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Environmental Risk Evaluation of Air and Water Categories in Irrigation Development Activities in Sukasari Village, Indramayu Regency, Indonesia

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ABSTRACT

The process of development activities in Sukasari Village, Indramayu, produces several environmental contaminants that may cause disruption to the health of the surrounding community. The pollution is in the form of exceeding the Threshold Value of the BOD agent in the water parameter and air pollution in the sound (noise) section. This study aims to determine the concentration and risk level of BOD agent pollution in water parameters and noise pollution. The research was conducted in the Sukasari Village area with a grab sampling method of water and air components (SNI 8995: 2021), based on Indonesian Government Regulation No. 22 of 2021 and KepMenLH No. KEP-48/MENLH/11/11: KEP-48/MENLH/11/1996, as well as Environmental Health Risk Analysis (EHR) conducted on 32 people based on the purposive sampling method. The results showed that the BOD concentration in the residential area was 13 $mg.L^{-1}$, with a safe risk category for 30 people with body weight criteria of 49 to 81 kg and unsafe for 2 people with body weight criteria ≤ 43 kg. The sound parameter measurement results showed a figure of 68 dB(A), which exceeded the threshold value of 55 dB(A). Decreased BOD quality can cause several diseases, including skin irritation and digestive problems. The impact of noise on hearing can include balance disorders, hearing loss, until permanent hearing loss, increased blood pressure, psychological disorders, and behavioral disorders.

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INTRODUCTION

Indramayu Regency is one of the regencies located in West Java. Indramayu itself became the center of government as well as the center of the crowd. The Regency is bordered by the Java Sea to the North, Cirebon Regency to the Southeast, Majalengka Regency and Sumedang Regency, and Subang Regency to the south. According to data from indramayukab.go.id. Indramayu has 31 sub-districts, which are divided into 313 villages and kelurahan. According to data from *pertanian.sragenkab.go.id*, Indramayu is the largest rice barn in Indonesia, the largest in Indonesia with a land area of 226.626 hectares (ha) and the acquisition of production of 1,363,312 tons GKG, or equivalent to 782,132 tons of rice. With the development and modernization of irrigation, which is a program of the Center for River Basin, it is expected that the increase in the results of the production process will increase and can reduce the process of rice import activities from abroad. But on the other hand, the construction of irrigation that too intersects with some areas of the village with the residence of residents live, which can potentially cause inconvenience and problems to residents living around the development area. Based on a journal written by Badmus et al. (2021), the balance and sustainability of natural ecosystems can be managed through assessment, practical analysis, and treatment of surfactants.

High BOD levels can cause several new types of problems. For the Indramayu district, which is known as a national rice granary, an excessive increase in BOD levels can cause new problems in the future. For example, in irrigation water, if the BOD level has exceeded the Threshold Value that has been set, it can cause glooming algae problems where the algae there will cover the entire surface of the water, which will then kill the entire ecosystem in it (water biota). As for humans, if water polluted by BOD enters or is ingested by humans, it will cause problems such as skin irritation and digestive problems. This is supported by research conducted by Rachmawati (2019).

Meanwhile, excessive noise can cause balance disorders, hearing loss until permanent hearing loss, increased blood pressure, psychological disorders, physiological disorders, and behavioral disorders. This is in accordance with research conducted by Mukhlish et al. (2018). Environmental monitoring supported by the awareness of the surrounding community in maintaining their living environment is a sure step in regulating the levels of pollution that occur in the area where they live.

Referring to Sa'ban et al. (2020), social capital can be used for communities channeled through basic knowledge, which can then be used as a means of socializing the importance of awareness of protecting the environment where they live. This social capital activity is carried out through several stages, including socialization to provide an initial understanding of the community. Then, proceed with assistance to monitor and direct the community so that they can practice managing their environment in a correct and directed manner. Then, supporters can seek supporting facilities and facilities so that environmental management that occurs in the area can be carried out more optimally.

The purpose of this study was to identify what pollutant agents that can be caused by irrigation development activities carried out in Sukasari Village, Indramayu. Based on initial observations, it appears that the river around the construction area has a thick green color, which is thought to be the result of pollution caused by the construction. This study is important to do because, looking at river irrigation in the area, it has begun to appear that the algae that live there are very fertile. Based on research from Sellner et al. (2003), the growth of algal blooms is caused by two main factors, namely the natural circulation process, the reversal of water mass and river flow, and anthropogenic activities that cause eutrophication.

MATERIALS AND METHODS

Location and Time of Research

Administratively, this study was conducted in Sukasari Village, Indramayu, which is one of the locations for irrigation development and modernization carried out within the scope of the BBWS program. Data retrieval of environmental components (air, water, and sound) can be seen in the colored dots shown in Fig. 1. Sampling is

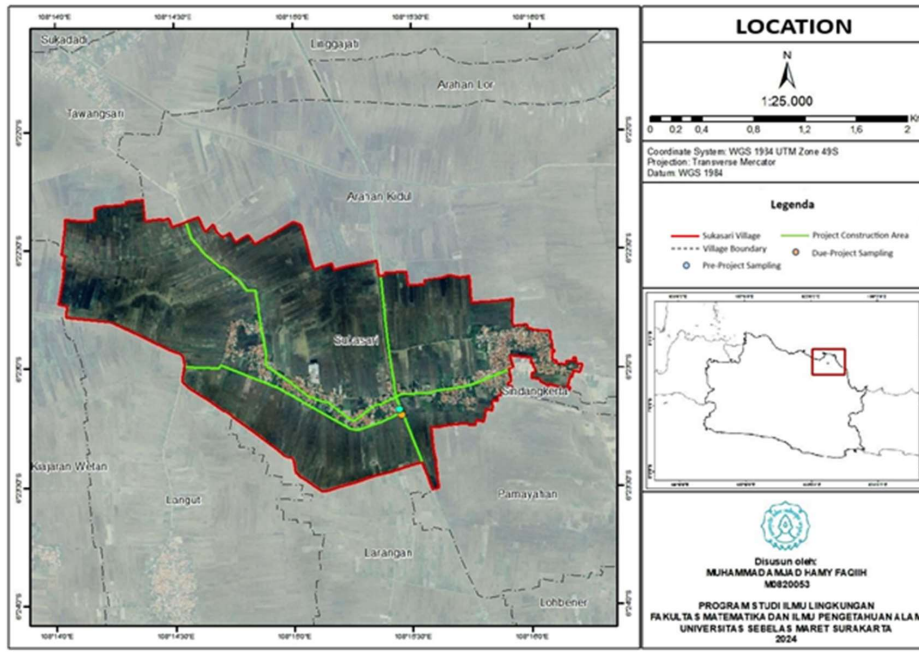

Fig. 1: Research Map Area.

carried out at the project site and is being implemented to see how the influence of changes in risk agents that occur at the construction site takes place. This research was conducted from August 2023 to March 2024. The sampling point was chosen because, based on observations with the environmental consultant, the air and sound sampling point is the busiest point of activity in the area. Meanwhile, for water sampling, because the water was calm and there was no sign of movement, the sample point was taken as a reference sample to determine the chemical components of the water.

Types of Research and Data Collection Techniques

In this study, the research method used is a combination of qualitative and quantitative descriptive analysis methods. The Data used in this study include primary data such as sampling point data, surface water, dust, and noise, interview data, as well as documentation and secondary data, including data related to the characteristics of Sukasari village. The primary data collection technique used is through direct data collection in the field and interviews with relevant parties (Suhardono et al. 2023).

Interview and Observations

According to Djaelani (2013), the main qualitative data collection is by participatory observation and in-depth interviews, supported by document review, which aims not only to explore data but to reveal the meaning contained in the research setting. The use of this data collection technique is intended to determine the effect of the irrigation development work stage on the air and water components. As well as respondents' personal data, along with some other important data needed by researchers, such as responses to development, age, weight, and symptoms or complaints of diseases experienced related to pollution exposure in residential areas. The respondents studied in this research are a population consisting of the people of Sukasari Village, Indramayu. The total number of people in Sukasari Village consists of ± 5,985 people (Cidempet Health Center data). Researchers only took a representative sample of 32 families using the purposive sampling method, which has a location that actually intersects with the area where the project work is running. Researchers have sampling criteria, namely, people whose residences are adjacent to irrigation channels that are being built and people who often move around the water body/ construction site. Purposive sampling is a technique widely used in qualitative research to identify and select effective information with limited resources (Iqbal et al. 2025).

Environmental Condition Analysis of Sukasari village

The data of the measurement of the quality parameters of environmental components (water, air, and sound) obtained from field measurements and laboratory tests are compared with the established regulations, as well as the water component is compared with PP No.82 of 2001 (water class classification), PPRI No.22 of 2021 (National Water Quality Standard); air compared with PPRI No.22 of 2021 (ambient air quality standard); and sound compared with KepmenLH No: KEP-48/MENLH/11/1996 (noise level standard). Then, the flora observation data in Sukasari village were analyzed for pollution absorption based on Dahlan (2008) and Handayani et al. (2024). Then, the environmental component assessment step is performed using the Environment Sensitivity Index method based on a reference from Damayanti et al. (2004).

Analysis of Public Health Status in Sukasari Village

The water quality parameter measurement data obtained from field measurements and laboratory tests are then analyzed and calculated using the Environmental Health Risk Analysis/Environmental Protection Agency (EPA) method to see whether the levels of the tested environmental components can be accepted or used in community activities in the village area. According to Junarto (2016), the EPA itself consists of 4 steps, namely: hazard identification, dose-response analysis, exposure analysis, and risk characterization. Pollution from a part cannot be determined only from its concentration, but by determining the value of RfD, RfC, or SF obtained from the results of research or experimental studies from several sources, whether carried out directly on human or animal experimental subjects. RfD, RfC, and SF of a part can be seen in the Integrated Risk Information System (IRIS), which can be accessed at www.epa.gov/iris. EPA calculation uses 2 related formulas, the first formula is used to see the safe limit of use, while the second formula is used to see whether the water is fit for use. Determining the dose-response analysis does not have to be done by conducting their own experiments, but can be done by reading toxicological reviews, journals and related scientific articles (Tsani et al. 2018). The formulas used include:

Intake of non-carcinogenic (Ink) ingestion

$$Ink = \frac{C \times R \times fE \times Dt}{Wb \times tavg}$$

Risk level calculation for non-carcinogenic ingestion

$$RQ = \frac{I}{RfD}$$

Description:

- Ink: the amount of concentration of risk agents that enter

the human body with a certain body weight every day ($mg.kg^{-1}.day^{-1}$).

- C: concentration of risk agent in clean water ($mg.L^{-1}$).
- R: the rate of consumption or the amount of water volume ($L.day^{-1}$), has a default adult (settlement) of 2 liters/day and children (settlement of 1 $L.day^{-1}$).
- Dt: duration or number of years of exposure (years). It has a value for residential (residential)/lifetime exposure of 30 years for adults and 6 years for children.
- fE: duration or number of days that exposure occurs annually (days/year). A for exposure to the settlement of 350 Days/year and exposure to the work environment of 250 $days.year^{-1}$.
- Wb: human body weight/population/population group (kg). It has a value for adults of 55 kg and for children of 15 kg.
- tavg: average time period of non-carcinogenic effects (days). Can be determined by the equation of length of Work × 365 days.
- I (Intake): Intake that has been calculated by the formula Ink above.

Univariate Analysis

Univariate analysis in this study serves to summarize the data set of measurement results in such a way that the data set turns into useful and easy-to-understand information. The summary can be in the form of statistical measures, diagrams, tables, or graphs. Univariate analysis was carried out on each variable studied in this study.

Environmental Sensitivity Index

Referring to research (Ardiansyah 2019), the environmental sensitivity index in this study is calculated by combining data into variables and accumulating the weight of the criteria of each variable that has been determined.

Cause Root Analysis

Referring to research (Charles et al. 2016), to determine the root of the problem that is the possibility in this research, the '5 Why Tools' method is used, where the method is used to ask and answer every problem that arises repeatedly, until finally finding the root of the problem that has been formulated.

RESULTS AND DISCUSSION

Environmental Condition of Sukasari Village, Indramayu

The data obtained were compared with the calculation of plant pollution absorption based on data (Handayani et al. 2024) and (Dahlan 2008). Based on the data presented in

Table 1: Flora Observation Data

No.	Species Name	Latin Name	Number of Species
1	Noni Tree	Morinda citrifolia	2
2	Srikaya Tree	Annona squamosa	4
3	Mango Tree	Magnifera indica	3
4	Banana Tree	Musa paradisiaca	12
5	Guava Tree	Psidium guajava	2
6	Jackfruit Tree	Artocarpus heterophyllus	4
7	Bamboo Tree	Bambusoideae	10
8	Singapore Orchid Flower	Orchidaceae	2
9	Long Beans	Vigna sinensis L.	1 garden
10	Cassava	Manihot esculenta	1 garden
11	Red Shoots	Syzygium oleana	3
12	Papaya Tree	Carica papaya	3
13	Lime Tree	Citrus aurantifolia	4
14	Rambutan Tree	Nephelium lappaceum	5

Table 1, the location can be seen that mango trees planted in Sukasari Village are a plant that has the highest absorption, with an absorption value of 455.17 $kg.Tree^{-1}.year^{-1}$, compared to other plants. However, when compared with the data collected by Dahlan (2008), the plant is not included in the category of the 5 plants absorbing the highest pollution that have been studied.

Based on the interview activities that have been carried out by Mr. Waskadi as Mr. Kuwu (Village head), if there is currently no integrated disposal site (TPT), so for waste management, it is usually collected at the edge of the river to be burned together, or personal burning is carried out on his own vacant land. In the past, garbage bins were made, which were then called cars from the Environment Agency (DLH), but only lasted 1 month because the local community did not want further contributions, as it was cheaper to dispose of garbage by burning and throwing it into water bodies. Sometimes to bring meeting activities to discuss these problems, the local community is difficult, and sometimes even be nagging. The provincial government has also planned a waste bank/maggot activity for waste treatment, but it has not been carried out until now. However, the villagers themselves have never complained to the local government regarding the problem, because they are afraid of being considered problematic people themselves (Tini, villagers).

Public Health Sukasari Village, Indramayu, can be said to be very sad according to the results of field surveys and interviews with the head of the Local Health Center (Posyandu, Puskesmas). Based on the results of interviews with 30 residents and Mr. Kuwu, it was found that the people

Table 2: Upper Respiratory Tract Infection Data January-December 2023.

Village	Population	Child (10 of %Population)	Child Pneumonia	Child, That's Hard to Breathe	Child Cough	Pneumonia	Severe Pneumonia	Total	% Coverage
Sukasari	5,983	598	28	3	3	2	0	36	86.83

Table 3: Water and Sanitation Latrine Data.

Village	Clean Water Facilities			Toilet	
	Families Don't Have Clean Water Facilities	Families Have Unprotected CleanWater Facilities	Means of Clean Water Protected Behavior	FamiliesHave SanitaryLatrines	Family Doesn't Have Any Pets
Sukasari	3	1	13	9	3

Table 4: Diarrhea Coverage Data.

Village	Population	Child ppl	Case Discovery Target		Toddler Diarrhea				% Coverage
			All Ages	Child	<6 month	6-<12 month	1-<5 years	ToddlerDiarrhea	
Sukasari	5,995	91	162	15	4	0	0	4	26.67

of Sukasari village prefer to seek treatment from midwives in the area and wait for a mobile health car that comes every month. This was made clear by an interview with the head of the puskesmas, who said that the people of Sukasari village were not so aware of their own health. The posyandu policy, which is almost routinely carried out 2X a month, is still relatively quiet for enthusiasts. Based on Table 2, it is noted that very few people are affected by upper respiratory tract infections (ARI); this is explained not because few are affected, but those who are recorded as affected by the disease are only a few people who feel disturbed by the disease they have experienced. Likewise, with health surveys conducted door to door, referred to by the puskesmas as the introspective Survey program, this activity was not carried out too smoothly because some local people did not want and did not care about the health data collection activities carried out by the puskesmas itself. As well as those listed in the data Table 3, it can be seen that there were still 3 families who did not have private latrines, and 9 families did not have sanitized latrines. As recorded in Table 4, the diarrhea experienced by the Indramayu community recorded that there were about 162 people and 15 toddlers. The treatment given by the Puskesmas was by giving ORS and zinc to overcome diarrhea. However, until now there have been no recorded people who have died due to diarrhea and Ari that occurred in the Sukasari Village area.

Environmental Parameter Test Results

In this case, the measurement of the field parameters that have been implemented (Table 5, Table 6, and Table 7), it can be seen that the results of measurements that have been carried out for almost all the parameters tested have a value below the threshold. However, in one of the water and sound parameters tested, has results are above the proper threshold value. As well as BOD agents in the tested water parameters have a test result value of 13 $mg.L^{-1}$,

Table 5: Measurement of Sukasari Village Air Parameters.

No	Parameter	MeasurementTime	Unit	RegulationLimit *)	Result
1	Sulfur Dioxide (SO_2)	1 h	$\mu g/Nm^3$	150 *)	28
2	Carbon Monoxide (CO)	1 h	$\mu g/Nm^3$	10,000 *)	599
3	Nitrogen Dioxide (NO_2)	1 h	$\mu g/Nm^3$	200 *)	20
4	Oxidant (O_2)	1 h	$\mu g/Nm^3$	150 *)	32
5	Particle < 100 µm (TSP)	24 h	$\mu g/Nm^3$	230 *)	80
6	Particle < 10 µm (PM_{10})	24 h	$\mu g/Nm^3$	75 *)	56
7	Lead (Pb)	24 h	$\mu g/Nm^3$	2 *)	0,01
8	Ammonia (NH_3)	1 h	ppm	2,0 **)	0,03

Information:

*) = Peraturan Pemerintah Republik Indonesia Nomor 22 Tahun 2021 (Attachment VII) Ambient Air Quality Standards

**) = Keputusan Menteri Negara Lingkungan Hidup Nomor 50 Tahun 1996 Odor Quality Standard.

Table 6: Sukasari Village Sound Parameter Measurement.

Sample ID	Measurement Time (WIB)	Noise dB (A)
K.2	06.00 - 09.00	45
	09.00 - 11.00	68
	14.00 - 17.00	55
	17.00 - 22.00	40
	22.00 - 00.00	41
	00.00 - 03.00	42
	03.00 - 06.00	46
	Ls	63
	Lm	44
	Ls-m	61

Table 7: Measurement of Water Parameters, Sukasari Village.

No	Parameter	Unit	Regulation Limit *)	Result AP 4
A.	Physical Properties			
1.	Temperature	°C	Deviation 3[a]	29.8
2.	Total Suspended Solid (TSS)	$mg.L^{-1}$	400	56
B.	Chemical Properties			
1.	pH	-	6 - 9	7,2
2.	BOD (5 Day 20°C)	$mg.L^{-1}$	12	13
3.	COD	$mg.L^{-1}$	80	20
4.	DO	$mg.L^{-1}$	1 [b]	3
5.	Chloride (Cl^-)	$mg.L^{-1}$	600	21
6.	Nitrate as N (NO_3-N)	$mg.L^{-1}$	20	1
7.	Manganese (Mn)	$mg.L^{-1}$	-	< 0,004
8.	Zinc (Zn)	$mg.L^{-1}$	2	< 0,002

Information:

*) = Peraturan Pemerintah Republik Indonesia Nomor 22 Tahun 2021 (Attachment VI.I, Class IV) National Water Quality Standards

a = Temperature deviation from air temperature above the water surface

b = Minimum value

while according to SNI 6989.72:2009, which was agreed on February 23, 2009, the river water limit that can be utilized is in Class IV with a threshold value (NAB) of 12 $mg.L^{-1}$. As well as on the sound measurement results in the range at 09.00 – 11.00 has a measurement result of 68 dB(A), which is in accordance with KEP-48/MENLH/11/1996, the sound limit that homes and settlements can accept is 55 dB(a). This can affect the problems that may occur in the future, for example, in BOD agents that exceed NAV, which can cause unexpected problems in the future. As well as in the BOD itself contains bacteria Pseudomonas fluorescens, which can cause a green color in pollution, and according to data from PubMed Central (PMC), these bacteria can cause pneumonia. According to the University of South Carolina, on how to prevent bacteria, Proteus vulgaris addition, these bacteria can cause infection in a wound and infection of the urinary tract. While the risk that may occur in noise pollution is the occurrence of increased stress levels, hearing loss, disturbances when resting, and weakening the immune system.

Environmental Health Risk Analysis

Hazard Identification

One of the hazards identified as a risk agent in the Sukasari Village area, Indramayu, is the discovery of Biological Oxygen Demand (BOD) that exceeds the threshold value (NAB) that has been set. The results of the analysis of BOD levels in the water sampling test used at irrigation construction sites showed BOD levels of 13 $mg.L^{-1}$. As discussed earlier, this value has exceeded the NAV of the BOD parameters as set out in the Indonesian national standard agreed on February 23, 2009 (SNI 6989.72:2009).

The activities carried out by this project found the main source of the BOD contamination in the Sukasari Village irrigation area. However, according to Lusiana et al. (2020), household wastes such as feces and food waste still dominate as a cause of environmental pollution of water. Heavy equipment and raw materials in the process of ongoing development activities may also be influential in the process of pollution of water bodies located in the village of Sukasari. According to Rachmawati (2019), the declining water BOD quality can cause several diseases, including skin irritation and digestive problems.

Based on interviews with 32 residents of Sukasari village, it was found that the majority of the surrounding community did not have expenses for self-medication. The villagers prefer to seek treatment from the local midwives, whose medical costs can be negotiated, or wait for Dokmaru (Doctor on Call program from the Regent) or wait for a mobile health car. Based on interviews with Mrs. Wartani and Mrs. Saringkem, they were affected by a disease that attacks the skin that has been running for 2 years and until the time these data were obtained, has not improved. Some other residents also experienced the same thing, but prefer to remain silent because they are afraid to be asked more deeply. As well as Mr. Naspan, who in appearance has irritated wounds on the skin of his hands and neck, but he insists that it is not a big problem.

Response Dose Analysis

The concentration of BOD on water characteristics in Sukasari village has exceeded the applicable NAB limit that which will cause some direct impacts on public health and the environment around the area. Some of the impacts on

public health that have been identified include symptoms of skin irritation, digestive issues, and respiratory tract issues such as shortness of breath, diarrhea, purulent skin that does not heal, itching, and scabies. The findings are in line with Rachmawati (2019), who also states that high levels of BOD have a relationship with the incidence of digestive disorders and skin irritation than lower levels of BOD in water, and also in accordance with Indriyani et al. (2017), who stated that exposure to dust that has entered the respiratory system can cause non-specific body defense mechanism reactions such as coughing, sneezing, shortness of breath, and wheezing. Although the air levels in the area are still below NAV, it is still necessary to be aware of climate change, natural conditions, and industrial growth/development in each area (Rumselly 2016). The government sets regulations to regulate the requirements and supervision of clean water quality that must meet the requirements, among others: chemical, physical, microbiological, and radioactive requirements; these regulations are set based on PerMenKes No. 416/ MEN.CASE/PER/IX/1990. Government Regulation of the Republic of Indonesia No. 22 of 2021 on Environmental Protection and Management Organizers have also set the maximum limit for BOD levels in river water for Class One at 2 $mg.L^{-1}$, Class Two at 3 $mg.L^{-1}$, Class Three at 6 $mg.L^{-1}$, and Class Four at 12 $mg.L^{-1}$. Further, several chemical mandatory parameters have a value Reference Dose (RfD), which means that if on these parameters there is an increase in concentration exceeding the quality standard, it will be able to interfere or endanger public health (Agustina 2019).

Exposure Analysis

Exposure analysis is done by calculating the value of intake or intake of risk agents experienced by people who interact directly with risk agents from nitrate (NO_3^-), Seng (Zn), Mangan (Mn), dan Besi (Fe). Value intake for non-carcinogenic effects was analyzed using dose-response values (RfD) of previously known risk agents. Some data are needed in conducting exposure analysis that includes anthropometric parameters and other parameters related to the existing condition of the Sukasari Village Community, Indramayu. The value of some of these parameters can be obtained through literature studies or through the results of measurements or research that have been carried out in the field. Some of the parameters used in the analysis of exposure in this study include the respondent's body weight (Wb) obtained from the results of interviews of respondents and measured in kilograms (kg), the rate of ingestion (R) or the amount of incoming volume ($mg.L^{-1}$), has a default of 2 $L.day^{-1}$ for adults and 1 $L.day^{-1}$ for a child (6-12 years), frequency or number of days of exposure (fE) which has a default for settlement of 350 Days/year and working environment of 250 days/year, concentration of polluting agent for 24 h (C) obtained through field measurement results and measured in mg/l units, number of years of exposure (Dt) which has a default value for residential (residential)/ seumut exposure life span of 30 years for adults and 6 years for children, and the period of exposure time (tavg) which can be determined by the equation of length of Work × 365 days. After the value of the existing condition parameter is known, there is no need to calculate the value intake in identifying what age range is safe in the consumption or use of water, the next value can be calculated Intake non-carcinogenic (Ink) of the BOD risk agent which is calculated based on the currently accepted risk calculation as can be seen in Fig. 2.

Based on Fig. 2 above, can be seen the value intake of non-carcinogens from the overall 33 samples of respondents who were given the Code A to G. The calculation results show that the value intake of the smallest non-carcinogen is in the community sample coded G ', with the value intake 0.1299 $mg.kg^{-1}.day^{-1}$. The G ' community is taken from the

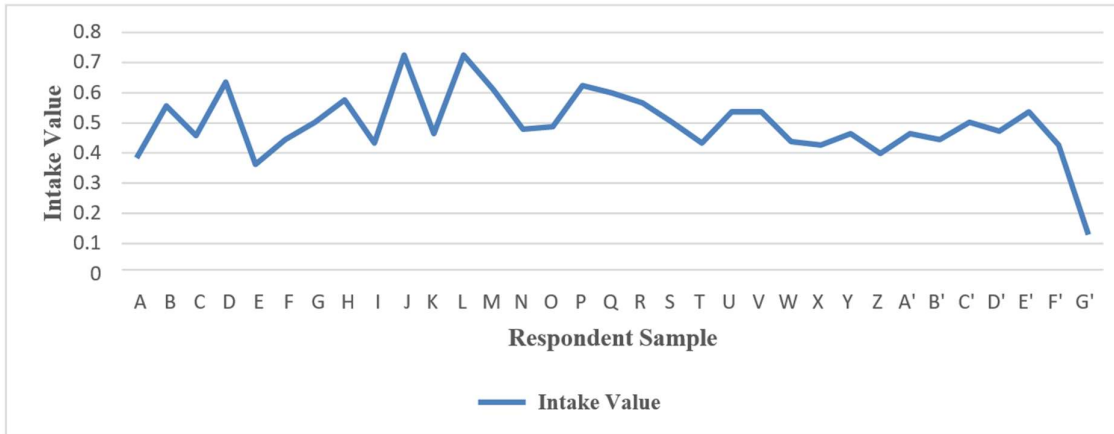

Fig. 2: Intake calculation Table non-carcinogenic.

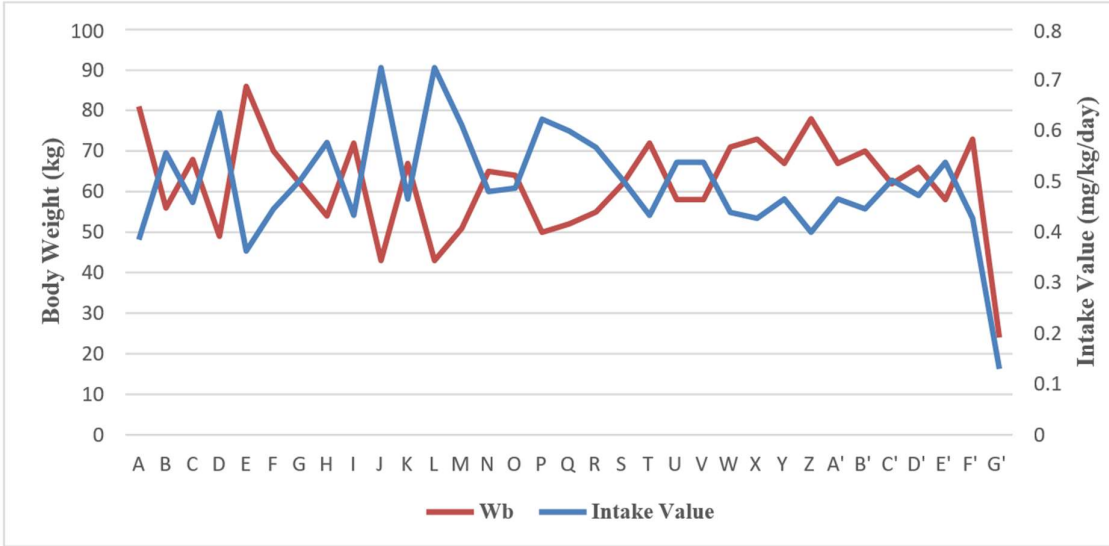

Fig. 3: Relationship between large values of Intake by weight.

sample data of young children listed in the data collection that has been carried out with a body weight of 24 kg with an age range of 9 years, while the value intake tersebesar exists in the sample coded J and L, which has a value intake of 0.7248 $mg.kg^{-1}.day^{-1}$. People J and L have a body weight of 43 kg with an age range of 60 and 82 years. Then, for the average calculation results, with average body weight (Wbaverage) amounted to 62.03 kg, and the average duration (Dtaverage), the obtained results intake amounted to 0.4957 $mg.kg^{-1}.day^{-1}$. These findings indicate that the weight factor (Wb) has a strong influence on the value intake than the duration factor (Dt), which is in accordance with the findings of Nur et al. (2021), which states when the value intake inversely proportional to the weight, so the greater the weight, the smaller the value intake accepted. The relationship between the value of community weight with the value of intake in local communities is described in Fig. 3.

Based on Fig. 3 above, it can be seen that the form of the relationship between the graph value intake with the weight of the Village Community Sukasari is inversely proportional. The Fig. can explain the inverse relationship between the value intake with the weight of the community, which is where the greater the weight of the community, the smaller the value intake produced. The relationship between the value of body weight with the value of intake is in accordance with the findings of Wahyuni et al. (2018) and Darmawan (2018), which states that the greater the body weight it will make the intake value (intake), which will result in a smaller health risk. Mallongi et al. (2018) stated that in the concept of risk analysis, the greater a person's body weight, the risk received by respondents receive due to pollution sources, because people who have larger bodies also have greater nutrition. In addition, research from Lan et al. (2023) also stated that the daily intake (daily intake) for children is five times larger than adults, mainly due to hand-to-mouth activity (hand to mouth) being higher, and the size of the body weight is classified as smaller.

Risk Characteristics

The risk characterization stage is done by determining the level of risk Risk Quotient (RQ) for non-carcinogenic (Ardhaneswari & Wispriyono2022). The level of risk is calculated based on mathematical calculations between the value intake by value Slope Factor (SF). The dose Reference (RfD) of the BOD is unknown. In this calculation, use 2 values of the parts of SF, that is, with the value of Pseudomonas fluorescens with a value of 1.05, which can cause Greening problems in water, and the value of Proteus vulgaris with a value of 0.965, which can cause urinary tract infections (UTIs) (Jouanneau et al. 2014). The results of these calculations can be seen in Fig. 4.

Fig. 4 above only includes two biological components contained in the BOD water polluting agent in the Sukasari Village area. The risk level for non-carcinogenic health effects (RQ) is said to be safe if the RQ is < 1 and is said to be unsafe if the RQ value is > 1 (Pangestika & Wilti 2021). As can be seen in Fig. 4, the safe value is designated by the number 1 and is denoted by a line in green. Seen from the results above, almost the majority of people in Sukasari Village, Indramayu have a risk level value below 1, which shows that the majority of people have a risk level that is classified as safe, and 2 people are classified as unsafe in

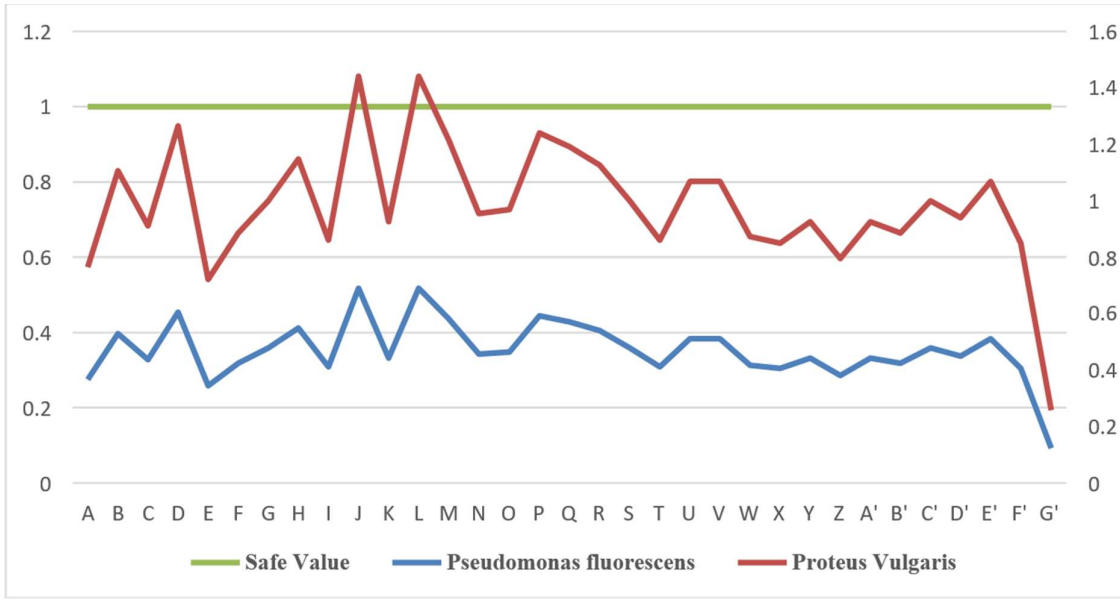

Fig. 4: The results of the calculation of the risk level (RQ) in the Village Community Sukasari, Indramayu.

Fig. 5: Distribution of Risk Levels Based on Community Weight.

terms of Proteus vulgaris. Same as value intake, the value of the risk level also has a significant relationship with the value of people's body weight. To show this, the value of the risk level can be classified by the value weight of society, which can be seen in Fig. 5.

Based on Fig. 5, there are 2 communities that are categorized as unsafe and 30 communities that are in the safe category. For people who have a body weight range of 43 kg has a range of values of 0.7510, which is where the RQ value is said to be safe but the greatest potential for Disease is high, while in people who have a body weight with a range of 49-81 which has a range of values of 0.6591 to 0.3987 can be biology). These results are in accordance with the results that have been proposed by Erdinur et al. (2021); the greater the value of body weight, the less the risk it faces.

Risk Management

Risk Management Strategies: Based on water class classification, it can be seen that the BOD polluting agent owned by the water component in Sukasari Village shows that the river water in the area is already classified as polluted and cannot be used for irrigation in large quantities. With

this classification, it can be made clear that the river water cycle in Sukasari Village is not suitable for use, and if used, it will cause new problems in the future. In accordance with research from (Sellner et al. 2003), which suggests that the growth of bloom is because there are two main types of algae, namely the natural circulation process, the reversal of the mass of water (upwelling), and river flow; and anthropogenic activities leading to eutrophication. Here is an example if in a water occurs eutrophication and algal growth.

a) Nutritional advantages: A high BOD indicates a high level of organic matter in the water, which causes a high amount of nutrients to be contained and is excessive for algae and other aquatic plants.

b) Rapid growth of algae: A lot of nutrients can cause algae growth to be difficult to control, and algae can cover the surface of the water, blocking sunlight and oxygen.

c) Decreased Diversity: Excessive algal growth can inhibit and even kill biodiversity and aquatic organisms in it.

How to Manage Risk: After knowing about the risk management strategies that can be applied, it can then be determined how to manage risk in accordance with the circumstances that have occurred in the field (Sukasari Village, Indramayu). According to the Indonesian Ministry of Health in 2012, the way of risk management can be arranged in tables to facilitate interpretation, especially for laypeople who do not understand aspects of risk analysis, as for how the management can be done as presented in Table 8.

Irrigation development project activities that are being carried out in Sukasari Village, Indramayu itself, according to the data that has been discussed in the previous discussion, show that there is a potential that pollutes, namely the BOD agent in water and noise parameters in the range of 09.00-11.00 h The impact that can be caused by the implementation of this development activity, from the data that has been compiled above, can be seen in the results of the Sensitivity Index assessment that has been compiled in Table 9.

The method is done with semi-quantitative, the frequency of occurrence and the amount of influence on the activities of irrigation development projects can be seen from Table 9 and the sensitivity value can be seen in Tabel 10, so that the value of the total risk that occurs in the development activities of this project can be calculated, and shown by Tabel 11. Analysis using semi-quantitative methods known risk value of each part of the problem that can be reviewed to be considered in depth. In accordance with the statement of (Damayanti et al. 2004), Environmental Risk Analysis is an activity to estimate the possibility of the emergence of a risk and to determine the impact of ongoing activities. From the results of these measurements, we can see that the risks posed by the ongoing project activities are classified as low risk, with a value of 85. The resulting risk only needs to be done by managing it with routine and monitored procedures, so that the estimated risk does not become a serious impact that will be faced in the future. In accordance with Silva & Lopes (2017), periodic monitoring of pollutant sources is

Table 8: Risk Management Based on Regulation.

No	Management	Alternative Approaches		
		Technology	Socio-Economic	Institutional
1	Reduction of risk agent concentrations to below safe limits	• Nothing	• Make a statement aboutthe No.18 of 2018 about throwing garbage in its place. • Do not usefertilizers excessively, in accordance with PerMenTan No.13 of 2022. • Do not placelivestock adjacent towater bodies or with the guidelines stated in PerMenTan No.31 of 2014.	• Conduct an appeal activity, whether the water pollution that has occurred is really caused by thecompany or not. • Conducting water control accompanied by cooperation with relatedBBWS.

Table 9: Matrix of Frequency and Magnitude of Risk Events.

Risks	Frequency of Occurrence	Magnitude of Occurrence	Description
Decreased Air Quality	5	2	Air pollution is due to dust generated in cement stirring activities, heavy vehicle traffic, and soil dredging. However, based onlaboratory results show that air pollution levels are completely below the specified quality standards.
Water Quality Decline	5	5	Water pollution due to mobilization oftools and materials; rehabilitation of primary, secondary, sluice, and siphonchannels; physical improvement of weirs; and construction of sedimenttraps.
Public Health	3	2	Public health is affected due to themobilization of tools and materials, aswell as Channel rehabilitation and supporting facilities.

Description: 1 = No risk, 2 = The risks and effects are small, 3 = Moderate risk, 4 = Big risk, 5 = Huge risk

Table 10: Risk Event Sensitivity Matrix.

Risks	Incident Sensitivity	Description
Decreased Air Quality	3	Regional/local attention
Water Quality Decline	4	Become a national concern
Declining Levels of PublicHealth	3	Regional/local attention

Description: 1 = Not a public concern, 2 = Attention of the group, 3 = Regional/local attention, 4 = National Attention, 5 = Not being international/world/media

Table 11: Total Risk Value Matrix Results.

Risks	Frequency (F)	Quantity (S1)	Sensitivity (S2)	Risks Value(F x (S1+S2))
Decreased Air Quality	5	2	3	25
Water Quality Decline	5	5	4	45
Declining Levels of PublicHealth	3	2	3	15
Total Risk				85

Description: R = 1-150: Low risk, management is done with routine procedures only; R = 151-300: Moderate risk, high level of management attention required; R = 301-450: High risk, detailed research and management required

necessary so that the process control of these activities can be better maintained. By looking at the data from Table 11, it can be seen that the development activities carried out in Sukasari Village, Indramayu, still have the potential risk of damaging the water/land ecosystem located in the Sukasari Village development site area. The mobilization of heavy equipment and the processing of materials to be used for development activities can affect the surrounding ecosystem. As in the case of heavy equipment that will be used to carry out the construction, if it is known that there are obstacles in the mobilization process, all means will be sought to be able to send the goods, and usually, the disturbing flora will be cut down for the smooth mobilization of the tools to be used. Based on data in Table 7, it can be seen that the value of BOD levels owned by water parameters in Sukasari village exceeds the NAV. These possible risks can be seen from research conducted by Sellner et al. (2003), that the possibility of occurrence of blooming algae increased, especially by seeing that Indramayu Regency is a national rice barn where the maintenance and growth of rice in the region will not escape the use of fertilizer. In practice, algal blooming is a serious problem that can potentially kill aquatic biota within the area covered by it. If an area has been covered by algae, it will be more difficult to restore it, especially since algae blooms are very fast-growing. The fertilizer will certainly have the potential to further increase the burden of water BOD located in the Sukasari Village area itself. To determine the root cause of the problems that may arise from the environmental conditions of Sukasari village can reflect on the theory of Charles et al. (2016), namely by using the theory of Cause Root Analysis (CRA). In looking at the root of the problem, results can be seen from Fig. 6.

From Fig. 6 it can be seen that the root problem of the cause of the high levels of BOD water parameters in the Sukasari Village area is due to the assumption of the community that by participating in the socialization activities will not change the environmental conditions directly, it is confirmed by the head of Sukasari Village, Indramayu(Mr. Waskadi), at the time of socialization many villagers were also present at the event. This is in accordance with the pre-construction activities in which the majority of villagers were

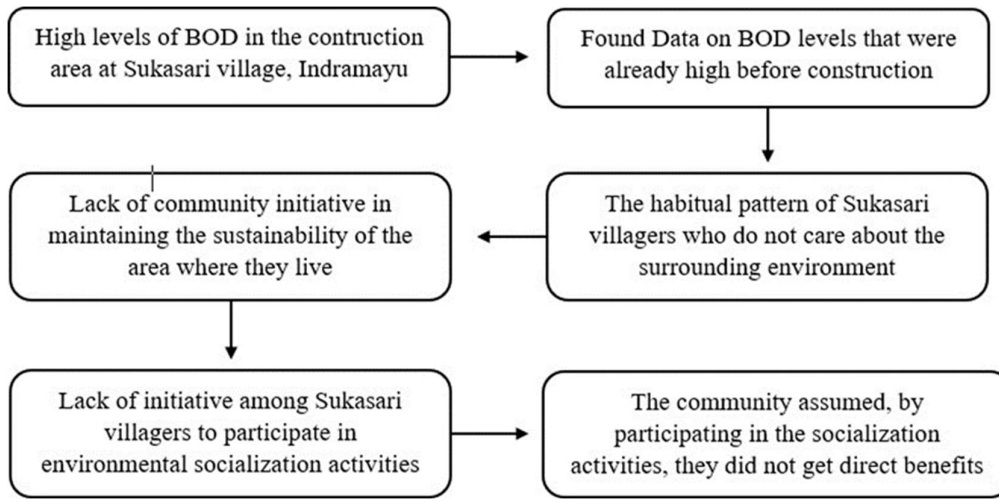

Fig. 6: Cause Root Analysis Sukasari Village, Indramayu.

present in the socialization activities (because it concerns the issue of citizen activities directly.

CONCLUSIONS

Project development work activities carried out in Sukasari Village, Indramayu, can have an impact on the environment, namely the mobilization of tools and materials, which can cause air and noise pollution. B3 waste (oil and batteries), construction activities on water bodies, and waste generated by the activities of workers around, which can cause pollution in the water. Indramayu city is an area that is included in the national rice barn in Indonesia. If the government does not pay attention to the circulation of water there, let alone if farmers do not pay attention to the use of fertilizers in the region, then the water conditions there will get worse day by day. An activity that the government can do, in order to prevent pollution from becoming more widespread, is to conduct in-depth education, which is then consciously and obediently carried out by the village community. Air parameters do not have a value above the threshold that has been set, so the risk of pollution is relatively low. However, the level of pollution risk that results from exceeding the threshold value (NAB) exists in BOD agents in water and soil. Where it is not in accordance with the threshold value that has been determined by SNI 6989.72:2009, which, for the classification of water pollution limits that can be used (for the BOD category) is 12 mg/L, in the field measurement results, the value for the BOD agent has a value of 13 mg/L. As well as on noise pollution, according to KEP-48/MENLH/11/1996 the sound limit that homes and settlements can accept is 55 dB(A), which in the field measurements at 09.00 – 11.00 shows the value of 68 dB(A). BOD pollution is not affected by the development; the development of BOD tested and produced a value of 16 mg/L. And, on the noise parameters before the project activities, at 09.00-11.00, showed the results of the value of 54 dB (a). There is no Sukasari Village community that filed a complaint (disclaimer) and feels disturbed about the project activities in the village or about the project directly. And, based on the results of the assessment formulated by measuring the sensitivity index, the overall value reached 85, which indicates that the results of the risks posed are low (not too impactful) and only need to be managed regularly.

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