Filariasis Vulnerability Zonation Based on Environmental and Behavioural Aspects in Pekalongan City, Indonesia

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Abstract. Pekalongan City is a filariasis endemic area in Central Java, Indonesia with Mf-rate >1%. It had held Mass Drug Administration (MDA) in 2011-2015. The evaluation result recommended it to re-hold MDA. This study aimed to compose filariasis vulnerability zonation based on environmental and behavioural aspects in Pekalongan City. The observed environmental aspects were the location of shrubs, cattle pen and tidal flood. The surveyed behavioural aspects were applicating mosquito repellent and hanging clothes habits. Filariasis cases data were collected from health office. This was a descriptive quantitative study with spatial approach. The environmental and behavioural aspects were observed and surveyed in 6 urban villages (38 RWs) with 387 households as samples which were chosen with proportional random sampling. The instruments were checklist sheets, Global Positioning System (GPS), satellite imagery and GIS software. Data were analysed with scoring, buffering and overlaying procedures. Results indicated some areas were categorized as highly vulnerable where shrubs, cattle pen, tidal flood and hanging clothes habit were present. It was concluded that all urban villages in this study had highly vulnerable RWs which are very potential for filariasis transmission. Applicating mosquito repellent habit was not potential aspect for controlling filariasis transmission in the studied areas.

1. Introduction

Filariasis is a systemic infection caused by filarial worms whose adult stages live in the lymph glands and human blood, then are transmitted through mosquitoes (i.e. Culex sp., Anopheles sp., Aedes sp., Armigeres and Mansonia). Filariasis is chronic and will cause permanent disabilities such as enlargement of the legs, arms, breasts, and genitals in women or men. Filariasis is caused by 3 species of filarial worms, such as Wuchereria bancrofti, Brugia malayi and Brugia timori [1]. The disabilities will decrease the productivities [2], [3]. Filariasis risk factors are related to mosquito’s life and behavior. Previous studies had proven that lack of knowledge, poor sewerage condition, stagnant water existence, cattle pen existence and shrubs existence contribute to be the breeding and resting places for mosquitoes. Some behaviors are also proved to ease filariasis transmission, like hanging clothes, doing night outdoor
activities, not using mosquito net during sleep, not install mosquito net on ventilation, not applying mosquito repellent, etc [4]–[10].

Pekalongan City is a filariasis endemic area in Central Java, Indonesia with Mf-rate >1%. It had held Mass Drug Administration (MDA) in 2011-2015. The evaluation result recommended it to re-hold MDA because it had not decreased the Mf-rate and filariasis cases number yet. In 2010 there were 55 clinical cases and 8 chronic cases, in 2011 there were 110 clinical cases and 7 chronic cases, in 2012, there were 59 clinical cases and 7 chronic cases. There were 5 clinical cases in 2013, 65 clinical cases in 2014 and 3 clinical cases in 2015. Pekalongan City had some urban villages with Mf-rate >1% based on Finger Blood Survey (FBS). They were Kertoharjo Village (4.18%), Pabean Village (3.39%), Tegalrejo Village and Bandengan Village (2.39%). Based on Pekalongan City Health Office data, in 2015, there were 24 clinical and 3 chronic clinical cases in Banyurip Ageng, there were 82 clinical and 3 chronic cases in Jenggot Village, 1 clinical and 130 chronic cases in Kertoharjo Village, 2 clinical cases and 1 chronic in Kuripan Lor Village, 61 clinical and 4 chronic cases in Pabean Village, 20 clinical and 2 chronic cases in Bandengan Village.

Based on preliminary study to 38 households in Bandengan Village, Pabean Village, Kertoharjo Village, Kuripan Lor Village, Jenggot Village and Banyurip Ageng Village, 63.15% of households with shrubs around it, 5.26% of households were surrounding with cattle pens, 21.05% of households were nearby water puddles, 71.05% of households use mosquito repellent and 65.78% of households had hanging used clothes habit. Previous studies in the urban villages indicated that there were many potential breeding and resting places for mosquitoes and the community still practice unsafe behavior relating to filariasis transmission [11]–[15].

The community does not realize that they live surrounded by potential factors of filariasis transmission. The health officers also need any tool which can ease them to give more understandable and arosuable information. Some researchers had tried to compose simulation and other predicting instruments for determining the risk of filariasis transmission or also preventing filariasis transmission [16], [17]. Those sometimes are not familiar to the common people and difficult to understand. Visual media could be more understandable [18]. Khikmah & Pawenang (2018) had compose filariasis risk vulnerability zone mapping in the studied urban villages based on review to sewerage condition, presence of stagnant water, night outdoor habit and using mosquito net habit [19]. There are some environmental and behavioral aspects which are not included yet in the mapping from Khikmah & Pawenang (2018) that it is needed to complete it.

This study aimed to compose filariasis vulnerability zonation based on environmental and behavioral aspects in the studied urban villages. The chosen urban villages were villages with Mf-rate >1% namely Banyurip Ageng Village, Jenggot Village, Bandengan Village, Pabean Village, Kuripan Lor Village and Kertoharjo Village. They are in Pekalongan Utara District and Pekalongan Selatan District. The observed environmental aspects were the location of shrubs, cattle pen and tidal flood. The surveyed behavioral aspects were applicating mosquito repellent and hanging clothes habits.

2. Methodology

Data were collected from 6 urban villages. These urban villages were chosen based on their filariasis cases number and Mf-rates in the periods before. They are Kertoharjo Village, Jenggot Village, Pabean Village, Kuripan Lor Village, Bandengan Village and Banyurip Ageng Village. Banyurip Ageng Village, Kertoharjo Village, Jenggot Village and Kuripan Lor Village are urban villages in Pekalongan Selatan District, whereas the rest are urban villages in Pekalongan Utara District. Urban villages consist of some RWs. RW is Rukun Warga which consists of some RTs. RT is Rukun Tetangga which consists of 60-100 households. The 6 studied urban villages consists of 38 RWs. Samples were chosen with proportional random sampling. The total population of the 6 urban villages is 11,070 households. Samples number was determined by calculating using random sampling formula and took 387 households. This was a descriptive quantitative study with spatial approach. The instruments were checklist sheets, Global Positioning System (GPS), satellite imagery and GIS software. The observed environmental aspects were the location of shrubs, cattle pen and tidal flood. Their coordinates were
mapped. The surveyed behavioral aspects were applying mosquito repellent and hanging clothes habits. RWs were colored on map based on the percentages of samples which had “good practice” criteria for behavior aspects. The filariasis cases data were collected from health office and mapped according to their coordinates. ArcGIS software was used to process the analytical steps. Data were analyzed with scoring, buffering and overlaying procedures. The final scoring of the environmental behavioral aspects was obtained from the multiplication results between the scores and the weight criteria of each aspect. Frequency distribution of behavior aspects were compared to the vulnerability level limits. Vulnerability zonation classifying was determined with Sturgess Formula. Vulnerability zonation was classified into 3 categories, i.e. highly vulnerable, moderately vulnerable and not vulnerable.

3. Results and discussion
The data of shrubs vulnerability were obtained only from Pekalongan Selatan District (Figure 1a). A vegetation object could be assessed as shrubs when it has minimally 2 m of height and 4 m$^2$ of large area. Vegetation objects in Pekalongan Utara District did not meet the criteria to be assessed as shrubs. Every village in Pekalongan Selatan District had their highly vulnerable RW(s). The most vulnerable RW was RW 2 of Banyurip Ageng Village. It had 100% buffer coverage and 100% filariasis cases in its Village. The data of tidal flood vulnerability were obtained only from Pekalongan Utara District because it has sea border in the north side (Figure 1b). Pekalongan Selatan District had no tidal flood case because it has no sea border. RW 13 of Pabean Village was the most vulnerable from all highly vulnerable RWs because it had 100% buffer coverage and 28.57% filariasis cases in its village.

Mapped cattle pen were cattle of cows and goats (Figure 1c and 1d). Every village in both Pekalongan Utara District and Pekalongan Selatan District had its highly vulnerable RW(s) for cattle pen vulnerability. RW 2 of Banyurip Ageng Village is the most vulnerable RW in Pekalongan Selatan District whose 100% filariasis cases in its village and 97% buffer coverage. RW 13 of Pabean Village was the most vulnerable RW in Pekalongan Utara District whose 76.89% buffer coverage and 28.57% filariasis cases in its village.

Applicating mosquito repellent habits vulnerability was described in Figure 1e and 1f. There were two RWs in Pekalongan Selatan District with highly vulnerable status because of their 30% coverage of applicating mosquito repellent habits, in contrary, they had no filariasis cases. There was not highly vulnerable RW in Pekalongan Utara District for applicating mosquito repellent vulnerability.

Hanging clothes habits vulnerability was illustrated in Figure 1g and 1h. This habit was verified when one hangs after use clothes for more than 1 day. Every village in the both districts had their highly vulnerable RW(s). They were RW 12 and RW 15 of Pabean Village, RW 5 of Bandengan Village, RW 1-6 of Banyurip Ageng Village, RW 1 and RW 4 of Kuripan Lor Village, RW 5, 7 and 10 of Kertoharjo Village and RW 2, 4 and 11 of Jenggot Village.

Figure 2 described the composite vulnerability status of filariasis transmission. Figure 2 indicated both Pekalongan Selatan District and Pekalongan Utara District had highly vulnerable RW(s) in each village. Bandengan Village had its RW 5 as highly vulnerable zone for filariasis transmission, whereas Pabean Village had its RW 13, Banyurip Ageng Village had its RW 2, Kertoharjo Village had its RW 9, Jenggot Village had its RW 3 and RW 11, and Kuripan Lor had its RW 3. RW 5 of Bandengan Village had its highly vulnerable status from variables of cattle pen, tidal flood, hanging clothes habits, and had 18.8% of filariasis cases in its village. RW 13 of Pabean Village had its highly vulnerable status from variables of cattle pen, tidal flood and had 28.57% of filariasis cases in its village. RW 2 of Banyurip Ageng had its highly vulnerable status from variables of shrubs, cattle pen, hanging clothes habits and had 100% of filariasis cases in its village. RW 9 of Kertoharjo Village had its highly vulnerable status from variables of shrubs, cattle pen and had 89.47% of filariasis cases in its village. RW 3 of Jenggot Village had its highly vulnerable status from variables of shrubs, cattle pen, hanging clothes with no filariasis cases. RW 11 of Jenggot Village had its highly vulnerable status from variables of shrubs, cattle pen, hanging clothes habits and had 71.42% of filariasis cases in its village. RW 3 of Kuripan Lor Village had its highly vulnerable status from variables of shrubs and cattle pen with no filariasis case.
Figure 1. Vulnerability map of shrubs (a), tidal flood (b), cattle pen (c-d), mosquito repellent (e-f) and hanging clothes (g-h)
Both Pekalongan Selatan District and Pekalongan Utara District had highly vulnerable RW(s) in each village for composite vulnerability of filariasis transmission in various variables. It leaded to general conclusion that all villages in Pekalongan Selatan District and Pekalongan Utara District had risky habits and potential mosquito breeding and resting places. This condition would make filariasis transmit easier. The presence risky habits as well mosquito breeding and resting places are risk factors for filariasis transmission related to filariasis vector flight distance which could reach 200 m until 2 km [4], [5], [7]–[9], [15], [20]. Preventive efforts should be applicated in all villages.

4. Conclusion
Each village had at least one RW with highly vulnerable status for shrubs, cattle pen and tidal flood. Pekalongan Selatan District had two RWs with highly vulnerable for applicating mosquito repellent. Each village had its highly vulnerable RW(s) for hanging clothes habits. Each village had its highly vulnerable RW(s) for composite vulnerability status of filariasis transmission. This condition would make filariasis transmit easier. Preventive efforts should be applicated in all villages.

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References
[1] World Health Organization 2013 *Global Programme to Eliminate Lymphatic Filariasis: Managing Morbidity and Preventing Disability* (Geneva: Department of Control of Neglected Tropical Diseases (NTD) World Health Organization)
[2] Babu B V, Nayak A N, Dhal K, Acharya A S, Jangid P K, and Mallick G 2002 The Economic Loss Due To Treatment Costs And Work Loss To Individuals With Chronic Lymphatic Filariasis In Rural Communities Of Orissa, India *Acta Trop.* 82 (1) 31–38
[3] Babu B V, Swain B K, and Rath K 2006 Impact Of Chronic Lymphatic Filariasis On Quantity And Quality Of Productive Work Among Weavers In An Endemic Village From India *Trop. Med. Int. Heal.* 11 (5) 712–717
[4] Windiastuti N A I A and Suhartono 2013 *Hubungan Kondisi Lingkungan Rumah, Sosial Ekonomi, dan Perilaku Masyarakat dengan Kejadian Filaria* *sis di Kecamatan Pekalongan Selatan Kota Pekalongan* The Association between Environmental House Condition, Socio-economic, and Behaviour Factors with fi *J. Kesehat. Lingkung. Indones.*** 12 (1) 51–57

[5] Juriastuti P, Kartika M, Djaja I M, and Susanna D 2010 Faktor Risiko Kejadian Filaria*dis Di Kelurahan Jati Sampurna *Makara Kesehat.*** 14 (1) 31–36

[6] Kouassi B L *et al.* 2018 Perceptions, knowledge, attitudes and practices for the prevention and control of lymphatic filariasis in Conakry, Republic of Guinea *Acta Trop.*** 179 (March 2017) 109–116

[7] Mariappan T, Thenmozhi V, Udayakumar P, and Bhavaniumadevi V, 2015 An Observation On Breeding Behaviour Of Three Different Vector Species ( *Aedes Aegypti* Linnaeus 1762, *Anopheles Stephensi* Liston 1901 And *Culex Quinquefasciatus* Say 1823 ) In Wells In The Coastal Region Of Ramanathapuram District , Tamil Nadu , India *Int. J. Mosq. Res.* 2 (2) 42–44

[8] Paiting Y S, Setiani O, and Sulistiyan Y S 2012 Faktor risiko lingkungan dan kebiasaan penduduk berhubungan dengan kejadian filariasis di Distrik Windesi Kabupaten Kepulauan Yapen Provinsi Papua *J. Kesehat. Lingkung. Indones.*** 11 (1) 76–812

[9] Syuhada Y, Nurjazuli, and N E W 2012 Studi Kondisi Lingkungan Rumah dan Perilaku Masyarakat Sebagai Faktor Risiko Kejadian Filaria*sis di Kecamatan Buaran dan Tirto Kabupaten Pekalongan* ( Study Of Environmental And Behavioral As Risk Factor Of Filaria*sis In District Of Buaran And Tirto Pekalo *Kesehat. Lingkung. Indones.*** 11 (1) 95–101

[10] Siwiendrayanti A, Pawenang E T, and Indarjo S 2019 Changes In Knowledge, Behavior, And Environmental Control For Filaria*sis Prevention With ‘Mandiri’* Pocket Book In Pekalongan City Society : A Longitudinal Study *J. Pendidik. IPA Indones.*** 8 (2) 177–184

[11] Siwiendrayanti A, Pawenang E T, and Indarjo S 2017 Spatial Analysis And Behavior Evaluation To Identify Differentiating Factors Of Filaria*sis Endemic Status *Adv. Sci. Lett.*** 23 (4) 3349–3354

[12] Indarjo S, Siwiendrayanti A, and Pawenang E T 2016 The Community Diagnosis of Filaria*sis Endemic Villages in Pekalongan District, *J. Kesehat. Masy.* 12 (1) 100–110

[13] Lestari S D and Indarjo S 2017 Analisis Pengetahuan, Sikap Dan Praktik Pencegahan Filaria*sis Di Kelurahan Kertoharjo* Kota Pekalongan Tahun 2016-2017 *Unnes J. Public Heal.* 6 (4) 209–217

[14] Munawwaroh L and Pawenang E T 2017 Evaluasi Program Eliminasi Filaria*sis Dari Aspek Perilaku Dan Perubahan Lingkungan *Unnes J. Public Heal.* 5 (3) 195–204

[15] Wulandhari S A and Pawenang E T 2017 Analisis Spasial Aspek Kesehatan Lingkungan Dengan Kejadian Filaria*sis Di Kota Pekalongan *Unnes J. Public Heal.* 6 (1) 59–67

[16] Dyson L, Stolk W A, Farrell S H, and Hollingsworth T D 2017 Measuring And Modelling The Effects Of Systematic Non-Adherence To Mass Drug Administration *Epidemics*** 18 56–66

[17] Smith M E *et al.* 2017 Predicting Lymphatic Filaria*sis Transmission And Elimination Dynamics Using A Multi-Model Ensemble Framework *Epidemics*** 18 16–28

[18] Putihra Prathap K A P D 2006 Effectiveness of Four Mass Media Channels on the Knowledge Gain of Rural Women *J. Int. Agric. Ext. Educ.* 13 (01) 73–81

[19] Khikmah N and Pawenang E T 2018 Review of Environmental Aspects and Community Behavior in the Determination of Filaria*sis Risk Vulnerability Zone *Unnes J. Public Heal.* 7 (1) 38–49

[20] Uloli S and Sumarni R 2008 *Analisis Faktor–Faktor Risiko Kejadian Filaria*sis J. Ber. Kedokt. Masy.*** 24 (1) 44