.17	0.17	0.22	0.22	0.38	0.38
	Irrigable area (ha)	'000<	'000<	'000<	'000<	'000<	'000<	'000<	'000<	'000<	'000<	676	713	776	'000<	429	359	236	236	197	208	941	'000<	'000<	'000<

Note : '000< = Irrigable area is more than 1,000 ha.

Table V-7 Hydraulic Analysis of Citiis-A Irrigation Pipeline System

	SP (m)	Distance (m)	Pipe Diameter (mm)	Type of pipe	Velocity coefficient C	Discharge Q (lit./s)	Velocity v (m/s)	Gradient I (%)	Losses h (m)	Ground level GH (m)	Planned level H0 (m)	Hydraulic water level (m)	Hydraulic head (m)	Static water level (m)	Static head (m)	Remarks
Conveyance P	0.00		200		150	49.800	1.585			1320.00	1319.2	1320.15		1320.15		
Citiis-A FP	850.00	850.00	200	PVC S16	150	49.800	1.585	0.977	9.13	1309.00	1308.2	1311.02	2.82	1320.15	11.95	
Main pipeline	850.00	850.00	200	PVC S16	150	49.800	1.585	0.977	9.13	1309.00	1308.20	1311.02	2.82	1310.20	2.00	
BMTR1	2.00	2.00	200	PVC S16	150	59.400	1.891	1.354	0.03	1309.00	1308.20	1310.20 1310.20	2.00	1310.20 1310.20	2.00 2.00	
BMTR2	60.00	58.00	200	PVC S16	150	57.300	1.824	1.267	0.81	1305.00	1304.20	1309.39	5.19	1310.20	6.00	
BMTR3	140.00	80.00	200	PVC S12.5	150	57.300	1.824	1.267	1.11	1290.00	1289.20	1308.28	19.08	1310.20	21.00	
BMTR4	260.00	120.00	200	PVC S8	150	57.300	1.824	1.267	1.67	1255.00	1254.20	1306.61	52.41	1310.20	56.00	
BMTR5	360.00	100.00	200	PVC S10	150	57.300	1.824	1.267	1.39	1230.00	1229.20	1255.00 1253.61	24.41	1255.00 1255.00	25.80	Pressure control stand
BMTR6	560.00	200.00	200	PVC S8	150	57.300	1.824	1.267	2.79	1202.00	1201.20	1250.82	49.62	1255.00	53.80	
BMTR7	660.00	100.00	200	PVC S8	150	57.300	1.824	1.267	1.39	1195.00	1194.19	1249.43	55.24	1255.00	60.81	
BMTR8	770.00	110.00	200	PVC S8	150	46.500	1.480	0.860	1.04	1197.00	1196.19	1248.39	52.20	1255.00	58.81	Diversion cum
BMTR9	840.00	70.00	200	PVC S16	150	42.500	1.353	0.728	0.56	1185.00	1184.20	1197.00 1196.44	12.24	1197.00 1197.00	12.80	Pressure control stand
BMTR10	940.00	100.00	150	PVC S12.5	150	28.100	1.590	1.375	1.51	1174.00	1173.20	1194.93	21.73	1197.00	23.80	
BMTR11	1030.00	90.00	150	PVC S16	150	16.000	0.905	0.484	0.48	1167.00	1166.20	1194.45	28.25	1197.00	30.80	
BMTR12	1070.00	40.00	100	PVC S10	150	12.000	1.528	2.049	0.90	1164.00	1163.20	1193.55	30.35	1197.00	33.80	
BMTR13	1310.00	240.00	100	PVC S10	150	6.800	0.866	0.716	1.89	1137.00	1136.20	1191.66	55.46	1197.00	60.80	
BMTR8a	830.00	60.00	150	PVC S12.5	150	26.500	1.500	1.233	0.81	1180.00	1179.20	1196.19	16.99	1197.00	17.80	
BMTR8b	980.00	150.00	150	PVC S12.5	150	20.900	1.183	0.794	1.31	1160.00	1159.20	1194.88	35.68	1197.00	37.80	
BMTR8c	1080.00	100.00	150	PVC S12.5	150	11.700	0.662	0.271	0.30	1142.00	1141.20	1194.58	53.38	1197.00	55.80	

Table V-8 Hydraulic Analysis of Citiis-B Irrigation Pipeline System

	SP (m)	Distance (m)	Pipe Diameter (mm)	Type of pipe	Velocity coefficient C	Discharge Q (lit./s)	Velocity v (m/s)	Gradient I (%)	Losses h (m)	Ground level GH (m)	Planned level H0 (m)	Hydraulic water level (m)	Hydraulic head (m)	Static water level (m)	Static head (m)	Remarks
Citiis-A FP	0.00	0.00	150			22.400	1.585	0.977	9.13	1309.00	1308.20	1311.02	2.82	1310.20	2.00	
	340.00	340.00	150	PVC S10	150	22.400	1.268	0.903	3.38	1252.00	1251.20	1307.64	56.44	1310.20	59.00	
	(340.00)											1253.20		1253.20		Pressure control stand
	650.00	310.00	150	PVC S10	150	22.400	1.268	0.903	3.08	1194.00	1193.20	1250.12	56.92	1253.20	60.00	Scouring valve
Citiis-B FP	860.00	210.00	150	PVC S12.5	150	22.400	1.268	0.903	2.09	1215.00	1214.20	1248.03	33.83	1253.20	39.00	
Main canal											1214.20	1216.20		1216.20	2.00	
BMTL1	90.00	90.00	200	PVC S16	150	48.400	1.541	0.927	0.92	1202.00	1201.20	1215.28	14.08	1216.20	15.00	
BMTL2	160.00	70.00	200	PVC S12.5	150	48.400	1.541	0.927	0.71	1189.00	1188.20	1214.57	26.37	1216.20	28.00	
BMTL3	250.00	90.00	200	PVC S10	150	48.400	1.541	0.927	0.92	1175.00	1174.20	1213.65	39.45	1216.20	42.00	
BMTL4	450.00	200.00	200	PVC S10	150	48.400	1.541	0.927	2.04	1165.00	1164.20	1211.61	47.41	1216.20	52.00	
	(450.00)											1166.20		1166.20		Pressure control stand
BMTL5	550.00	100.00	200	PVC S16	150	48.400	1.541	0.927	1.02	1152.00	1151.20	1165.18	13.98	1166.20	15.00	
BMTL6	650.00	100.00	200	PVC S12.5	150	48.400	1.541	0.927	1.02	1139.00	1138.20	1164.16	25.96	1166.20	28.00	
BMTL7	770.00	120.00	200	PVC S10	150	48.400	1.541	0.927	1.22	1124.00	1123.20	1162.94	39.74	1166.20	43.00	
BMTL8	810.00	40.00	200	PVC S10	150	46.400	1.477	0.857	0.38	1118.00	1117.20	1162.56	45.36	1166.20	49.00	
BMTL9	990.00	180.00	200	PVC S8	150	38.800	1.235	0.615	1.22	1099.00	1098.20	1161.34	63.14	1166.20	68.00	
	(990.00)											1100.20		1100.20		Pressure control stand
BMTL10	1080.00	90.00	150	PVC S12.5	150	32.800	1.856	1.830	1.81	1078.00	1077.20	1098.39	21.19	1100.20	23.00	
BMTL11	1310.00	230.00	150	PVC S10	150	27.600	1.562	1.330	3.36	1049.00	1048.20	1095.02	46.82	1100.20	52.00	
BMTL12	1390.00	80.00	150	PVC S10	150	24.400	1.381	1.058	0.93	1046.00	1045.20	1094.09	48.89	1100.20	55.00	
BMTL13	1500.00	110.00	150	PVC S10	150	20.800	1.177	0.787	0.95	1039.00	1038.20	1093.14	54.94	1100.20	62.00	
BMTL14	1600.00	100.00	150	PVC S10	150	16.400	0.928	0.507	0.56	1036.00	1035.20	1092.58	57.38	1100.20	65.00	
	(1600.00)											1037.20		1037.20		Pressure control stand
BMTL15	1700.00	100.00	100	PVC S16	150	12.000	1.528	2.049	2.25	1031.00	1030.20	1034.95	4.75	1037.20	7.00	
BMTL16	1760.00	60.00	75	PVC S16	150	5.600	1.268	2.028	1.34	1021.00	1020.20	1033.61	13.41	1037.20	17.00	

Table V-9 Hydraulic Analysis of Ciremes Irrigation Pipeline System

	SP (m)	Distance (m)	Pipe Diameter (mm)	Type of pipe	Velocity coefficient C	Discharge Q (lit./s)	Velocity v (m/s)	Gradient I (%)	Losses h (m)	Ground level GH (m)	Planned level H0 (m)	Hydraulic water level (m)	Hydraulic head (m)	Static water level (m)	Static head (m)	Remarks
Ciremes Conveyance P	0.00		75		150	5.600	1.268			1283.00	1282.20	1283.15		1283.15		
Ciremes FP	340.00	340.00	75	PVC S12.5	150	5.600	1.268	2.028	7.59	1258.00	1257.20	1275.56	18.36	1283.15	25.95	
Main pipeline	0.00	0.00	75	PVC S12.5	150	5.600	1.268	2.028	7.59	1258.00	1257.20	1259.20	18.36	1259.20	2.00	
BMR1	5.00	2.00	100	PVC S16	150	12.400	1.579	2.177	0.05	1257.00	1257.20	1259.15	1.95	1259.20	2.00	
BMR2	45.00	40.00	100	PVC S16	150	12.400	1.579	2.177	0.96	1256.00	1255.20	1258.19	2.99	1259.20	4.00	
BMR3	315.00	270.00	100	PVC S10	150	12.400	1.579	2.177	6.47	1214.00	1213.20	1251.73	38.53	1259.20	46.00	
BMR4	415.00	100.00	75	PVC S8	150	6.400	1.449	2.597	2.86	1190.00	1189.20	1248.87	59.67	1259.20	70.00	

Table V-10 Hydraulic Analysis of Gekbrong Right Irrigation Pipeline System

	SP (m)	Distance (m)	Pipe Diameter (mm)	Type of pipe	Velocity coefficient C	Discharge Q (lit./s)	Velocity v (m/s)	Gradient I (%)	Losses h (m)	Ground level GH (m)	Planned level H0 (m)	Hydraulic water level (m)	Hydraulic head (m)	Static water level (m)	Static head (m)	Remarks
Conveyance P	0.00		200		150	41.000	1.305			1117.00	1116.2	1117.15		1117.15		
	870.00	870.00	200	PVC S16	150	41.000	1.305	0.681	6.52	1100.00	1099.2	1110.63	11.43	1117.15	17.95	
Farm pond 1	1170.00	300.00	200	PVC S12.5	150	41.000	1.305	0.681	2.25	1078.00	1079.00	1108.38	29.38	1117.15	38.15	
												1081.00		1081.00	2.00	
Main pipeline	0.00	0.00								1078.00	1079.00	1079.10	0.10	1081.00	2.00	
BGR1	5.00	5.00	150	PVC S16	150	25.100	1.420	1.115	0.06	1075.00	1074.20	1079.04	4.84	1081.00	6.80	
BGR2	70.00	65.00	150	PVC S16	150	25.100	1.420	1.115	0.80	1069.00	1068.20	1078.24	10.04	1081.00	12.80	
	100.00	30.00	150	PVC S16	150	23.700	1.341	1.003	0.33	1066.00	1065.20	1077.91	12.71	1081.00	15.80	
	200.00	100.00	150	PVC S12.5	150	23.700	1.341	1.003	1.10	1056.00	1055.20	1076.81	21.61	1081.00	25.80	
	300.00	100.00	150	PVC S12.5	150	23.700	1.341	1.003	1.10	1047.00	1046.20	1075.70	29.50	1081.00	34.80	
	400.00	100.00	150	PVC S10	150	23.700	1.341	1.003	1.10	1038.00	1037.19	1074.60	37.41	1081.00	43.81	
BGR3	420.00	20.00	150	PVC S10	150	23.700	1.341	1.003	0.22	1036.00	1035.19	1074.38	39.19	1081.00	45.81	
												1036.00		1036.00		Open Stand
	500.00	80.00	150	PVC S16	150	23.700	1.341	1.003	0.88	1029.00	1028.20	1035.12	6.92	1036.00	7.80	
	600.00	100.00	150	PVC S16	150	23.700	1.341	1.003	1.10	1021.00	1020.20	1034.01	13.81	1036.00	15.80	
	700.00	100.00	150	PVC S12.5	150	23.700	1.341	1.003	1.10	1011.00	1010.20	1032.91	22.71	1036.00	25.80	
	800.00	100.00	150	PVC S12.5	150	23.700	1.341	1.003	1.10	1003.00	1002.20	1031.81	29.61	1036.00	33.80	
	900.00	100.00	150	PVC S12.5	150	23.700	1.341	1.003	1.10	1001.00	1000.20	1030.71	30.51	1036.00	35.80	
BGR4	1000.00	100.00	150	PVC S10	150	23.700	1.341	1.003	1.10	997.00	996.20	1029.60	33.40	1036.00	39.80	
BGR5	1070.00	70.00	150	PVC S12.5	150	15.300	0.866	0.446	0.34	993.00	992.20	1029.26	37.06	1036.00	43.80	
	1100.00	30.00	100	PVC S12.5	150	6.900	0.879	0.735	0.24	992.00	991.20	1029.02	37.82	1036.00	44.80	
BGRM	1140.00	40.00	100	PVC S12.5	150	6.900	0.879	0.735	0.32	990.00	989.20	1028.69	39.49	1036.00	46.80	

Table V-11 Hydraulic Analysis of Gekbrong Left Irrigation Pipeline System (1/2)

	SP (m)	Distance (m)	Pipe Diameter (mm)	Type of pipe	Velocity coefficient C	Discharge Q (lit./s)	Velocity v (m/s)	Gradient I (%)	Losses h (m)	Ground level GH (m)	Planned level H0 (m)	Hydraulic water level (m)	Hydraulic head (m)	Static water level (m)	Static head (m)	Remarks
Main pipeline	0.00									1078.00	1079.00	1079.10	0.10	1081.00	2.00	
BGL1	30.00	30.00	200	PVC S12.5	150	61.000	1.942	1.422	0.47	1074.00	1073.20	1078.63	5.43	1081.00	7.80	
BGL2	80.00	50.00	200	PVC S12.5	150	61.000	1.942	1.422	0.78	1069.00	1068.20	1077.85	9.65	1081.00	12.80	
	100.00	20.00	200	PVC S12.5	150	58.500	1.862	1.316	0.29	1067.00	1066.20	1077.56	11.36	1081.00	14.80	
	200.00	100.00	200	PVC S10	150	58.500	1.862	1.316	1.45	1058.00	1057.20	1076.11	18.91	1081.00	23.80	
BGL3	230.00	30.00	200	PVC S10	150	58.500	1.862	1.316	0.43	1056.00	1055.20	1075.68	20.48	1081.00	25.80	
	300.00	70.00	200	PVC S10	150	58.500	1.862	1.316	1.01	1048.00	1047.20	1074.66	27.46	1081.00	33.80	
BGL4	370.00	70.00	200	PVC S10	150	58.500	1.862	1.316	1.01	1040.00	1039.20	1073.65	34.45	1081.00	41.80	
	400.00	30.00	200	PVC S8	150	58.500	1.862	1.316	0.43	1038.00	1037.20	1073.22	36.02	1081.00	43.80	
	500.00	100.00	200	PVC S8	150	58.500	1.862	1.316	1.45	1028.00	1027.20	1071.77	44.57	1081.00	53.80	
BGL5	530.00	30.00	200	PVC S8	150	58.500	1.862	1.316	0.43	1025.00	1024.20	1071.33	47.13	1081.00	56.80	
	(530.00)											1025.00		1025.00		Open stand
	600.00	70.00	200	PVC S12.5	150	58.500	1.862	1.316	1.01	1020.00	1019.20	1023.99	4.79	1025.00	5.80	
BGL6	670.00	70.00	200	PVC S12.5	150	58.500	1.862	1.316	1.01	1016.00	1015.20	1022.97	7.77	1025.00	9.80	
	700.00	30.00	200	PVC S12.5	150	58.500	1.862	1.316	0.43	1014.00	1013.20	1022.54	9.34	1025.00	11.80	
BGL7	760.00	60.00	200	PVC S12.5	150	58.500	1.862	1.316	0.87	1010.00	1009.20	1021.67	12.47	1025.00	15.80	
	800.00	40.00	200	PVC S12.5	150	58.500	1.862	1.316	0.58	1005.00	1004.20	1021.09	16.89	1025.00	20.80	
BGL8	850.00	50.00	200	PVC S10	150	58.500	1.862	1.316	0.72	1002.00	1001.20	1020.37	19.17	1025.00	23.80	
	900.00	50.00	200	PVC S10	150	58.500	1.862	1.316	0.72	998.00	997.20	1019.64	22.44	1025.00	27.80	
	1000.00	100.00	200	PVC S10	150	58.500	1.862	1.316	1.45	987.00	986.20	1018.19	31.99	1025.00	38.80	

Table V-11 Hydraulic Analysis of Gekbrong Left Irrigation Pipeline System (2/2)

	SP (m)	Distance (m)	Pipe Diameter (mm)	Type of pipe	Velocity coefficient C	Discharge Q (lit./s)	Velocity v (m/s)	Gradient I (%)	Losses h (m)	Ground level GH (m)	Planned level H0 (m)	Hydraulic water level (m)	Hydraulic head (m)	Static water level (m)	Static head (m)	Remarks
BGL9	1050.00	50.00	200	PVC S10	150	58.500	1.862	1.316	0.72	985.00	984.20	1017.47	33.27	1025.00	40.80	
	(1050.00)											985.00		985.00		Open stand
	1100.00	50.00	200	PVC S16	150	45.700	1.455	0.833	0.46	983.00	982.20	984.54	2.34	985.00	2.80	
BGL10	1150.00	50.00	200	PVC S16	150	45.700	1.455	0.833	0.46	982.00	981.20	984.08	2.88	985.00	3.80	
	1200.00	50.00	150	PVC S12.5	150	34.900	1.975	2.053	1.13	980.00	979.20	982.95	3.75	985.00	5.80	
BGL11	1250.00	50.00	150	PVC S12.5	150	34.900	1.975	2.053	1.13	978.00	977.20	981.82	4.62	985.00	7.80	
	1300.00	50.00	150	PVC S16	150	23.100	1.307	0.956	0.53	974.00	973.20	981.30	8.10	985.00	11.80	
BGL12	1370.00	70.00	150	PVC S16	150	23.100	1.307	0.956	0.74	973.00	972.20	980.56	8.36	985.00	12.80	
	1400.00	30.00	100	PVC S16	150	11.800	1.502	1.986	0.66	972.00	971.20	979.91	8.71	985.00	13.80	
BGLM	1460.00	60.00	100	PVC S16	150	11.800	1.502	1.986	1.31	971.00	970.20	978.60	8.40	985.00	14.80	

Table V-12 Project Cost Summary

unit: mil.Rp

		Mekarjaya	Tanjungkarya	Gekbrong	Langensari	Common	Total
I	Construction cost						
	Direct construction cost						
	a Irrigation	1,778.0	893.7	1,066.5	800.2	(181.1)	4,538.4
	b Marketing road	688.7	509.1	300.8	242.1		1,740.7
	c Collection center	111.0	337.4	143.0	107.5		698.9
	d Rural water supply			174.7	251.9		426.6
	e Others					(135.4)	0.0
	f Physical contingency (10 % of a to d)	257.8	174.0	168.5	140.2	(31.7)	740.5
	sub-total	2,835.5	1,914.2	1,853.5	1,541.9	(348.2)	8,145.1
	Tax (10 % of direct construction cost	283.6	191.4	185.4	154.2	(34.8)	814.6
	Total	3,119.1	2,105.6	2,038.9	1,696.1	(383.0)	8,959.7
II	Training and extension cost by area						
	Village coordinator	240.0	180.0	120.0	180.0		720.0
	Training of farmers/farmers group	184.5	127.1	97.6	133.6		542.8
	Training of village coordinator	5.9	5.5	5.0	5.5		21.9
	Total	430.4	312.6	222.6	319.1		1,284.7
III	Common cost for Highland Development						
	External expert					10,196.6	10,196.6
	Adaptive Trial Farm					383.0	383.0
	Machine/Equipment cost					389.0	389.0
	Training of task team					246.4	246.4
	Total					11,215.0	11,215.0
IV	Total I, II, III	3,549.5	2,418.2	2,261.5	2,015.2	11,215.0	21,459.4
V	Price coningency (8% annum for L/C)	336.2	367.7	237.8	184.2	21.5	1,147.4
	Disbursement of (I+II+III)						
	1st year	458.1	327.6	282.7	274.7	3,289.0	4,632.1
	2nd year	3,298.5	2,364.5	2,149.8	1,829.0	4,697.9	14,339.7
	3rd year	129.1	93.8	66.8	95.7	3,249.6	3,635.0
	4th year						
VI	Total Direct cost	3,885.7	2,785.9	2,499.3	2,199.4	11,236.5	22,606.8
VII	Related cost						
	Administration cost	621.7	445.7	399.9	351.9	1,797.8	3,617.0
	Land acquisition and compensation	3.3	43.7	1.8	6.7		55.5
	Pre-implementation arrangement cost	85.1	60.0	55.6	46.3		247.0
	Total	710.1	549.4	457.3	404.9	1,797.8	3,919.5
TOTAL PROJECT COST (VI + VII)		4,595.8	3,335.3	2,956.6	2,604.3	13,034.3	26,526.3

Table V-13 Construction Cost of Mekarjaya Model Area

Item			Cost
Irrigation			
1	Ciremes Irrigation System (8.4 ha)		
		Intake facilities	30.9
		Farm pond	47.2
		Conveyance and main pipeline	60.7
		Lateral pipeline	15.4
		sub-total	154.2
2	Citiis-A Irrigation System (40.9 ha, including Citiis Weir and Conveyance Pipeline)		
		Intake weir at Citiis River	91.3
		Conveyance pipeline	102.8
		Farm pond	201.6
		Main pipeline	340.0
		Lateral pipeline	154.8
		sub-total	890.5
3	Citiis-B Irrigation System (33.5 ha)		
		Conveyance pipeline	137.2
		Farm pond	190.0
		Main pipeline	289.7
		Lateral pipeline	116.4
		sub-total	733.3
Total for Irrigation			1,778.0
Rural Marketing Road			
1.0	District road to Mekarjaya Village (2,300 m)		440.4
2.0	RW06 to upstream (1,400 m)		248.3
Total for Rural Marketing Road			688.7
Collection Center			
1.0	Collection Center 1 (upstream)		58.4
2.0	Collection Center 2 (RW06)		52.7
Total for Collection Center			111.1
Total Direct Construction Cost for Mekarjaya Model Area			2,577.8
Physical Contingency (10 %)			257.8
sub-total			2,835.6
Value Added Tax (10%)			283.6
Total Construction Cost for Mekarjaya Model Area			3,119.2

Table V-14 Construction Cost of Tanjungkarya Model Area

Item	Cost
Irrigation	
1 Tanjungpura Irrigation System (Rehabilitation, 2.9 ha)	52.4
2 Cidadalilebak Irrigation System (Rehabilitation, 29.9 ha)	372.1
3 Cisaat Irrigation System (Rehabilitation, 18.0 ha)	247.4
4 Cilembang Irrigation System (Rehabilitation, 9.0 ha)	65.7
5 Cibuntu Irrigation System (Rehabilitation, 6.0 ha)	72.2
6 Cilatung Irrigation System (Rehabilitation, 10.7 ha)	83.9
Total for Irrigation	893.7
Rural Marketing Road	
1 Improvement (400m, Tanjung - Makam)	75.9
2 New construction (800m, Makam - Engkol)	433.2
Total for Rural Marketing Road	509.1
Collection Center	
1 Collection Center 1 (Engkol)	65.2
2 Collection Center 2 (Cidadalilebak)	91.9
3 Collection Center 3,4,5 (Makam, Pakuhaj, Grendung)	180.3
Total for Collection Center	337.4
Total Direct Construction Cost for Tanjungkarya Model Area	1,740.2
Physical Contingency (10 %)	174.0
sub-total	1,914.2
Value Added Tax (10%)	191.4
Total Construction Cost for Mekarjaya Model Area	2,105.6

Table V-15 Construction Cost of Gekbrong Model Area

Item	Cost
Irrigation	
1 Intake weir at the Cibeleng river	85.9
2 Conveyance pipe line	153.6
3 Farm pond	274.7
4 Main pipe line	354.6
5 Lateral pipeline	197.7
Total for Irrigation	1,066.5
Rural Marketing Road	
1 Improvement (Loji, 1000m))	300.8
Total for Rural Marketing Road	300.8
Collection Center	
1 Collection Center 1,2,3 (Loji)	143.0
Total for Collection Center	143.0
Rural Water Supply	
1 Reservoir tank with filter	20.0
2 Pipeline and distribution system	154.7
Total for Rural Water Supply	174.7
Total Direct Construction Cost for Tanjungkarya Model Area	1,685.0
Physical Contingency (10 %)	168.5
sub-total	1,853.5
Value Added Tax (10%)	185.4
Total Construction Cost for Mekarjaya Model Area	2,038.9

Table V-16 Construction Cost of Langensari Model Area

Item		Cost
Irrigation		
1	Ciremes Irrigation System (8.4 ha)	
	Intake weir at the Cibogo river (Pemandian Kuda)	20.9
	Irrigation canal	94.5
	sub-total	115.4
2	Cikareo Gravity Irrigation System (3.5 ha)	
	Intake box at Cikole Spring	3.2
	Irrigation canal	10.6
	sub-total	13.8
3	Cikukang Electric Pump System (A) (8.2 ha)	
	Pump and related facilities	80.4
	Farm pond	41.3
	Conveyance and distribution pipelines	47.9
	sub-total	169.6
4	Cikukang Electric Pump System (B) (10.2 ha)	
	Pump and related facilities	80.4
	Farm pond	44.7
	Conveyance and distribution pipelines	79.6
	sub-total	204.7
5	Cikukang and Ciputri Portable Pump System (24.1 ha)	
		296.8
Total for Irrigation		800.3
Rural Marketing Road		
1.0	Improvement (Ckidang 200 m, Ciputri - Langensari 900 m)	242.1
Total for Rural Marketing Road		242.1
Collection Center		
1	Collection Center at Ciputri	57.4
2	Collection Center at Nyampai	50.1
Total for Collection Center		107.5
Rural Water Supply		
1	Pump and related facilities	71.7
2	Pipeline and distribution system	180.2
Total for Rural Water Supply		251.9
Total Direct Construction Cost for Tanjungkarya Model Area		1,401.8
Physical Contingency (10 %)		140.2
sub-total		1,542.0
Value Added Tax (10%)		154.2
Total Construction Cost for Mekarjaya Model Area		1,696.2

Table V-17 Construction Cost of Adaptive Trial Farm

Item	Cost
1 Irrigation facilities	181.2
2 Operational tools	75.9
3 Building and related facilites	59.5
Total Direct Construction Cost for Tanjungkarya Model Area	316.6
Physical Contingency (10 %)	31.7
sub-total	348.3
Value Added Tax (10%)	34.8
Total Construction Cost for Mekarjaya Model Area	383.1

Table V-18 CommonCost for Highland Development and Training and Extension Cost

<u>Common cost for highland development</u>

A. Exteranl Expert					
1. Remuneration	88 M/M	US$	1,164,000		
2. Direct cost		US$	232,800		
Total				US$	1,396,800
Note : BAPPENAS Rate ; based on BAPPENAS Rate					
B. Training of Task Team				Rp.	246,480,000
1. District task team initial training					
2. District task team bimonthly meeting					
3. Overseas training					
C. Machine/Equipment Cost				Rp.	389,000,000
1. Vehicle	2 nos				
2. Computer	5				
3. Photocopy machine	1				
4. Motor cycle	16				

<u>Training and extension cost</u>

A. Village coordinator (NGO)	360 M/M	Rp.	720,000,000	
B. Training of farmers/farmers group				720,000,000
Mekarjaya		Rp.	184,480,000	
Tanjungkarya		Rp.	127,120,000	
Gekbrong		Rp.	97,580,000	
Langensari		Rp.	133,640,000	
sub-total				542,820,000
C. Training of Village Coordinator		Rp.	5,880,000	
Mekarjaya		Rp.	5,460,000	
Tanjungkarya		Rp.	5,040,000	
Gekbrong		Rp.	5,460,000	
Langensari				
Sub-total				21,840,000
<u>Total</u>				1,284,660,000