

## Cross-sectoral role and community empowerment in controlling schistosomiasis in Indonesia

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### ABSTRACT

The role of cross-sectors in synergy with community empowerment in controlling schistosomiasis is a very effective model. Until mid-2017, the incidence rate of disease in humans in 28 endemic villages still ranged 0.00-2.15%. This research aims to evaluate schistosomiasis control activities that have been carried out across sectors based on a road map for schistosomiasis eradication and community empowerment in controlling schistosomiasis. The study was mixed method. Data were obtained by in-depth interview with key informants and evaluation of the results of cross-sectoral and community activities. The research was carried out in an endemic area for schistosomiasis on the Bada Plateau, Indonesia, from January to November 2019. In conclusion, the potential of cross-sector collaboration in controlling schistosomiasis has not been fully realized due to budget constraints. Community empowerment is carried out to eliminate snail foci, increase the scope of feces collection and change community behavior for the better in order to avoid infection and always try to clean up snail foci.

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## 1. INTRODUCTION

Trematode worms *Schistosoma japonicum* with snail intermediate host *Oncomelania hupensis lindoensis* cause schistosomiasis or snail fever in Indonesia. This disease, in addition to infecting humans, also infects all types of mammals, both domestic and wild animals. Chronic schistosomiasis decreases the ability of patients to work, and some cases cause death in all age groups. In children, schistosomiasis gives rise stunting, anemia, and decreased learning ability [1].

Transmission of schistosomiasis is reported in 78 countries with an estimated 229 million people in need treatment in 2018 [2]. This disease is spread in developing countries both tropical and subtropic, namely China, Japan, the Philippines, Indonesia, Vietnam, Laos, Thailand, Cambodia. Schistosomiasis in Indonesia is only found in Central Sulawesi Province, namely Napu Plateau and Bada Plateau, Poso Regency and Lindu Plateau, Sigi Regency. The disease causes economic losses and public health problems in many developing countries. Schistosomiasis is the second deadliest parasitic disease after malaria [3].

Control of schistosomiasis is conducted by the health sector in the form of routine activities, namely fecal surveys, snail surveys, treatment, focus surveys, and rat surveys, as well as making family latrines for residents in all endemic areas. Control of snails is conducted mechanically and chemically. Mechanical control is conducted by repairing water channels in the focus area, drying the focus area, and backfilling. Chemical control is conducted by spraying Bayluscide on focus areas [4].

Efforts to control this disease have been running for at least the last 35 years and provide lessons that the eradication of this disease must be through a cross-sectoral approach, simultaneously in endemic villages, Indonesia [5]. This disease can only be completely overcome through a cross-sectoral approach and community empowerment to reduce and subsequently eliminate parasitic infections in humans, animals, and intermediate snails. In this context, the role of cross-sector and village communities is necessary, especially in the management of livestock and the habitat environment of intermediate snails [6], [7].

From these problems, a schistosomiasis eradication roadmap was prepared as a joint action plan across sectors and communities in efforts to eradicate schistosomiasis. The new solution implemented is to invite cross-sectors to participate by involving local people to work on making waterways, making fishponds to eliminate sites of transmission of schistosomiasis. Community empowerment in accordance with local wisdom is by making regulations at the village level, regarding fecal collection, treatment, cleaning of focus areas, containment of livestock (cows, horses, pigs, buffaloes). Forming a schistosomiasis control group at the village level consisting of family welfare development/*pembinaan kesejahteraan keluarga* (PKK) cadres, Dasa Wisma, Community Health Center, Schistosomiasis Laboratory officers and village officials to jointly eliminate the focus of snails and invite the community to collect feces so that the prevalence of schistosomiasis can be known [8].

## 2. METHOD

The instruments used by the team during the evaluation were literature study, evaluation checklist, fecal examination coverage and mass treatment coverage, in-depth interview guidelines, and focus group discussion guidelines. The research method used is implementation research and data obtained by mixed method, namely qualitative and quantitative data collection. Data was obtained through in-depth interviews with twenty informants across sectors. Focus group discussion with six village heads and 6 community leaders to equalize perceptions. Quantitative measurements were conducted from the results of training of schistosomiasis control teams formed in each village, improving fecal collection, and measuring the success of cross-sector activities.

Sample selection is determined based on purposive sampling, which is a sampling technique that involves selecting samples that align with the characteristics of the research. Sample determination in this context is not based on the idea that the sample must be representative of the population but rather that the sample should be representative in providing the necessary information in line with the focus and objectives of the research. Tools used during in-depth interviews and focused group discussions include recording devices and cameras.

The validity and reliability of the instrument are tested through source and method triangulation. Data are obtained from multiple sources of information and using various methods such as in-depth interviews, focused group discussions, document searches, and field observations. To control confounding variables, informants who have knowledge of schistosomiasis are selected, and cross-sector involvement directly in the field in schistosomiasis control is considered.

This research has obtained ethical approval from the Health Research Ethics Committee-National Institute of Health Research and Development (HREC-NIHRD) Number: LB.02.01/2/KE.012/2019. Data validity is managed through triangulation, which involves checking the authenticity of data with other sources using several methods, including in-depth interviews, focused group discussions, document searches, and field activity observations.

## 3. RESULTS AND DISCUSSION

### 3.1. Results of cross-sector schistosomiasis control evaluation in 2019

A total of 20 cross-sector informants have conducted in-depth interviews. Poso Regency consists of seven people, namely the head of the health office; the head of the village community empowerment office; the head of the animal health division of the agriculture office; the head of facilities and infrastructure of the agriculture office; the head of fisheries seed cultivation; the head of the human development division of bappeda; and the head of the public works office. Sigi Regency has six informants, namely Secretary of Regional Development Planning Agency/*Badan Perencanaan Pembangunan Daerah* (Bappeda); head of disease control section of health office; head of public works water resources; head of facilities and

infrastructure of agriculture office; head of seed cultivation Department of Fisheries Office; and head of livestock and animal health office. Central Sulawesi Province has seven informants, namely head of disease control of the health office; head of livestock; head of administration of Technical Implementation Unit (UPT) veterinary plantation and livestock service; head of socio-cultural division of Bappeda; head of planning subdivision of the agriculture service; head of seed cultivation of the marine and fisheries service; and head of Lore Lindu National Park planning subdivision.

The schistosomiasis control program led by the health office as an effort to eliminate the spread of schistosomiasis disease has long been implemented, especially by the health office. Since the discovery of this disease, the health office has been involved in treating and preventing the spread of schistosomiasis. The serious involvement of the health office in the schistosomiasis control program began with the preparation of the schistosomiasis eradication roadmap in Indonesia in 2018 to 2020. The implementation of this program involves various related agencies, such as: livestock and animal health service (Disnakeswan), public works and spatial planning service (Dinas PUPR), Bappeda, food crops and horticulture service (Dinas TPH), forestry service (Dishut), plantation and animal husbandry service (Disbunak), marine affairs and fisheries service (DKP), and community and village empowerment service (DPMD). Overall, the implementation of this program uses budgets from the state budget (APBN) and regional budget (APBD). The amount and other budget sources vary in each agency. Their involvement in this program is also handed over authority according to their respective capacities and tupoksi (main tasks and functions). However, in the realization of the program, all agencies generally do not find significant obstacles in the field. The toughest obstacle is only in budgeting which is considered too little, so there are some programs whose realization is delayed or even not implemented at all. Overall, the program target has not been achieved. Each agency hopes that all foci can be handled in 2020 in accordance with the target of achieving eradication. However, due to budget constraints, this target cannot be achieved in 2019 or even in 2020. Such as excerpts from interviews with informant representatives from the following agencies:

*"Yes... actually, if the program is necessary financial support. Yes... the suggestion just now was. We can be more synergistic. Means... the program is to mace... What does it look like... We are both sitting. You're welcome to... What is it called, if indeed... The goal is to... to... a... That Schisto."* PUPR Office of Central Sulawesi Province (interview October 2, 2019)

*"Actually, the obstacle is just a budget problem. Means... Actually, if he... The maximum is obviously the budget must really support. .... That's the most urgent obstacle. Budget issues. If it is something else, there is none. In our field, actually, if it is directly related to community empowerment, there is 1 activity, namely POSYANDU coaching. Well, that's been a long time since it was budgeted. Actually, that's where we can if budgeted, POSYANDU coaching, we can do this... What is it called, that cadre meeting. Schisto socialization there. In direct contact with society. Gone hehehe... if the budget. .... But not supported by budget. .... It should be if... his name is this, right, if it is like sir... You said it then right, it is also ashamed of us, right. The world says we have Schisto right. In Indonesia, right? That means nationally, at least if that's the case, let's be together. Maybe if the national wants to go down directly, don't you? Give for example the budget to the regions. Then we... what can we do this. We carry it out."* PMD Office of Sigi Regency (interview October 1, 2019)

*"The budget... hehehe... a... so far, right? It is expected that this is from the local government, so that the ownership of this program is strong, if this is waiting from the center, it may be easy, yes if the regions that feel a... This responsibility for this financing, so that they can quickly eliminate this. If... From the center burdening continues, the region does not feel the budget burden on its territory. Maybe if in... switch to it, maybe the local government will be more serious, so that he will not be undermined by his budget again. Yes, maybe slowly this observation was shifted to... area. But maybe it will be the 2025 phase, huh? The fear is that we will fail this, this Roadmap."* Central Sulawesi Provincial Health Office (interview October 7, 2019)

If reviewed as a whole, the target of Schistosomiasis eradication is aiming 3 main things, namely: i) controlling the spread of schistosomiasis in humans; ii) control the spread of schistosomiasis in animals; and iii) control the spread of schistosomiasis in intermediate snails. Each agency involved in this program has its own targets, namely:

- To control the spread of schistosomiasis in humans, the authority is handed over to the health office.
- To control the spread of schistosomiasis in animals, the authority is handed over to the livestock service.

- To control the spread of schistosomiasis in intermediate snails, the authority is handed over to other agencies outside the health office and livestock office.

Donggala Health Research and Development Center has a role as the head of the focus control team for schistosomiasis intermediate snails based on the decree of the schistosomiasis integrated team of Central Sulawesi Province in 2017 to 2022. The role of the Donggala Health Research and Development Center is to conduct research and provide recommendations to accelerate and synergize efforts to eliminate schistosomiasis, the Ministry of National Development Planning/Bappenas together with the Ministry of Health has coordinated the preparation roadmap schistosomiasis eradication 2018 to 2025 involving all stakeholders related both at the central level and at the regional level. Drafting process series roadmap this schistosomiasis eradication includes mapping strategic activities, mapping budgeting needs (sourced from the APBN, special allocation funds (DAK), and APBD), and synchronizing planning and budgeting at both the central and regional levels [9]. Experience in schistosomiasis control in China combines snail control with spraying and environmental modification through relevant cross-sector engagement [10], [11]. The permanent construction of water channels by the public works office can drain water smoothly and quickly, it can also make it difficult for snails *Oncomelania hupensis lindoensis* to survive.

Evaluation or assessment activities are an integral part of the management function and are based on management information systems. Evaluation is conducted because of the encouragement or desire to measure the achievement of work results or program implementation activities against the objectives set. The evaluation is intended to obtain relevant information for decision making [12].

### 3.2. Community empowerment in the preparation of village regulations on conch fever

Regulation of the Minister of Health of the Republic of Indonesia number 19 of 2018 concerning the implementation of conch fever eradication, affirms that regional governments have the obligation to determine and implement policies for the implementation of conch fever eradication, as well as conduct advocacy and socialization to strengthen commitment with policy makers at the regional level. One of the expected commitments from the local government is the regulation on the control of conch fever at the village level which is outlined in the form of a village regulation/*peraturan desa* (Perdes). Perdes is designed to increase the use of personal protective equipment (PPE) in the community, increase the scope of faecal collection, increase community participation in the treatment of both individuals and mass, increase the use of latrines, contain livestock (mammals), and reduce the number of focus areas of conch.

### 3.3. Community empowerment by forming schistosomiasis control team

Schistosomiasis control has been conducted by the Central Sulawesi Provincial Health Office together with the Poso Regency Health Office and the Lengkeka Schistosomiasis Laboratory, which has not involved much of the community. Communities need to be involved and empowered in the control of schistosomiasis to achieve elimination by 2025. To increase community participation in schistosomiasis control at the village level, a schistosomiasis control team was formed in each village.

The village schistosomiasis control team was formed with the aim of conducting schistosomiasis control activities and mobilizing the community in schistosomiasis control activities at the village level. The formation of the team was included in the content of the village regulation on snail fever control. The team consisted of schistosomiasis cadres in each village in West Lore. The number of team members is adjusted to the needs of each village. In 2019, the number of schistosomiasis control teams in Tuare, Kageroa, and Lengkeka Villages was five people each. The number of members of the Tomehipi Village schistosomiasis control team is four people, and in Kolori and Lelio Villages, there are three people each. The structure of the schistosomiasis control team consists of one chairperson, one secretary, and members. In performing its duties, the schistosomiasis control team is responsible to the village head.

The schistosomiasis control team formed was given training to improve the team's knowledge and skills in controlling schistosomiasis. Based on this, training activities for the schistosomiasis control team were conducted. The training has been held from 22 to 25 July 2019. The training provided is in the form of theory in class and practice both in the Schistosomiasis Lengkeka Laboratory and in the field to provide skills in performing their duties. The training resource persons came from the Poso Regency Health Office, Donggala Health Research and Development Center, and Lengkeka Schistosomiasis Laboratory. There was an increase in average pre-test scores (77) and post-test scores (84.8) after training. Statistically, the training conducted can significantly increase the knowledge of the schistosomiasis control team about schistosomiasis with a p-value of <0.001.

The use of personal protective equipment (PPE) is targeted in this village regulation. This is because schistosomiasis is a disease whose transmission occurs in watery areas, through snail intermediate hosts *Oncomelania hupensis lindoensis* which is amphibious [13], [14]. This is what causes people who do not use

PPE, such as boots, to get schistosomiasis when crossing or heading to the focal area of an infected snail *S. Japonicum* [15].

Another thing regulated in Perdes is community participation in collecting feces. Low stool examination coverage will cause inaccurate and fluctuating prevalence data. In addition, low fecal examination coverage will cause people suspected of suffering from schistosomiasis not to be netted, so it will be a source of transmission [16], [17].

Farm animal containment is also targeted in Perdes, because considering that one of the difficulties in controlling schistosomiasis is due to its zoonotic nature, which in addition to infecting humans can also infect animals, especially mammals. Host animals that function as worm reservoirs include deer, cows, buffaloes, sheep, pigs, dogs, rats and squabbles and other rodents [18], [19]. Restrictions on the movement of farm animals are expected to reduce the infection rate *Schistosoma japonicum* in mammals. A study states that livestock that are kept free to roam have a higher tendency to be infected compared to animals raised by cages [20].

Control of schistosomiasis intermediate snails *Oncomelania hupensis lindoensis* is important to do because it is one way to break the chain of transmission of schistosomiasis [19], [21], [22]. Community participation is certainly needed in controlling schistosomiasis intermediate snails. The success of controlling the focus of snails in China is due to community involvement [11], [23], [24]. This is what encourages community participation to be regulated in village regulations so that the transmission of schistosomiasis can be controlled. As already mentioned above, the intermediate snail schistosomiasis (*O. hupensis lindoensis*) is amphibious, so that the snail can live in waterlogged areas or dry soil. Thus, the eradication of snails can be done by environmental management [25]–[27].

The village regulation on conch fever mitigation sanctions people who do not have latrines. Open defecation can increase the transmission of schistosomiasis. The behavior of defecation not in latrines can cause soil pollution by worm eggs and if contaminated with water, the eggs can hatch into cercariae so that the location can be a source of transmission. The results showed that there was a meaningful relationship between the incidence of schistosomiasis infection and the use of latrines [28], [29].

Based on the literature, community involvement and empowerment are a powerful strategy in determining the success of disease control programs, both infectious and non-communicable [30]. Several community interventions conducted through community empowerment in several middle-income countries such as India and Mongolia have shown promising results in terms of sustainability. Health promotion strategies with community empowerment require high participation of the target to have a significant impact on behavior change [31].

#### 4. CONCLUSION

Control of schistosomiasis by related cross-sectors has not been maximized from the target roadmap for schistosomiasis elimination. Advantages of cross-sectoral control of schistosomiasis: all cross-sectors included in the roadmap have been involved and play a role in controlling schistosomiasis. The lack of schistosomiasis control by cross-sectors is the location of control that has not been on target, schistosomiasis is not a priority in cross-sectors other than the health sector, so the budget is limited. Community empowerment can increase the scope of human fecal collection, captivity of mammals, decrease the number of focal areas of *O. hupensis lindoensis* snails, and increase public knowledge about schistosomiasis. We would also like to suggest that Bappeda at the regional level coordinate the budget and coordination of schistosomiasis control together across sectors so that the achievement target can be maximized. Evaluation of community empowerment so that it can be sustainable and can be applied in the Lindu and Napu regions which are also endemic to schistosomiasis.

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#### REFERENCES

- [1] P. A. Mawa, J. Kincaid-Smith, E. M. Tukahebwa, J. P. Webster, and S. Wilson, "Schistosomiasis morbidity hotspots: roles of the human host, the parasite and their interface in the development of severe morbidity," *Frontiers in Immunology*, vol. 12, Mar. 2021, doi: 10.3389/fimmu.2021.635869.
- [2] E. Y. Li, D. Gurarie, N. C. Lo, X. Zhu, and C. H. King, "Improving public health control of schistosomiasis with a modified WHO strategy: a model-based comparison study," *The Lancet Global Health*, vol. 7, no. 10, pp. 1414–1422, Oct. 2019, doi: 10.1016/S2214-109X(19)30346-8.




- [3] Y. Li *et al.*, “Schistosomiasis surveillance-China, 2015-2018,” *China CDC Weekly*, vol. 2, no. 3, pp. 39–43, 2020, doi: 10.46234/ccdcw2020.011.
- [4] S. Knopp *et al.*, “A 5-year intervention study on elimination of urogenital schistosomiasis in Zanzibar: parasitological results of annual cross-sectional surveys,” *PLoS Neglected Tropical Diseases*, vol. 13, no. 5, May 2019, doi: 10.1371/journal.pntd.0007268.
- [5] N. Clarke, “Optimising control programs for soil-transmitted helminths,” The Australian National University, 2019.
- [6] J. E. Guerrero and E. Hansen, “Cross-sector collaboration in Oregon’s forest sector: insights from owners and CEOs,” *International Wood Products Journal*, vol. 12, no. 2, pp. 135–143, Feb. 2021, doi: 10.1080/20426445.2021.1889164.
- [7] H. D. Mazigo, “Participatory integrated control strategies and elimination of schistosomiasis in sub-Saharan Africa,” *The Lancet Global Health*, vol. 7, no. 8, pp. 998–999, Aug. 2019, doi: 10.1016/S2214-109X(19)30271-2.
- [8] S. Binder *et al.*, “The schistosomiasis consortium for operational research and evaluation 2008-2020: approaches, experiences, lessons, and recommendations,” *American Journal of Tropical Medicine and Hygiene*, vol. 103, pp. 114–124, Jul. 2020, doi: 10.4269/ajtmh.19-0786.
- [9] N. Monnier, T. Barth-Jaeggi, S. Knopp, and P. Steinmann, “Core components, concepts and strategies for parasitic and vector-borne disease elimination with a focus on schistosomiasis: a landscape analysis,” *PLoS Neglected Tropical Diseases*, vol. 14, no. 10, pp. 1–22, Oct. 2020, doi: 10.1371/journal.pntd.0008837.
- [10] M. B. Qian *et al.*, “Neglected tropical diseases in the People’s Republic of China: progress towards elimination,” *Infectious Diseases of Poverty*, vol. 8, no. 1, Oct. 2019, doi: 10.1186/s40249-019-0599-4.
- [11] G. M. Williams *et al.*, “Field testing integrated interventions for schistosomiasis elimination in the people’s republic of China: outcomes of a multifactorial cluster-randomized controlled trial,” *Frontiers in Immunology*, vol. 10, Apr. 2019, doi: 10.3389/fimmu.2019.00645.
- [12] C. A. Torres-Vitolas, N. Dhanani, and F. M. Fleming, “Factors affecting the uptake of preventive chemotherapy treatment for schistosomiasis in sub-saharan africa: a systematic review,” *PLoS Neglected Tropical Diseases*, vol. 15, no. 1, pp. 1–33, Jan. 2021, doi: 10.1371/journal.pntd.0009017.
- [13] Y. Liu, J. Ge, and Z. Li, “Epidemic characteristics of schistosomiasis in Jiangxi Province,” in *Parasitology Research Monographs*, Springer International Publishing, 2019, pp. 25–49.
- [14] F. Hu *et al.*, “Distribution pattern of the snail intermediate host of schistosomiasis japonica in the poyang lake region of China,” *Infectious Diseases of Poverty*, vol. 8, no. 1, Mar. 2019, doi: 10.1186/s40249-019-0534-8.
- [15] A. Ross, M. Inobaya, R. Olveda, T. Chau, and D. Olveda, “Prevention and control of schistosomiasis: a current perspective,” *Research and Reports in Tropical Medicine*, Oct. 2014, doi: 10.2147/rrtm.s44274.
- [16] A. Oleaga *et al.*, “Epidemiological surveillance of schistosomiasis outbreak in Corsica (France): are animal reservoir hosts implicated in local transmission?,” *PLoS Neglected Tropical Diseases*, vol. 13, no. 6, Jun. 2019, doi: 10.1371/journal.pntd.0007543.
- [17] S. J. Krauth, J. Balen, G. N. Gobert, and P. H. L. Lamberton, “A call for systems epidemiology to tackle the complexity of schistosomiasis, its control, and its elimination,” *Tropical Medicine and Infectious Disease*, vol. 4, no. 1, Jan. 2019, doi: 10.3390/tropicalmed4010021.
- [18] E. Léger *et al.*, “Prevalence and distribution of schistosomiasis in human, livestock, and snail populations in northern Senegal: a One Health epidemiological study of a multi-host system,” *The Lancet Planetary Health*, vol. 4, no. 8, pp. 330–342, Aug. 2020, doi: 10.1016/S2542-5196(20)30129-7.
- [19] C. L. Faust *et al.*, “Schistosomiasis control: leave no age group behind,” *Trends in Parasitology*, vol. 36, no. 7, pp. 582–591, Jul. 2020, doi: 10.1016/j.pt.2020.04.012.
- [20] J. Gaspard *et al.*, “Survey of schistosomiasis in Saint Lucia: evidence for interruption of transmission,” *American Journal of Tropical Medicine and Hygiene*, vol. 102, no. 4, pp. 827–831, Apr. 2020, doi: 10.4269/ajtmh.19-0904.
- [21] M. Nelwan, “Data on elimination of schistosomiasis,” *SSRN Electronic Journal*, 2019, doi: 10.2139/ssrn.3435454.
- [22] L. Worku, D. Damte, M. Endris, H. Tesfa, and M. Aemero, “Schistosoma mansoni infection and associated determinant factors among school children in Sanja Town, northwest Ethiopia,” *Journal of Parasitology Research*, pp. 1–7, 2014, doi: 10.1155/2014/792536.
- [23] L. J. Zhang *et al.*, “The epidemiological status of schistosomiasis in P. R. China after the World Bank Loan Project, 2002-2017,” *Acta Tropica*, vol. 195, pp. 135–141, Jul. 2019, doi: 10.1016/j.actatropica.2019.04.030.
- [24] B. Zhong, L. Chen, J. Xu, K. Yang, L. Zhang, and S. Li, “National plan for schistosomiasis control and achievements,” in *Tropical Diseases in China*, Springer Nature Singapore, 2022, pp. 219–261.
- [25] M. L. Nelwan, “Schistosomiasis: life cycle, diagnosis, and control,” *Current Therapeutic Research-Clinical and Experimental*, vol. 91, pp. 5–9, 2019, doi: 10.1016/j.curtheres.2019.06.001.
- [26] Y. Feng, “Management of China-Zanzibar cooperation project: lessons learned,” in *Parasitology Research Monographs*, Springer International Publishing, 2021, pp. 253–272.
- [27] M. E. Sengupta *et al.*, “Environmental DNA for improved detection and environmental surveillance of schistosomiasis,” *Proceedings of the National Academy of Sciences of the United States of America*, vol. 116, no. 18, pp. 8931–8940, Apr. 2019, doi: 10.1073/pnas.1815046116.
- [28] T. A. Adekiya, R. T. Aruleba, B. E. Oyinloye, K. O. Okosun, and A. P. Kappo, “The effect of climate change and the snail-schistosome cycle in transmission and bio-control of schistosomiasis in sub-saharan africa,” *International Journal of Environmental Research and Public Health*, vol. 17, no. 1, Dec. 2020, doi: 10.3390/ijerph17010181.
- [29] Y. Li and S. Lyu, “Eliminating plan and challenges,” in *Parasitology Research Monographs*, Springer International Publishing, 2019, pp. 187–201.
- [30] M. Pagès, A. Fischer, R. van der Wal, and X. Lambin, “Empowered communities or ‘cheap labour’? engaging volunteers in the rationalised management of invasive alien species in Great Britain,” *Journal of Environmental Management*, vol. 229, pp. 102–111, Jan. 2019, doi: 10.1016/j.jenvman.2018.06.053.
- [31] A. Katre, A. Tozzi, and S. Bhattacharyya, “Sustainability of community-owned mini-grids: evidence from India,” *Energy, Sustainability and Society*, vol. 9, no. 1, Jan. 2019, doi: 10.1186/s13705-018-0185-9.

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