NOVEMBER 2024

INSECTICIDE TREATED NET (ITN) WASTE MANAGEMENT IN SIERRA LEONE – A SUSTAINABLE SOLUTION TO REDUCING THE ENVIRONMENTAL IMPACT OF MALARIA PREVENTION

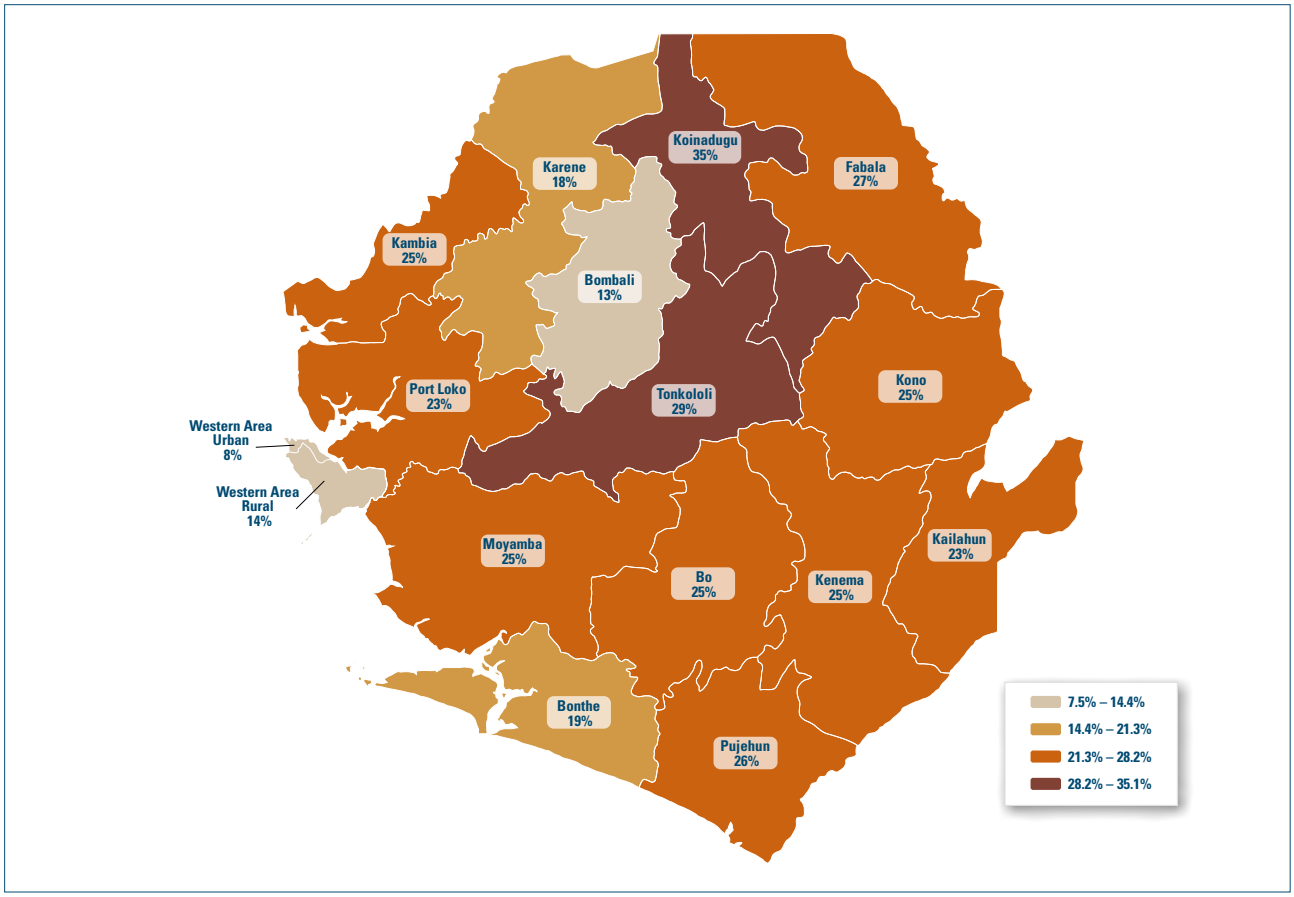
amp | The Alliance for Malaria Prevention
Expanding the ownership and use of mosquito nets

CONTENTS

OVERVIEW

Malaria is endemic in Sierra Leone, with stable and perennial transmission in every part of the country[1]. *Plasmodium falciparum* is the most common malaria parasite, accounting for over 90 per cent of all malaria cases in the country. *Anopheles gambiae* and *Anopheles funestus* are the dominant vector species responsible for the transmission of malaria. Everyone in Sierra Leone is prone to malaria infection, but the highest morbidity and mortality rates are seen among pregnant women and children under five years of age. Malaria is currently the leading cause of morbidity and mortality among under-five children. It accounts for 40.3 per cent of outpatient morbidity for all ages and 47 per cent of outpatient morbidity for under-five children (see figure 1). Malaria is also responsible for 37.6 per cent of hospitalized cases with a case fatality rate of 17.6 per cent[2].

Figure 1: Prevalence map of malaria in children under five by district (Malaria Indicator Survey, 2021)



The then Ministry of Health and Sanitation (MoHS), now Ministry of Health (MoH), through the National Malaria Control Programme (NMCP), bears the sole responsibility for coordinating, organizing and delivering all government and donor sponsored malaria interventions in collaboration with other MoH programmes and departments, as well as with technical, funding and implementing partners at country level. The NMCP is guided by the 2021—2025 National Malaria Elimination Strategic Plan, which is aligned to technical guidance from the World Health Organization (WHO) and supported by the Government of Sierra Leone and partners such as the Global Fund, the US President's Malaria Initiative (PMI) and the Roll Back Malaria Partnership (RBM), among others.

1. Sierra Leone National Malaria SME Plan 2021—2025.
2. Surveillance, Monitoring and Evaluation Plan 2021—2025.

Insecticide-treated nets (ITNs) represent one of the most effective malaria prevention interventions. Due to their demonstrated effect on malaria, ITNs are the core vector control strategy in many malaria-endemic countries, including Sierra Leone. The NMCP leads a coordinated strategy for ITN vector control across partners, including distribution through mass campaigns every three years, as well as via routine health services to pregnant women at antenatal care (ANC) and children at immunization visits. ITN distribution to school-aged children through school-based distribution activities is implemented in a limited number of districts.

In 2023, the Sierra Leone MoH/NMCP and partners began planning for a mass ITN campaign, which would be the country's first-ever digitalized campaign, using digital devices to collect information for household registration, ITN distribution, in-country supply chain management, national and independent monitoring. Using insecticide resistance monitoring data, the NMCP decided to distribute two types of nets – dual active ingredient (Dual AI) nets and ITNs with a piperonyl butoxide (PBO) synergist.

Based on the mass campaign macro-quantification for ITN types, a total of 2,405,694 Dual AI nets were to be delivered, as well as 2,939,537 PBO nets (see Table 1). By March 2024, the NMCP and partners concluded the nationwide mass campaign, with over 4.8 million ITNs distributed across 1,445 fixed distribution points, as well as outreach and mobile distribution sites.

Table 1: ITN allocation/distribution table

Districts	ITNs allocated			ITNs distributed		
	Dual AI	PBO	Total	Dual AI	PBO	Total
Kailahun	397,500		397,500	378,357		378,357
Tonkolili	377,200		377,200	355,025		355,025
Pujehun	228,650		228,650	218,509		218,509
Kambia	255,550		255,550	243,228		243,228
Moyamba	236,250		236,250	224,285		224,285
Falaba	140,950		140,950	130,813		130,813
Koinadugu	149,050		149,050	140,682		140,682
Bonthe	154,150		154,150	145,523		145,523
Port Loko	413,700		413,700	384,913		384,913
Kono		380,250	380,250		349,755	349,755
Bombali		322,450	322,450		301,629	301,629
Western Area Urban		757,932	757,932		608,767	608,767
Western Area Rural		417,400	417,400		339,265	339,265
Karene		212,950	212,950		198,073	198,073
Bo		432,800	432,800		408,256	408,256
Kenema		468,450	468,450		441,027	441,027
Total	**2,405,694**	**2,939,537**	**5,345,232**	**2,221,335**	**2,646,772**	**4,868,107**

© Sierra Leone NMCP campaign report

Macroplanning for the ITN waste management

The Sierra Leone NMCP set the specifications for the different types of nets to be distributed during the campaign. The PBO nets were ordered packed in bulk for campaign distribution (also termed naked nets), with 50 nets included in each bale, while the Dual AI nets do not have a bulk packaging option and are packaged in individual plastic bags, with 50 nets included in each bale. Given the inability to procure Dual AI nets without individual packaging, the NMCP recognized the importance of ensuring that a robust waste management plan was developed and costed early to ensure that the environmental impact of the ITN distribution was minimized. The 2023 ITN mass campaign was estimated to generate over 70 metric tonnes of ITN plastic waste (see Table 2 for a breakdown of estimated ITN waste generated).

Table 2: Average weight of waste generated from the 2023/24 ITN mass campaign

Districts	ITN distributed			Weight of ITN waste		
	Dual AI	PBO	ITNs (bales)	Dual AI waste (kg)	PBO waste (kg)	Tonnes (kg/1000)
Kailahun	378,357		7567	10442.46		10.443
Tonkolili	355,025		7100	9798.00		9.798
Pujehun	218,509		4370	6030.60		6.031
Kambia	243,228		4864	6712.32		6.712
Moyamba	224,285		4485	6189.30		6.189
Falaba	130,813		2616	3610.08		3.610
Koinadugu	140,682		2813	3881.94		3.882
Bonthe	145,523		2910	4015.80		4.016
Port Loko	384,913		7698	10623.24		10.623
Kono		349,755	6995		1650.82	1.651
Bombali		301,629	6032		1423.55	1.424
Western Area Urban		608,767	12175		2873.30	2.873
Western Area Rural		339,265	6785		1601.26	1.601
Karene		198,073	3961		934.80	0.935
Bo		408,256	8165		1926.94	1.927
Kenema		441,027	8820		2081.52	2.082
Total (tonnes)	**2,221,335**	**2,646,772**	**97,356**	**61,303.74**	**12,492.19**	**73.797**

To inform the waste management plan, the NMCP and partners reviewed the most recent WHO guidance, *WHO Recommendations on the Sound Management of Packaging for Long-Lasting Insecticidal Nets*[3] (2011), which gives the guidance summarized in Table 3.

Table 3: Do's and Don'ts of ITN packaging waste management

GUIDANCE	
PRACTICES TO BE AVOIDED **DO NOT**	**ACCEPTABLE PRACTICES** **DO**
➠ Encourage the reuse of ITN bags for any other purpose to avoid the risk of pesticide poisoning. ➠ Dispose of ITN bags and contaminated baling material as ordinary waste or in improper sanitary landfills. ➠ Burn ITN bags and baling material in open air as there is a risk of emission of harmful substances that mainly pollute the air, surface water, soil and food.	✔ Where possible, and with no reduction in the public health benefit, distribute ITNs without leaving any packaging with the intended ITN recipient. ✔ Recycle ITN packaging. Recyclers processing used ITN bags and baling material should apply proper controls of their materials and processes to ensure the bags are only recycled into appropriate products which have "limited potential for human contact and are not likely to be recycled again". ✔ Ensure proper personal protective equipment (PPE) is used and control measures are strictly followed by workers involved in all stages of waste management operations for collection, sorting, recycling and disposal of ITN bags and baling material. ✔ Incinerate ITN bags and baling material ONLY if specified high temperature incineration conditions for pesticide-tainted plastic can be assured following *Basel Convention Technical Guidelines*[4] and in accordance with national regulations and requirements ✔ Store used ITN packaging awaiting future safe recycling, disposal or other processes in dry, well-ventilated and secure facilities. ✔ If recycling or incineration is not possible and if the ITN manufacturer provides directions on methods for safe disposal, follow the manufacturer's recommendation. Alternatively, landfilling of bags and baling material in a properly engineered landfill is an option, as detailed in the Food and Agriculture Organization (FAO)/*WHO Guidelines on Management Options for Empty Pesticide Containers*[5]. ✔ National pesticide registration authority to make mandatory that manufacturers provide recommendations on the safe disposal and/or recycling of ITN packaging. This will include information on labels of ITN bags regarding the material used in the production of such bags. ✔ Assure that disposal of ITN packaging is included as a condition in the procurement of ITNs. ✔ Develop national ITN packaging management protocols for these wastes and assure that all stakeholders are aware of proper packaging disposal procedures that are aligned with national regulations and requirements. ✔ Integrate good practice recommendations on the sound management of ITN packaging into the existing national malaria strategy and related frameworks; and ensure that recommendations are aligned with national regulations concerning the safe handling and disposal of chemical waste (or pesticide-tainted waste).

3. WHO (2011) *Recommendations on the Sound Management of Packaging for Long-Lasting Insecticidal Nets.* https://continuousdistribution.org/wp-content/uploads/2022/03/WHO-Recommendations-LLIN-Packaging.pdf
4. *Basel Convention Technical Guidelines for the Identification and Environmentally Sound Management of Plastic Wastes and for their Disposal:* http://www.basel.int/meetings/cop/cop6/cop6_21e.pdf. "The condition for the optimal incineration of material is: "Temperature of 850—1100°C for hydrocarbon waste and 1100—1200°C for halogenated wastes….".
5. *FAO (2008) Guidelines on management options for empty pesticide containers.* See: https://www.fao.org/documents/card/en/c/a99d7652-8322-4a28-92a2-726c92dd3bc4

As an initial step during macroplanning, the NMCP undertook a mapping of incineration capacity and the availability of functional incinerators at health facilities that met the WHO criteria for incineration of ITN packaging. The findings revealed that most facilities lacked functional controlled incinerators and could not, therefore, handle the volume of plastic waste estimated to be generated from the ITN mass campaign. Given the lack of incinerator capacity the NMCP initiated work to identify options for waste recycling, a more environmentally friendly and sustainable option.

Identification and assessment of private sector waste recycling options

The NMCP began a search to partner with a private recycling company within the country that could manage the volume of plastic waste produced from the ITN mass campaign, and that could comply with the WHO recommendations by applying proper controls of materials and processes to ensure the bags were recycled into appropriate products as specified by WHO.

After exploring the limited private sector options available for plastic recycling, the NMCP selected and entered a public-private sector partnership with Premier Enviro Solutions Limited (PES) for their ability to comply with the requirements and their willingness to take on the waste recycling without additional cost to the campaign.

Public-private sector partnership

Premier Enviro Solutions Limited is a local company based in Sierra Leone that was started in response to an evident problem in the urban capital area. PES estimates that only 20 of the 90 tonnes of plastic waste generated per day in the capital, Freetown, end up at dumpsites, while the remaining 70 tonnes contribute to pollution across the city[6], and thus demonstrate the need for an alternative and innovative approach to the management of ITN associated waste.

To be part of the solution to the plastic waste problem, PES started a "plastic to build" initiative to recycle plastic waste. The waste would be crushed into the form of flakes, which would then be blended with aggregate (a mix of sand and stone) in a recycling process to repurpose into building blocks and paving bricks.

In collaboration with the Sierra Leone NMCP, PES would use this technology to recycle the ITN waste at no additional cost. This is to date the largest scale public–private sector partnership for ITN waste management in Africa. The NMCP was, however, responsible for the transport of the waste from source to the recycling plant.

> *Deputy Minister of Environment, Yema Mimi Soba-Stephens, said Sierra Leone being a developing country faces a lot of challenges. Plastic, she noted, has become one of the most popular resources for the population, partly because of its affordability. The problem, she went on, is that most of the plastic products are designed to be discarded, posing potential health effects on humans, animals and marine resources, as well as contributing to the climate crisis*[6].

6. https://manoreporters.com/news/tech/sierra-leone-launches-week-long-campaign-against-plastic-pollution/

Working together: Developing considerations and assumptions

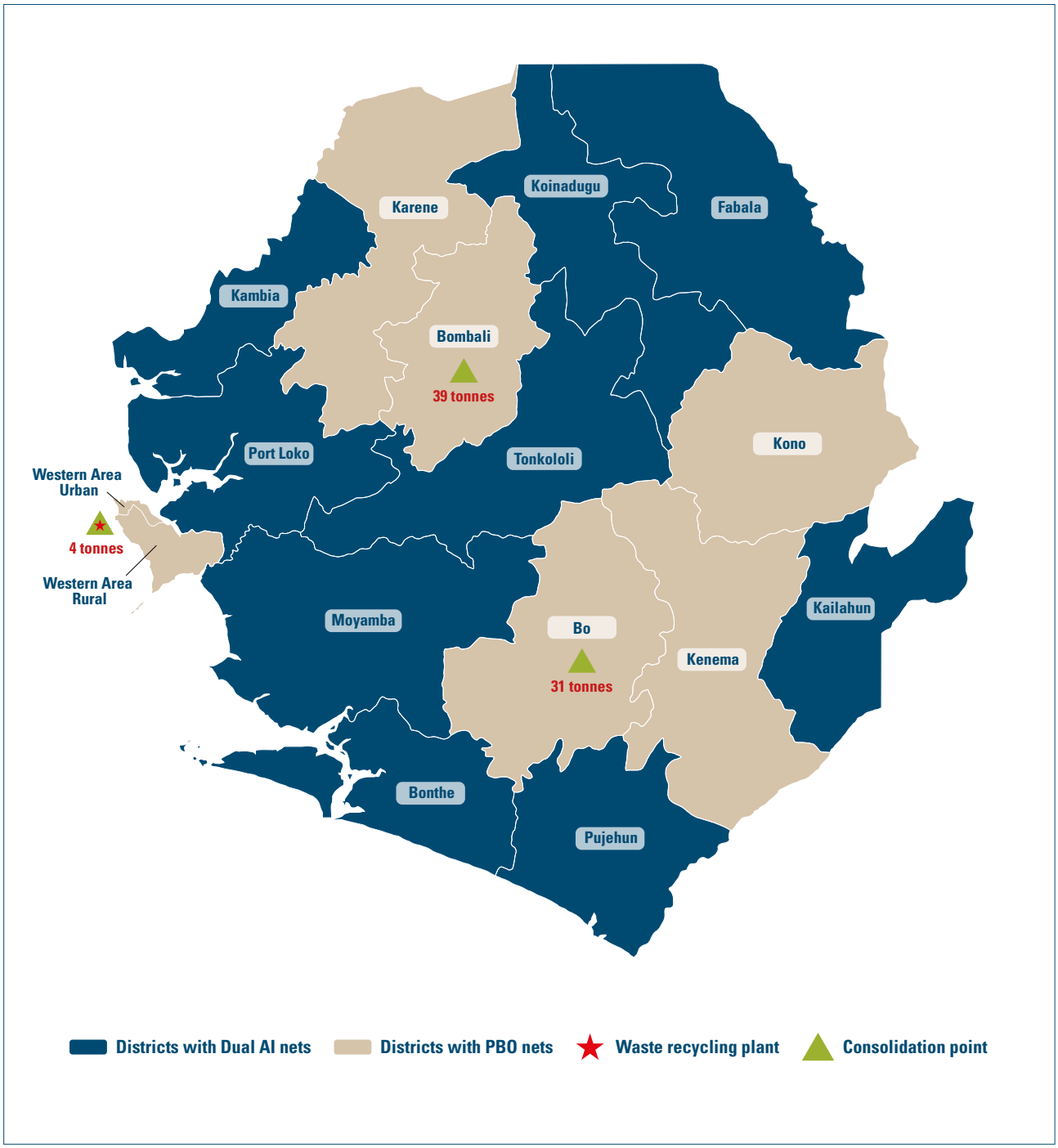
Once identified, PES began working on details with the NMCP campaign team to guide both the detailed costing and the operational timeline. The considerations and assumptions identified during these working sessions for the ITN waste management planning process (operational and financial) are found in Table 4.

Table 4: Considerations and assumptions made in the planning for waste management

Considerations	Assumptions
Waste to be generated	Empty bale sacks for all nets procured + plastic bale straps + individual net packaging for dual AI nets
Weight of empty bale sack	From the label of a bale of nets previously used for routine distribution (with individual packaging): Gross weight – Net weight = Weight of waste 28.46kg – 27.86kg = 0.60kg 
Transport	Trucks from District Medical Stores (DMS) to consolidation point (where waste would be crushed) and from the consolidation point to the recycling plant
Waste packaging after crushing	Jumbo bags
Waste packaging at DPs	Empty bale sacks
Waste collection and storage	ITN distributors and DP supervisors
Waste transport mode	• Vehicles of national monitors and supervisors during supportive supervision from DPs to DMS • MoH medical trucks from DMS to consolidation points and from the consolidation points to the recycling plant in Freetown
Waste tracking and verification	Waste tracker tool and waste crushing report
Waste sorting and separation	Manual labour at the time of crushing at the consolidation point
Waste crushing/consolidation points	Regional level consolidation points: Bo, Bombali and Western Area Urban (WAU) (see map in figure 2, for expected tonnage of waste to be crushed)
Waste recycling point	PES recycling plant, Freetown

Figure 2 shows the distribution of the two types of nets, with the amount of waste expected in tonnes, the waste consolidation points in Bombali, Bo and Freetown and the site of the eventual PES recycling plant in Freetown.

Figure 2: Map of Sierra Leone showing the distribution of the types of ITNs



Implementation of the ITN waste management process

***Waste collection and storage*:** During the distribution, trained distribution teams were responsible for welcoming household representatives, using their digital devices to scan vouchers to determine the number of ITNs each representative should receive, issuing the correct number of ITNs without the individual packages (for districts distributing Dual AI nets) to the householder as prompted by the device and providing social and behaviour change (SBC) messages. Distribution teams retained the ITN waste (empty bale sacks, bale strapping and individual ITN plastic packages for Dual AI nets) at the distribution points and returned the waste to the fixed DP store daily throughout the distribution period.

A member of the distribution team carefully cut open the bale sack since they were used to pack the waste after distributing the ITNs. The individual net packages were then counted as they were placed in a bale sack until it was full, then tied and kept in the ITN store or a separate store for waste depending on the availability of storage space. Bale straps were also packed into empty bale sacks either with the other ITN waste or separately and then stored.

Waste tracking and transport: A waste tracker was developed by the logistics sub-committee of the NMCP to be used by the ITN distributors and the district supervisors who were to transport the waste from the DPs to the DMS. The waste tracker captured the number of empty bales and number of empty individual ITN packs, including other details such as origin of waste, destination, signature of the DP supervisor and that of the conveyor of the waste (national monitors/district supervisors). Bale straps were not counted. See sample of the waste tracker in figure 3 below.

Figure 3: Waste tracker

Waste Tracker

Sierra Leone 2023/24 ITN Mass Distribution Campaign

Fixed DP _____ **DP supervisor** _____

SN	Date	Origin	Destination	Vehicle plate number	Number of empty bales (pcs)	Number of individual plastic (pcs)	Are there bale strapes in the waste	Signature of DP supervisor	Signature of transporter or conveyor	Remarks by supervising NM or DHMT

Beginning from the second day of distribution when all the waste from day one had been returned to the DP store, national monitors and district supervisors (members of the District Health Management Teams [DHMTs]) visiting any DP for supportive supervision were expected to request to see and verify the stored waste, sign the waste tracker filled by the DP supervisor, collect the waste into their vehicles and support in transporting the waste to the DMS from where larger MoH medical trucks would further transport the waste to the regional consolidation points at the end of the distribution period (Bo, Bombali and Freetown) for crushing and volume reduction before then transporting the waste to the PES recycling plant in Freetown.

At the end of the distribution process, national monitors confirmed through the DP supervisors that all the waste in their stores had been moved to the DMS. Any waste still left at the DP store was moved by the DP supervisor while conducting ITN reverse logistics activities.

If there were no ITNs left over at the DP store for reversal, the DHMT made immediate arrangements to convey the waste to the DMS (see figure 4).

Figure 4: DHMT transporting ITN waste from DP to the DMS

© Sierra Leone NMCP

***Waste crushing (pilot phase)*:** A pilot of the ITN mass distribution campaign took place in Bo district, including the waste crushing and consolidation, for the waste component of the ITN campaign. All the waste retained at the DPs was transported to the DMS in Bo, which was one of the consolidation points.

In February 2024, a dry run of the waste crushing process took place to quantify the level of volume reduction that could be achieved by crushing the ITN plastic waste into flakes (see figure 5 below).

Figure 5: Crushing of ITN waste into flakes

© Sierra Leone NMCP

The average weight of the various ITN packaging types was determined to support accurate documentation, calculation of total ITN waste mass or tonnage, and future estimations and budgeting for waste management. These data will also enhance waste tracking and verification through reverse calculations (see level 2 verification of waste below), reducing the need for the cumbersome manual counting of large waste volumes at the DMS. Tables 5 to 8 show the determined weight of various ITN waste types.

Table 5: Average weight of empty white coloured ITN bale sack (PBO nets packaging).

Sample number	Number of empty bale sacks	Weight (kg)	Sample image	Plastic type
1	20	3.0		Polypropylene (PP)
2	20	3.5		
3	20	2.9		
TOTAL	**60**	**9.4**		
Average weight of an empty PBO ITN bale sack is 0.156kg				

© Sierra Leone NMCP/PES

Table 6: Average weight of empty blue coloured ITN bale sack (dual AI nets packaging).

Sample number	Number of empty bale sacks	Weight (kg)	Sample image	Plastic type
1	20	3.5		Polypropylene (PP)
2	20	3.5		
3	20	3.5		
TOTAL	**60**	**10.5**		
Average weight of an empty dual AI ITN bale sack is 0.175kg				

© Sierra Leone NMCP/PES

Table 7: Average weight of plastic bale strap

Sample number	Number of empty bale straps	Weight (kg)	Sample image	Plastic type
1	100	2.0		PET
2	100	2.0		
3	100	2.0		
TOTAL	**300**	**6.0**		
Average weight of a plastic bale strap is 0.020kg				

© Sierra Leone NMCP/PES

Table 8: Average weight of empty individual ITN plastic pack (dual AI nets packaging)

Sample number	Number of empty plastic packs	Weight (kg)	Sample image	Plastic type
1	200	4.5		Blend of low-density polyethylene (LDPE) and polypropylene
2	200	4.5		
3	200	4.5		
TOTAL	**600**	**13.5**		
Average weight of an empty ITN plastic pack is 0.0225kg				

© Sierra Leone NMCP/PES

Average weight of waste generated from a bale of PBO nets:
Average weight of an empty PBO net bale sack +
(Average weight of a plastic bale strap x4)
0.156kg + (0.020kg x 4) = **0.236kg**

Average weight of waste generated from a bale of dual AI nets:
Average weight of an empty dual AI net bale sack +
(Average weight of empty individual net plastic pack x 50) +
(Average weight of a plastic bale strap x 4)
0.175kg + (0.0225kg x 50) + (0.020kg x 4) = **1.38kg.**

Verification of waste collected from the distribution points (DPs) and transported to the District Medical Stores (DMS) for crushing

Each DP supervisor was expected to fill out the waste tracker at the point of handing over the waste to the national monitor or DHMT for transporting to the DMS. At the DP, the national monitor/district supervisor was expected to verify the quantity of waste as the DP supervisor counted and filled the waste tracker, then sign and make appropriate remarks.

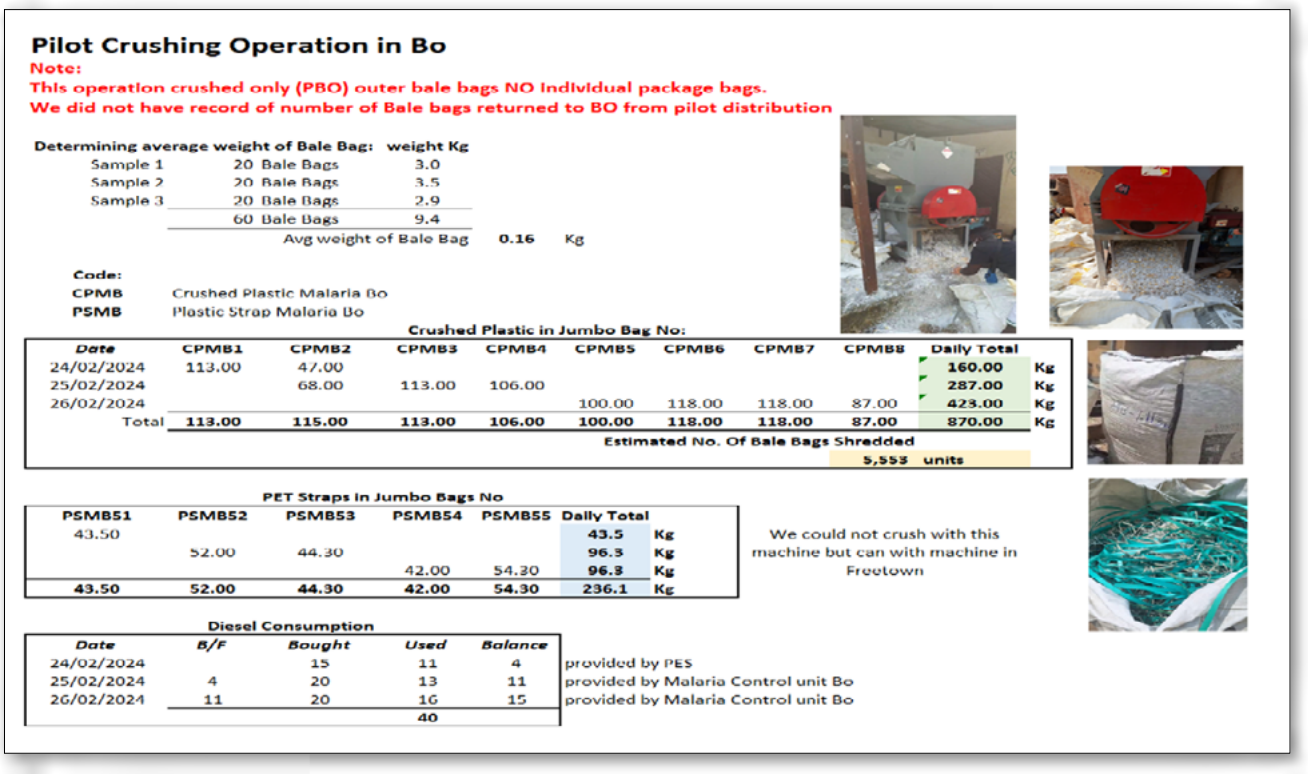
There were two levels of verification planned for the waste retrieved from each DP and transported to the DMS:

- **Level 1:** The supervising national monitor or DHMT verified the waste at the DP before transporting it to the DMS and made appropriate remarks in the designated column.
- **Level 2:** Using reverse/back calculation, the total quantity of a specific ITN waste material (either empty bale or individual ITN pack) brought to the DMS for crushing was weighed and divided by the weight of a single unit of the same waste type.

For example, if a DP records on the waste tracker to have brought in **X** number of empty PBO bale sacks, the combined weight of the **X** number of empty PBO bale sacks (crushed or uncrushed) divided by 0.156kg (weight of a single unit of a PBO empty bale sack) should be equal to **X**.

This level of verification was done by the recycling company (PES) for the district, before crushing the waste and then documented in their report for the Bo district waste crushing process (see figure 6).

Figure 6: Summary of the pilot waste crushing process



Pilot Crushing Operation in Bo

Note:
This operation crushed only (PBO) outer bale bags NO individual package bags.
We did not have record of number of Bale bags returned to BO from pilot distribution

Determining average weight of Bale Bag:		weight Kg
Sample 1	20 Bale Bags	3.0
Sample 2	20 Bale Bags	3.5
Sample 3	20 Bale Bags	2.9
	60 Bale Bags	9.4
	Avg weight of Bale Bag	0.16 Kg

Code:
CPMB Crushed Plastic Malaria Bo
PSMB Plastic Strap Malaria Bo

Crushed Plastic in Jumbo Bag No:

Date	CPMB1	CPMB2	CPMB3	CPMB4	CPMB5	CPMB6	CPMB7	CPMB8	Daily Total	
24/02/2024	113.00	47.00							160.00	Kg
25/02/2024		68.00	113.00	106.00					287.00	Kg
26/02/2024					100.00	118.00	118.00	87.00	423.00	Kg
Total	113.00	115.00	113.00	106.00	100.00	118.00	118.00	87.00	870.00	Kg

Estimated No. Of Bale Bags Shredded: 5,553 units

PET Straps in Jumbo Bags No

PSMB51	PSMB52	PSMB53	PSMB54	PSMB55	Daily Total	
43.50					43.5	Kg
	52.00	44.30			96.3	Kg
			42.00	54.30	96.3	Kg
43.50	52.00	44.30	42.00	54.30	236.1	Kg

We could not crush with this machine but can with machine in Freetown

Diesel Consumption

Date	B/F	Bought	Used	Balance	
24/02/2024		15	11	4	provided by PES
25/02/2024	4	20	13	11	provided by Malaria Control unit Bo
26/02/2024	11	20	16	15	provided by Malaria Control unit Bo
			40		

© Premier Enviro Solutions Bo pilot waste crushing report

Challenges during the waste management process

1. **Absence of source separation plan:** There was no specific plan for source separation of the ITN waste as the waste materials were mixed and tied up in empty bale sacks. Since the crushing machine used to crush the bale sacks and individual ITN packs could not crush the thick plastic bale straps, the crushers had to first sort out the different waste types (bale sack, individual ITN packs and straps). This led to the crushing process being slow and cumbersome.

2. **Inefficient and inadequate waste transport plan:** The initial waste transport strategy to use vehicles of national monitors and district supervisors to transport waste from fixed DPs that they visited daily during the campaign implementation was inefficient and unsustainable. The vehicles were unable to transport all the waste from the DPs to the DMS. At the end of the distribution period, it was estimated that about 70 per cent of the ITN waste was still at the DP stores across the 15 districts with no budgetary provisions for the first level transport of waste from the DPs to the DMS for the consolidation and crushing process.

3. **Insufficient waste management budget:** The approved waste management budget only covered for the transport of waste from the DMS to the consolidation point, plus the waste crushing and transport of crushed waste from the consolidation points to the recycling plant in Freetown.

4. **No dedicated campaign personnel at the DMS:** Nobody was tasked with tracking incoming waste and, consequently, there was no record of the origin of the waste brought into the DMS. This meant that waste trackers were not properly filled in nor used to track retrieved waste from the DMS to the recycling plant.

5. **Insufficient budget for lifting the mobile waste crusher**: The means of lifting the mobile waste crusher using a crane truck was not envisaged at the planning stage and as such there were no budgetary provisions made for it.

6. **Insufficient designated storage space**: Delays in the waste management process due to the above challenges, meant that waste materials stored at the DPs were at risk of improper handling and disposal in order to clear space for incoming routine medical supplies.

Revision of the waste transport plan

Based on the lessons learned and funding gap, the waste transport strategy was revised. The bulk of the funds meant for the second level waste transport (DMS to recycling plant) was sent to the district to effect the first level waste transport (DPs to DMS). The waste was then transported from the DPs and DMS directly to the PES recycling plant in Freetown (as shown in figure 7). This enabled the district teams to move out a reasonable amount of waste from some DPs and DMS that were constrained with storage space to free up storage for other routine medical supplies.

Figure 7: Trucks offloading ITN waste at the PES recycling yard in Freetown.

© Sierra Leone NMCP

However, the revision of the transport strategy did not solve the funding gap and there was still waste left at many DPs and DMS. In addition, tracking of the waste was not monitored and therefore the first level verification was not properly conducted.

Even though the second level verification of the waste was conducted, the origin of the waste was not properly tracked. The data from this level of verification did not reliably account for district specific waste data as can be seen in Table 9 below for Western Area Rural, Karene and Bo, where the amount of ITN waste retrieved in kilograms exceeded the anticipated mass based on the number of ITN bales distributed.

Table 9: Quantity and weight of ITN waste retrieved from the districts to the waste recycling plant as of 7 August 2024

Districts	ITNs distributed		Weight of ITN waste to be retrieved (kg) based on ITNs distributed		Weight of ITN waste retrieved		
	Dual AI (bales)	PBO (bales)	Dual AI Waste (empty bale, individual ITN packs & straps)	PBO waste (empty bale & straps)	Dual AI waste (kg)	PBO waste (kg)	Tonnes (kg/1000)
Kailahun	7567		10442.46		1297.50		1.298
Tonkolili	7100		9798.00		1109.00		1.109
Pujehun	4370		6030.60		676.00		0.676
Kambia	4864		6712.32		1281.50		1.282
Moyamba	4485		6189.30		954.00		0.954
Falaba	2616		3610.08		–		–
Koinadugu	2813		3881.94		586.50		0.587
Bonthe	2910		4015.80		740.00		0.740
Port Loko	7698		10623.24		496.00		0.496
Kono		6995		1650.82		373.00	0.373
Bombali		6032		1423.55		584.00	0.584
Western Area Urban		12175		2873.30		1747.80	1.748
Western Area Rural		6785		1601.26		2629.50	2.630
Karene		3961		934.80		1169.50	1.170
Bo		8165		1926.94		1831.00	1.831
Kenema		8820		2081.52		487.00	0.487
Total	**44,423**	**52,933**	**61,303.74**	**12,492.19**	**7,140.50**	**8,821.80**	**15.965**

© Sierra Leone NMCP/PES

Figure 8: Pie chart showing the percentage of ITN waste retrieved against that yet to be retrieved

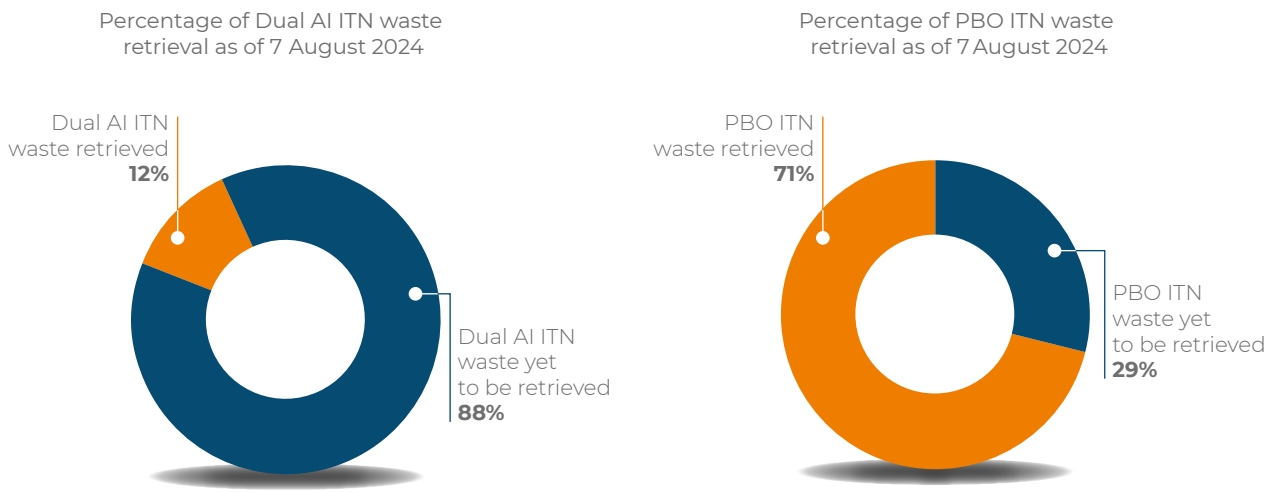
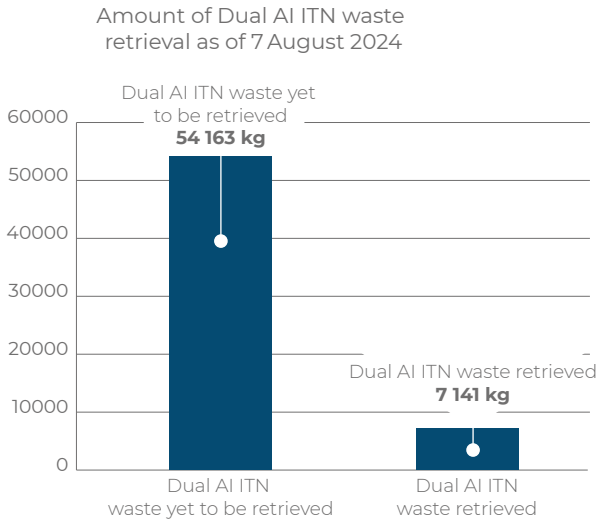
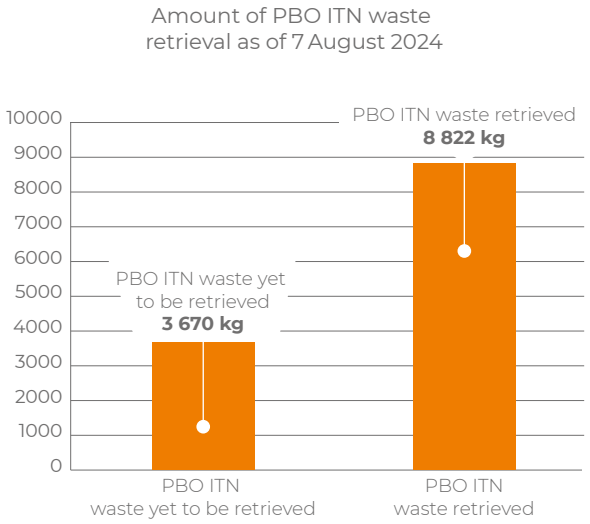


Figure 9: Bar chart showing the amount of ITN waste in kilograms retrieved against that yet to be retrieved.





These charts provide a graphical representation of the data in Table 9, illustrating the amount of waste retrieved compared to what remains to be collected from various DPs/DMS as of 7 August 2024. This visualization highlights the significant progress made by the NMCP in advancing the ITN waste management process, despite the challenges previously outlined.

Main achievements

Training of the DP supervisors and team members on the waste management process was well understood, judging by the volume of waste retained at the DPs, especially the individual ITN packaging. Despite the limited storage space and the huge volume of waste, the materials were well organized in DP stores, where quantities of waste generated during the distribution were all recorded. The pilot test run of the crushing process was successful, recording up to 50 per cent reduction in volume.

Recommendations

- Proper planning and budgeting for ITN waste collection and transport from the DP through to the recycling plant as defined by the NMCP and the recycling partner(s) is required. Early engagement of the NMCP with the national environmental authority to identify private sector options for further assessment is critical to avoid delays in the waste management operations during and after the ITN distribution.

- Source separation process should be encouraged to save time during crushing and make waste tracking easier and accountable. The process should be communicated during training of DP teams and upper-level supervisors and standard operating procedures (SOPs) for DP teams should include detailed steps for waste management.

- Adequate storage space for storage of waste at DMS or extension of warehousing contract to accommodate waste storage for districts with limited or no indoor storage space should be provided. Alternatively, arrangements should be made for transport of waste from DPs directly to higher level storage levels.

- The role of district storekeeper or security personnel should be revised so that they are made responsible for documenting/tracking waste brought into the DMS.

CONCLUSION

According to the Alliance for Malaria Prevention (AMP) Net Mapping Project[7], over three billion ITNs have been delivered to countries since 2004. While WHO estimated ten years ago that ITNs and their packaging currently accounted for one to five per cent of total plastic consumption in Africa[8], the volume of ITNs shipped to countries has dramatically increased year on year.

While many national malaria programmes had shifted to bulk packaged ITNs to reduce the plastic generated through mass campaigns, they are left with limited options in the context of Dual AI nets, which are currently only available in individual plastic packages. The need to minimize the environmental impact of vector control interventions, particularly large-scale ITN distribution, has become an increasing concern with the return to large-scale ITN campaigns involving individually packaged nets.

This initiative from Sierra Leone shows how innovative approaches and public-private sector partnerships can be used to support sustainable and climate-friendly solutions to plastic waste management in large-scale vector control activities.

7. https://allianceformalariaprevention.com/itn-dashboards/net-mapping-project/
8. *WHO recommendations on the sound management of old long-lasting insecticidal nets,* March 2011. https://apps.who.int/iris/bitstream/handle/10665/338356/WHO-HTM-GMP-MPAC-2014.1-eng.pdf?sequence=1&isAllowed=y

AMP CONTACTS

To join the weekly AMP conference call each Wednesday at 10:00 AM Eastern time (16.00 PM CET) use the following Zoom meeting line:
https://us06web.zoom.us/j/2367777867?pwd=a1lhZk9KQmcxMXNaWnRaN1JCUTQ3dz09

You can find your local number to join the weekly call:
https://zoom.us/u/acyOjklJj4

To be added to the AMP mailing list visit:
https://allianceformalariaprevention.com/weekly-conference-call/signup-for-our-mailing-list/

To contact AMP or join an AMP working group please e-mail:
allianceformalariaprevention@gmail.com

For further information please go to the AMP website:
https://allianceformalariaprevention.com

amp | The Alliance for Malaria Prevention
Expanding the ownership and use of mosquito nets