An Analysis of the Environmental Impact Management of Tingal Irrigation Scheme in Temanggung Regency

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Abstract

A study of the environmental impacts of Tingal Irrigation Scheme should be conducted to derive maximum benefits from the project development and management. This research aimed to identify the pre-existing environmental conditions, describe the expected potential impacts, and recommend some methods to manage and monitor the impacts. The analysis results indicated that the pre-existing environmental conditions of the study area were generally good, different types of impacts potentially arose from each stage of the development, and each type of impacts required specific, detailed management and monitoring.

Keywords: *Development, Impact, Environmental Management, Monitoring.*

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A. INTRODUCTION

Agricultural activities play a strategic role and function for an agrarian society in which a majority of the population relies on the agricultural sector to meet their daily needs (Tayibi, Choura Lopez & Alguacil, 2009). Consequently, irrigated land holds not only economic values but also philosophically religious values which is central to the society. To maintain and optimize agricultural land, sufficient infrastructure is required and utilization of natural resources should adopt the concept of environmental balance and modern management (Tiwary, 2001).

The irrigation network in Tingal Irrigation Scheme mainly consists of natural channels utilized by farmers to flow water from natural drainage systems. The irrigation network is irregularly used and damaged, with sedimentation found along the channels as well as incomplete irrigation structures, thereby preventing it from functioning properly (Gomiero, Pimentel & Paolewtti, 2011). This condition therefore requires optimum development.

The environmental impacts of Tingal Irrigation Scheme development activities should be analyzed due to the increasing number of issues related to the natural resources management (Li, Liu, Leamon & Chen, 2017). In addition, to maximize the benefits of the development and management of Tingal Irrigation Scheme, an environmental feasibility study should be conducted to examine both the potentially beneficial and adverse impacts on the society (Franks & Vanclay, 2013).

This study aims to: 1) identify the pre-existing environmental conditions prior to the development of Tingal Irrigation Scheme; 2) clearly identify the potential

impacts of the development of Tingal Irrigation Scheme; and 3) recommend a number of methods to manage and monitor the potential impacts.

B. LITERATURE REVIEW

Environmental management is defined as a conscious effort to maintain and or improve the quality of the environment to meet basic human needs at its best. It is an integrated effort in the utilization, planning, maintenance, monitoring, control, restoration, and development of the environment (Manik, 2003).

Environmental management planning for a development project is generally done by taking into account the potential impacts of the project (Yadav & Samaddeer, 2018). The methods of environmental management planning are referred to as Environmental Impact Assessment (Kaplan & Bannett, 2018). Such analysis is a means of examining the feasibility of a project plan from an environmental perspective (Soemarwoto, 2004).

Indonesia has issued and enforced Law No. 32/2009 on Environmental Protection and Management as well as its related regulations. A development proponent is obligated to perform the analysis and prepare the documents with reference to the level of impacts outlined in the regulation. The analysis is prepared in environmental documents which contain AMDAL (Environmental Impact Assessment), DELH (Environmental Evaluation Document), UKL-UPL (Environmental Management Efforts – Environmental Monitoring Efforts), or SPPL (Statement of Environmental Management and Monitoring Undertaking).

C. METHOD

1. Data Collection Methods

Secondary Data Collection. The secondary data was collected from a number of previous studies, analyses, and reports as well as from the reports provided by the related agencies and applicable regional regulations. This method included a literature study and institutional analysis.

Data Collection through Observation and Field Survey. The data collected by this method mainly consisted of social environment components (demography, economy, culture, and public health). The technique to obtain the data involved a questionnaire survey (Deus, Mele, Bezerra & Battistelle, 2020).

Using the purposive random sampling, the quota for one subdistrict was 30 respondents, thereby totaling 60 respondents for the study. The required sample size for a simple statistical analysis in cross-tabulation is a minimum of 20 respondents.

Data Collection through Observation and Measurement. The field survey/observation resulted in primary data consisting of the components of the environment that were potentially affected by the project, namely the physicochemical, socioeconomic and cultural, biological, and public health conditions to be analyzed (Amato, Rocchetti & Beolchini, 2017). The data described the environmental conditions during the field study. The air quality and noise level were assessed at two points of observation: 1) in front of SDN 1 Sanggrahan,

Kranggan Subdistrict, Temanggung Regency as part of Tingal Kiri (left) Irrigation Scheme, and 2) in front of the Office of Geblog Village, Kaloran Subdistrict, Temanggung Regency as part of Tingal Kanan (right) Irrigation Scheme.

Meanwhile, the water quality was measured at two sites: 1) Mandang River as part of Tingal Kiri Irrigation Scheme, and 2) Mereng River as part of Tingal Kanan Irrigation Scheme.

2. Data Analysis Methods

Analysis of Physicochemical Conditions: 1) Water quality. The analysis methods and equipment for river water samples referred to the Government Regulation No. 82/2001 on Water Quality Management and Water Pollution Control for Class II Waters. The parameters and quality standards also referred to this regulation; 2) Air Quality and Noise Level. The analysis methods in the laboratory and the equipment for air samples referred to the Government Regulation No. 41/1999 on Air Pollution Control. The noise data was analyzed based on the noise level per time-interval (Leq), day noise level (LS), night noise level (LM), and day-night noise level (LSM). The formulas referred to the Decree of the State Minister for the Environment Number Kep-48/MNLH/11/1996; 3) Analysis of Socioeconomic and Cultural Conditions. The methods were adjusted to the type of data to be analyzed, i.e. quantitative analysis for numerical data and qualitative analysis for perceptions, residents' income, and prevailing values in the society; 4) Analysis of Public Health Conditions (Al-Rumaihi, McKay & Al-Anshari, 2020). Data on public health was analyzed using the environmental health impact assessment, including (1) simple statistics, (2) descriptive evaluative analysis, and (3) formal guidelines, in accordance with the significance (Palmeiri, Forleo, Giannoccaro & Suardi, 2017). The data analyzed consisted of environmental sanitation, patterns of disease, and public health services. The data was presented in a frequency table.

The environmental management and impact analysis was performed by analogy with the preparation of environmental documents by referring to the Regulation of the State Minister for the Environment No. 16/2012 on Guidelines for the Preparation of Environmental Documents.

D. RESULTS AND DISCUSSION

Tingal Irrigation Scheme is situated in Kaloran Subdistrict (Villages: Geblog and Gandon) and Kranggan Subdistrict (Villages: Kemloko, Klepu, Sanggrahan, and Pendowo) of Temanggung Regency. This Irrigation Scheme lies on the Tingal River which covers 62,614 km2 area of Tingal Watershed.

The area surrounding Tingal Irrigation Scheme has a temperature of 18 - 30°C, with potentially high rainfall reaching approximately 2750-3250 mm/year. Temanggung Regency has a tropical climate with two alternating seasons throughout the year, the rainy season and the dry season (BMKG, 2018). The air quality and noise level are shown in Table 1. No parameters exceed the quality

standards at the two sampling locations, thus indicating good air quality and noise-free area.

Table 1. Air Quality and Noise Level around Tingal Irrigation Scheme

No	Parameter	Unit	Method/Equipment	Quality Standard	Analysis Result	
					Point 1	Point 2
1	NO_2*	µg/Nm³	SNI 7119.2-2017	316	32.36	26.14
2	SO_2*	µg/Nm³	SNI 7119.7-2017	632	115.54	100.21
3	CO	µg/Nm³	SNI 7119.10-2011 Spectrophotometer	15,000	1,285.81	1,196.55
4	TSP*	µg/Nm³	SNI 7119.3-2017	230	144.78	130.51
5	Noise*	dBA (L^{eq})	SNI 8427-2017 (Sound Level Meter)	70	59.4	48.1

Source: Primary Data (2020)

Note: *KAN accredited parameter (ISO/IEC 17025)

Point 1 = in front of SDN 1 Sanggrahan; Point 2 = in front of the Office of Geblog Village. The water quality is shown in Table 2. The parameters and quality standards referred to the Government Regulation No. 82/2001 on Class II Waters.

Table 2. Water Quality in Tingal Irrigation Scheme

No	Parameter	Unit	Method	Quality Standard for Class II Waters	Test Result	
					Site 1	Site 2
	Physical					
1	Dissolved solids*	mg/L	SNI 06 - 6989.27 - 2005	1000	284	608
2	Suspended solids*	mg/L	SNI 06 - 6989.3 - 2004	50	16	22
	Inorganic Chemical					
3	pH*	-	SNI 06 - 6989.11 - 2004	6-9	6.97	6.81
4	BOD*	mg/L	SNI 6989.72 : 2009	3	3.99	3.34
5	COD*	mg/L	SNI 6989.2 : 2009	25	24.76	24.76
6	DO*	mg/L	SNI 06 - 6989.14 - 2004	4	4.61	4.78
7	Total Phosphate as P	mg/L	SNI 06 - 6989.31 - 2005	0.2	0.09	0.10
8	Nitrate	mg/L	SNI 06 - 2480 - 1991	10	5.02	3.95
9	Ammonia*	mg/L	SNI 06 - 6989.30 - 2005	(-)	<0.012	<0.012
10	Iron*	mg/L	SNI 6989.4 : 2009	(-)	0.195	0.185
11	Nitrite*	mg/L	SNI 06 - 6989.9 : 2004	0.06	0.03	0.03
12	Sulfate*	mg/L	SNI 6989.20 : 2009	(-)	3.00	3.19
	Organic Chemical					
13	Oil and fat*	µg/L	SNI 06 - 6989.10 - 2004	1000	410	470
14	Detergent/MBAS	µg/L	SNI 06 - 6989.51 - 2005	200	56	58
	Microbiological					
15	Total coliform	MPN/100 mL	MPN	5000	880	980

Source: Primary Data (2020)

Note: *) KAN accredited parameter (ISO/IEC 17025)
(-) Parameter not required for this class

Table 2 shows a parameter that does not meet the quality standard that is BOD. The value of BOD exceeds the quality standard which is estimated to be caused by the high frequency of domestic activities nearby the water bodies into which the residents dispose washing and bathing wastewater (Yilmaz, Kara & Yetis, 2017). This indicates non-optimal conservation in the upstream.

Meanwhile, among the conditions that can describe social dynamics is safety and convenience. All of the respondents (100%) assessed the environment in which they reside as safe and comfortable. All of them (100%) also stated that the relationship among the residents in the study area is excellent and harmonious.

In addition, the public health conditions in terms of sanitation for bathing, washing, toilet (MCK) showed that most of the respondents use well water (38 residents or 54.29%). Meanwhile, 6 residents (8.57%) use PDAM (pipe water) tap water (state-owned water utility company), and the remaining 26 residents (37.14%) use other sources. Similarly, the majority of the respondents (41 residents or 58.57%) use well water for drinking and cooking, followed by 6 residents (8.57%) using PDAM water, and 1 resident (1.43%) purchasing mineral water while the remaining participants use other sources.

The availability and quality of toilets also affect public health. All respondents have a toilet in their home. The majority of them (84.29%) also have a septic tank for the toilet. Meanwhile, the most common types of disease from which the residents suffered are the flu, cold, and fever (50 respondents or 71.43%). Five respondents (7.14%) once had skin conditions, and 15 respondents (21.43%) suffered from other disease types.

The development of Tingal Irrigation Scheme potentially has both positive and negative impacts on the environment. Despite the insignificant potential impacts, efforts should be made to manage and monitor the environment. The environmental impacts are estimated to occur during the pre-construction, construction, and operation stages. The potential impacts of the development of Tingal Irrigation Scheme are presented in Table 3.

Table 3. Potential Impacts of Tingal Irrigation Scheme

Development stage	Activity	Type of impact	Impact significance
Pre-construction	1. Planning, survey, and measurement	Public perception and attitude	The attitude of a majority of the society members was in accordance with the activity plan.
	2. Dissemination and land acquisition	Positive perception of the society	The attitude of a majority of the society members was in accordance with the activity plan.
Construction	1. Recruitment of construction workers	Job opportunities and business opportunities	A large number of workers were involved in the development activities.

Development stage	Activity	Type of impact	Impact significance
		Social envy	Some of the workers from the neighboring village felt unsatisfied and went on strike.
	2. Construction and operation of basecamp	Public perception and attitude	There was a social conflict between the society members and migrant workers who stayed in the basecamp.
		Poor environmental sanitation	The construction workers had a lack of awareness of the environmental sanitation in the project area.
	3. Mobilization of equipment and materials	Higher levels of dust deposits and exhaust gases	The level of dust deposits was ≤230 μg/m^3 and the level of exhaust gases exceeded the quality standard in the project area and settlement area during the project construction.
		Damaged access roads	The types of road damage included grade depression, potholes, and mud-covered slippery roads.
		Public concern	Some residents blocked the access routes/roads to the mobilization of vehicles.
	4. Land development	Land-use change	Vegetated land was converted into open land. Wildlife habitat was disrupted.
		Disruption of wildlife habitat	There was wildlife-habitat destruction or loss.
	5. Development activities	Potential occupational accidents and diseases	Construction workers experienced occupational accidents and diseases during the project.
Operation	1. Utilization of irrigation network	Poor environmental sanitation	Canal cleanliness decreased and water pollution increased.
		Increased population of aquatic biota	There was a balanced ecosystem for aquatic biota marked by the higher zooplankton diversity index.
		Increased population of flora	Numerous vegetation/plants could grow well in the irrigation network area.

Development stage	Activity	Type of impact	Impact significance
		Higher standard of living for farmers	Farmers had a higher standard of living.
		Conflict of irrigation water utilization	There were conflicts of irrigation water utilization.
	2. Irrigation network maintenance	Well-maintained conditions of irrigation network and supporting facilities	The level of damage to the irrigation network and supporting facilities during the operation could be lower.

Source: Data Analysis (2020)

The above mentioned impacts require environmental management and monitoring efforts described in the matrices in Table 4 and Table 5.

Table 4. Matrix of Environmental Management Efforts

Source of Impact	Type of Impact	Environmental Management Efforts		
		Form of Effort	Location	Period
Planning, survey, and measurement	Public perception and attitude during the activities	• Giving notification of the survey from the development proponent to the community representatives • Equipping the surveyors with an authorized letter of assignment • Requiring the surveyors to have the capability of explaining the purpose of the survey	Surrounding area of Tingal Irrigation Scheme	Once during the period of planning, survey, and measurement

Source of Impact	Type of Impact	Environmental Management Efforts		
		Form of Effort	Location	Period
Dissemination and land acquisition	Public perception and attitude during the activities	• Conducting transparent dissemination of development plan from the authority to the potentially affected residents • Providing clear answers to the questions from the residents • Inviting some residents as the community representatives in the study area • Conducting a participatory land acquisition process for the affected landowners	Surrounding area of Tingal Irrigation Scheme	Once during the pre-construction period
Recruitment of construction workers	Job opportunities and business opportunities	• Prioritizing local workers from the villages by recruiting a minimum of 50% of them in order to empower local human resources • Providing business opportunities by allowing the local residents to open shops in the surrounding area of the project • Engaging in a direct dialogue (deliberation) with the members of society surrounding the construction site and inviting community leaders	Surrounding area of Tingal Irrigation Scheme	During the recruitment process and during each development activity

Source of Impact	Type of Impact	Environmental Management Efforts		
		Form of Effort	**Location**	**Period**
	Social envy	• Issuing open and transparent announcement about the job vacancies • Providing business opportunities by allowing the local residents to open shops in the surrounding area of the project • Engaging in a direct dialogue (deliberation) with the members of society surrounding the construction site and inviting community leaders	Surrounding area of Tingal Irrigation Scheme	During the construction period (during the recruitment process and during each development activity)
Construction and operation of basecamp	Public perception and attitude	• Requiring the workers who stayed in the basecamp to maintain cleanliness and display clean and healthy life behavior • Maintaining good relationships with the local residents	Surrounding area of Tingal Irrigation Scheme	During the construction period

Source of Impact	Type of Impact	Environmental Management Efforts		
		Form of Effort	**Location**	**Period**
	Poor environmental sanitation	• Providing basic sanitation facilities (public bathing, washing, and toilet facilities) in the project boundaries • Managing waste and placing trash bins in the basecamp area • Requiring the workers who stayed in the basecamp to maintain cleanliness and display clean and healthy life behavior • Implementing the Covid-19 preventive health protocol in the basecamp	Irrigation network of Tingal Irrigation Scheme	During the construction period
Mobilization of equipment and materials	Higher levels of dust deposits and exhaust gases	• Tightly covering soil/materials with truck tarps during mobilization • Scheduling mobilization of equipment and materials • Sprinkling water on dry areas of the project and on the mobilization routes every day at the beginning and end of construction hours • Transporting materials at working hours to avoid public inconvenience, such as during their study, worship, rest, and sleep time • Scheduling the mobilization of equipment and materials • Limiting mobilization activities from 8 a.m. to 5 p.m.	• Along the access routes/roads to the construction site • Surroundind area of the project • Settlement area and irrigation network area	During the construction period

Source of Impact	Type of Impact	Environmental Management Efforts		
		Form of Effort	**Location**	**Period**
	Damaged access roads due to overloaded vehicles	• Checking the load of construction vehicles to fit the capacity • Directing the truck drivers to be careful and adjust the speed and tonnage when passing potentially damaged roads • Paving the access roads to improve the route carrying capacity for vehicle mobilization • Repairing the damage to the access roads	• Access roads to the construction site • Along the access routes/roads to the construction site	During the construction period
	Potential traffic accidents	• Installing warning signage along the in-out access roads of the project boundaries and limiting the vehicle speed • Directing the truck drivers to be careful and adjust the vehicle speed	• Along the access routes/roads to the construction site • In the construction site and surrounding area	During the construction period
	Public concern	• Proactively making a social approach to the local residents to seek viable solutions • Installing warning signage along the in-out access roads of the project boundaries and limiting the vehicle speed	• Along the access routes/roads to the construction site • In the construction site and surrounding area	During the construction period

Source of Impact	Type of Impact	Environmental Management Efforts		
		Form of Effort	**Location**	**Period**
Land development	Land-use change	• Performing selective logging • Compacting and backfilling the canal excavations when the construction is completed • Replanting flora/trees or doing reforestation in the surrounding area of the land development after the construction is completed	Irrigation network area of Tingal Irrigation Scheme	During the construction period
	Disruption of wildlife habitat	• Avoiding animal killing • Removing bird nests or animal burrows to a safe place	Irrigation network area of Tingal Irrigation Scheme	During the construction period

Source of Impact	Type of Impact	Environmental Management Efforts		
		Form of Effort	**Location**	**Period**
Development activities	Potential occupational accidents and diseases	• Registering the construction workers for BP Jamsostek (labor social security program) • Implementing a maximum of 40 working hours per week and a maximum overtime work of 7 hours per week • Installing construction hoarding in the project area • Installing workplace safety signage (K-3) and disseminating the signage to the workers • Facilitating and requiring the workers to wear personal protective equipment (safety helmet, boots, and mask) and to work in accordance with the standard operating procedure • Signing a statement of the constructor's accountability for all the expenses arising out of occupational accidents • Implementing the Covid-19 preventive health protocol	Project boundaries of the irrigation network area	During the construction period

Source of Impact	Type of Impact	Environmental Management Efforts		
		Form of Effort	Location	Period
Utilization of irrigation network	Poor environmental sanitation	• Installing "Do not litter" signage around the irrigation network area • Functioning the irrigation management and regulatory institutions to accommodate environmental sanitation issues • Actuating the clean and healthy life behavior among the members of society in the surrounding area of the project • Installing water depth signage to prevent water-related accidents	Irrigation network area of Tingal Irrigation Scheme	During the operation period
	Increased population of aquatic biota	• Spreading fish seeds • Installing poison-fishing and electrofishing prohibition signage • Prohibiting trash littering along the irrigation canals • Prohibiting waste disposal to the irrigation canals	Irrigation network area of Tingal Irrigation Scheme	Periodic management as required
	Increased population of flora	Prohibiting logging and animal hunting/killing in the surrounding area of the project	Irrigation network area of Tingal Irrigation Scheme	Bi-annually
	Higher standard of living for farmers	Providing education about efficient and effective utilization of irrigation water	Irrigation network area of Tingal Irrigation Scheme	During the operation period
	Conflict of irrigation water utilization	Establishing an irrigation management institution, such as P3A, and optimizing irrigation officers for water distribution	Irrigation network area of Tingal Irrigation Scheme	During the operation period

Source of Impact	Type of Impact	Environmental Management Efforts		
		Form of Effort	Location	Period
Irrigation network maintenance	Well-maintained conditions of irrigation network and supporting facilities	▪ Regularly monitoring the fluctuation in water volume and depth ▪ Making inventory/recording data of damage to the irrigation network ▪ Relocating a specific budget for maintenance and repair of irrigation network ▪ Carrying out regular maintenance checks on flap gates with regard to the weather and lifespan ▪ Painting the facilities and infrastructure buildings ▪ Periodically removing trash and dredging sediment ▪ Monitoring and evaluating the operation and maintenance	Irrigation network area of Tingal Irrigation Scheme	Annually

Source: Data analysis (2020)

Table 5. Matrix of Environmental Monitoring Efforts

Source of Impact	Type of Impact	Environmental Monitoring Efforts		
		Form of Effort	Location	Period
Planning, survey, and measurement	Public perception and attitude during the activities	Direct field observation through interviews with the members of society	Surrounding area of Tingal Irrigation Scheme	Once during the period of planning, survey, and measurement
Dissemination and land acquisition	Public perception and attitude during the activities	Interviews with the members of society	Surrounding area of Tingal Irrigation Scheme	Once during the pre-construction period

Source of Impact	Type of Impact	Environmental Monitoring Efforts		
		Form of Effort	**Location**	**Period**
Recruitment of construction workers	Job opportunities and business opportunities	Inventory of manpower and local business opportunities	Surrounding area of Tingal Irrigation Scheme	During the construction period
	Social envy	Direct observation and interviews	Surrounding area of Tingal Irrigation Scheme	During the construction period
Construction and operation of basecamp	Public perception and attitude	Direct field observation	The basecamp for construction workers' activities and surrounding area	During the activities of the construction workers in the basecamp
	Poor environmental sanitation	Direct field observation	The basecamp for construction workers' activities	During the activities of the construction workers in the basecamp
Mobilization of equipment and materials	Higher levels of dust deposits and exhaust gases	Direct field observation	Access roads to the construction site and along the access routes/roads to the construction site	Once during the construction period
	Damaged access roads due to overloaded vehicles	• Direct field observation • Inventory of damaged access routes/roads	Access roads for the mobilization of equipment and materials	During the construction period
	Potential traffic accidents	• Direct field observation • Interviews with the members of society	Access roads for the mobilization of equipment and materials	Once during the construction period

Source of Impact	Type of Impact	Environmental Monitoring Efforts		
		Form of Effort	**Location**	**Period**
	Public concern	• Direct field observation • Interviews with the members of society	Access roads for the mobilization of equipment and materials	During the construction period
Land development	Land-use change	Direct field observation	Irrigation network area of Tingal Irrigation Scheme	Once during the construction period
	Disruption of wildlife habitat	Direct field observation	Irrigation network area of Tingal Irrigation Scheme	Once during the construction period
Development activities	Potential occupational accidents and diseases	Direct field observation through interviews and direct examination of occupational diseases and accidents	Irrigation network area of Tingal Irrigation Scheme	Once during the construction period
Utilization of irrigation network	Poor environmental sanitation	Direct field observation	Irrigation network area of Tingal Irrigation Scheme	Annually
	Increased population of aquatic biota	Direct field observation	Irrigation network area of Tingal Irrigation Scheme	Bi-annually
	Increased population of flora	Direct field observation	Irrigation network area of Tingal Irrigation Scheme	During the utilization period
	Higher standard of living for farmers	Interviews and direct field observation	Irrigation network area of Tingal Irrigation Scheme	During the utilization period
	Conflict of irrigation water utilization	Institutional assistance and direct field observation	Irrigation network area of Tingal Irrigation Scheme	During the utilization period

Source of Impact	Type of Impact	Environmental Monitoring Efforts		
		Form of Effort	Location	Period
Irrigation network maintenance	Well-maintained conditions of irrigation network and supporting facilities	Observation and inventory of damage to the facilities	Irrigation network area of Tingal Irrigation Scheme	Annually

Source: Data Analysis (2020)

The map of Environmental Management and Monitoring is presented in Figure 1.

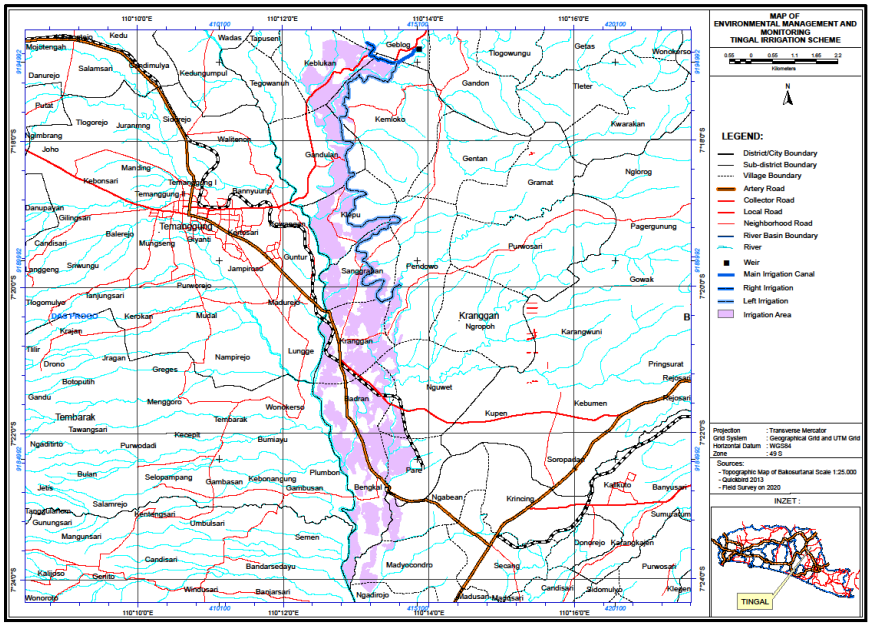

Figure 1. Environmental Management and Monitoring Map

E. CONCLUSIONS

The analysis results lead to the following conclusions: 1) The existing environmental conditions in the study area are generally of a good category; 2) The types of potential impacts in regard to the development project in the study area include: a) Planning, survey, and measurement: public perception and attitude during the activities; b) Dissemination and land acquisition: public perception and attitude during the activities; c) Recruitment of construction workers: job opportunities and business opportunities social envy; d) Construction and operation of basecamp: public perception and attitude poor environmental sanitation; e) Mobilization of equipment and materials: higher levels of dust deposits and exhaust gases: damaged access roads/routes due to overloaded vehicles potential traffic accidents public concern; f) Land development: land-use change, disruption of wildlife habitat; h) Utilization of irrigation network: poor environmental sanitation: increased population of aquatic biota, increased population of flora, higher standard of living for farmers, conflicts of irrigation water utilization; i) Irrigation network

maintenance: well-maintained conditions of irrigation network and supporting facilities, Environmental management efforts should be made for each type of the potential impacts.

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