BRIN
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DAN INOVASI NASIONAL

Impact on schistosomiasis snail control and spatial cluster change in Indonesia

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The National Research and Innovation Agency,Indonesia

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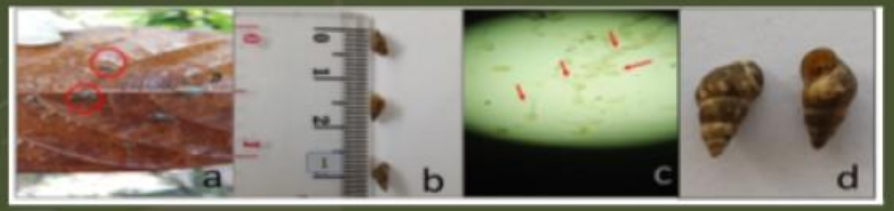
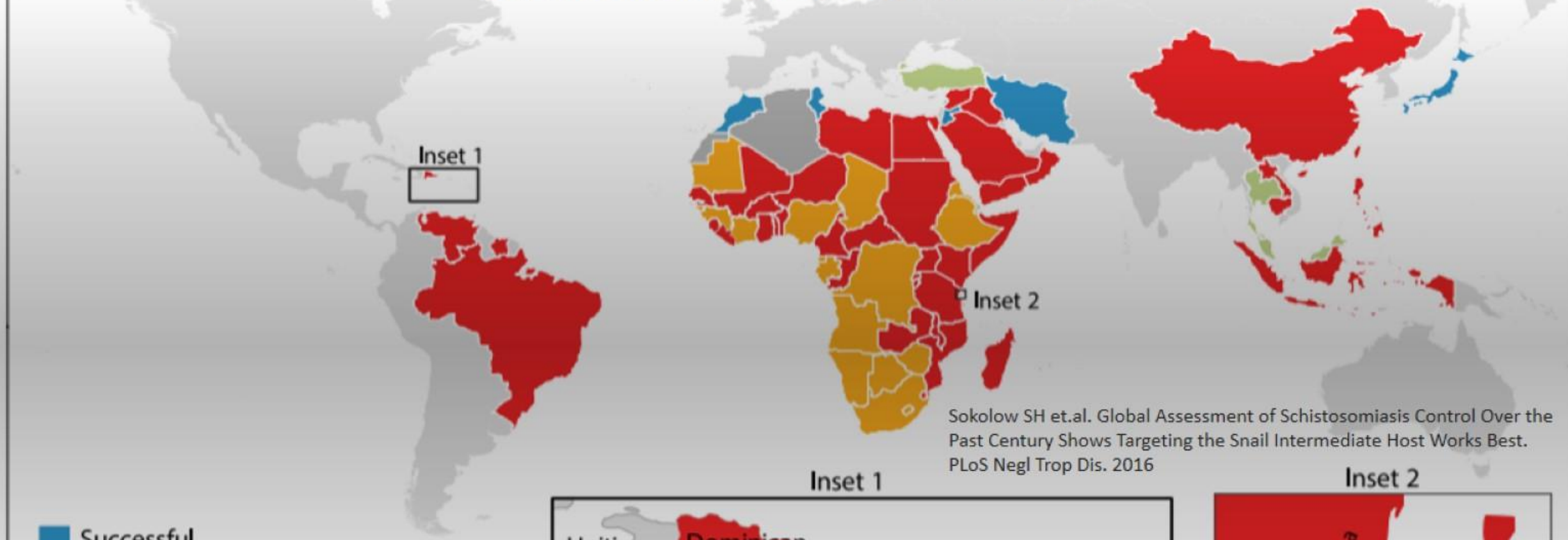
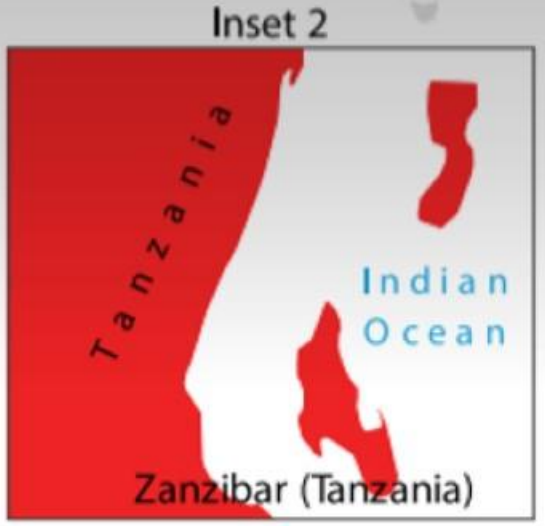


Countries and territories evaluated and their outcomes for schistosomiasis control or elimination



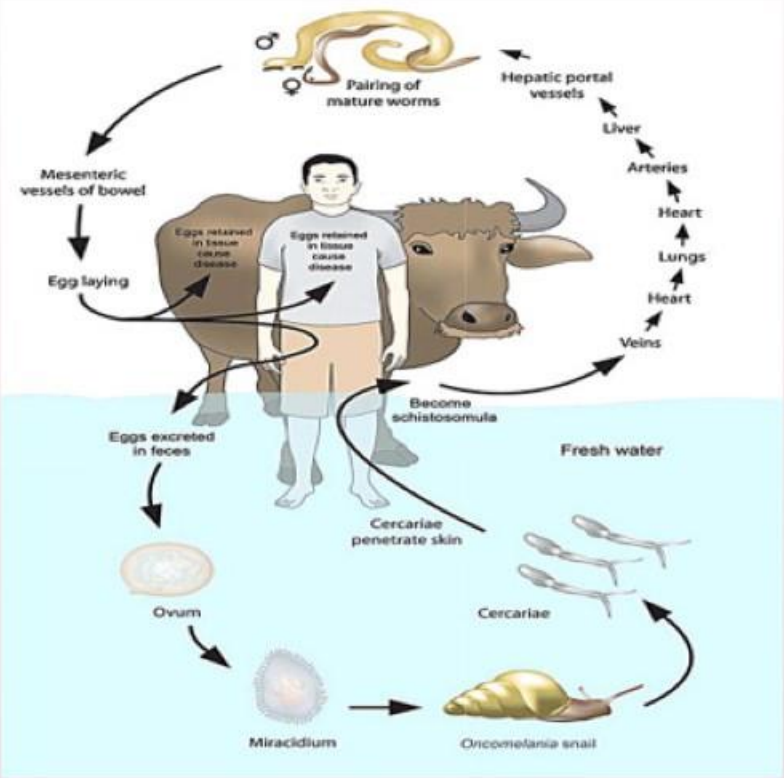
Sokolow SH et.al. Global Assessment of Schistosomiasis Control Over the Past Century Shows Targeting the Snail Intermediate Host Works Best. PLoS Negl Trop Dis. 2016

- Successful
- Fortuitous elimination
- Minimal control
- Not (yet) successful
- No data
- Outside schistosomiasis endemic zone

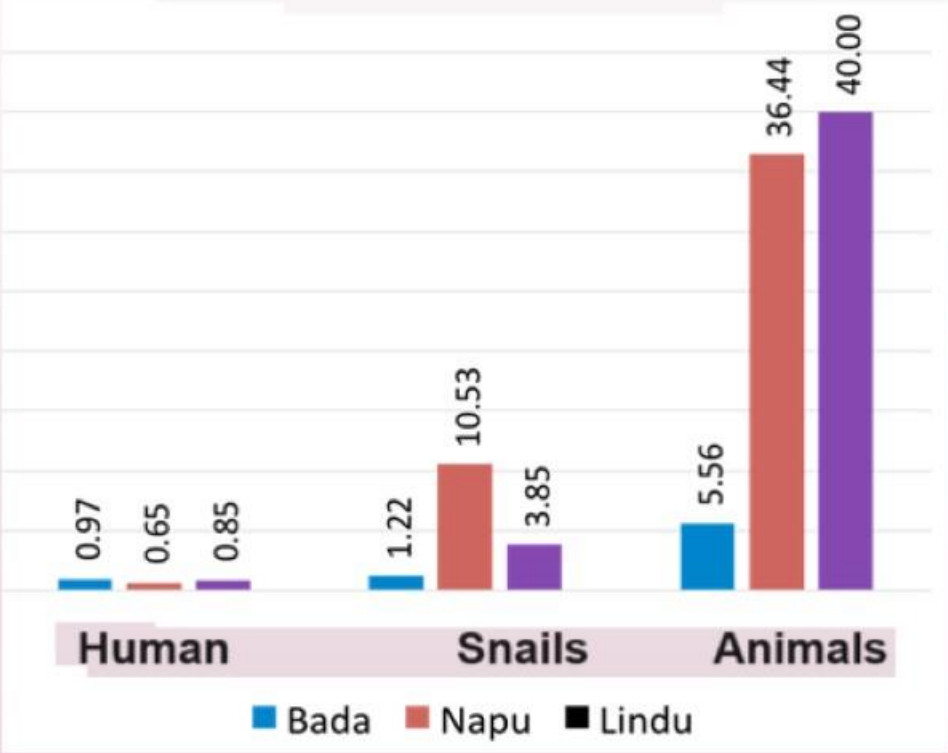


Introduction

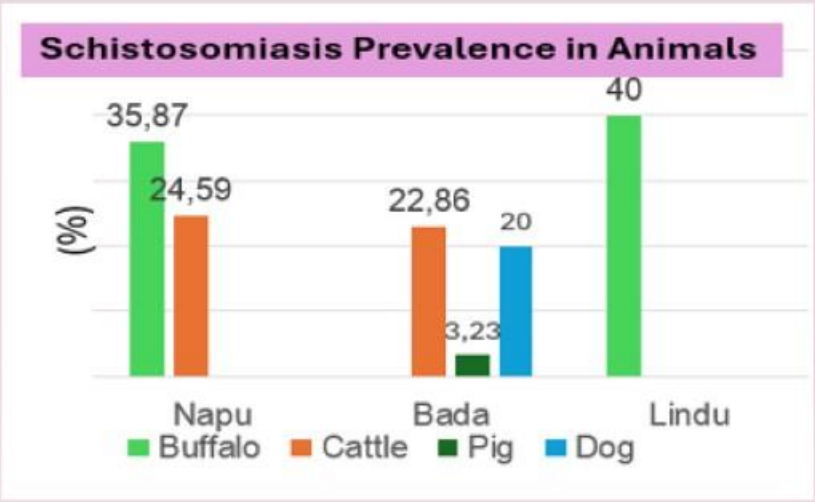
- The Government of Indonesia committed to eliminating schistosomiasis by 2025 through launched Roadmap Schistosomiasis Jan 2018 (The ministry of National Development Planning)
- Collaboratively snail control became one of the crucial strategies to ensure that the prevalence of *Schistosoma japonicum* in *Oncomelania hupensis lindoensis* reaches zero by the end of the program.
- Ending the neglect to attain the Sustainable Development Goals: A road map for neglected tropical diseases 2021–2030 (WHO)



Schistosomiasis infection rate, 2017



Schistosomiasis Prevalence in Animals



26 (9%)

243 (80%)

32 (11%)

301 Foci of *O. hupensis lindoensis*

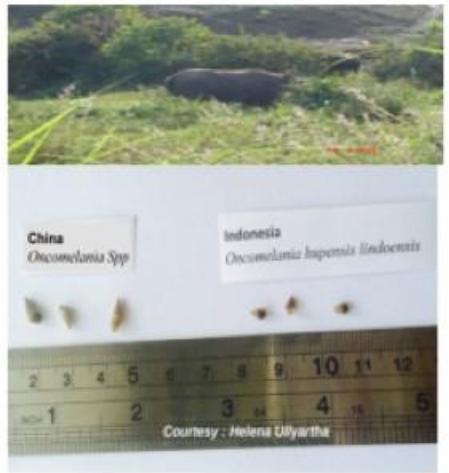
SCH-Policy and Update INO

Source : Roadmap 2018

SCHISTOSOMIASIS IN INDONESIA
(POSO & SIGI District , CENTRAL SULAWESI PROVINCE)

Schistosomiasis (also known as DEMAM KEONG) is a chronic disease caused by past or present infection with parasitic blood flukes of ***S. japonicum*** **in Indonesia**

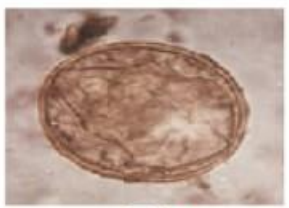
Schistosoma japonicum is transmitted through *Oncomelania hupensis lindoensis* snails



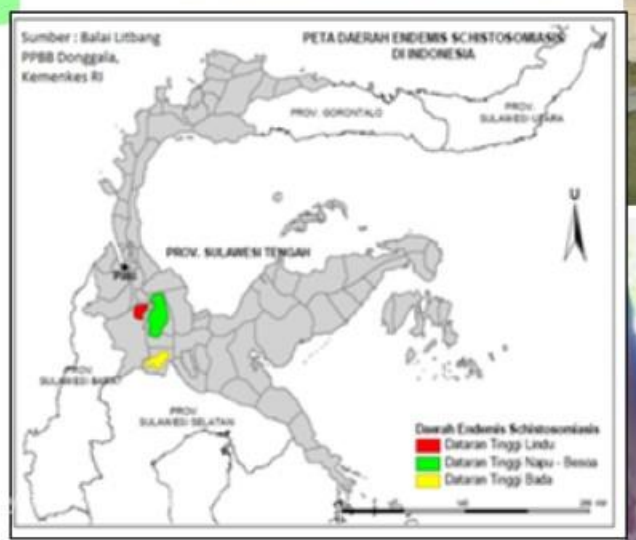
Various animals such as cattle, dogs, cats, rodents, pigs, horses, and goats, serve as reservoirs for *S. japonicum*,

Mirasidium

Serkaria



Telur
Schistosoma japonicum



Human schistosomiasis infection rate in Lindu and Napu highland

Compilation Result of survey conducted by DHO, PHO and NIHRD, MoH

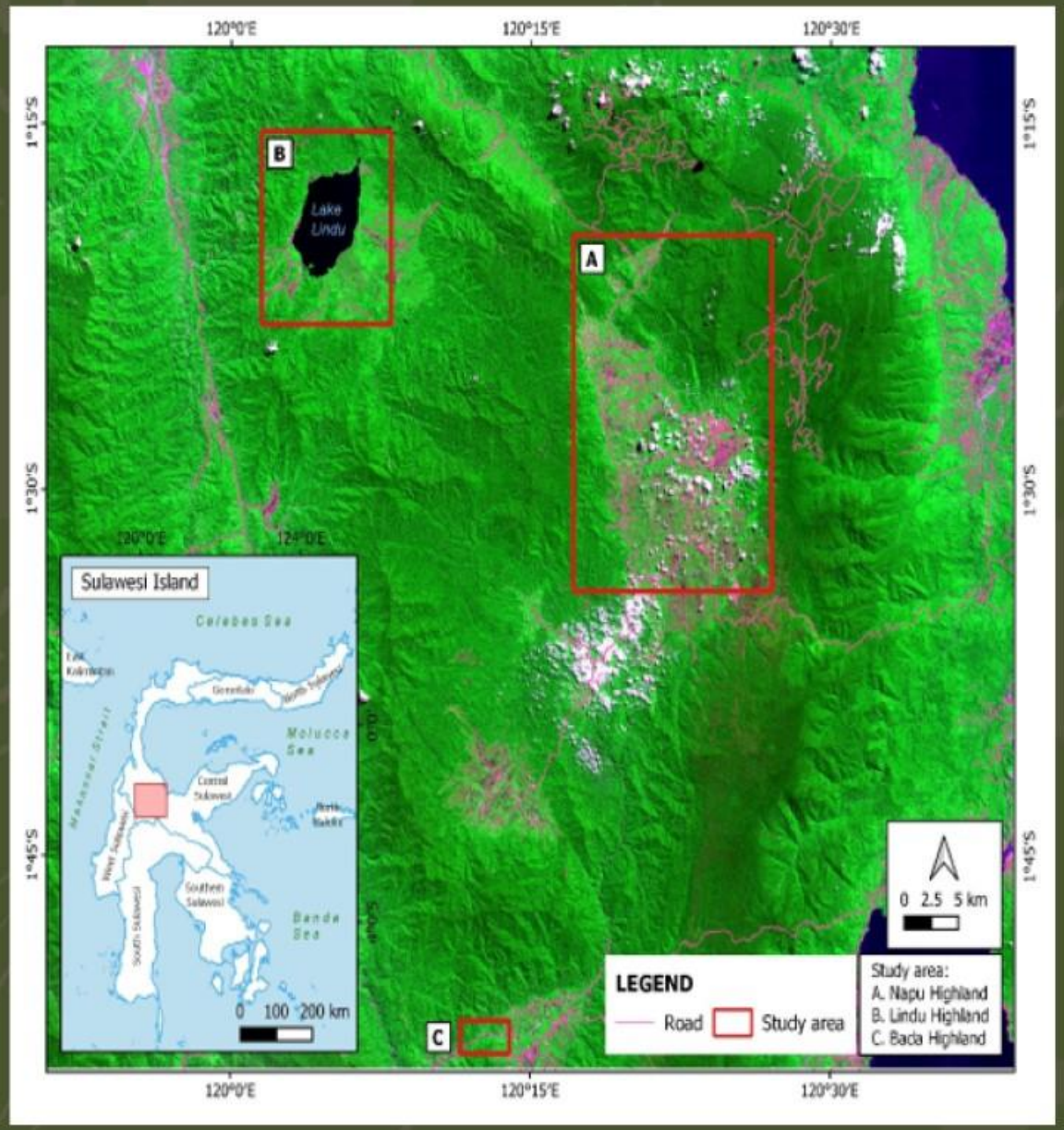
Snails habitat in Napu Highland

Cocoa tree plantation

House drainage

Village drainage

abandoned land with notification board



Method

- Malacology survey conducted during two distinct periods: February to November of the year 2017 and July to November 2021.
- Study areas: Napu Highlands and Bada Highlands (Poso district) as well as Lindu Highlands (Sigi district)
- The man-per-minute or random quadrant method was used for snail sampling.

Figure 2.Method and Procedure of Malacology Survey

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Research Article

The Impact of Snail Control on Intestinal Schistosomiasis Endemic Areas in Indonesia

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DOI: https://doi.org/10.24321/0019.5138.202332

Results

Table 1.Number of Schistosomiasis-infected Snails in Different Years in Poso and Sigi Districts

Year/ Place of Collection	No. of Villages	No. of Foci	Number of Snails Collected (n)	Number of Infected Snails * (n (%))	Others Snails ♦	Type of Foci	Area (m^2)
Total number	29	301	43,247	2,732 (6.3)	20	20	1,649,405
2017							
Napu	18	243	40,194	2,481 (6.0)	-	1,2,3	1,082,185
Lindu	5	32	2,576	200 (7.0)		1,2,4	552,759
Bada	6	26	477	51 (10.0)	20	1,2,4,5	14,461
Total number	19	198	30,060	1,461 (4.8)	50	50	663,672
2021							
Napu	18	183	25,972	1,043 (4.0)	50	1,2,3	636,284
Lindu	2	25	2,485	400 (16.0)	-	1,2,4	26,988
Bada	1	4	1,603	18 (1.0)		4,5	400

1: rice field; 2: plantation; 3: swampy field, 4: water seepage; 5: pond
•*Oncomelania hupensis lindoensis* •*Sulawesidrobia* spp.

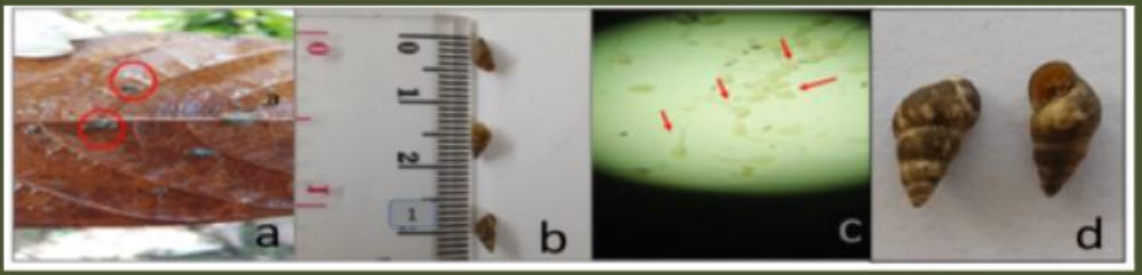

Table 2.Snail Habitat Numbers in Schistosomiasis Endemic Villages in 2017 and 2021

No.	Highland	Villages	Number of Habitats		Type of Foci	No.	Highland	Villages	Number of Habitats		Type of Foci
			2017	2021					2017	2021	
1.	Napu	Sedoa	33	13	1,2,3	-	-	Wanga	5	3	1,2
-	-	Watumaeta	19	14	1,2	-	-	Watutau	2	2	1
-	-	Wuasa	4	3	1,2	-	-	Betue	0	0	0
-	-	Banyusari	1	1	1	-	-	Torire	0	0	0
-	-	Kaduwa	11	7	1,2,3	2.	Lindu	Anca	12	11	1,2,4
-	-	Dodolo	34	26	1,2,4	-	-	Tomado	16	14	1,2
-	-	Alitupu	23	22	1,2,4	-	-	Langko	1	0	1
-	-	Winowanga	39	20	1,2	-	-	Puroo	3	0	1
-	-	Maholo	24	29	1,2	-	-	Olu	0	0	0
-	-	Mekarsari	16	13	1,2	3.	Bada	Lengkeka	5	4	4,5
-	-	Tamadue	7	17	1,2	-	-	Kageroa	4	0	1,2,5
-	-	Kalimago	14	13	1,2	-	-	Tomihipi	8	0	1
-	-	Tinimbo	9	0	1,2	-	-	Tuare	8	0	1,2,5
-	-	Siliwanga	2	0	1	-	-	Kolori	1	0	1

- Since the official launch of the schistosomiasis elimination roadmap in 2018, efforts to control the disease have been quite impactful.
- The Bada model, which was implemented in the Bada area in 2019, as well as the Poso district health office-initiated community-led movement to eliminate schistosomiasis, have both reinforced community participation.
- The potential habitat for snails in the Napu Valley is much larger than that available in Lindu and Bada.
- The infection rate in Lindu was 7% in 2017 but rose to 16% by 2021 due to the 2018 tsunami (national disaster, impacting snail habitat control effort)

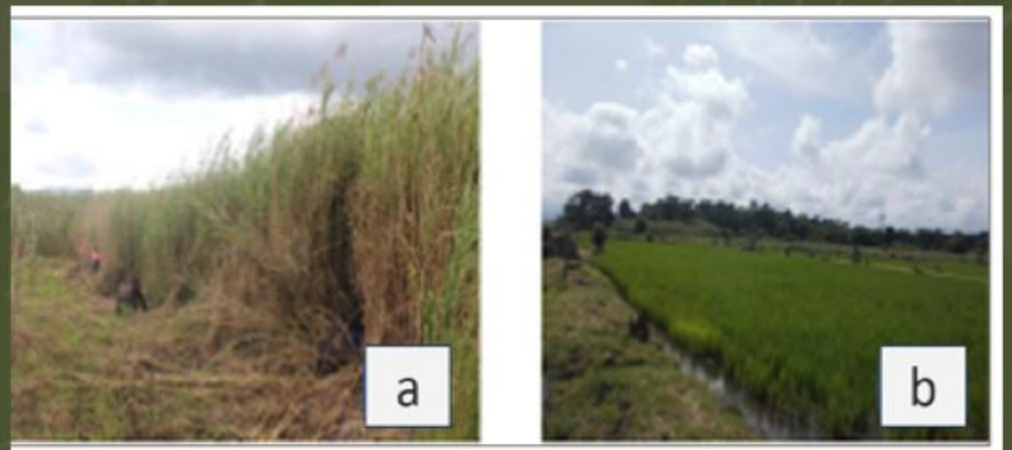

Figure 3.Snail Habitat Conversion (a) Before (Swamp) (b) After (Paddy Field)

Discussion

- Snail habitats have declined due to a variety of factors, including conversion to rice fields or plantations, being carried away by floodwaters, being buried by soil due to landslides, and molluscicide spraying.
- According to the observations, the swamp area has been converted to rice fields
- Integrated control targeting the entire life cycle is the only approach for long-term sustainability and elimination.
- Habitat influences snail control preferences.
- Lindu's main priority is the expansion of cross sectoral responsibilities, which involves the establishment enduring water channels and ponds, and the prominent initiatives within the agricultural sector that center around rice field shaping.

POSO GEMA BERAKSI (Independent Community Movement to control Snails)

The movement to aims at enhancing community involvement and empowerment in the fight against snail, with a declaration made in the pilot village of Tomehipi, West Lore district

Source : Podo District Health Office

Conclusion

Infective snails are still present in the endemic areas of Lindu, Bada, and Napu.

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The intervention method implemented in the regions of Napu and Bada focuses primarily on enhancing community engagement.

There is a higher risk of schistosomiasis transmission near human water contact sites with snail habitats.

Water seepage habitats serve as community water sources in the villages of Lengkeka and Alitupu.

Primary causes of reduction: snail control, water-based intervention, conversion to productive land, irrigation systems, and molluscicide.

Integrated snail control may improve infection control success..

Acta Parasitologica (2024) 69:759–768
https://doi.org/10.1007/s11686-024-00802-5

ORIGINAL PAPER

Spatial Cluster Change of *Schistosoma japonicum* Transmission Foci in Indonesia During the Schistosomiasis Elimination Program

Afi Nursafingi[1,2] · Junus Widjaja[1,2] · Anis Nur Widayati[1,2] · Ade Kurniawan[2] · Leonardo Taruk Lobo[2] · Abdul Rauf[3] · Opyn Mananta[4] · Helena Ullyartha Pangaribuan[2,5]

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The Government of Indonesia committed to eliminating schistosomiasis by 2025.

Collaboratively snail control became one of the crucial strategies to ensure that the prevalence of Schistosoma japonicum in *Oncomelania hupensis lindoensis* reaches zero by the end of the program.

This research investigated the spatial cluster change of *S. japonicum* transmission foci in Indonesia between 2017 and 2021.

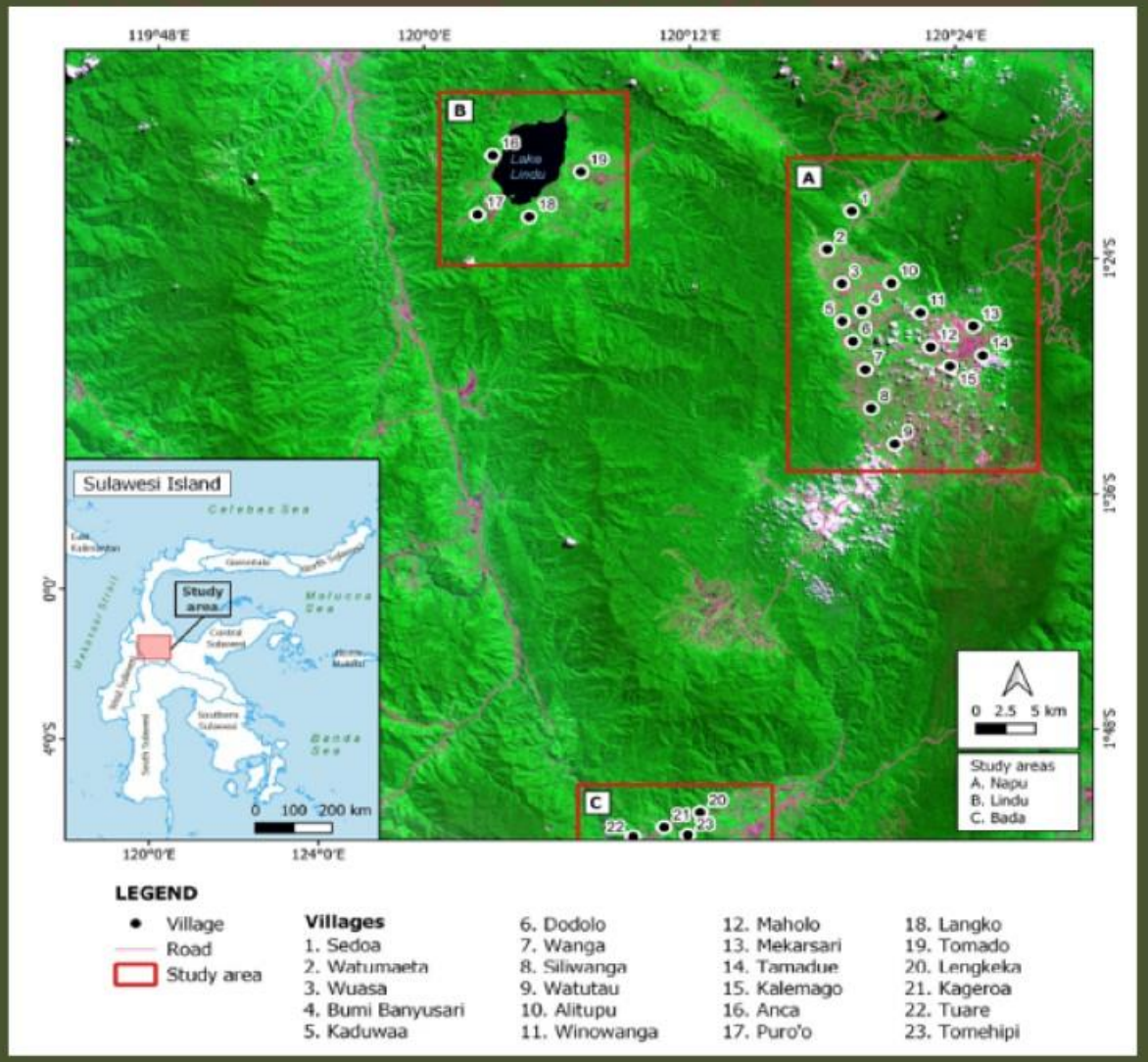
Methods We mapped the snail foci, collected the snails, and calculated the snail density.

We also conducted laboratory tests to detect the existence of cercariae in the snails. Identified infected snails were used to calculate the infection rate (IR) or snails' prevalence of schistosome cercariae among freshwater snails.

We then analysed the spatial cluster using the Getis-Ord Gi* statistic to identify the hot and cold spots.QGIS version 3.22.5 for spatial data processing, analysis, and visualisation.

Nursafingi A, Widjaja J, Widayati AN, Kurniawan A, Lobo LT, Rauf A, Mananta O, Pangaribuan HU. Spatial Cluster Change of Schistosoma japonicum Transmission Foci in Indonesia During the Schistosomiasis Elimination Program. Acta Parasitol. 2024 Mar;69(1):759-768. doi: 10.1007/s11686-024-00802-5. Epub 2024 Feb 28. PMID: 38416327.

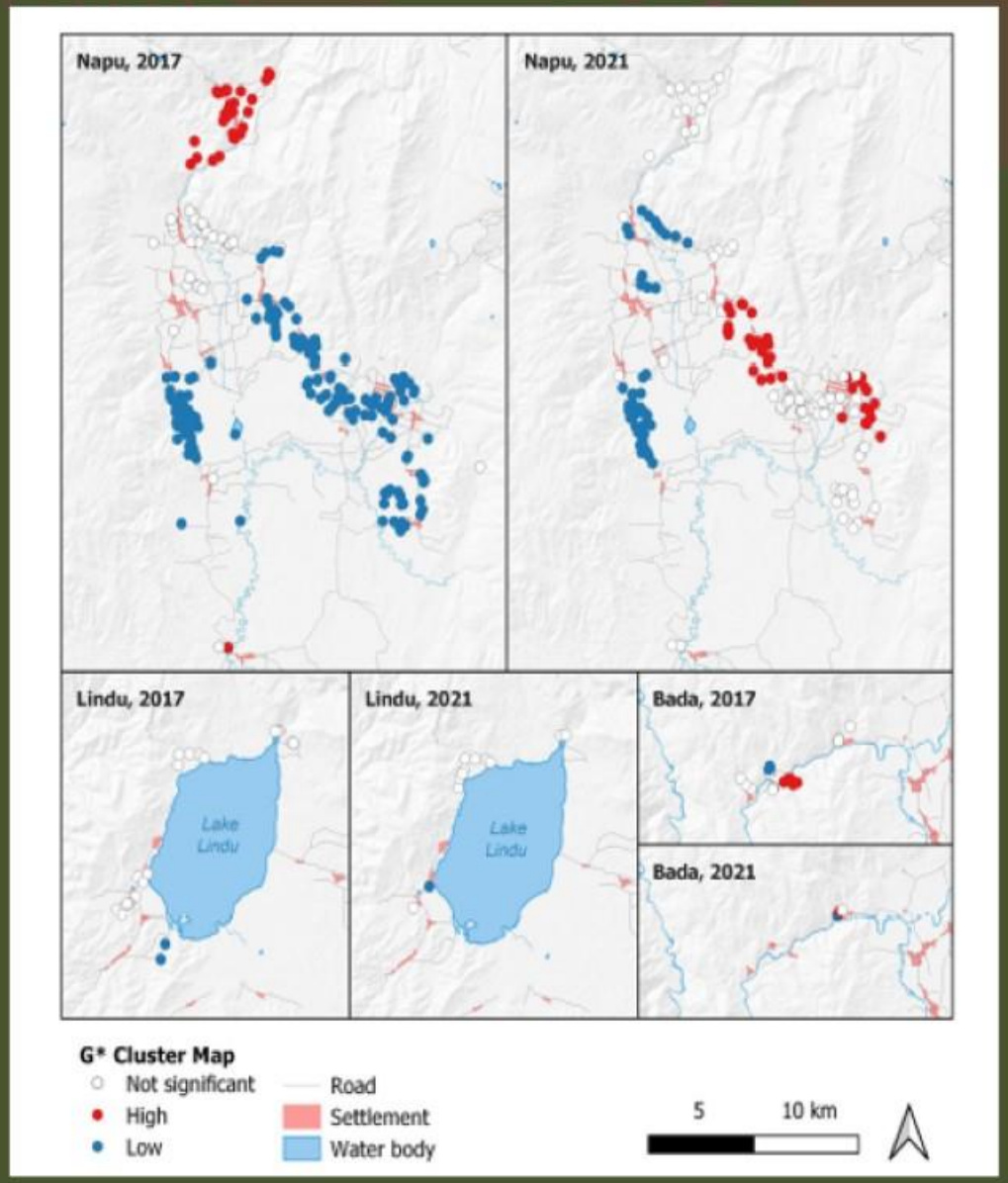
Study areas : Napu, Lindu, and Bada



The spatial pattern of hot spots also changed during the schistosomiasis elimination program

	The year 2017						The year 2021					
	Snail density			Infection rate			Snail density			Infection rate		
Villages	H	C	NS	H	C	NS	H	C	NS	H	C	NS
Napu area												
Alitupu		24	1			25	11		11			22
Bumi Banyusari		1				1			1			1
Dodolo		33			1	32		26		26		
Kaduwaa		9				9		6	1	2		5
Kalemago		14				14			13			13
Maholo		25			9	16			28			28
Mekar Sari		16				16	6		7		1	12
Sedoa	31		2	2		31			13			13
Siliwanga		2		2								
Tamadue		15	1			16	8		6			14
Wanga		2	1			3		3		3		
Watumaeta		20	2			22		12	2			14
Watutau	1		1			2			2		1	1
Winowanga		37				37	16		2		13	5
Wuasa			5			5		5	1			6
Lindu area												
Anca			8	3		5			10	1	2	7
Langko			1			1						
Puro'o		2		2								
Tomado			14			14		1	1			2
Bada area												
Kageroa		3	1		4							
Lengkeka			4	3		1	1	2	0		1	3
Tomehipi	5		3		4	4						
Tuare			3			3						

- Local spatial autocorrelation of snail density and infection rate revealed that the number of cold spots decreased by 53.91% in 2017 and 0% in 2021.
- Nevertheless, the hot spots increased by 2.63% and 56.1%, respectively.
- In 2017, the hot spots of snail density clustered in Sedoa, Tomehipi and Watutau villages, while the hot spots of infection rate clustered in Sedoa, Siliwanga,and Puro'o villages.
- The survey conducted in 2021 identified the hot spots of snail density clustered in Alitupu, Mekarsari, Tamadue, and Winowanga villages, while the hotspot of infection rate clustered in Dodolo, Kaduwaa, Wanga, and Anca villages.
- Almost 78% of the hot spots are within 500 m of the settlements



The cluster maps of snail density in three endemic areas of schistosomiasis between 2017 and 2021. The red dot indicated hot spots, while the blue indicated cold spots (significant at the p < 0.01 level)

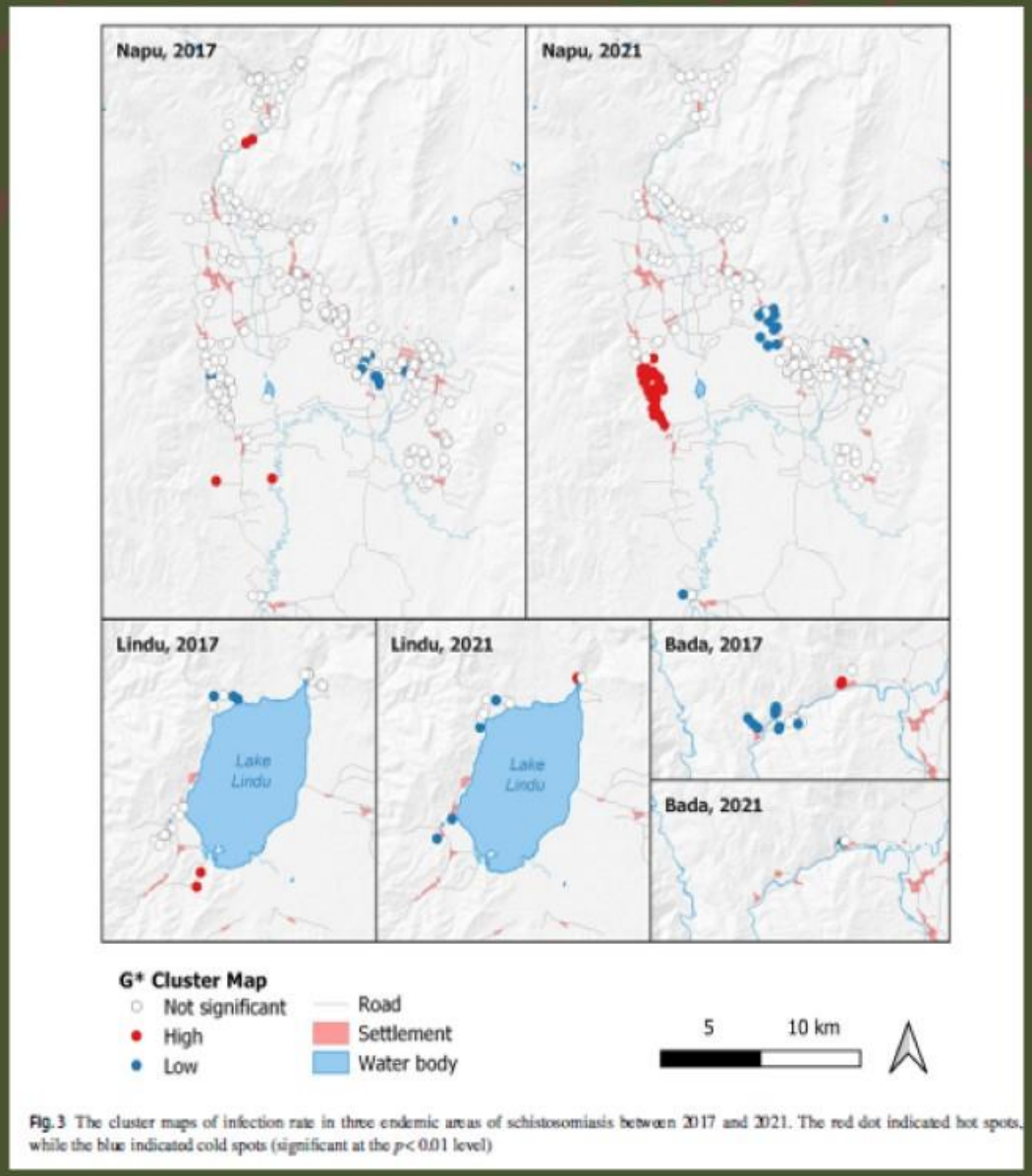
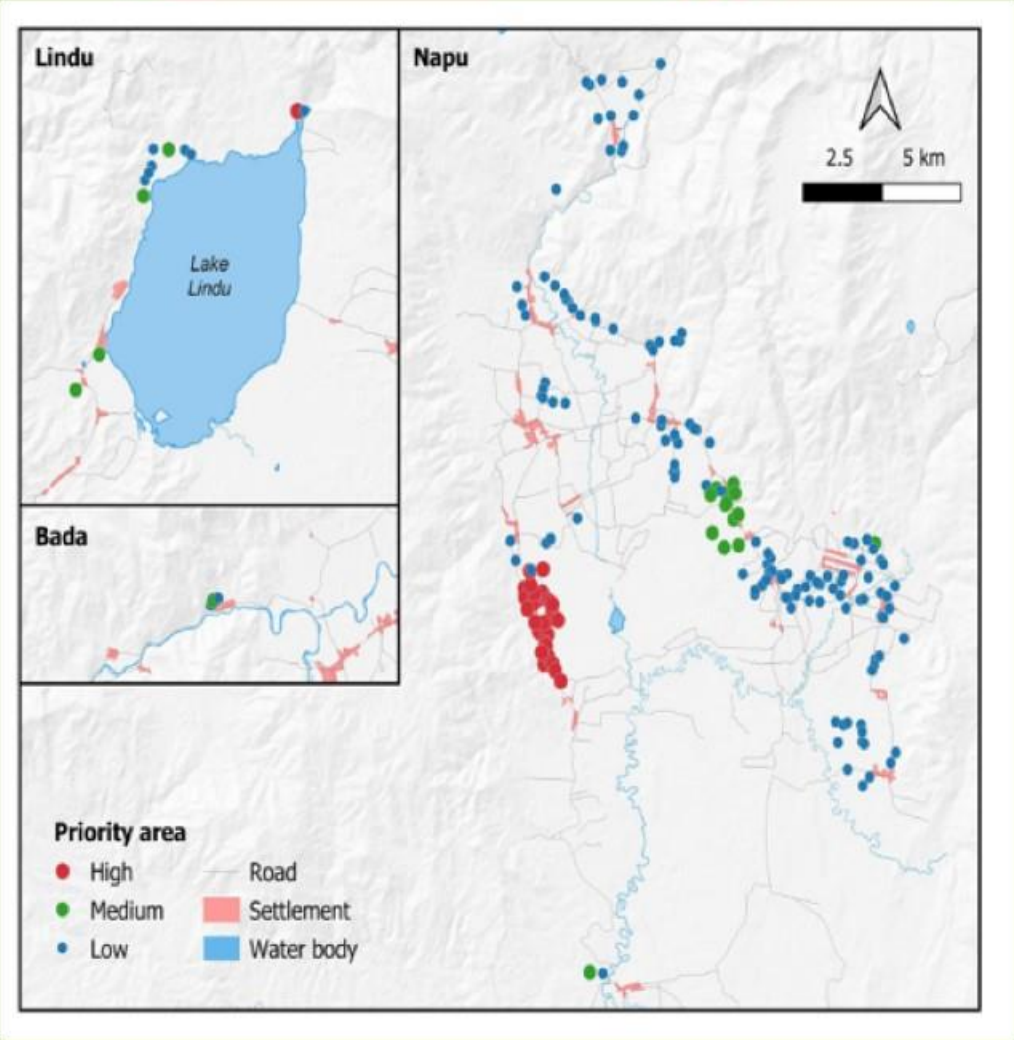


Fig. 3 The cluster maps of infection rate in three endemic areas of schistosomiasis between 2017 and 2021. The red dot indicated hot spots, while the blue indicated cold spots (significant at the $p < 0.01$ level)

The cluster maps of infection rate in three endemic areas of schistosomiasis between 2017 and 2021. The red dot indicated hot spots, while the blue indicated cold spots (significant at the p < 0.01 level)

Map of the priority areas for intervention



Most of the hot spots had been identified in nearby settlements

They were found in cocoa plantations, developed and abandoned rice fields, grassland, and bush wetlands

Priority areas for intervention

Priority scale	High priority			Medium priority			Low priority		
	1	2	3	4	5	6	7	8	9
Infection rate	H	H	H	C	C	C	NS	NS	NS
Snail density	H	C	NS	H	C	NS	H	C	NS
Number of snail foci	0	31	1	15	1	4	27	23	94
Villages	Anca, Dodolo, Kaduwaa, Wanga			Anca, Lengkeka, Mekarsari, Tomado, Winowanga, Watutau			Alitupu, Anca, Bumi Banyusari, Kaduwaa, Kalemago, Lengkeka, Maholo, Mekarsari, Sedoa, Tamadue, Watumaeta, Watutau, Winowanga, Wuasa		

- Dodolo, Kaduwaa, Wanga, and some parts of Anca villages become high-priority areas for snail control because parasite transmission hot spots exist in these villages.
- Previous studies have also found that Dodolo village has the highest prevalence
- The cluster of cold spots indicated that parasite transmission in these areas was low.
- The snail control in Alitupu, Bumi Banyusari, Kalemago, Maholo, Sedoa, Tamadue, Watumaeta, Wuasa, and some parts of Kaduwaa, Lengkeka, Mekarsari, Watutau, Winowanga villages are low priority due to non-significant of infection rate.

THE 5-YEAR SCHISTOSOMIASIS ELIMINATION PROGRAM SUCCESSFULLY REDUCED 18.84% OF SNAIL FOCI AND 40.37% OF INFECTED ONES.

THE HOT SPOTS INCREASED, INDICATING A RISE IN FOCI WITH HIGH SNAIL DENSITY AND INFECTION RATES.

THE PROGRAM'S IMPLEMENTATION WAS NOT OPTIMAL, AND PARASITE TRANSMISSION THROUGH DOMESTIC ANIMALS IMPACTED HOT SPOT CLUSTERS.

Conclusion

- During the schistosomiasis elimination program, the number of hot spots increased while cold spots decreased, and the spatial cluster of hot spots changed.
- The results of the 2021 hot spots investigation in Dodolo, Kaduwaa, Wanga, and different parts of Anca village are very important for setting priorities for management strategies. This makes this area the main focus of efforts to control snails.
- More application of spatial analysis techniques is essential to strengthening schistosomiasis surveillance.
- The integration of multiple sectors plays a critical role in strengthening efforts aimed at controlling the transmission of *S. japonicum* through domestic animals.


Thank you/謝謝你/Xièxiè nǐ