

# Mapping The Risk Factor of Leptospirosis in Klaten District

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## 1 MAPPING THE RISK FACTOR OF LEPTOSPIROSIS IN KLATEN DISTRICT

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**Background:** Leptospirosis is a zoonotic, that occurs in many part of the world, most countries in Southeast Asia declared as endemic areas of leptospirosis. Indonesia is a country with high case fatality rate of leptospirosis reaching 7.1%, with a range between 2.5 - 16.45%, in patients aged over 50 years the mortality rate can reach 56%. Klaten district includes one of the distribution of leptospirosis. Data in 2008 showed that 21 were positively infected by leptospire of 66 people under investigation. In 2010 there were 5 deaths from 15 cases were found. Cases continue to rise in 2011 and expanded in several villages and districts, especially areas that are near the area of rice fields and streams. Knowing distribution maps the risk factor of leptospirosis in Klaten.

**Methods:** An observational study design with a combination of ecological and case-control study. Implemented in Klaten in 2011. Subjects were residents who are leptospirosis diagnosed or infected with *Leptospira*. Diagnosis is confirmed by a doctor based on clinical criteria of WHO-1982 and/or diagnostic test equipment (leptotec and/or MAT). Samples were taken of 210 people consisting of 105 cases and 105 controls. Analysis of data used is average nearest neighbor, Mc. Nemar and conditional logistic regression (CI: 95%).

**Results:** The mapping distribution of leptospirosis in Klaten is clustered at coordinates 454 230, 9.15211 zone 49S, a radius of 423.86 meters. Mapping of risk factors in areas with poor sanitation. Risk factors showed that house sanitation (OR = 7.89, 95% CI: 2.68 to 23.21, p = 0.000), employment (OR = 3.77, 95% CI: 1.49 to 9.54, p = 0.005) and the presence of mice (OR = 3.58, 95% CI: 1.35 to 9.49, p = 0.010).

**Conclusion:** Characteristics of cluster formation region is close to the rice field area, a densely populated residential houses at a distance close enough/meetings (less than 20 meters). The most dominant risk factor is a house sanitation.

**Key words:** Mapping, risk factors, leptospirosis

Leptospirosis including zoonoses that occur throughout the world, especially in the tropics and subtropics<sup>1</sup>. Most countries in Southeast Asia expressed as leptospirosis<sup>2</sup> endemic areas. Leptospirosis incidence worldwide is difficult to know exactly, because the disease is often under diagnosed. Mild cases are often not diagnosed as leptospirosis. World Health Organization (WHO) noted that the incidence in temperate regions ranged between 0.1-1/ 100,000 population per year, whereas in the humid tropics tend to be higher at 10-100 / 100,000 population per year. During an outbreak in a high risk group the incidence can reach >100/100,000 penduduk<sup>3,4</sup>.

Reports Leptospirosis Society (ILS), states that in 1999-2000 the outbreak of leptospirosis occur several countries, namely in India, Thailand, France, USA, Brazil, Uruguay, Indonesia and several other countries. In fact, the 2000 data mentioned

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case fatality rate (CFR) in Indonesia (16.7%) ranks third in the world after Uruguay (100%) and India (21%)<sup>5</sup>. On average CFR leptospirosis in Indonesia is quite high at 7.1%, with a range between 2.5 to 16.45%. In fact, in patients aged over 50 years the mortality rate can reach 56%.

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Leptospirosis in Indonesia in the last 6 years (2004-2010) tends to increase, as a result of the increase in cases in several areas that are often flooded, especially in Jakarta and Central Java. It was reported that in 2007 the number of cases reached 666 with 57 deaths in 2008 fell to 263 cases with 16 deaths. Regional distribution of leptospirosis in Indonesia, West Java, Central Java, Yogyakarta, Lampung, South Sumatra, Bengkulu, Riau, West Sumatra, North Sumatra, Bali, West Nusa Tenggara, South Sulawesi, North Sulawesi, East Kalimantan and West Kalimantan. Recorded outbreaks in Indonesia occurred in Riau (1986), Jakarta (2002) (138 specimens

1 obtained with 44.2% positive), Bekasi (2002), and Semarang (2003)<sup>6,7</sup>.

Leptospirosis disease was first discovered in the district of Klaten in 2005 were 3 cases. Based on the incident Klaten District Health Office carry out screening. Screening results indicate that 21 people tested positive for leptospira infection of 66 people were examined. Leptospirosis re-emerged in 2008 in the Northern District of Klaten. In 2010 there were 5 deaths of 15 cases were found. Until 2011 leptospirosis in Klaten district continues to increase<sup>8</sup>.

The problems is disease already widespread in several villages and districts, especially areas that are close to the rice fields and streams. The rainy season, housing and environmental sanitation conditions where rats around the residence is thought to be the cause of the increase in cases. Mapping the incidence of leptospirosis is one attempt to obtain location information accurately mapping the spread of leptospirosis following risk factors.

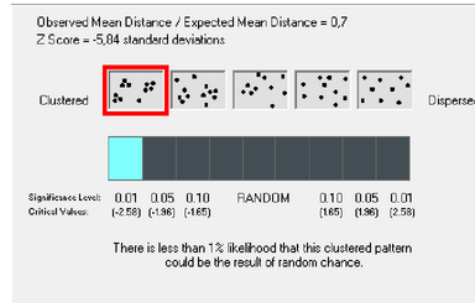
### Reseach Methods

This observational study design was used with a combination of ecological studies case control study, to study the distribution pattern and risk factors for leptospirosis in Klaten District. The variables studied were individual characteristics (income, occupation and education), and environmental (density residential, home sanitation, where rats and location of the cage). Subjects were people who were diagnosed with leptospirosis either found in hospitals and in the community survey results, confirmed by a doctor's diagnosis based on clinical criteria set by the WHO (1982) and or diagnostic test equipment (leptotek and or MAT). Sampling was done by purposive sampling. Spatial analysis is used to view the distribution pattern of leptospirosis.

## Results and Discussion

### 1. Mapping analysis of leptospirosis

Results of the analysis showed that the average nearest neighbor nearest neighbor index (nearest neighbor ratio) from the point of the case was 0.7 (<1), the value of Z score is -5.84 and p-value of 0.01, thus it can be said distribution pattern of leptospirosis in the district of Klaten is clustered distribution (clustered), as shown in Figure 1.



1 *Figure 1. Analysis of Leptospirosis Risk Factors in the district of Klaten April 2009 - August 2011*

Regional grouping use cases seen Purely Spatial analysis Bernoulli model. Results of the analysis as shown in Figure 2 shows a grouping in the form most likely cluster centered at coordinates 454 230, 9.15211 UTM zone 49S, a radius of 423.86 meters and a p-value of 0.017, in the village of the District Senden Ngawen. Two secondary cluster, centered on the coordinates 470 031, 9.15427 UTM zone 49S, a radius of 102.59 meters and a p-value of 0.017, in the village of the District Kenaiban Juwiring. District of Karangdowo Karangjoho village centered on the coordinates 474 406, 9.1474 UTM zone 49S, a radius of 107.17 meters and p-value of 0.017.

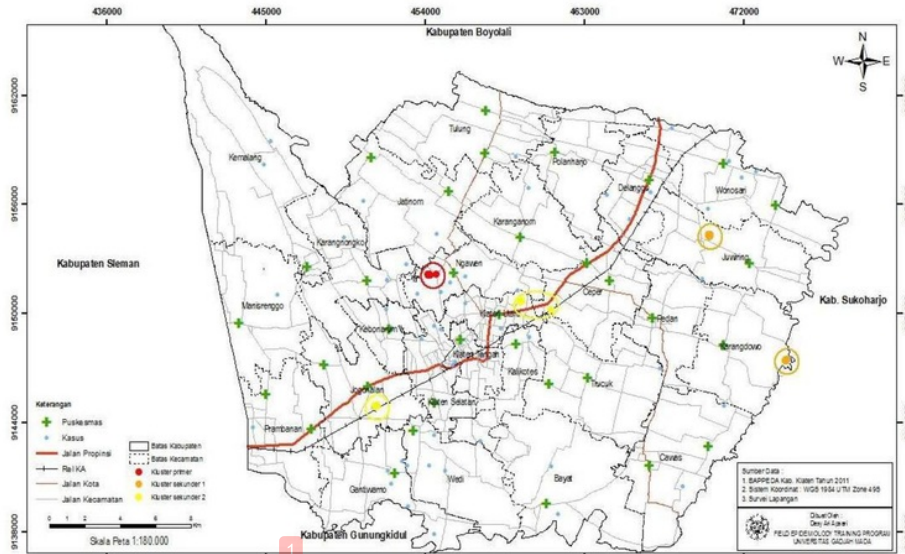


Figure 2. Clustered of Leptospirosis

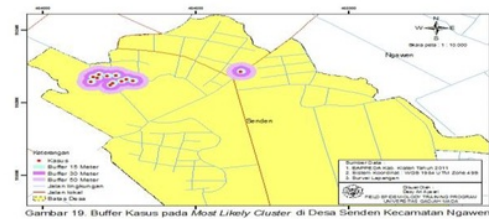
Grouping of leptospirosis cases that occurred in the Klaten district shows that the potential transmission of leptospirosis to the people who live in areas where clusters (most likely cluster and cluster secondary) are likely to be greater when compared to people living in other areas outside the clusters.

Characteristics of cluster formation region (most likely cluster and cluster secondary) in general is an area with a high population density, the majority of the population worked as farmers or agricultural laborers and the distance between the houses are very close. Results indicate that the buffer in the case of point clusters of cases at the primary and secondary clusters tend to cluster in a radius of 15 m - 30 m (Fig 3). Leptospirosis cases are more common in residential areas with fairly high density of buildings, thus environmental conditions are very favorable for mice. Homes are fairly close distance rat facilitate moving from one house to another either for nesting and foraging.

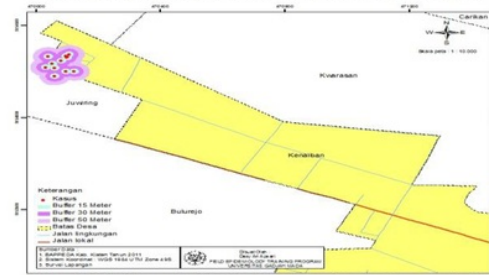
Results of research on leptospirosis transmission occurring in urban areas in Salvador, Brazil showed that leptospirosis transmission tends to occur in poor residential areas with fairly dense residential neighborhood poor sanitary conditions<sup>9</sup>.

Similarly, the results of research conducted in São Paulo Southeastern Brazil,

stated that the increase in cases of leptospirosis occurs largely in the poor, who live in dense residential area and dirty<sup>10</sup>. WHO states that the environment is very dense slum is one of the risk factors of leptospirosis<sup>11</sup>.



Gambar 19. Buffer Kasus pada Most Likely Cluster di Desa Senden Kecamatan Ngawen



Gambar 20. Buffer Kasus pada Secondary Cluster di Desa Kembang Kecamatan Juwiring

Figure 3. Buffer in Rice Fields Most Likely and Secondary Clustered

Buffer in rice fields showed that 62.96% of cases of leptospirosis in the primary and secondary clusters tend to cluster in a radius of 15 m - 50 m from the edge of the fields, as shown in Figure 4. Based on

1 observations in the field looks a lot holes around the rice field which is a nesting and breeding place for rats. Habits make holes around the rice fields aims to nurture their children, besides mice will also make a hole in the dike irrigation to reside. Availability of rice can be used as indicators of an increase in the rat population, because this environment is a suitable habitat for the development of rat<sup>12</sup>.

Sehgal research on leptospirosis epidemiological patterns, noted that leptospirosis is often seen in rural agricultural areas in some South and Southeast Asian countries including India's rural peninsula, Northeast Thailand, southern China and the Philippines. In which case the peak usually occurs in the growing season and the harvest season<sup>13</sup>.

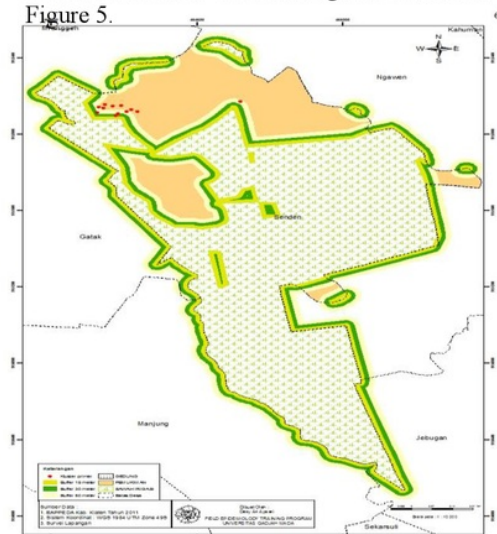
Results of multiple ring buffer against local roads or districts showed 44% of cases of leptospirosis stay at a radius of 15-50 m from local road / districts, but almost all of the cases live quite close to the road environment. However results observations showed that 50.5% of cases stayed in a radius of <50 m of sewerage, most of these facilities are open sewerage. Sunaryo research on factors that affect the mapping and leptospirosis, stating that the spread of leptospirosis cases that form cluster in Semarang due to the environmental risk factors that slum with waste water disposal system which poor<sup>14</sup>.

Reis in an environmental impact study to *Leptospira* infection in slum dwellings mention that the house is located close to the sewerage open (<20 m) greater risk of *Leptospira* infection (PR = 1.42, 95% CI: 1, 14 to 1.75)<sup>15</sup>. Bovet in the study also stated that the occurrence of leptospirosis in humans because of their interaction with the environment one of which is the physical environment associated with the state of the waste water ways<sup>16</sup>.

Buffer river showed that 28.57% of the cases live in a radius of  $\leq 50$  m from the river. Nardone stated that the residence location adjacent to the river (ORMH = 3.0, 95% CI: 1, 6 to 5.6) is a risk factor associated with the incidence of leptospirosis. but in this

1 study the proportion of cases who live very close to the river <30%, so it can be concluded that the risk factors for transmission of leptospirosis is not dominated by residential location close to river<sup>17</sup>. These results are similar to studies Sugunan which states that one of the risk factors for leptospirosis outbreak was soaking in water (OR = 3.23, 95% CI: 1.47 to 7.21), whereas one of the risk factors that could potentially cause acute leptospirosis is to make the river as a source of drinking water (OR = 4.4, 95% CI: 1.1 to 18.0)<sup>2</sup>.

Visualization using satellite images on the Google Earth shows that the geography of the spread of leptospirosis tend to be similar among closely to the area of rice fields, settlements densely populated with houses close enough distance/conference (less than 20 meters). Primary cluster distribution region that is located in the village of the District Senden Ngawen and secondary clusters located in the village of the District Karangjoho Karangdowo and Village Kenaiban District of Juwiring, as shown in Figure 5.



1 Figure 4. Buffer Rice Field in Most Likely Cluster



Figure 5. Maps The Spread of Leptospirosis

## 2. Analysis of risk factors for leptospirosis

Bivariable analysis aims to determine the relationship of each variable that is suspected as a risk factor to the incidence of leptospirosis. Mc.Nemar test results at 95% confidence level can be seen in Table 1.

Table 1. Analysis Bivariable for Risk Factor of Leptospirosis

Case	Control		OR	95%CI	p
	Exp	Unexp			
Income					
Low	33	43	3,30	1,74-6,70	0,00*
Standart	13	16			
Employment					
Exposure	21	43	4,78	2,29-11,14	0,00*
Unexposur <sup>9</sup>		32			
Educatations					
Low	44	31	2,38	1,21-4,97	0,00*
High	13	17			
Density					
Exposure	2	9	4,5	0,93-42,79	0,03*
Unexposur <sup>2</sup>		92			
House sanitation					
Poor	43	54	13,5	4,98-51,33	0,00
Good	4	4			
Present of rodents					
Exposure	7	42	7	2,96-20,15	0,00*
Unexposur <sup>6</sup>		50			
Cattle pen position					
< 50 mtr	29	44	2,44	1,38-4,49	0,00*
≥ 50 mtr	18	14			

The analysis showed that the income (OR = 3.30, 95% CI: 1.74 to 6.70, p; 0,00) is a risk factor for leptospirosis cases in the district of Klaten. This means that people who are included in the category of low-income or below the minimum wage (<Rp. 766 022) tend to be more likely to be exposed to leptospirosis. Data showed 58.10% and 72.38% of cases the respondents have incomes below the minimum wage (UMR).

Okatini research that reveals that the individual characteristics such as socioeconomic level is a risk factor for the incidence of leptospirosis in Jakarta (OR = 1.93, 95% CI: 1.073 to 3.462, p; 0.039)<sup>18</sup>. Other studies have shown a positive correlation between individual characteristics, namely economic levels with the incidence of leptospirosis. Stated that the increase in cases mostly occur in poor people who live in the slums, inadequate sanitation conditions mentioned as a source of transmission of leptospirosis. Economic level low enough to trigger allegedly poor sanitation in the area<sup>10</sup>.

Employment (OR = 4.78, 95% CI: 2.29 to 11.14, p: 0.00), this means that people in occupations potentially comes in contact with the source of contaminants, (eg: farmers / farm workers, ranchers, ornamental fish sellers, abattoir workers, scavengers or other jobs that are associated with water and or sources of contaminants) are most likely to be exposed to leptospirosis. In accordance with Murtiningsih research that says that work as a

farmer (OR = 4.09, 95% CI: 1.18 to 14.12, p: 0.025) were risk factors for leptospirosis in Yogyakarta<sup>19</sup>. Sarkar also said that exposure to sources of contaminants in the workplace increases the risk of leptospirosis<sup>20</sup>.

Level of education (OR = 2.38, 95% CI: 1.21 to 4.97, p: 0.00) indicates that pertained education leptospirosis risk factors in Klaten District. Factors person's educational background is often associated with the type of work that ultimately have an impact on earnings. Someone who has a higher level of education are more likely to get a good job, a good income with standard anyway. Thus it would affect the quality of life. Research Okatini mentioned that the level of education (OR = 3.74, 95% CI: 1.72 to 8.21) were risk factors leptospirosis<sup>18</sup>.

Residential density is a risk factor for leptospirosis (OR = 4.5, 95% CI: 0.93 to 42.79, p: 0.03). Residential density often associated with the arrangement of the house. If the house irregular arrangement will create places that can be used as a rat's nest, as well as the waste generated, it can be used as a source of food for rodents. Sanitary house seen in this study is based on several components of basic sanitation among waste management, waste water disposal, building construction, type of floor and rat proofing conditions. The results showed that 92.38% of cases of leptospirosis in the district of Klaten live in houses with poor sanitation. Hand and Ristiyanto in the research stated that hygiene / sanitation home (PR = 3.75, 95% CI: 1.28 to 10.16, p = 0.010) were risk factors for leptospirosis in Demak. The low quality of such services can be caused due to the handling of poor waste management<sup>21</sup>.

The existence of rats (OR = 7, 95% CI: 2.96 to 20.15, p = 0.00) and the location of the enclosure (OR = 2.44, 95% CI: 1.38 to 4.49, p = 0.00), so it can be said that the exposure of these two factors can increase the risk of leptospirosis. The results showed that 97.14% of the cases seen rats around her house and 46.66% of them stated often see rats in the house (> 3 times/week). Similarly, the location of the enclosure which showed that 45.71% of cases put the cage together with a dwelling (0 meters from the house), while 28.81% making cattle pen in a radius <50 meters from the house.

Results of multivariable analysis using logistic regression conditional test showed that the risk factors that have a relationship with the incidence of leptospirosis in Klaten district in order are sanitary housing (OR = 7.89, 95% CI: 2.68 to 23.21, p = 0.000), work (OR = 3.77, 95% CI: 1.49 to 9.54, p = 0.005) and the presence of rats (OR = 3.58, 95% CI: 1.35 to 9.49, p = 0.01) , The analysis also showed that 47.28% incidence of leptospirosis in Klaten district affected by their exposure to the three risk factors at the same time, as tampak in Table 2.

Table 2. Multivariable Analysis of Risk Factors incidence of leptospirosis

Variabel	OR	95%CI	p	PseudoLog R <sup>2</sup>	Li.hood
House sanitations	7,89	2,68- 23,21	0,000		
Employe nt	3,77	1,49-9,54	0,005	0,47	-37,038
Present of rodents	3,58	1,35-9,49	0,010		

These results are consistent with research Sarkar in Salvador Brazil, which mentions the incidence of leptospirosis due to sanitary conditions poor housing as the collection of garbage, close to open sewers and the presence tikus<sup>20</sup>. Reis also mentions that Lepospira infections caused by environmental exposure associated with housing, work environment and a sign of the presence of rats<sup>15</sup>.

### 3. Model spatial relationships

Model of spatial relationships is the visualization of the distribution of risk factors that have an association with leptospirosis, the results of multivariable analysis consisted of sanitation home, work and the presence of rats. visualization of the distribution of three risk factors shows that the distribution of leptospirosis in the district of Klaten more are in areas with higher levels of residential density. 56.19% of cases spread in the area of an average residential density > 3.475 per home (Figure 6).

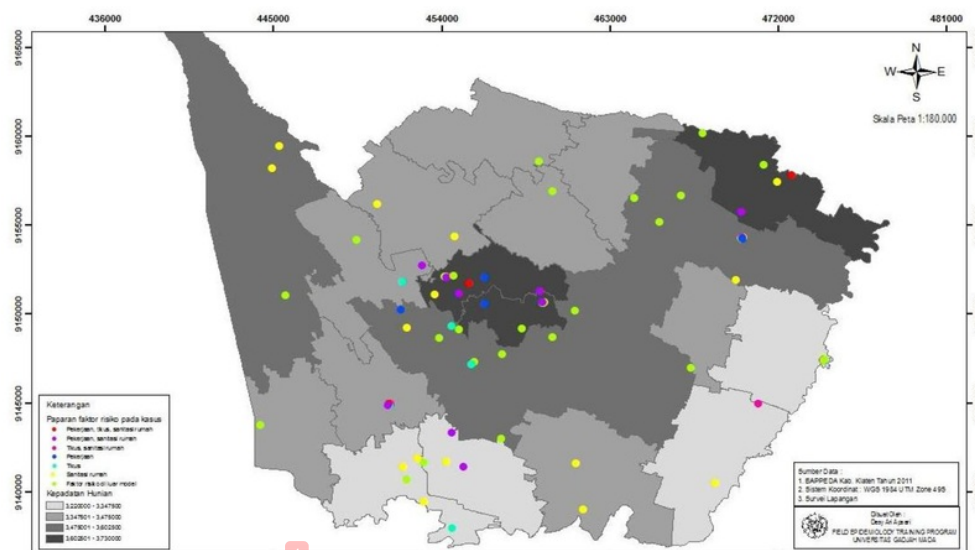


Figure 6. Spread Mapping of Risk Factor

Results overlay exposure to risk factors in cases of leptospirosis showed that 60% of cases of leptospirosis exposed by one or more of these three risk factors, while 40% of them are exposed to other risk factors outside the model. The frequency distribution of the combination of exposure to risk factors for leptospirosis in Klaten district can be seen in Table 3.

Table 3. Exposure Risk Factors incidence of leptospirosis

Exposure Risk Factors	Cases	
	N	%
House sanitations	23	21,90
Employment	11	10,48
Present of rodents	5	4,76
House sanitation and employment	16	15,24
House sanitation and present of rodents	5	4,76
House sanitation, employment and present of rodents	3	2,86
Risk factors outside the model	42	40

Data in the table showed the dominant exposure of risk factors of the case are as much as 21.90% of sanitary home and work as much as 10.48%. Exposure to a combination of two risk factors showed 15.24% of cases of exposure to risk factors for home sanitation and jobs, 4.76% of cases of exposure to risk factors for the presence of rats and sanitary home. As for exposure to the combination of

three risk factors shows the proportion of 2.86%. Furthermore, 40% of whom leptospirosis cases are caused by exposure to other risk factors, among which are equally harmful activity contact with sources of contaminants and environmental factors.

The results showed 82.9% of cases have a habit of activities related to the sources of contaminants in this water, including fishing, swimming or bathing cattle in the river, as well as looking eel, grazing and herding cattle in the fields. The data also showed that 69.5% of the cases are still found which build cattle sheds with a distance <50 meters from the main house and even some of them put the cage of the roof to the main house. On the other hand still found 82.9% of cases have a habit of activities related to the sources of contaminants in this water. Among the activities of fishing, swimming or bathing cattle in the river, as well as looking eel, grazing and herding cattle in the fields. This fact further strengthens the principle that the onset of disease epidemiology is needed more than one cause (multiple causation) <sup>22</sup>.

### Conclusion

1. Distribution of leptospirosis cases in the district of Klaten is clustered.
2. The incidence of leptospirosis in the district of Klaten scattered in a radius of 15-30 meters in the surrounding rice paddies, 30-



1. 50 meters around the local / district and less than 50 meters around the river.
3. Employment associated with the incidence of leptospirosis in Klaten District. Work as farmers / farm workers as well as work that allows a person exposed to contaminated water rat urine will increase the risk of transmission of leptospirosis.
4. The environmental conditions of housing and sanitary housing that is associated with the presence of rat leptospirosis cases in the district of Klaten. House poor sanitation and the number of mice around the house increases the risk of transmission of leptospirosis.
5. The mapping of leptospirosis in Klaten district associated with environmental factors. Home sanitary risk factors, the presence of rats and residential density is a risk factor dominant in the cluster area leptospirosis.

#### Recommendations

- A. Klaten District Health Office through health centers seek to increase community participation in the control of risk factors for leptospirosis in both cluster and non-cluster areas are:
  - a. preferably in the cluster area activities:
    1. motivate people to perform regular mutual cooperation to improve environmental sanitation housing
    2. dissemination of the importance of using personal protective equipment when working, especially on jobs at risk *Leptospira*
    3. encourage people to re-harness trap (mousetrap) in an effort to reduce pupolasi rats around the residence.
  - b. preferably non-cluster region on activities:
    1. The socialization of a clean and healthy lifestyle that focused on personal hygiene in an effort to prevent the occurrence of *Leptospira* infection, especially in those who frequently perform outside activities
    2. Dissemination of the importance of using personal protective equipment when working, especially on jobs at risk Spira
- B. Klaten District Health Office should improve coordination with health centers in the implementation of leptospirosis surveillance and monitoring system of mice, primarily in regions or clusters and dense residential area and close to the area of agriculture (rice) and rivers.

- C. It needs further research to determine the level of endemicity or level of vulnerability to the spread of leptospirosis in the region of Klaten District.

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