

PAPER • OPEN ACCESS

## The Implementation of Modern Irrigation to Improve the Farmer Welfare

To cite this article: Y Siahaan and D Rohmat 2019 *IOP Conf. Ser.: Earth Environ. Sci.* **286** 012018

View the [article online](#) for updates and enhancements.



**IOP | ebooks™**

Bringing you innovative digital publishing with leading voices to create your essential collection of books in STEM research.

Start exploring the [collection](#) - download the first chapter of every title for free.

# The Implementation of Modern Irrigation to Improve the Farmer Welfare

Y Siahaan<sup>1\*</sup>, D Rohmat<sup>2</sup>

<sup>1</sup>School of Postgraduate, Universitas Pendidikan Indonesia, Jl. Dr. Setiabudi 229, Bandung 40154, Indonesia

<sup>2</sup>Department of Geography Education, Universitas Pendidikan Indonesia, Jl. Dr. Setiabudi 229, Bandung 40154, Indonesia

\*yakubsiahaan73@gmail.com

**Abstract.** This study aims to formulate an action plan of modern irrigation at Cibuangeun. Cibuangeun is an irrigation area located in Banten Province, Indonesia. The area is situated in a sediment area, so the land is very fertile. Cibuangeun priority irrigated 2.809 hectares area which was distributed in 10 villages. Unfortunately, due to the lack of water, the area is dropping off. It reduces into 1.786 hectare and is only distributed in 4 villages. As a result, it influences the rice field productivity. Basically, the rice field productivity reached 5.17 ton/ha. Nowadays, it decreases to less than 5 ton/ha. This is lower than Indonesia national irrigation productivity which should reach 7 ton/ha. This condition indirectly indicates that there are relationship between rice field productivity and land area. Ninety five percent of rice productivity is influenced by the land area, and only 5% influenced by other factors, such agriculture intensifications. This means that the heightening of 1 hectares area can increase 4.91 tons of DMR. If irrigation area is expanded into 2.809, it can gain 5.024 tons of DMR. The farming income also will increase from 56.6 billion rupiah to 68.65 billion rupiah. Therefore, the intensification needs to be done. One of them is through the improvement of irrigation infrastructure and EM organization.

## 1. Introduction

Cibuangeun is an irrigation area located in Lebak regency, Banten, Indonesia. Its total area is 2.570 hectares that are situated in 5 villages in Mangliping and 5 villages in Wanasalam [1]. Cibuangeun consists of three channels: main canal with 774 meter length, secondary canal with 44.383 meter length, and dam entrance with 750 meter length. Its water supply comes from Cibuangeun River [2].

Cibuangeun priority irrigated 2.809 hectares that was distributed in 10 villages. Unfortunately, nowadays, it is only able to irrigate 1.768 hectares area (63.58%) in 4 villages. This impacts the rice field productivity. Basically, the land can produce 5.7 ton/hectare. Due to the lack of water, it decreases to less than 5 ton/hectares. This is lower than Indonesia national irrigation productivity which should reach 7 ton/ha [3].

Due to the duration and non-optimal OP activity, Cibuangeun irrigation get the decrease both in function and capacity. This influences the watering system that finally gives an impact to the farmers. The level of society welfare generally can be seen through various parameters, such income, the fulfilment of needs, home condition and ownership, transportation, and communication access [4, 5]. This study aims to formulate the action plan that can be applied in making modern irrigation based on 5 modern irrigation pillars [6, 7].



## 2. Methods

### 2.1. Site and Time

Survey was conducted in the beginning of July located in a number of villages covered by Cibuangeun irrigation area. Basecamp was situated at Bolang Village, Malingpong Regency.

### 2.2. Survey and Sampling

Respondents were 30 farmers at Cibuangeun irrigation area. The interviewed respondents are those who operate rain-fed land and use irrigation for watering their land. Incidental random sampling technique was used as most of the society condition in the field are similar, from education, culture, religion, and livelihood.

### 2.3. Data Analysis

Simple linear regression was used to find out the influence of independent variable on dependent variable. The formulation is in the following:

$$Y = a + b X. \quad (1)$$

where, Y is dependent variable, while X is independent variable. Coefficient a is the intersection between regression line and y axis at Cartesians coordinate.

## 3. Results and Discussion

The aim of irrigation modernization is to create a participatory irrigation management that is oriented to the improvement of irrigation service (Level of Service, LoS) [6]. The basis is to make irrigation management system to be more effective, efficient, and sustainable in order to support the national food security [7].

The implementation of irrigation modernization is based on 5 pillars. Those are: (1) the improvement in water supply, (2) the reparation of irrigation facilities and infrastructure; (3) the improvement of irrigation management system; (4) the strengthening of irrigation institutions; and (5) the empowerment of human resources in managing irrigation [6, 7].

### 3.1. The Improvement of Water Supply

FJ Mock method was used to find out the water availability in Cibuangeun weir outlet point. The result can be seen in Table 1.

**Tabel 1.** The Debit at Cibuangeun Weir Outlet Point

Mainstay Debit (m <sup>3</sup> /dt)	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Des
80%	3.7	4.6	5.4	4.9	3.0	1.2	0.7	0.5	0.32	0.31	4.1	5.0
50%	5.1	6.3	5.6	6.6	5.1	1.9	1.1	0.7	0.5	2.8	6.1	6.0
20%	7.0	9.6	6.8	8.4	7.2	4.3	4.2	17.0	2.1	5.7	8.5	9.0

The Table 1 analysis shows that the debit of water availability (Q8) is 2.82 m<sup>3</sup>/second or 2.815 litre/second. The debit reached maximum level (5.4 m<sup>3</sup>/second) in March. Regarding this condition, it can be summed up that the water supply from Cibuangeun River is still sufficient although water-sharing system should be applied for irrigation. Land use condition in catchment are forest, rice field, and fields.

### 3.2. The Improvement of Irrigation Management System

In a number of irrigation area, management, revitalization, and rehabilitation are done. Some actions also should be done as the environment has been changed [8]. The action here can be renewal (modernization) in the implementation of irrigation management including humans as its actor. The focus of the action is mentioned in the following principle of irrigation modernization:

- Integrate the development and management of irrigation system. This should be done by The Ministry of Public Work, The Ministry of Agriculture, regional government (province and district), and farmers [1].
- Do revitalization/rehabilitation for existing network, so that optimal performance can be achieved. This is in accordance with Regulation of PUPR No 12/PRT/M/2015. After that,

irrigation modernization can be done continuously. Thus, effective and efficient services can be created [2].

- c) The implementation and elaboration of Law No 41/2009 concerning the protection of sustainable agriculture [3].

### 3.3. The Strengthening of Institution in Managing Irrigation

Based on Regulation of PUPR No 04/PRT/M/2015 regarding the Criteria and Determination of irrigation area that becomes the authority of central government [1]. This regulation states that there are 5 irrigation areas with the total area of 62.209 Ha. The irrigation area located in Lebak Regency is Ciliman with the total area of 5.423 Ha. Meanwhile, there are 21 irrigation areas determined by regional government. The total area is 29.221 ha. One of them is Cibuangeun.

The unavailability of written data related to the irrigation area and Water User Farmer Association (Perkumpulan Petani Pemakai Air, P3A) becomes the obstacle in this study. Therefore, the data is gained through the interview with some irrigation agents and the Chair of Joint Water User Farmer Association (GP3A).

According to the interview with the Chair of GP3A, there are only four villages that are still irrigated from Cibuangeun. From these 4 villages, there are 7 P3A. The data can be seen in the following table 2.

**Table 2.** P3A in D.I. Cibuangeun

No.	Name of P3A	Chairman	Village
1	Tirta Mukti	H. Acim	Bolang
2	Tirta Jaya	Isra	Bolang
3	Sumber Tani	Tisman	Bolang
4	Lutung Kasarung	Ruja	Bolang
5	Reang	Sanwani	Bolang
6	Gapura Tani	Eman	Sumber Waras
7	Bangkong Reang	Dyat	Dayat

In five villages covered in Malingping regency, there are 30 farmer groups, while the number of farmers group in Wanasalam cannot be identified due to the the lack of secondary data from Local Technical Implementation Unit (UPTD).

### 3.4. The Empowerment of Human Resources in Managing Irrigation

The respondent in this study are the farmers, especially those who cultivate the rice field in Cibuangeun irrigation area. Most of them have side or main job, such as farm labourers, construction workers, civil servants, entrepreneurs, and other profession. Regarding the educational background, most of them are elementary school graduates. There are also respondents who were not attending school (20%). The detail characteristic of respondents in this study is presented in the table 3.

**Table 3.** The Characteristic of Respondents' Educational Background

Level of Education	Total	Percentage
No school	6	20.00
Elementary/equivalent	14	46.67
Middle/ equivalent	6	20.00
High school/equivalent	4	13.33
College	0	0.00
<b>Total</b>	<b>36</b>	<b>100.00</b>

### 3.5. Land Productivity

Land productivity is the comparison between the total area of the land and the result of productivity, commonly declared in term of ton/ha [9]. The data from data from agriculture UPTD in Malingping Regency shows that the rice productivity in this area is 5-6 ton/ha. Meanwhile, the interview with 30 farmers reveals that the average of rice productivity is 5.17 ton/ha. The highest production is 7 ton/ha, while the lowest production is 3 ton/ha.

The rice productivity in Malingping is influenced by the water availability. The land with enough water supply can produce > 5 ton/ha. On the other hand, those with the lack of water supply can only produce < 5 ton/ha and even below 4 ton/ha.

The average of rice productivity in this area (which is only 5/17 ton/ha) is still below the national rice productivity which is 5.7 ton/ha [10]

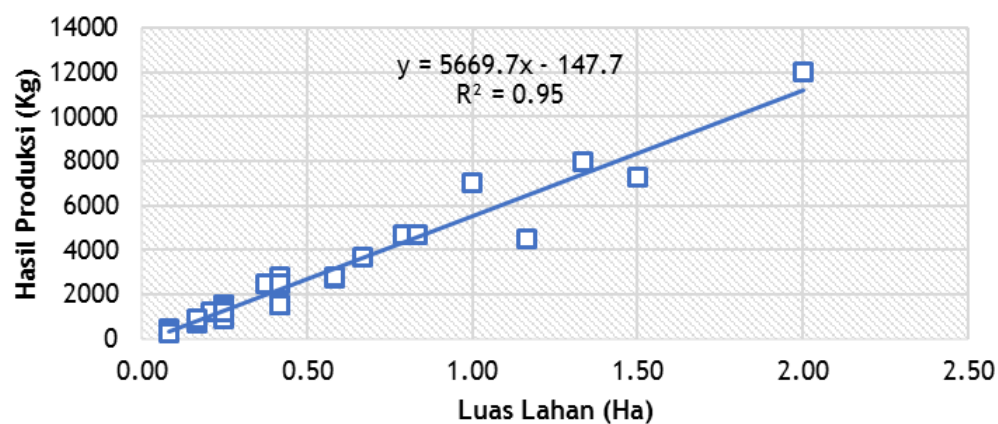


Figure 1. The Relation of Total Area and Production Result.

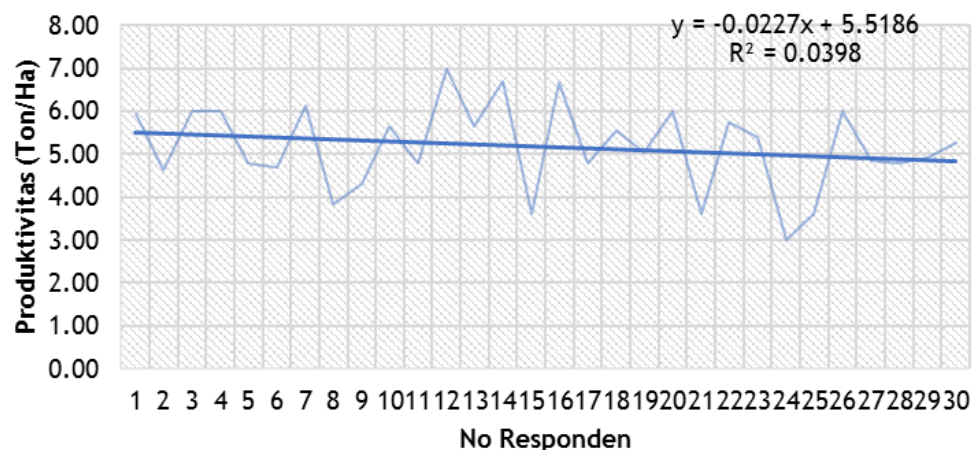
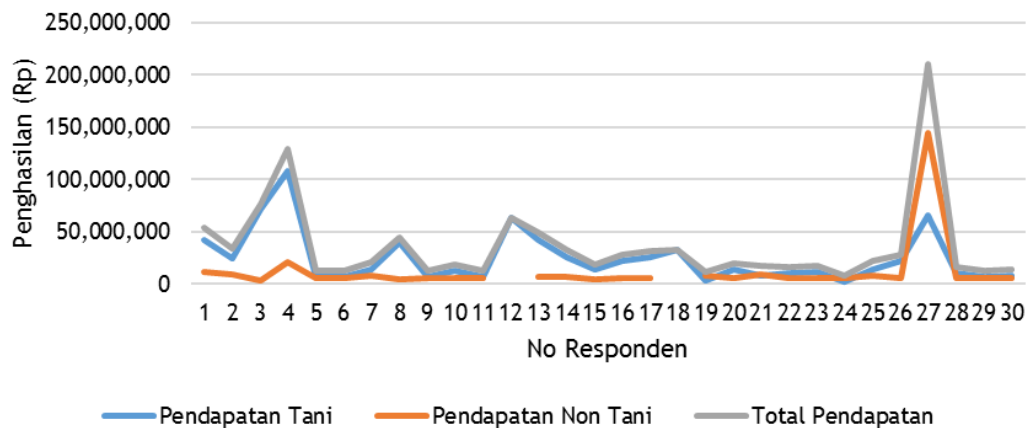


Figure 2. Land Productivity

### 3.6. Farmers Welfare

#### 3.6.1. Income

The following table shows the farmers' income. The income is gained from rice production, the summation of production result and price selling, and other business in a year.

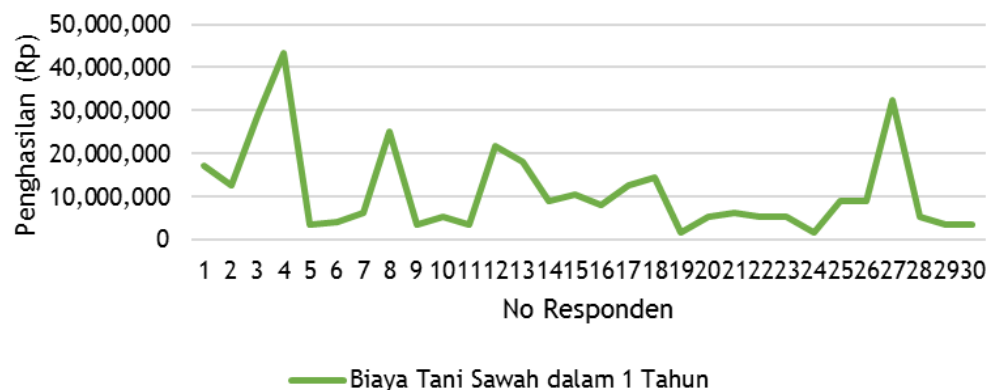


**Figure 3.** Respondents' Income in a Year (Farm and Off-Farm)

Based on the interview with 30 respondents, it is found that the average of their gross income from farming sector is Rp 24.822.000/ year, while from off-farming sector is 12.100.000/year. In total, the respondents' gross incomes is 36.115.333/year. This number has not been subtracted by farming activity and daily needs.

### 3.6.2. Farm Cost

Farm cost in a year can be seen in the following table:

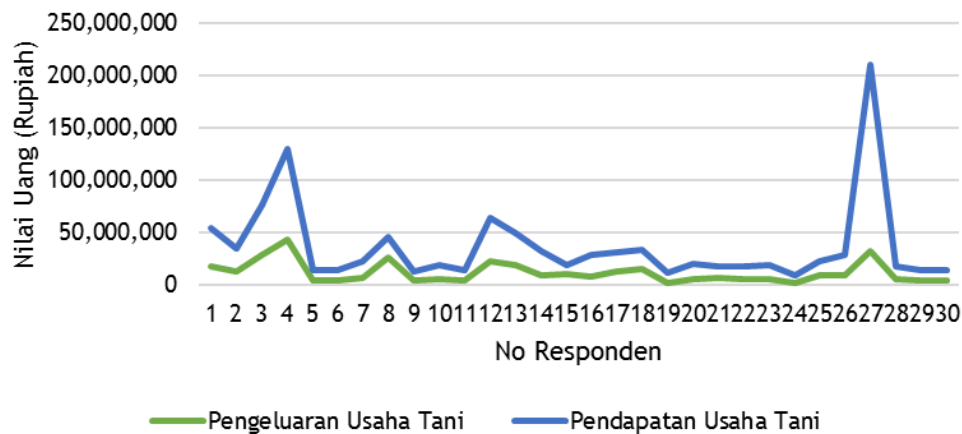


**Figure 4.** Farm Cost in a Year

The interview data shows that the farming cost depends on the total land that is cultivated by the farmer. It also depends on the use of water pump to irrigate the land. In average, the farmers spend Rp. 11.225.000/year. This is by assumption each paddy field needs Rp 900.000 or Rp 10.800.00/ha, including the cost for land preparation, weeding, fertilizer, pesticides, etc.

### 3.6.3. Gross Farm Income

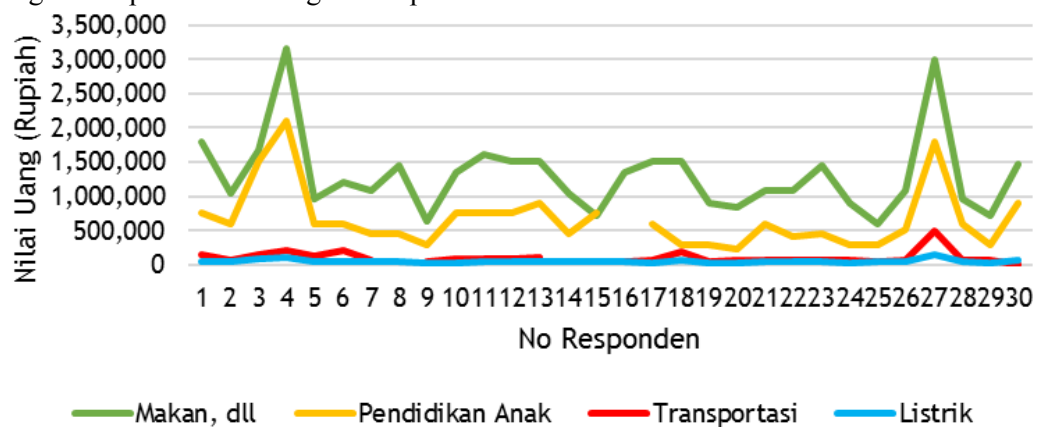
Gross farm income is the comparison of farm income and expenditure in cultivating the land. The respondents admitted that they still get enough profit from the land cultivation [11]. The income in this case is still above the expenditure, especially for those who cultivate the land in above 1 hectares.

**Figure 5.** Farm Income

### 3.6.4. Living Cost

Living cost is the expense for food, education, transportation, electricity, and other household needs.

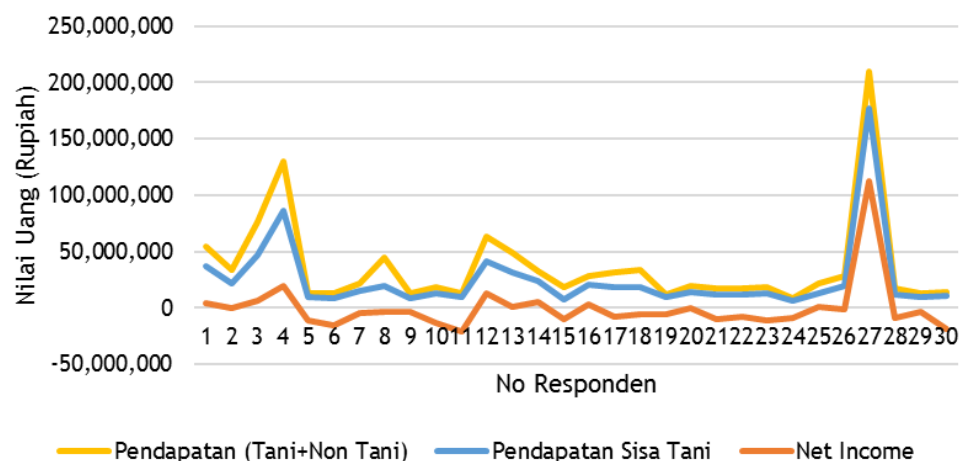
The average of respondents' living cost is presented in table below:

**Figure 6.** Living Cost in a Month

The above data shows that the biggest household expenditure is for food and education. On the other hand, the smallest is for electricity which is < Rp 70.000/month.

### 3.6.5. Net Income

Net income is the respondents' total income (off-farm + farm) reduced by the need of processing farmland and daily household. Regarding this, the interview data shows that there are only 33.33% respondents that can save the money at the end of the year. The other 66.67% get a minus income. They usually cover their need from dry land. The result can be seen in the following:



**Figure 7.** Respondents Net Income in a Year

The population welfare generally can be seen from their income, the fulfilment of need, home condition and ownership, communication access and other parameters.

#### 4. Conclusion

The result indicates that not all farmers can save the money at the end of the year. Those who get minus income will cover their need from the dry land farming. In response to this condition, it is required to do improvement, revitalisation or rehabilitation in the irrigation area. Some efforts also should be done as the environment has been changed. The effort can be the modernization in the irrigation management, including human as its actor.

#### References

- [1] Kementerian Pekerjaan Umum Dan Perumahan Rakyat. 2015. Nomor 12/PRT/M/2015. Tentang: Eksploitasi Dan Pemeliharaan Jaringan Irigasi. Kementerian Pekerjaan Umum Dan Perumahan Rakyat. Jakarta
- [2] Pemerintah Indonesia. 2009. Nomor 41 Tahun 2009. Tentang: Perlindungan Lahan Pertanian Pangan Berkelanjutan. Lembaran Negara RI Tahun 2009 No. 115. Sekretariat Negara. Jakarta.
- [3] Kementerian Pekerjaan Umum Dan Perumahan Rakyat. 2015. Nomor 04/PRT/M/2015. Tentang: Kriteria Dan Penetapan. Wilayah Sungai. Kementerian Pekerjaan Umum Dan Perumahan Rakyat. Jakarta
- [4] W. M. Adams, T. Potkanski and J. E. G. Sutton. 1994. *The Geographical Journal*. Vol. 160, No. 1, pp. 17-32
- [5] J.W. Knox, M.G. Kay, E.K. Weatherhead. 2012. Water regulation, crop production, and agricultural water management—Understanding farmer perspectives on irrigation efficiency. *Agricultural Water Management*. Volume 108, pp. 3-8
- [6] Mulyadi, Indratmo Soekarno and Winskayati. 2014. Analisis Pilar Modernisasi Irigasi dengan Pendekatan Analytical Hierarchy Process (AHP) pada Daerah Irigasi Barugbug - Jawa Barat. *Jurnal Teknik Sipil*. Vol. 21 No. 3 pp. 213- 220
- [7] Wolter, H.W., 1997, Concept of Modernization. Water Resources Development and Management Service FAO – UN. Rome
- [8] Sahat M. Pasaribu & Jayant K. Routray. 2005. Performance of Farmer-managed Irrigation Systems for Rice Production in East Java Province, Indonesia, *International Journal of Water Resources Development*, 21:3, 473-491, DOI: 10.1080/07900620500139192
- [9] Sato, S., Yamaji, E. & Kuroda, T. Paddy Water Environ (2011) 9: 79. <https://doi.org/10.1007/s10333-010-0242-2>
- [10] Asean Food Security Information System (AFSIS). 2017. ASEAN Agricultural Commodity Outlook. AFSIS Secretariat Office of Agricultural Economics (OAE)
- [11] Vermillion, D.L. Irrig Drainage Syst (1990) 4: 133. <https://doi.org/10.1007/BF01102802>