Republic of Rwanda
Ministry of Health

Rwanda Biomedical Centre
Healthy People, Wealthy Nation

Rwanda Malaria and Neglected Tropical Diseases

ANNUAL REPORT 2022-2023

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Foreword

The Ministry of Health and Rwanda Biomedical Centre (RBC) would like to take this opportunity to express our deep gratitude and sincere thanks to everyone (Partners and Stakeholders) who contributed to the compilation of this FY 2022-2023 Annual Report of the Malaria and Other Parasitic Diseases Division (MOPDD) in Rwanda.

This report has been developed based on Health Management Information System (HMIS) and Program Data as well as program activity reports from July 2022 to June 2023. It presents a comprehensive picture of the prevention, control and management of Malaria and Neglected Tropical Diseases (NTDs) in Rwanda and is structured based on the National Malaria and NTDs Strategic Plans.

Actions needed to control Malaria and NTDs burden in Rwanda require partnership and close collaboration between stakeholders in environmental control programs, as well the strengthening of surveillance systems across all sectors at both national and decentralized levels. These programs must be conducted using an innovative and evidence-based package of interventions for prevention, treatment and support for patients, community health workers, and the communities where these strategies are implemented.

I would like to acknowledge the efforts of the dedicated staff in the various institutions of the Government of Rwanda who worked tirelessly to complete this report. We remain entirely grateful to the inputs and support provided by our Malaria and NTDs Partners.

Special thanks to the members of the Civil Society Organizations, Local and International Non-Governmental, Bilateral Organizations as well as the Rwandan Government institutions who fully supported the implementation of Malaria and NTDs control activities.

I would also like to thank all members of the Malaria and NTDs Technical Working Groups that reviewed and validated the content of this report. We thank you all for your support in the fight against Malaria and NTDs in Rwanda.

Zachee IYAKAREMYE

Permanent Secretary

List of Abbreviations

ACT	Artemisinin-based Combination Therapy
AL	Artemether Lumefantrine
ANC	Ante-Natal Care
SBCC	Social Behavior Change Communication
CDC	Center for Disease Control
CHW	Community Health Worker
CPDS	Coordinated Procurement and Distribution System
DQA	Data Quality Audit
EPI	Expanded Program on Immunization
EQA	External Quality Assurance
FY	Fiscal Year
GF	Global Fund
GoR	Government of Rwanda
HBM	Home Based Management
HBMA	Home Based Management in Adults
HMIS	Health Management Information System
HSSP IV	Third Health Sector Strategic Plan IV
iCCM	Integrated Community Case Management of Malaria
IRS	Indoor Residual Spraying
ITN	Insecticide Treated Net
IVM	Integrated Vector Management
LLINs	Long-Lasting Insecticide Nets
MCP	Malaria Contingency Plan
MDA	Mass Drug Administration
MIP	Malaria In Pregnancy

MoH	Ministry of Health
MOPDD	Malaria and Other Parasitic Diseases Division
MPPD	Medical Procurement and Provision Division
MSP	Malaria Strategic Plan
MTEF	Mid-Term Expenditure Framework
NRL	National Reference Laboratory
NSP	National Strategic Plan
NTD	Neglected Tropical Diseases
PCR	Polymerase Chain Reaction
PMI	President's Malaria Initiative
PSM	Procurement and Supply chain Management
QC	Quality Control
QMIA	Quality Management Improvement Approach
RBM	Roll Back Malaria
RDT	Rapid diagnostic test
SBC	Social Behavior Change
SCH	Schistosomiasis
SOP	Standard Operating Procedure
STH	Soil Transmitted Helminthiasis
TWG	Technical Working Group
UC	Universal Coverage
WHO	World Health Organization

Executive Summary

The Malaria, Neglected Tropical Diseases and Other Parasitic Diseases Division (MOPDD) is a technical division with key role in Malaria, Neglected Tropical Diseases (NTDs) and Other Parasitic Diseases (OPDs) Prevention, Diagnosis and Treatment countrywide.
Despite the previously reported increase in malaria between 2012-2016, almost all 30 districts of Rwanda registered a decline in malaria during the reporting period of July 2022-June 2023.
With the end of this reporting Fiscal Year 2022-2023, malaria incidence in Rwanda reduced from 76 per 1,000 person per year in FY 2021-2022 to 47 per 1,000 (39% reduction) while the Slide Positivity Rate (SPR) dropped from 22% in FY 2021/2022 to 14% in FY 2022/2023.
Uncomplicated malaria cases dropped from 998,811 cases in FY 2021/2022 to 622,900 cases in FY 2022/2023 (38 % reduction) with currently 58% of these cases managed at community level. Severe malaria cases reduced from 1,831 cases in FY 2021-2022 to 1,316 severe cases in FY 2022/2023 representing 28% decrease in severe malaria.

The number of deaths due to malaria decreased significantly from 71 in FY 2021-2022 to 51 deaths in FY 2022-2023 (28 % reduction).

During the same period, a total of 6,075,797 LLINs were procured (3,368,785 from PMI and 2,707,012 from Global Fund) These nets were delivered to health facilities for routine and mass distribution to ensure Universal Coverage. Those LLINs include Standard LLINs and PBO Nets. During this FY, a total of 353,204 LLINs were distributed to pregnant women over 353,466 who attended the first visit of antenatal care (100%) and while 336,199 LLINs were distributed to children under one year over 343,226 who attended MR1 (98%). Regarding the universal coverage of households, a total of 218,936 LLIN rectangular LLINs were distributed to the general population through the household's mass campaign in PBO nets were distributed in 14 districts of Gasabo, Kicukiro, Nyarugenge, Karongi, Nyamasheke, Ngororero, Rubavu, Rusizi, Rutsiro, Gakenke, Gicumbi, Rulindo, Muhanga and Nyaruguru and standard nets were distributed in 3 districts of Nyabihu, Bureraand Musanze.

Blanket Indoor Residual Spraying (IRS) was sustained in 12 districts in the FY 2022-2023 while focal IRS was conducted in 9 high burden sectors of Rusizi District. This helped the program protecting 5,207,731 people out of 5,231,805 of those targeted in these 13 districts (99.5%)

Introduction

Malaria and NTDs represent major public health problems in Rwanda and are considered among the leading causes of morbidity and mortality. Rwanda has made significant strides in controlling these disease through implementation of various control interventions including: mass and routine distribution of Long-Lasting Insecticide Nets (LLINs), Indoor Residual Spraying (IRS) in high endemic districts, adoption of mandatory laboratory confirmation of malaria prior to the treatment, use of artemisinin-based combination therapies (ACTs) in the treatment of uncomplicated malaria cases, national scale up of community based management and improvement in routine surveillance, monitoring and evaluation platforms, Mass Drug Administration (MDA) targeting Soil Transmitted Helminthiasis (STH) and Schistosomiasis (SCH). Despite these combined efforts, Malaria and NTDs still represent a public health concern in Rwanda with millions of people affected every year.

The Rwanda Malaria and NTDs Strategic Plans build on National Policies and Strategies such as the Health Sector Strategic Plan IV (HSSP IV) which recognizes malaria and NTDs as major diseases that contribute to health and economic related burden. The vision of the Malaria and NTDs Strategic Plans is for Rwanda to become free from malaria and NTDs to contribute to socioeconomic development. Reduction of malaria and NTDs burden will be achieved by strengthening and implementing appropriate control interventions and delivering quality health services. Achievement of Rwanda free from Malaria and NTDs vision will require a concerted and collaborative effort between the Government of Rwanda (GoR) and other partners.

Today, Malaria and NTDs control efforts are being implemented at all levels through evidence-based interventions to reduce the burden of both diseases in the population. This consists of effective implementation of high impact interventions, including countrywide MDA for NTDs chemoprophylaxis, LLINs mass and routine distribution, IRS using an effective insecticide in targeted high malaria endemic districts, early diagnosis and treatment at health facility and community level, environmental management, Surveillance/Monitoring and Evaluation and Social Behavior Change Communication (SBCC).

The following report details malaria control activities implemented from July 2022 to June 2023. These activities have been coordinated by the Malaria and Other Parasitic Diseases Division (MOPDD) of the Rwanda Biomedical Centre (RBC) with support from other GoR institutions, Health Facilities and Community Health Workers (CHWs) and implementing partners under the leadership of RBC, the Ministry of Health (MoH) and Partners.

Malaria Program Results per Strategic Plan Framework

Goal: By 2024, reduce malaria morbidity and mortality by at least 50% of the 2019 levels
Objective 1: By 2024, at least 85% of population at risk will be effectively protected with preventive interventions
Objective 2: All suspected malaria cases are promptly tested and treated in line with the national guidelines
Objective 3: By 2024, strengthen surveillance and reporting in order to provide complete, timely and accurate information for appropriate decision making at all levels
Objective 4: Strengthen coordination, collaboration, procurement & supply management and effective program management at all levels
Objective 5: By 2024, 85% of the population at risk will have correct and consistent practices and behaviors towards malaria control interventions.

PART I: MALARIA PREVENTION

Objective 1: By 2024, At Least 85% of Population Will Be Effectively Protected with Malaria Preventive Interventions

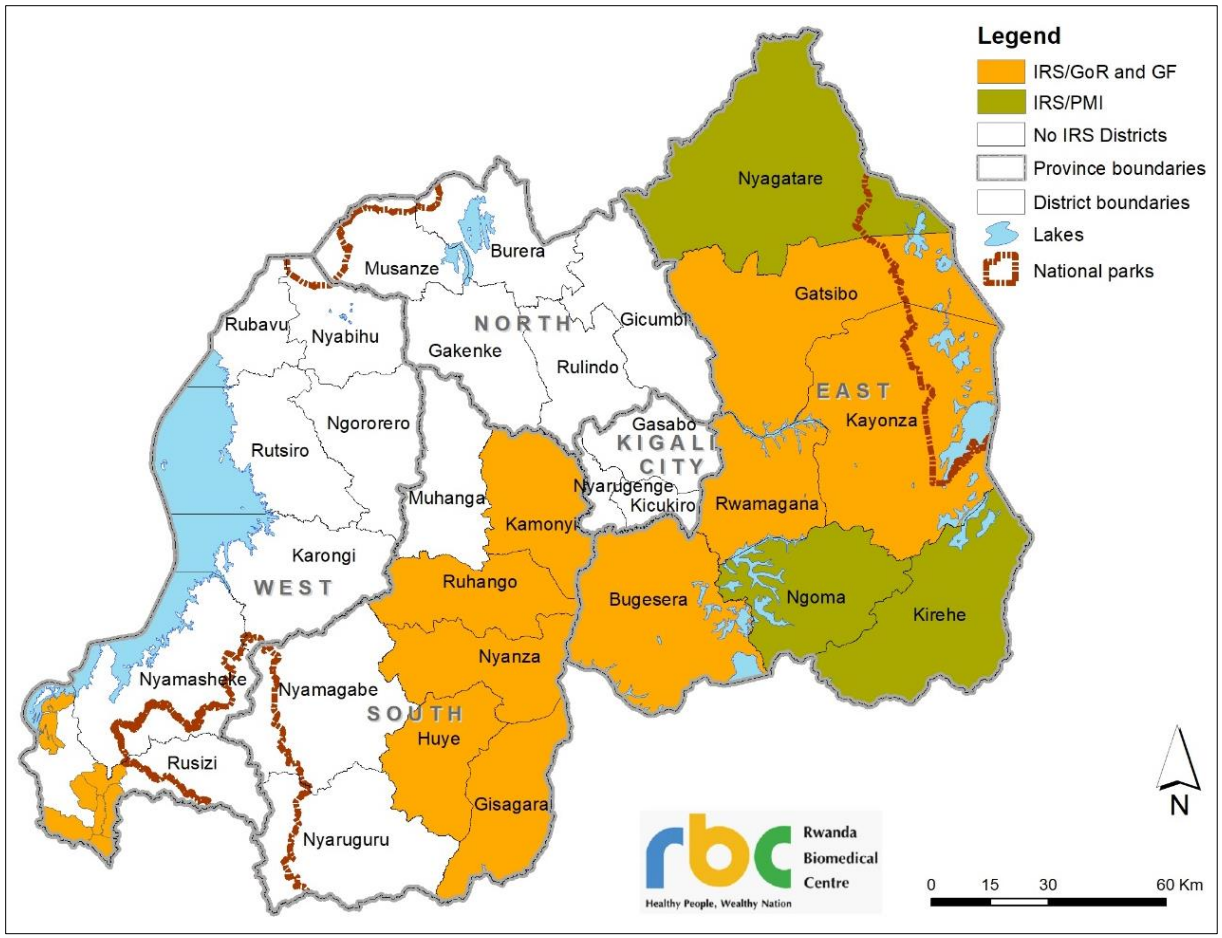
Strategy 1. Sustain and Expand IRS in High Malaria Incidence Districts

1. Indoor Residual Spraying

During the FY 2022-2023, 13 districts were sprayed out of 13 targeted districts for Indoor Residual Spraying (IRS). Three out of the above districts (Nyagatare, Kirehe, and Ngoma) were supported by PMI/VectorLink project implemented by Abt Associates. The remaining 9 districts received the support from The Global Funds and Rwanda Government (GF/GoR) with blanket coverage of IRS: Bugesera, Gatsibo, Kayonza, Rwamagana in Eastern Province; Gisagara, Huye, Nyanza, Ruhango, Kamonyi, an additional nine sectors (Gikundamvura, Gitambi, Bugarama, Nyakabuye, Muganza, Kamembe, Nkanka, Gihundwe and Nzahaha) in Rusizi district, Western with high malaria burden received focal IRS. **(Fig. 1)**

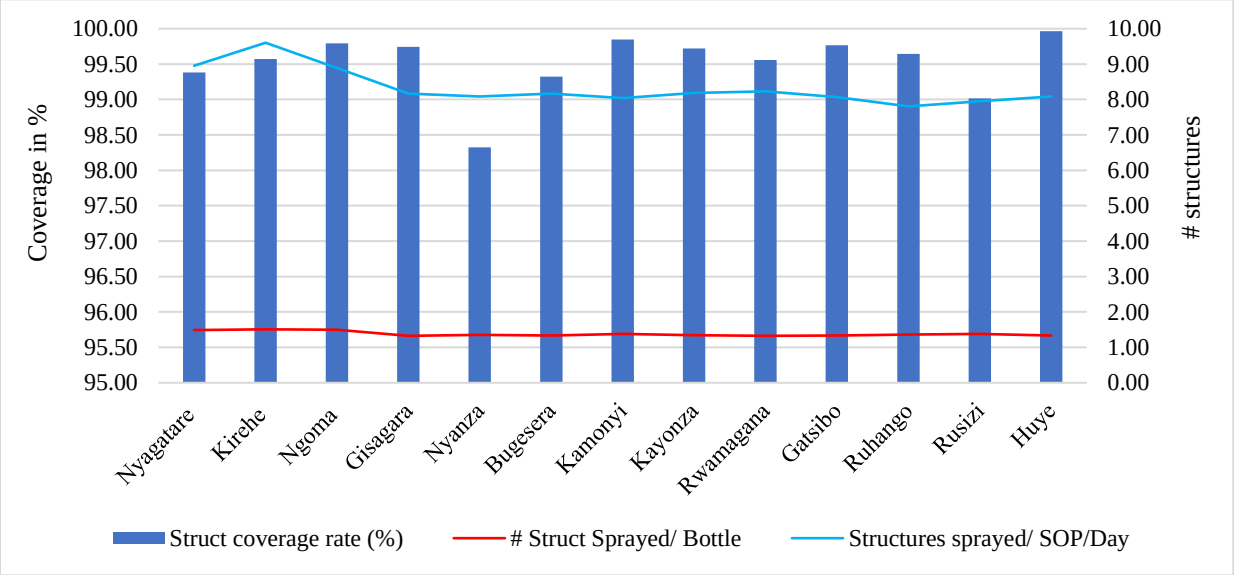
Over the FY 2022-2023, a total number of 1,423,116 out of 1,429,721 structures were sprayed making a coverage rate of 99.5%. The PMI/VectorLink project sprayed 354,876 out of 356,461 structures found with a coverage of 99.6% while the support from GF/GoR covered 1,068,240 out of 1,073,260 found structures with a coverage of 99.5%. The support from the GF/GoR represented 75.06% and 24.94% from PMI/VectorLink Project. In the targeted districts, the IRS intervention was performed with blanket coverage in a total of 12 districts (153/153 administrative sectors). A focal IRS was implemented in Rusizi district where 9 sectors (50%) were sprayed out of the 18 sectors **(Table 1).** In terms of rooms covered, 4,991,558 were sprayed from 5,071,091 rooms found with a coverage of 98.4%. The total population protected was 5,207,731 out of 5,231,805 targeted populations with an estimated population coverage of 99.5% in IRS districts. Among the population protected, 67,707 were pregnant women (1.3%) and 674,184 were children below five years (12.94%). The total insecticide used was 1,030,316 of Actellic 300CS. The quantity of 237,114 bottles of Actellic 300CS procured by PMI, while the quantity of 793,202 bottles of Actellic were procured by GOR/GF **(Table 2).**

Figure 1 : Indoor Residual Spraying Districts, FY 2022/2023



In terms of performance, one sprayer operator (SOP) performed an average of 8.3 structures per day, with 9.1 and 8.1% structures/SOP/Day in districts supported by PMI and GF/GoR respectively. The highest performance was observed in Kirehe District with 9.6 structures sprayed per SOP per day. The average rooms per sprayed structure were 3.5 and ranging from 3.2 in Ruhango and 4 in Rusizi. In average, 1.38 structures were sprayed by one bottle of insecticide with 1.50 structures in districts supported by PMI and 1.35 structures in districts supported by GF/GoR and ranging from 1.51 in Kirehe district to 1.33 structures in Gisagara, Rwamagana and Gatsibo districts **(Figure 2).**

Figure 2:IRS Performance per District, (Coverage, Structures per SOP per Day and per bottle) FY2022-2023



Regarding the sources of funds for IRS operational cost, in total, 3,353,854,801 RFW were disbursed from GF/GOR and transferred to the district hospitals, with 2,730,963604 RFW (81.4%) from GF, 622,891,197RFW (18.6%) from GoR. The GoR also contributed 3,170,265,323Frw (19.28%) to procure insecticides and other IRS supplies (Sprayer pumps & PPEs), whereas the GF contributed 13,276,109,921.28Frw (80.72%).

Table 1: IRS Coverage per Partner and per District, FY 2022/2023

S/N	District	Month	Year	IRS Start	IRS end	# Structures targeted	# Structures found	# Structures sprayed	Structure coverage rate (%)	Structure sprayed/ SOP/Day
1	Nyagatare	9	2022	22.08.2022	16.09.2022	142 345	147 155	146 244	99.4	9.0
2	Kirehe	9	2022	22.08.2022	16.09.2022	105 402	109 170	108 703	99.6	9.6
3	Ngoma	9	2022	22.08.2022	16.09.2022	98 543	100 136	99 929	99.8	8.9
	Total covered by PMI					**346 290**	**356 461**	**354 876**	**99.6**	**9.1**
4	Gisagara	9	2022	12.09.2022	04.10.2022	102 868	105 243	104 971	99.7	8.2
5	Nyanza	9	2022	12.09.2022	04.10.2022	92 904	95 522	93 921	98.3	8.1
6	Bugesera	10	2022	17.10.2022	08.11.2022	108 410	111 471	110 716	99.3	8.2
7	Kamonyi	10	2022	17.10.2022	08.11.2022	115 245	116 013	115 837	99.8	8.0
8	Kayonza	10	2022	17.10.2022	08.11.2022	113 605	116 534	116 209	99.7	8.2
9	Rwamagana	1	2022	03.01.2023	25.01.2023	105 039	108 569	108 090	99.6	8.2
10	Gatsibo	3	2023	27.02.2023	30.03.2023	146 511	148 134	147 786	99.8	8.1
11	Ruhango	4	2023	03.04.2023	28.04.2023	108 297	106 068	105 690	99.6	7.8
12	Rusizi	4	2023	03.04.2023	25.04.2023	65 971	66 183	65 531	99.0	8.0
13	Huye	5	2023	08.05.2023	30.05.2023	98 478	99 523	99 489	99.97	8.1
	Total covered by GF/GoR					**1 057 328**	**1 073 260**	**1 068 240**	**99.53**	**8.1**
	Grand Total					**1 403 618**	**1 429 721**	**1 423 116**	**99.54**	**8.3**

Table 2 : Population Protected, Room Coverage and Insecticide Used per IRS District

S/N	District	Population targeted	Total Pop protected	Pregnant Women	Children < 5 years protected	Rooms sprayed	Coverage Sprayed Rooms (%)	Average room per structure	Total insecticides used	Insecticide products used	# Structures Sprayed/ bottle
1	Nyagatare	541 458	537 912	7 587	74 093	473 723	97.9	3.3	98 546	Actellic 300CS	1.48
2	Kirehe	442 006	439 944	6 052	59 053	397 522	98.0	3.7	72 016	Actellic 300CS	1.51
3	Ngoma	381 033	380 296	4 796	48 415	389 963	99.1	3.9	66 552	Actellic 300CS	1.50
Total PMI		**1 364 497**	**1 358 152**	**18 435**	**181 561**	**1 261 208**	**98.3**	**3.6**	**237 114**	**Actellic 300CS**	**1.50**
4	Gisagara	393 184	392 190	5 871	52 894	389 852	99.1	3.7	78 959	Actellic 300CS	1.33
5	Nyanza	336 882	331 130	3 986	40 435	305 173	96.3	3.3	69 334	Actellic 300CS	1.35
6	Bugesera	417 845	414 962	5 747	58 025	390 395	97.9	3.6	82 712	Actellic 300CS	1.34
7	Kamonyi	394 837	394 174	4 343	46 179	388 992	99.2	3.4	83 892	Actellic 300CS	1.38
8	Kayonza	422 958	421 814	5 694	56 472	397 373	99.1	3.4	86 324	Actellic 300CS	1.35
9	Rwamagana	380 727	380 248	4 261	47 473	389 274	98.6	3.6	81 520	Actellic 300CS	1.33
10	Gatsibo	524 758	523 240	6 533	66 528	509 313	98.8	3.5	110 707	Actellic 300CS	1.33
11	Ruhango	346 814	345 654	3 867	40 574	332 017	98.6	3.2	77 831	Actellic 300CS	1.36
12	Rusizi	289 963	286 965	4 558	39 008	259 042	97.3	4.0	47 488	Actellic 300CS	1.38
13	Huye	359 340	359 202	4 412	45 035	368 919	99.0	3.7	74 435	Actellic 300CS	1.34
Total GF/GoR		**3 867 308**	**3 849 579**	**49 272**	**492 623**	**3 730 350**	**98.5**	**3.5**	**793 202**	**Actellic 300CS**	**1.35**
Grand Total		**5 231 805**	**5 207 731**	**67 707**	**674 184**	**4 991 558**	**98.4**	**3.5**	**1 030 316**		**1.38**

2. Insecticide Resistance Monitoring

2.1. Biological Resistance

From July 2022 to June 2023, the biological resistance tests were performed in 30 sentinel sites selected for insecticide resistance surveillance. The tests were conducted using WHO guidelines with cylindrical tubes method[1] for the seven insecticides belonging to the five classes: Carbamates (Bendiocarb 0.1%); Organophosphates (Fenitrothion 1%, and Pirimiphos methyl 0.25%); Organochlorines (DDT 4%); Pyrethroids (Deltamethrin 0.05%, Permethrin 0.75%, and Alphacypermethrin 0.05%); CDC bottles (CDC, 2018)[2] for the two new classes of pyrrole (Chlorfenapyr 100µg) and Neonicotinoid (clothianidin 4µg).

Thus, larvae collections of Anopheles genus were performed using the dipping method as described by the WHO[3]. Mosquito larvae were subsequently reared using field insectarium established at each sentinel site following the standard conditions of temperature (26-28°C) and relative humidity (70-80%). The susceptibility test was carried out on adult *Anopheles gambiae* s.l aged 3 to 5 days and fed on glucose. A minimum of 100 mosquitoes were used for testing in 4 replicates with 25 females per insecticide for WHO method and 5 replicates of 20 female mosquitoes with CDC bottles. Each test had two control replicates of 50 mosquitoes.

The mosquitoes were exposed to the standard dose of insecticide for one hour to measure the knock down test and then observed for 24 hours' post-exposure for assessment of direct mortality and up to 72 hours for delayed mortality, especially for the two new insecticides (Chlorfenapyr 100µg and clothianidin 4µg). The mortality was calculated as the proportion of dead mosquitoes over the total number exposed. A mortality rate between 98% and 100% indicates fully susceptibility; 90-97% mortality for the possible resistance that needs to be confirmed. The mortality under 90% indicates the confirmed resistance. It was found that the resistance status to pyrethroid insecticide was more prevailing in malaria endemic districts of low land areas than in high land (Figure 3). The resistance was confirmed more to pyrethroid insecticide than other classes of insecticides with respectively Permethrin 0.75% for 90%, Alpha-cypermethrin 0.05% for 76.7%, and Deltamethrin 0.05% for 43.3% of the total sites surveyed (n=30). The highest fully susceptibility was found respectively on Fenitrothion 1% (100%) at 24 hours, clothianidin 4 µg at 72 hours (100%), pririmiphos methyl 0.25% (93.1%) and Bendiocarb (93.3%) (Figure 4).

[1] WHO (2013). Test procedures for insecticide resistance monitoring in malaria vector mosquitoes
[2] CDC (2018): Manual for Evaluating Insecticide Resistance Using the CDC Bottle Bioassay. 31 pp
[3] WHO (2013) Malaria entomology and vector control – Learner's Guide

Figure 3 : Distribution of Insecticide Resistance to Pyrethrinoid Insecticides

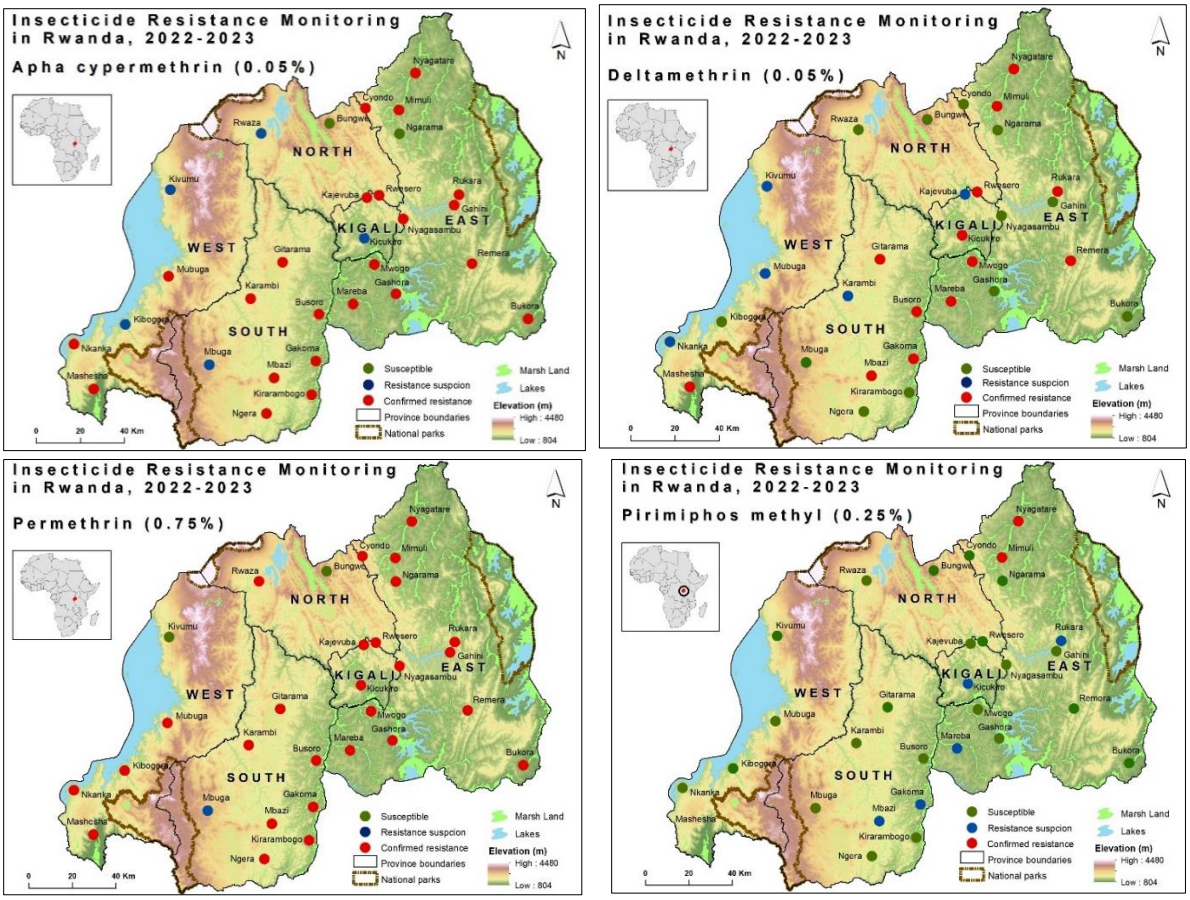
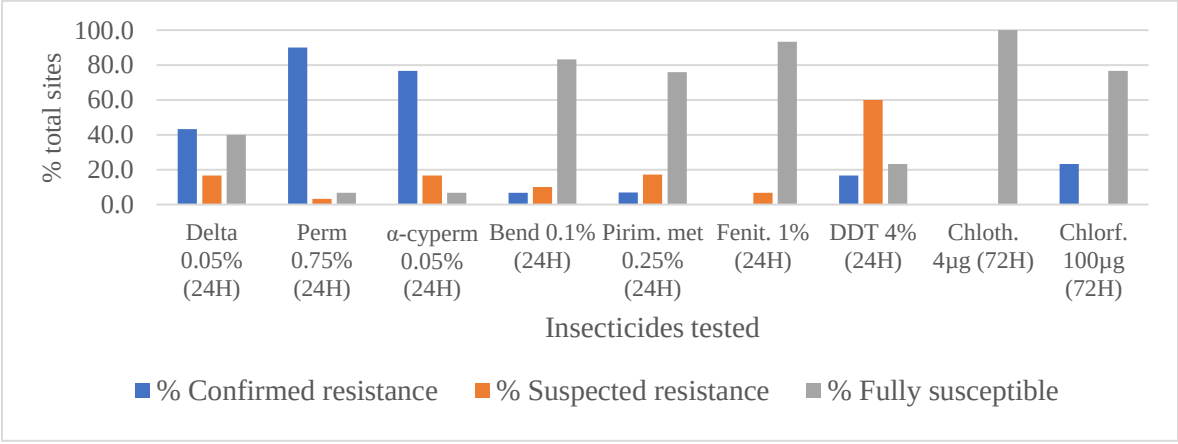


Figure 4 : Levels of Insecticide Resistance per Insecticide Product, FY 2022/2023



a. Resistance Mechanisms

In the sites with confirmed resistance to pyrethroid insecticides; the addition of synergist, the piperonyl butoxide (PBO) restored fully susceptibility (84.6%) to Deltamethrin 0.05%, 92.6% to permethrin 0.75% and 84% to Alphacypermethrin 0.05% **(Figure 5)**. The results suggest a role of metabolic mechanism of resistance in mediating pyrethroid resistance in malaria vectors from surveyed sites. Out of the three insecticides tested, the susceptibility was not restored at 100% in five sires respectively: Alph-cypermethrin for Kicukiro (93%), Mashesha (80%), Rukara (97%), Kirarambogo (95%); Deltamethrin 0.05% for Gakoma (92%), Rukara (92%), and Permethrin 0.75% for Kirarambogo (92.5% and Mashesha (80%). These above results imply the suspicion of other potential resistance mechanisms to be explored in the future **(Table 3).**

Table 3 : Results of Resistance Tests for Insecticides Performed, 2022-2023

Susceptibility Status	Product Name					
	Delta. 0.05%+PBO		***Perm. 0.75%+PBO***		***α-cyperm. 0.05%+PBO***	
	# Sites (n=13)	**%**	**# Sites (n=27)**	**%**	**# Sites (n=25)**	**%**
Confirmed resistance + PBO	0	0	1	3.7	1	4
Suspected resistance + PBO	2	15.4	1	5	3	12
Susceptibility restored + PBO	11	84.6	25	92.6	21	84

b. Resistance Intensity Using WHO Susceptibility Test Kits

The intensity of the resistance was also measured tested in sites where the resistance at diagnostic doses was confirmed to pyrethroid insecticides. The intensity assays were performed at five (5x) and ten (10 x) times the diagnostic dose described for biological resistance tests. The resistance was found to be low and to high levels. With the concentration of 5x times, 8. % to 33.3% and 66.7% to 92. % of surveyed sites were respectively of low to moderate resistance intensity. Therefore, with the concentration of 10x times, 75.0 % to 92.6% and 7.4% to 44.0 % of surveyed sites were of moderate to high insecticide resistance intensity. The highest resistance intensity was found to Alphacypermethrin and Deltamethrin insecticides with 44.0% and 25.0% of surveyed sites, respectively **(Table 4).**

Table 4: Insecticide Resistance Intensity in 26 Sites with Confirmation of Resistance

Insecticides tested and concentration	Total sites surveyed	# sites with mortality <98%	# sites with mortality ≥ 98%	% sites with mortality <98%	% sites with mortality ≥ 98%
Deltamethrin 0.05% (5x)	12	8	4	66.7	33.3
Permethrin 0.75% (5x)	27	19	8	70.4	29.6
Alpha cyperm. 0.05% (5x)	25	23	2	92.0	8.0
Deltamethrin 0.05% (10x)	12	3	9	25.0	75.0
Permethrin 0.75% (10x)	27	2	25	7.4	92.6
Alpha cyperm.0.05% (10x)	25	11	14	44.0	56.0

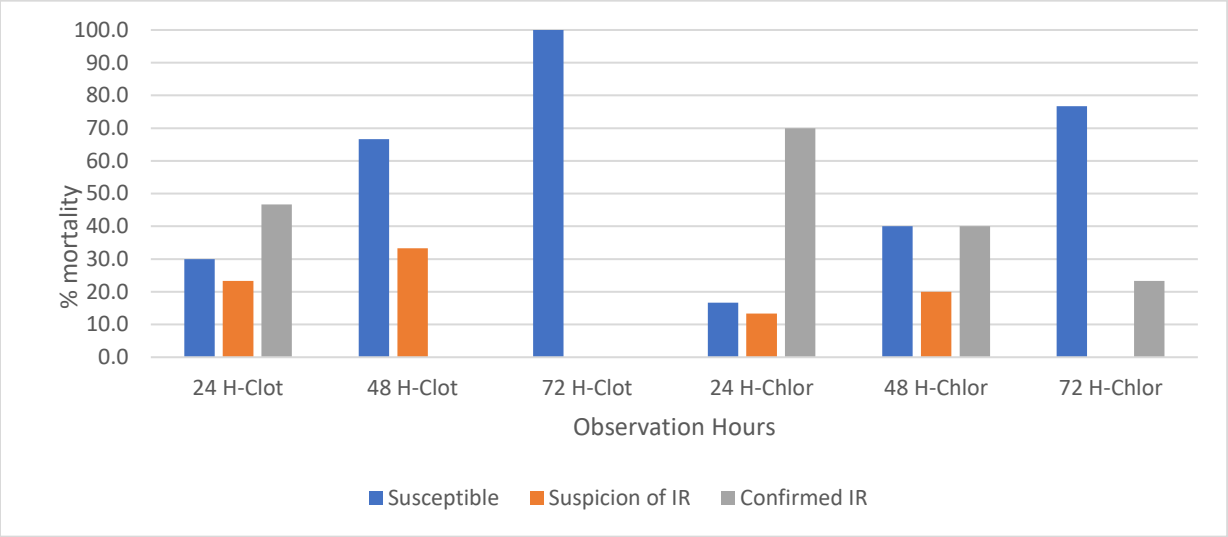
Remark: (5x ≥ 98% mortality = low intensity, < 98% mortality = moderate intensity; 10x ≥ 98% mortality = moderate intensity, < 98% mortality = high intensity)[4]

c. Delayed mortality tests on new insecticides

The delayed mortality observations up to 72 hours' time was carried out on two new insecticides, respectively Chlorfenapyr 100µg and clothianidin 4µg. The clothianidin insecticide was optimized at 100% at 72 hours of observation while Chlorfenapyr reached out 76.7% at the same period of mortality observations. Further mortality observations have to be conducted to confirm if the mortality of 100% is obtained at 120 hours, period recommended by the supplier of that insecticide.

[4] WHO (2013). Test procedures for insecticide resistance monitoring in malaria vector mosquitoes

Figure 5: Delayed mortality tests on new insecticides: Chlorfenapyr 100µg and clothianidin 4µg.

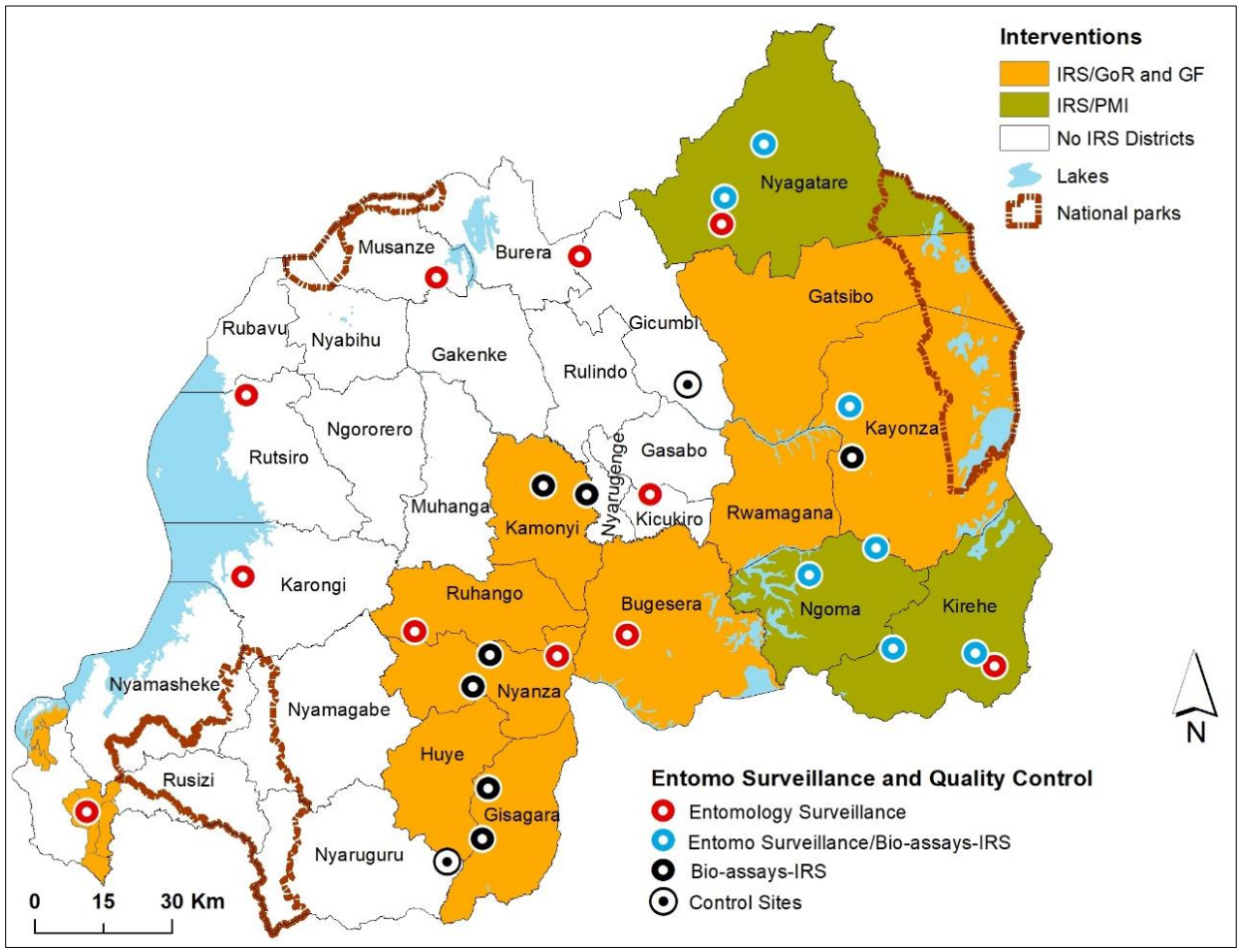


3. Quality Control of Interventions and Entomology Surveillance

3.1. Quality Control of IRS using Wall Bioassays

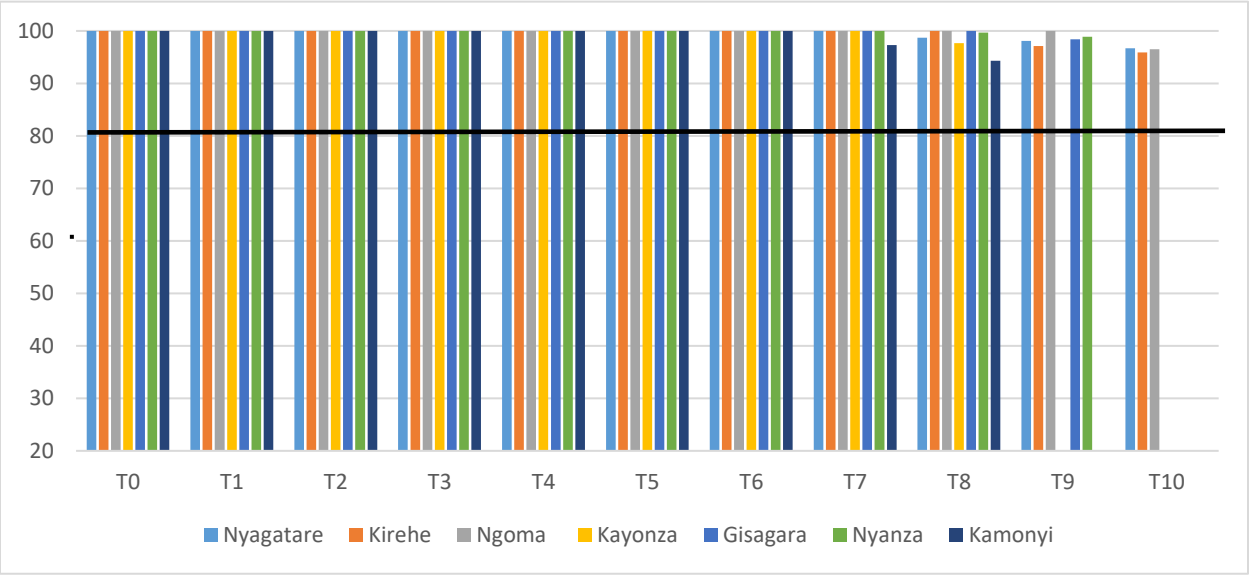
IRS quality control (wall bioassays) was performed one-week post IRS as well as on a monthly basis to determine the residual efficacy of the insecticide on sprayed house walls. The IRS campaigns were performed in different periods as indicated earlier. The districts were sampled for IRS Quality Control as following: Gisagara, Kamonyi, Kayonza, Kirehe, Ngoma, Nyagatare and Nyanza.

Figure 6: Quality Control of Interventions and Entomology Surveillance 2022-2023



The IRS quality control was performed in 2 sectors from each of the seven out of the 13 IRS districts. At each sector, 6 houses (2 plastered non-painted, 2 plastered painted, and 2 mud) were selected for bioassay tests. The susceptible Kisumu strains of *Anopheles gambiae* s.s. reared at the MOPDC/RBC insectary based at national entomology laboratory were used to run appropriate tests. Mosquitoes 2-5 days old were exposed in each wall house at the top, middle and bottom level of the walls. Two replicates for each type of house were applied. Mortality was read after 24 hours of exposure to the insecticide, the **Actellic®300CS (Organophosphate insecticide, Pirimiphos-methyl)**. The mortality was calculated for both exposed and control samples.

Figure 7 : Post IRS Wall Bioassays Performed in FY 2022-2023



The results and sites of the post IRS wall bioassays are shown in figure 7. The results of the wall bioassay were available up to eight months in Kamonyi and Kayonza; in Nyanza, and Gisagara nine months then in Nyagatare, Ngoma and Kirehe ten months post spraying. In all districts, the insecticide was still effective at the end of the evaluation period with mortality of exposed mosquitoes above the cut off mortality of 80% as recommended by WHO. Results confirm a residual efficacy of **Actellic®300CS (Organophosphate insecticide, Pirimiphos-methyl)** of more than ten months in the context of Rwanda as shown the above results from all Districts **(Fig. 7)**

2.1. Quality Control of IRS using Entomology Monitoring

The entomological monitoring was carried out, from July 2022 to June 2023 in two sites located in each IRS district respectively Nyagatare (Nyagatare & Rukomo), Kirehe (Gatore & Nyamugali), Ngoma (Zaza & Remera). The control district was Gicumbi (Rwamiko). Between July 2022 and June 2023, mosquitoes were collected from indoor and outdoor on a monthly basis for assessment of the following parameters: vector bionomics using human landing catching method and indoor resting behavior of mosquitoes using Pyrethrum Spraying catching method. The findings are summarized as following:

1. As shown in tables below, during the period of activities, 22 864 mosquitoes (Culicidae) were collected using human landing catching and PSC methods and out of them, 95.8% (n=21864) were Culicinae and 4.2% (n=970) *Anopheles* mosquitoes. The *Anopheles gambiae* s.l. were the major malaria vectors and representing 64.0%

(n=568) of the total catches of Anopheles mosquitoes. Other Anopheles mosquitoes collected were respectively *An. funestus* 4.4%, *An. pharoensis* 6.3%, *An. maculipalpis* 1.8%, *An. squamosis* 3.3% and *An. ziemanni* 20.3%. Of the *An. gambiae* s.l. collected, 68% (n=386) caught outside the houses while the 32% (n=182) of other Anophelines mosquitoes were also collected outside the dwellings.

2. The biting rate by *Anopheles gambiae* s.l. varied from 0.1 to 1.4 bites per person per night within sites, the biting rate by Anopheles varied from 0.2 to 4.7 bites per person per night within sites with an average of 1.4 bites per person per night. The average biting rate of mosquitoes in general (Culicidae) was 27.8 bites per person per night and ranging from 10.3 to 68.8 bites per person per night.
3. The total collected mosquitoes through PSC method were 1 383 mosquitoes including 74 *Anopheles gambiae* s.l., 8 total Anophelines and 1 301 Culicinae from eight sites. Among Anophelines, 46 (56.1%) were unfed and 36 (43.9%) were found fed. In total 17 were fresh fed, 9 half-gravid and 2 gravid. The proportion of gravid was 39% in all sites.
4. The determination of parity on a sample of 419 *Anopheles gambiae* s.l. dissected and collected from inside and outside in IRS sites and outside in none IRS site (control) showed respectively that the parous rates were 17.5% (n=384) in IRS sites and 65.7% (n=35) in none IRS sites. The results showed that the IRS intervention induce the reduction of the longevity of malaria vectors.
5. The entomological inoculation rate (EIR) which is the number of infectious bites per person per unit time was measured and expressed per year. The EIR was 0.3 infected bite per person and per year for 953 Anopheline tested with a sporozoites infection rate of 0.2 % from the seven sites.
6. Out of 27 anopheles' mosquito tested for blood meal, 7 (25,9%) were fed on human, 17 (63%) were fed on bovine, 2 (7.4%) were fed on human and other, 1 (3.7%) were fed on goat and bovine and HBI was 33.3%.
7. The speciation of *Anopheles gambiae* s.l. was performed in the entomology lab to identify the siblings of *Anopheles gambiae* complex. Out of 797 samples analyzed using PCR-identification, 5.6% samples were found to be *Anopheles gambiae* s.s. and 94.4% were *Anopheles arabiensis*. The dominant malaria vector recently became *Anopheles arabiensis* in the most entomological monitoring sites within IRS districts. Out of 39 samples analyzed using PCR-identification in none IRS District 79.5% samples were found to be *Anopheles gambiae* s.s.

Table 5 : Distribution of Malaria Vectors Collected Using HLC & PSC methods–July 2022-June 2023

No	Site name	Anopheles gambiae s.l. / HLC			Other Anopheles / HLC			Cn/HLC	PSC			Tot. An	Tot. Cn	Cd
		In	Out	Total	In	Out	Total		An.g	Ao	Cn			
1	Gatore	22	137	159	6	83	89	4445	30	2	154	280	4599	4 879
2	Nyamugali	5	27	32	0	2	2	1485	0	0	121	34	1606	1 640
3	Nyagatare	27	64	91	0	1	1	3576	1	0	65	93	3641	3 734
4	Rukomo	89	116	205	0	0	0	2873	25	0	161	230	3034	3 264
5	Remera	5	15	20	7	16	23	1590	2	2	159	47	1749	1 796
6	Zaza	10	12	22	20	55	75	4146	10	2	145	109	4291	4 400
7	Rwamiko	24	15	39	58	72	130	2478	6	2	496	177	2974	3 151
Total		**182**	**386**	**568**	**91**	**229**	**320**	**20593**	**74**	**8**	**1 301**	**970**	**21894**	**22 864**

Table 6 : Biting Behavior of Malaria Vectors Collected Using HLC–July 2022-June 2023

No	Site name	Biting behavior %				Biting rate person/night				Inf rate (%) An	EIR An
		An.g. Endo	An.g. Exo	An.g. Endo	An.g. Exo	An.g	An. sp	Cx	Cd		
1	Gatore	13,8	86,2	6,7	93,3	1,1	1,7	30,9	32,6	0,4	0,6
2	Nyamugali	15,6	84,4	0,0	100,0	0,2	0,2	10,3	10,5	0,0	0,0
3	Nyagatare	29,7	70,3	0,0	100,0	0,6	0,6	24,8	25,5	0,0	0,0
4	Rukomo	43,4	56,6	0	0	1,4	1,4	20,0	21,4	0,0	0,0
5	Remera	25,0	75,0	30,4	69,6	0,1	0,3	11,0	11,3	0,0	0,0
6	Zaza	45,5	54,5	26,7	73,3	0,2	0,7	28,8	29,5	0,0	0,0
7	Rwamiko	61,5	38,5	44,6	55,4	1,1	4,7	68,8	73,5	1,1	5,3
Total		**32,0**	**68,0**	**28,4**	**71,6**	**0,7**	**1,4**	**27,8**	**29,2**	**0,2**	**0,3**

Table 7: Results of Pyrethrum Spraying Catches: Anophelines –July 2021 to June 2022

Sites	**# of houses**	**# of Occupants**	***An. gambiae* s.l**	***Other Anopheles***	**Abdominal/Blood Digestion stages**				**Proportion of gravid**	***An. gambiae* s.l. *per house***	**Fed per house**	**Fed/ human host**	**Culicinae**
					UF^	F^	HG^	G^					
Gatore	180	764	30	2	23	4	5	0	56%	0,2	0,1	0,0	163
Nyamugali	180	872	0	0	0	0	0	0	0%	0,0	0,0	0,0	104
Nyagatare	180	1012	1	0	1	0	1	0	100%	0,0	0,0	0,0	96
Rukomo	180	888	25	0	13	10	0	0	0%	0,1	0,1	0,0	341
Remera	180	690	2	2	2	0	0	0	0%	0,0	0,0	0,0	67
Zaza	180	746	10	2	5	1	2	0	67%	0,1	0,0	0,0	153
Rwamiko	180	634	6	2	2	2	1	2	60%	0,0	0,0	0,0	69
	1260	**5606**	**74**	**8**	**46**	**17**	**9**	**2**	**39%**	**0,1**	**0,0**	**0,0**	**993**

Abbreviations: HLC: Human Landing Catching; PSC: Pyrethrum Spray Catch; In: Inside; Out: Outside; An: Anophelines; An.g: *Anopheles gambiae* s.l.; Cn: *Culicinae*; Cd: *Culicidae*; Inf: Infectivity; endo: Endophagic; exo: Exophagic, UF^: Unfed, FF^: Fresh fed, HG^: Half gravid, G^; Gravid, EIR: Entomological inoculation rate

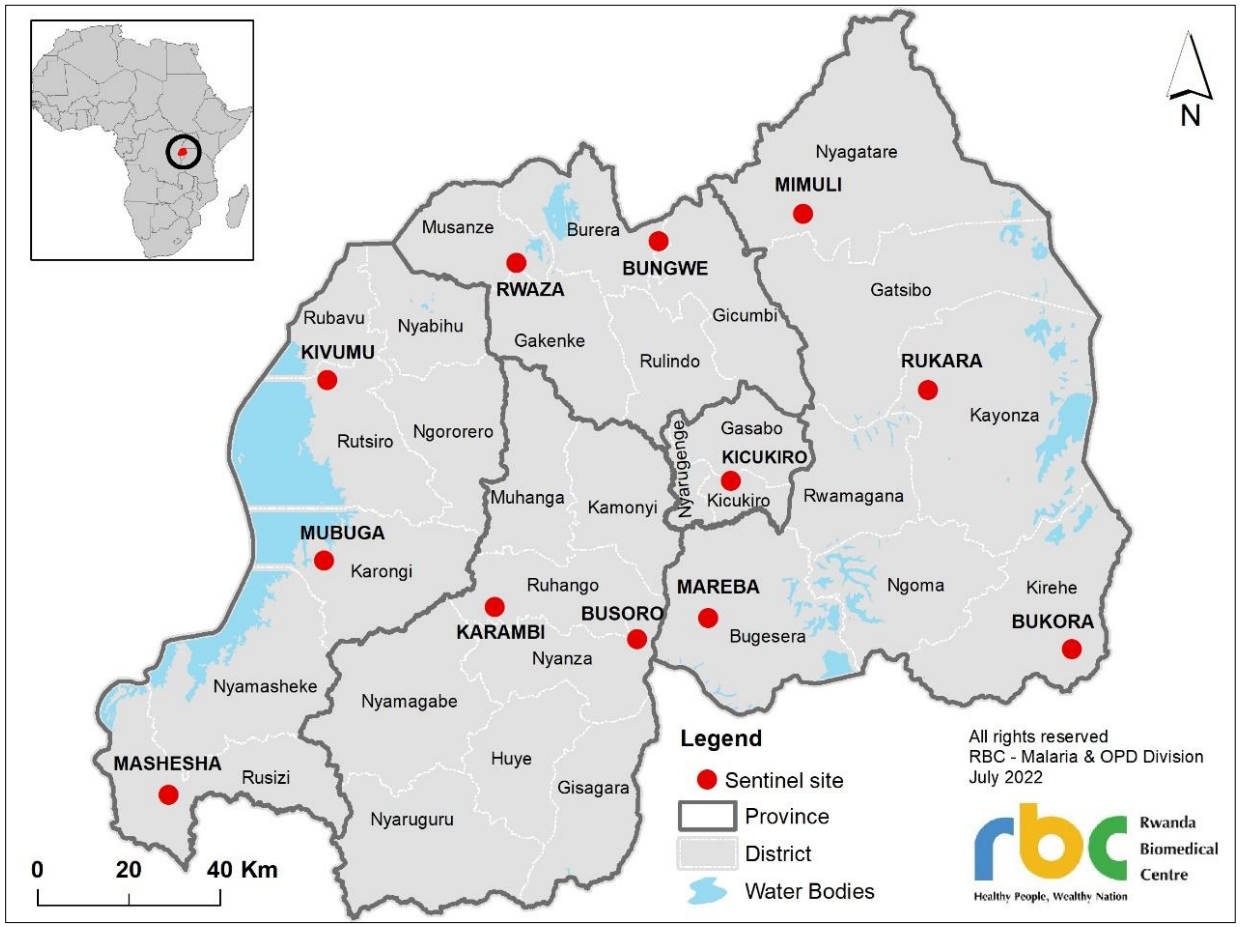
Table 8: Anopheles mosquito collected from PSC method per site, FY 2022-2023

Species	Gatore	Nyamugali	Nyagatare	Rukomo	Remera	Zaza	Rwamiko (Ctl)	Total	% Species
An. gambiae s.l.	159	32	91	205	20	22	39	568	64.0
An. funestus	0	0	0	0	0	0	39	39	4.4
An. pharoensis	56	0	0	0	0	0	0	56	6.3
An. maculipalpis	3	0	0	0	2	11	0	16	1.8
An. ziemanni	30	2	1	0	3	53	91	180	20.3
An. squamosus	0	0	0	0	18	11	0	29	3.3
Total colected	**248**	**34**	**92**	**205**	**43**	**97**	**169**	**888**	**100.0**
% sampling sites	**27.9**	**3.8**	**10.4**	**23.1**	**4.8**	**10.9**	**19.0**	**100**	

2.2. Entomology Surveillance in 12 Sentinel Sites

Routine entomological surveillance was carried out over twelve sentinel sites located in different districts according to malaria eco-epidemiological strata (Bungwe and Rwaza in Nothern Province, Rukara, Bukora, Mareba and Mimuli in Eastern Province; Busoro, Karambi in Southern Province; Mashesha, Kivumu, Mubuga in Western Province and Kicukiro in Kigali City **(Figure 8)**. Between July 2022 and June 2023, mosquitoes were collected using human landing catching method from indoor and outdoor on a monthly basis for assessment of the different entomological parameters.

Figure 8: The Sentinel Sites for Entomology Surveillance



As shown in table 11, during the entomology activities for the FY, 99,854 mosquitoes (Culicidae) were collected out of them 12.4% were An. gambiae s.l., 13.6% total anopheles and 86.4% culicines. Out of 13,556 total *anopheles* mosquitoes, 91.5% were An. gambiae s.l., 1.5% *An. funestus* and 8.5% other anopheles species. The primary malaria vector for this FY 2022/2023 is *An. gambiae* s.l. **(Figure 9)**. Over that period, 61.8.0% *Anopheles gambiae* s.l. were collected outside and ranging from 44.9% in Busoro to 71.4% in

Kivumu. The average of outdoor biting was 61.3% in non-IRS sites while it was 62.3% in IRS sites. Overall, 201 Anopheles funestus were caught with more than 94% of the total collections in only four sites of Kicukiro (55.7%, n=112%), Kivumu (27.9%, n=56), Mashesha (6%, n=12 and Mubuga (4.5%, n=9). The focal vector control intervention of IRS should be deployed and eliminate the above indoor malaria vector where it is appearing as the dominant species in malaria transmission.

Regarding the human biting rate by Anopheles gambiae s.l., it varies from 0 (Bungwe) to 9.1 (Mashesha) bites per person per night (b/p/n), with an average of 2.39 b/p/n. The average human biting rate of *An. gambiae* s.l. was found respectively 1.75 and 3.29 b/p/n in IRS and non-IRS sites while it was 19.26 b/p/n in Culicidae and ranging from 1.94 (Mubuga) to 58.85 (Kicukiro) bi/p/n with 13.83 and 26.87 b/p/n in IRS and non IRS sites. There was a decrease of mosquito density of 34.2% in *An. gambiae* s.l. (from 3.6 to 2.4 b/p/n) and increase of 4% in total Culicidae (from 18.5 to 19.3 b/p/n) in comparison with mosquito catches of 2021/2022. Except for five sites of Mimuli, Mareba, Bukora, Karambi and Busoro where the increase of *An. gambiae* s.l. was observed with 63.2%, 0.2%, 23.4%, 105.6%, and 8.2% respectively, other sites experienced a general decrease of the above species of primary malaria vector. The above increase in mosquito density should be linked to the abnormal rainfall followed by water flooding reported that occurred in the past FY. The general endophagic rate of An. gambiae s.l. was 38.2% and varying from 37.6% in IRS districts and 38.7% in non-IRS districts **(Figure 10).**

The entomological inoculation rate (EIR) which is the number of infectious bites per person per unit of time was measured and expressed per year (ib/p/y). The average of EIR was 0.7 ib/p/y for An. gambiae s.l. and 0.05 ib/p/y for An. funestus. The *An. gambiae* s.l. carrying *Plasmodium* sp infections were found in two sites of Kicukiro and Mubuga in non-IRS districts. The infection in *An. funestus* was only reported in two sites, Karambi sentinel site with 1.16 ibi/p/year and Kicukiro sentinel site with 0.96 ibi/p/year **(table 8)**. This information, particularly the prevailing of malaria infection at site level should be used to inform the focal control methods and to set the priorities in specific districts.

Figure 9: Comparison of *An. gambiae* s.l. and total *Anopheles* collected vs to total *Anopheles* spp and Culicidae FY 2022/2023

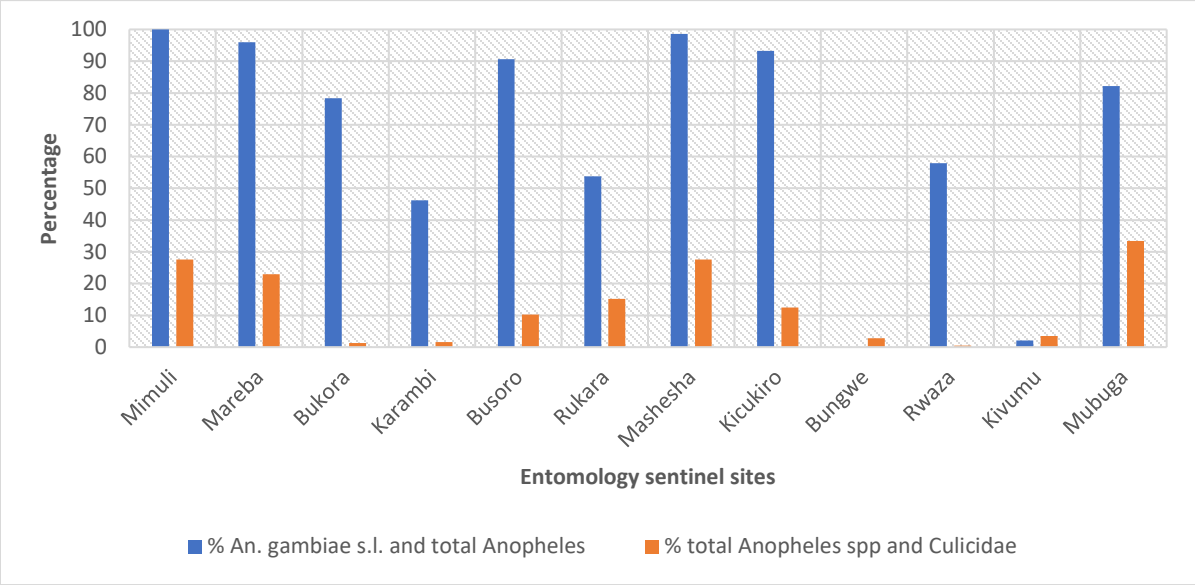


Figure 10: Trends of Endophagic Rate of *An. gambiae* s.l. per Site 2022/2023

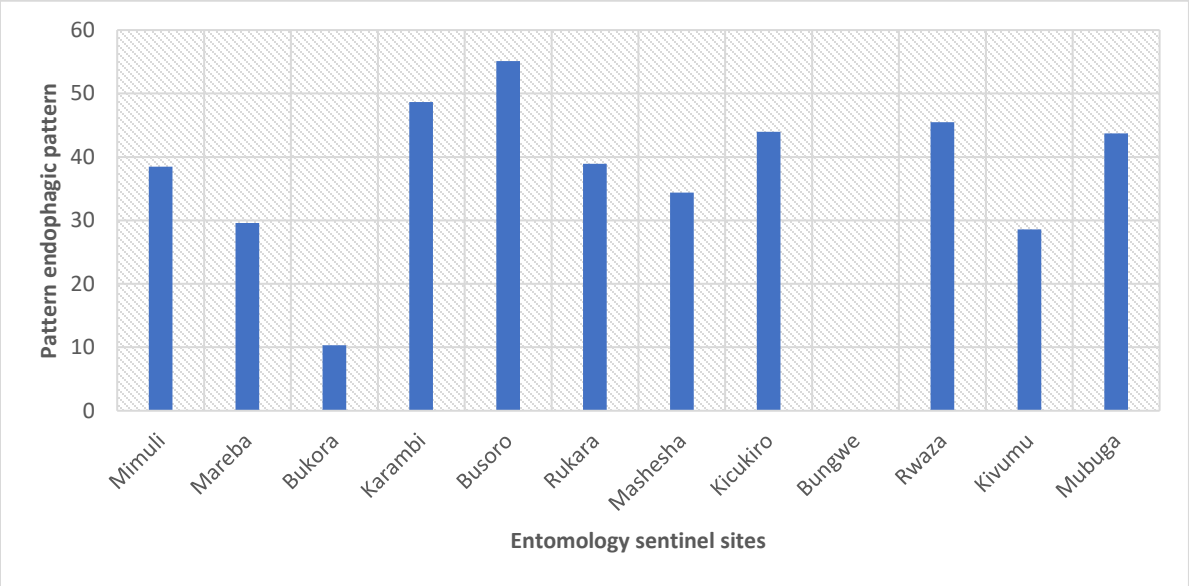


Table 9: Distribution of species composition of mosquitoes collected per sentinel site.

No	Site name	*Anopheles gambiae s.l.*			*Anopheles funestus*			Total *Anopheles*	Total Culicinae	Total *Culicidae*	% An. gambiae vs Total An.	% Total An. vs Culicidae	% Culicines vs Culicidae.
		Inside	Outside	Total	Inside	Outside	Total						
1	Mimuli	441	706	1 147	0	0	0	1 147	3 007	4 154	**100.0**	27.6	72.4
2	Mareba	797	1 896	2 693	1	1	2	2 807	9 443	12 250	95.9	22.9	77.1
3	Bukora	6	52	58	0	0	0	74	5523	5 597	78.4	1.3	98.7
4	Karambi	18	19	37	2	3	5	80	5005	5 085	46.3	1.6	98.4
5	Busoro	682	555	1 237	0	0	0	1 365	11 987	13 352	90.6	10.2	89.8
6	Rukara	44	69	113	0	0	0	210	1175	1 385	53.8	15.2	84.8
	IRS Districts	**1 988**	**3 297**	**5 285**	**3**	**4**	**7**	**5 683**	**36 140**	**41 823**	**93.0**	**13.6**	**86.4**
7	Mashesha	1 345	2 569	3 914	7	5	12	3 968	10 441	14 409	98.6	27.5	72.5
8	Kicukiro	1298	1654	2 952	53	59	112	3 166	22 259	25 425	93.2	12.5	87.5
9	Bungwe	0	0	0	0	0	0	112	3831	3 943	0.0	2.8	97.2
10	Rwaza	5	6	11	3	2	5	19	3945	3 964	57.9	0.5	99.5
11	Kivumu	2	5	7	26	30	56	327	9123	9 450	2.1	3.5	96.5
12	Mubuga	101	130	231	2	7	9	281	559	840	82.2	33.5	66.5
	Non-IRS Districts	**2 751**	**4 364**	**7 115**	**91**	**103**	**194**	**7 873**	**50 158**	**58 031**	**90.4**	**13.6**	**86.4**
	Total	**4 739**	**7 661**	**12 400**	**94**	**107**	**201**	**13 556**	**86 298**	**99 854**	**91.5**	**13.6**	**86.4**

Table 10: Biting behavior and infectivity of malaria vectors per site in 12 Sentinel Sites

No	Site name	Biting behavior, %				Human biting rate (b/p/n)			SIR (%) An. g	EIR Ag	SIR (%) An.f	EIR Af
		Ag. Endo	Ag. Exo	Af. Endo	Af. Exo	Ag	Af	Culicidae				
1	Mimuli	38.45	61.55	0.00	0.00	2.66	0.00	9.62	0.00	0.00	0.00	0.00
2	Mareba	29.60	70.40	50.00	50.00	6.23	0.00	28.36	0.00	0.00	0.00	0.00
3	Bukora	10.34	89.66	0.00	0.00	0.13	0.00	12.96	0.00	0.00	0.00	0.00
4	Karambi	48.65	51.35	0.00	0.00	0.09	0.01	11.77	0.00	0.00	100.00	1.16
5	Busoro	55.13	44.87	0.00	0.00	2.86	0.00	30.91	0.00	0.00	0.00	0.00
6	Rukara	38.94	61.06	0.00	0.00	0.26	0.00	3.21	0.00	0.00	0.00	0.00
	IRS Districts	**37.62**	**62.38**	**42.86**	**57.14**	**1.75**	**0.00**	**13.83**	**0.00**	**0.00**	**16.67**	**0.04**
7	Mashesha	34.36	65.64	0.00	0.00	9.06	0.03	33.35	0.00	0.00	0.00	0.00
8	Kicukiro	43.97	56.03	0.00	0.00	6.83	0.26	58.85	0.50	3.42	3.70	0.96
9	Bungwe	0.00	0.00	0.00	0.00	0.00	0.00	9.13	0.00	0.00	0.00	0.00
10	Rwaza	45.45	54.55	60.00	40.00	0.03	0.01	9.18	0.00	0.00	0.00	0.00
11	Kivumu	28.57	71.43	46.43	53.57	0.02	0.13	21.88	0.00	0.00	0.00	0.00
12	Mubuga	43.72	56.28	22.22	77.78	0.53	0.02	1.94	2.20	1.18	0.00	0.00
	Non-IRS Districts	**38.66**	**61.34**	**46.91**	**53.09**	**3.29**	**0.09**	**26.87**	**0.45**	**1.48**	**0.62**	**0.06**
	Total	**38.22**	**61.78**	**46.77**	**53.23**	**2.39**	**0.04**	**19.26**	**0.23**	**0.74**	**8.64**	**0.05**

Abbreviations: In: Inside; Out: Outside; An.: *Anophelines*; An.g: *Anopheles gambiae* s.l.; EIR/Y: Entomological inoculation rate per year, ibp/y: infected bites per person and per years

Table 11: Species of Anopheles Mosquitoes Tested for Detection of Plasmodium Infection

#	Anopheles species	IRS districts			Non IRS districts			Total		
		Total tested	Positives	SIR (%)	Total tested	Positives	SIR (%)	Total tested	Positives	SIR (%)
1	*An. gambiae s.l.*	4017	0	0	2639	14	0.53	6656	14	0.21
2	*An. funestus*	13	1	7.69	143	1	0.70	156	2	1.28
3	*An. ziemanni*	277	3	1.08	219	2	0.91	496	5	1.01
4	*An. maculipalpis*	40	0	0	4	0	0.00	44	0	0.00
5	*An. pharoensis*	174	0	0	0	0	0.00	174	0	0.00
6	*An. coustani*	8	0	0	23	0	0.00	31	0	0.00
7	*An. christyi*	10	0	0	202	0	0.00	212	0	0.00
8	*An. squamosus*	33	0	0	2	0	0.00	35	0	0.00
9	*An. moucheti*	0	0	0	2	0	0.00	2	0	0.00
10	*An. rhodesiensis*	0	0	0	42	1	2.38	42	1	2.38
11	*An. demeilloni*	1	0	0	0	0	0.00	1	0	0.00
12	*An. rufipes*	4	0	0	0	0	0.00	4	0	0.00
13	Anopheles spp	17	0	0	0	0	0.00	17	0	0.00
	Total	***4594***	***4***	**0.09**	**3276**	**18**	0.55	**7870**	**22**	**0.28**

Table 12 : Sibling Species of Anopheles gambiae s.l. per IRS or Non IRS Sites

#	Sites	Intervention	Tested	*An. gambiae* s.s.	*An. arabiensis*	% *An. gambiae* s.s. vs *An. arabiensis*
1	Nyagatare	IRS	69	0	69	0.0
2	Rukomo	IRS	222	0	222	0.0
3	Gatore	IRS	181	0	181	0.0
4	Nyamugali	IRS	30	1	29	3.3
5	Zaza	IRS	28	0	28	0.0
6	Remera	IRS	18	1	17	5.6
7	Mareba	IRS	338	0	338	0.0
8	Bukora	IRS	38	1	37	2.6
9	Rukara	IRS	36	0	36	0.0
10	Mimuli	IRS	118	1	117	0.8
11	Mashesha	IRS	257	5	252	1.9
12	Busoro	IRS	178	2	176	1.1
13	Karambi	IRS	9	0	9	0.0
	Total IRS		**1522**	**11**	**1511**	**0.7**
1	Rwamiko	Non IRS	39	31	8	79.5
2	Kicukiro	Non IRS	457	275	182	60.2
3	Rwaza	Non IRS	9	8	1	88.9
4	Kivumu	Non IRS	5	0	5	0.0
5	Mubuga	Non IRS	76	49	27	64.5
6	Kabuye	Non IRS+Bti	206	60	146	29.1
7	Rugende	Non IRS+Bti	125	3	122	2.4
	Total non IRS sites		**917**	**426**	**491**	**46.5**

#	IRS Sites	*An. gambiae s.s.*			*An. arabiensis*			Total		
		Tested	Positive	SIR %)	Tested	Positive	SIR (%)	Tested	Positive	SIR (%)
1	Nyagatare	0	0	0	69	0	0	69	0	0
2	Rukomo	0	0	0	222	0	0	222	0	0
3	Gatore	0	0	0	181	0	0	181	0	0
4	Nyamugali	1	0	0	29	0	0	30	0	0
5	Zaza	0	0	0	28	0	0	28	0	0
6	Remera	1	0	0	17	0	0	18	0	0
7	Mareba	0	0	0	338	0	0	338	0	0
8	Bukora	1	0	0	37	0	0	38	0	0
9	Rukara	0	0	0	36	0	0	36	0	0
10	Mimuli	1	0	0	117	0	0	118	0	0
11	Mashesha	5	0	0	252	0	0	257	0	0
12	Busoro	2	0	0	176	0	0	178	0	0
13	Karambi	0	0	0	9	0	0	9	0	0
	Total IRS	**11**	**0**	**0**	**1511**	**0**	**0**	**1522**	**0**	**0**
1	Rwamiko	31	0	0	8	0	0	39	0	0
2	Kicukiro	275	8	2.9	182	0	0	457	8	1.8
3	Rwaza	8	0	0.0	1	0	0	9	0	0.0
4	Kivumu	0	0	0.0	5	0	0	5	0	0.0
5	Mubuga	49	5	10.2	27	0	0	76	5	6.6
6	Kabuye (+Bti)	60	0	0.0	146	0	0	206	0	0.0
7	Rugende (+Bti)	3	0	0.0	122	0	0	125	0	0.0
	Total non IRS sites	**426**	**13**	**3.1**	**491**	**0**	**0**	**917**	**13**	**1.4**
	Grand Total	**437**	**13**	**3.0**	**2002**	**0**	**0**	**2439**	**13**	**0.5**

3. Climate Surveillance

3.1. Climate Surveillance

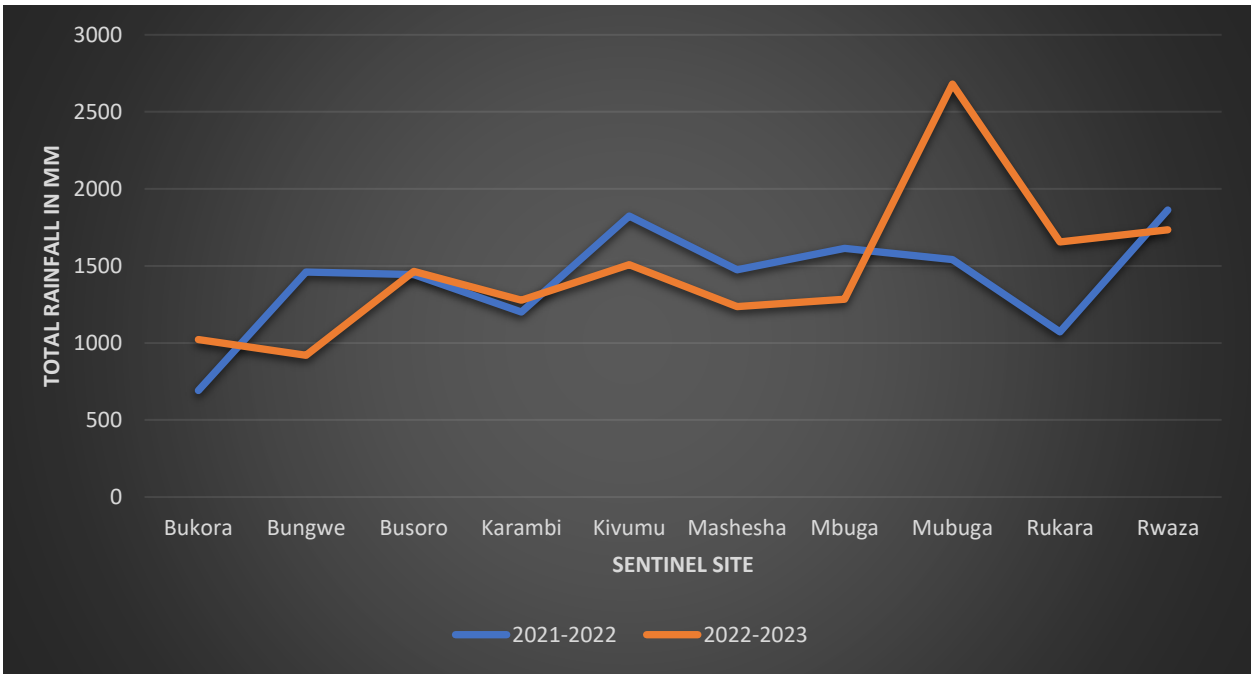
The spatial variation of the three climatic variables (temperature, rainfall, and R. humidity) is mostly contributing to the distribution of malaria vectors. From July 2022 to June 2023, Bukora (Kirehe District) and Mashesha (Rusizi District) are the most warmed stations with respectively 20.98°C and 21.76°C.

Table 13: Annual Rainfall, Temperature, and Relative Humidity for Ten Entomology Sentinel Sites in 2022-2023.

District	Station	An. Max Temp	An. Min Temp	An. Mean Temp	An. Rainfall	R. Humidity (%)
Kirehe	Bukora	27,44	14,58	20,98	1022,2	62,35
Burera	Bungwe	22,35	14,16	18,24	920	-
Nyanza	Busoro	26,02	12,56	19,29	1464,3	63,49
Ruhango	Karambi	25,93	14,7	20,2	1277,6	53,97
Rutsiro	Kivumu	24,99	12,54	18,76	1508,71	69,12
Rusizi	Mashesha	28,46	15,29	21,76	1235,9	64,32
Nyamagabe	Mbuga	24,14	12,96	18,5	1283,2	-
Karongi	Mubuga	25,21	15,33	20,23	2680,2	59,93
Kayonza	Rukara	25,91	14,87	20,37	1656	57,53
Musanze	Rwaza	25,05	13,89	19,47	1734,2	59,08

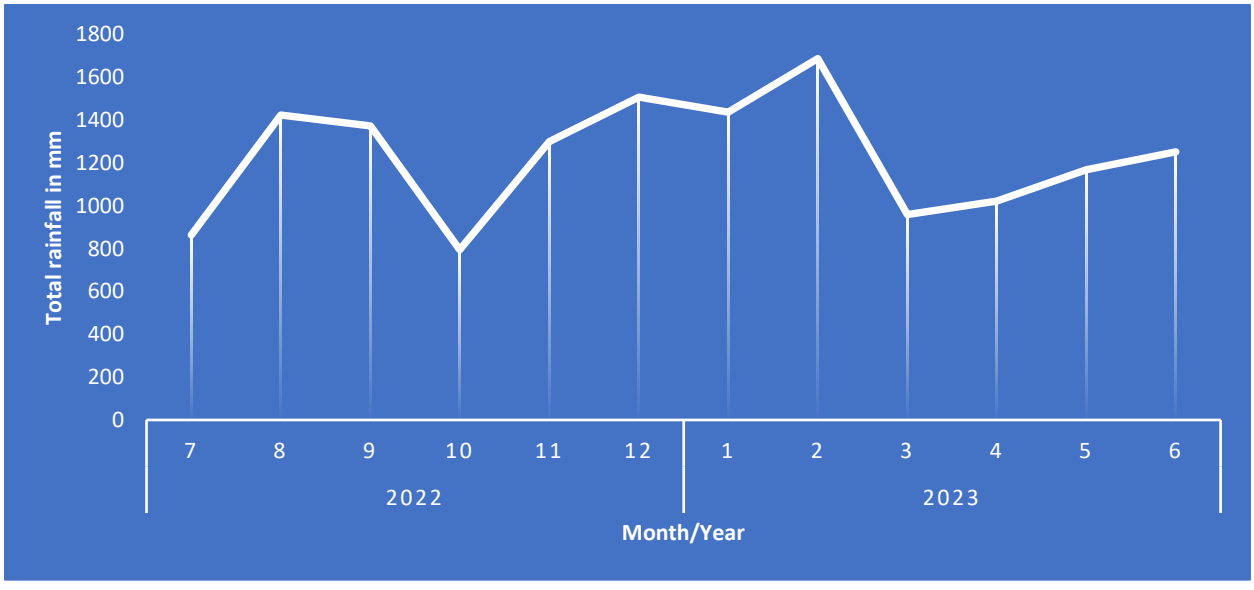
The annual rainfall increased in 2022-2023 compared to the previous year. The annual average recorded 1478.2 mm versus 1418.6mm in 2021-2022. Five stations out of ten registered an excess rainfall varying between 1464-2680mm. These are Busoro (Nyanza District, 1464.3mm), Kivumu (Rutsiro District, 1508.7mm), Rukara (Kayonza District, 1656mm), Rwaza (Musanze District, 1734.2mm) and Mubuga (Karongi District) with the highest depth of 2680.2mm).

Figure 11: Comparison of Rainfall between 2021-2022 and 2022-2023



The short dry season of mid-January to end February 2023 did not occur. It was rather at that period a peak of rainfall. A similar scenario occurred in mid-August to mid-September 2022. The bottom of rainfall occurred in October 2022 and March-April 2023. (Figure 12). This latter climate phenomenon was abnormal compared to the normal peaks of rainfall usually observed in April-May and November-December and the normal bottom in January-February and July-August of each year.

Figure 12: Annual Rainfalls Patterns Reported from 10 Sites, 2022/2023



It is likely to host more vectors in Mashesha catchment area compared to the other nine sites despite the intervention of IRS. Consequently, 29.2% (n=13,556) of all Anopheles collected at 12 sites were reported from Mashesha sentinel site (Table 12). The data indicate that climatic parameters collected in 10 sentinel sites remain a risk of malaria transmission in many sites. It has been confirmed that malaria transmission is more likely to occur where temperature ≥18 ≤ 35°C, rainfall > 80 mm, and Relative humidity > 60 % if prevention interventions are not optimized.

4. Maintenance of Insectary and Laboratory Animals

The susceptible Kisumu strain of *Anopheles gambiae* s.s. were maintained at the Mal&OPDC/RBC insectary based at National Entomology Laboratory of Kicukiro which comply with the WHO mosquito rearing standards. The total of 73000 including *Anopheles gambiae* s.s and wild Anopheles mosquitoes were supplied for the following activities. 54000 females *Anopheles gambiae* s.s. 2-5 days old were supplies for IRS quality control in sprayed districts. 13000 females *Anopheles gambiae* s.s. 2-5 days old were supplies for LLINs bioassay and 6000 wild Anopheles mosquitoes 2-5 days old were also collected, reared at sentinel sites to be used in LLINs bioassay as resistant mosquitoes. During the IVM training at Sector level, estimate of 90,000 wild larvae mosquitoes (L3 &L4, Pupae) were collected at different sites of training and were used as demonstration materials of mosquito life cycle and mosquito position in the water and on wall during different training including IVM.

During the period of July 2022 to June 2023, the total of 99 Guinnea pigs were kept at insectary for feeding mosquito colony. Out of them 72 were supplied in the community to improve food deficiency for the poor families around the entomology Laboratory. Current 27 are kept healthy and ready to supply blood for mosquitoes.

5. Supplemental Interventions, Capacity Building and Research

5.1. Supplemental Innovations

- The MOPDC with the partnership with SFH, a distribution through social marketing of mosquito repellents and bed nets has been organized countrywide. In total 244,094 Baygon coils, 11,477 Off lotion, 2948 Off sachets as mosquito repellents were distributed while the bed nets distributed were 86 through private sector channels of pharmacies and supermarkets and trading shops.

- RBC/MOPDD conducted the second pilot phase of larval source management using bio-larvicides (Bti). The larvicide product is sprayed using drones in flooded water bodies and irrigated rice fields and complemented with community-based hand applications in two marshlands, Rugende and Kabuye of Gasabo district. This extended pilot phase of larviciding is planned to cover a total surface of 964.9 ha of two marshlands with a combined land use of rice fields, wetland crops, located respectively in Kabuye with 396.2 ha and Rugende with 568.7 ha located in Gasabo District, Kigali City. The spraying operations are guided by the monthly mapping of mosquito breeding sites to estimate the sprayable surfaces. A community mobilization using drones in intervention areas is also performed on monthly basis in contingent villages to the intervention's areas in collaboration with Charis UAS and SFH. The spraying campaign and monitoring the impacts started from February 2023 with malaria saving funds and it is expected to last 12 months, until January 2024. Three partners are respectively involved, SFH for procurement of the larvicide product and recruitment of external experts, the Charis UAS for spraying, mapping and done based community mobilization, Caritas Rwanda through Kicukiro HC for entomology monitoring. The RBC ensure the overall coordination and evaluation of the impact.

5.2. Capacity Building

In the framework of integrated vector management (IVM) approach, building capacity and strengthening inter-sectorial collaboration, and community based environmental management and entomology surveillance, the following activities were achieved:

Training on Integrated Vector Management (IVM)

The RBC/MOPDC in collaboration with following Civil Society Originations: ASOFERWA, Rwanda NGOs Forum and CARITAS Rwanda conducted the IVM capacity building in 18 districts, covering 145 sectors out of the total 416 sectors. The training targeted different stakeholders at sector level and covered 57.5% (145) out of the 252 total sectors of the targeted districts. In total 842 participants have been trained as IVM trainers to support then after the cascade awareness and training on IVM approach to the identified targeted groups at the lay communities (Table 11). The training used mixed training methods involving in class theories and in field practices for mosquito larval collection and their physical identification "learning by doing or seeing" in anophilines and culicines levels. The participants were identified in collaboration with respective districts, and the three CSO partners. The trainees were mainly made by in charge of agriculture and livestock (Agronome), president of rice famers cooperatives (where applicable), president of fish famers cooperatives (where applicable), president of mining

cooperatives (where applicable), in charge of social affairs, in charge of schools, in charge of community health workers, head of health center, malaria focal person and CHW representative at sector level (Table 12). The partners contributed to the training with 52.5% for ASOFERWA, 32.7% for RNGOF, and 14.8% for CARITAS out of the 842 total trainees (table 12). For the last two financial years, 2043 TOTs from sector levels were trained with 58.8% in FY 2021/22 and 41.2% in FY 2022/23. INGOBYI, ASOFERWA and RNGOF were the most contributed to the IVM trainings with 35.4%, 21.6% and 13.5% of the total trainees, respectively (Figure 15).

Table 14: Sectors covered per district and partner for IVM trainings, FY 2022/2023

Districts	Total Sectors	Sector Covered			Total sectors covered	% sectors covered
		ASOFERWA	RNGOF	CARITAS		
Karongi	13	6	2	0	8	61.5
Nyamasheke	15	6	4	4	14	93.3
Rusizi	18	4	0	4	8	44.4
Kamonyi	12	5	4	0	9	75.0
Myamagabe	17	2	5	0	7	41.2
Nyaruguru	14	2	4	0	6	42.9
Bugesera	15	6	4	0	10	66.7
Gicumbi	21	4	4	0	8	38.1
Rutsiro	13	4	4	0	8	61.5
Rulindo	17	5	5	0	10	58.8
Gasabo	15	5	4	0	9	60.0
Kicukiro	10	3	3	0	6	60.0
Gisagara	13	6	5	0	11	84.6
Ruhango	9	4	0	0	4	44.4
Muhanga	12	3	0	0	3	25.0
Nyagatare	14	5	4	0	9	64.3
Nyanza	10	3	3	0	6	60.0
Huye	14	5	4	0	9	64.3
Total	**252**	**78**	**59**	**8**	**145**	**57.5**
% sectors covered per partner		**53.8**	**40.7**	**5.5**	**100.0**	

Table 15: Number of trainees in IVM approach per district, sector, **and partner**

Districts	Trained Sectors	# Trainees			Total Trainees	# Trainees/Sector
		ASOFERWA	RNGOF	CARITAS		
Karongi	8	20	23	0	43	5.4
Nyamasheke	14	26	22	70	118	8.4
Rusizi	8	26	0	55	81	10.1
Kamonyi	9	26	20	0	46	5.1
Myamagabe	7	21	20	0	41	5.9
Nyaruguru	6	21	22	0	43	7.2
Bugesera	10	25	17	0	42	4.2
Gicumbi	8	25	19	0	44	5.5
Rutsiro	8	26	18	0	44	5.5
Rulindo	10	20	5	0	25	2.5
Gasabo	9	32	21	0	53	5.9
Kicukiro	6	26	14	0	40	6.7
Gisagara	11	24	20	0	44	4.0
Ruhango	4	26	0	0	26	6.5
Muhanga	3	26	0	0	26	8.7
Nyagatare	9	20	14	0	34	3.8
Nyanza	6	27	20	0	47	7.8
Huye	9	25	20	0	45	5.0
Total	**145**	**442**	**275**	**125**	**842**	**5.8**
% trainees per partner		**52.5**	**32.7**	**14.8**	**100**	

Table 15: Total Trainees for the last two FY 2021/22 and 2022/23 per CSO partner

CSOs Parners	2021-2022	2022-2023	Total trainees	Percentage
Caritas	92	125	217	10.6
Ingobyi	724	0	724	35.4
Pro-Femme	44	0	44	2.2
RDO	44	0	44	2.2
RICH	142	0	142	7.0
SFH	155	0	155	7.6
ASOFERWA	0	442	442	21.6
RNGOF	0	275	275	13.5
Total	1201	842	2043	100.0
% of trainees per year	58.8	41.2	100.0	

Workshop on IRS Planning

From 23-26 May 2023, a technical workshop for the planning of the 2023-2024 IRS implementation in the targeted districts was conducted at Splendid Hotel, Muhanga district. The main goal of the workshop was to carry out the review of IRS campaign conducted in FY 2022/23 and effective planning of IRS campaigns for the FY 2023/2024 with all GF and GOR implementing hospitals with three following objectives: (1) identify the past IRS campaigns gaps, challenges, and recommendations, (2) to assess the IRS structures, required staffing, (3) discuss the IRS logistics, procurement processes and procedures, reporting and financial compliance (4) calculate the IRS needs and related budget to be incorporated into the action plans of district hospitals for the next FY 2023/24, (5) define the components of the IRS reporting and financial compliance and (6) develop the detailed implementation plan. A total of fifty-nine participants attended to this workshop and from the following institutions or partners: (1) Rwanda Biomedical Center (Malaria and OPDC Division, Corporate services/finance, SPIU/finance and malaria program management focal person), IRS implementing district or provincial hospitals: Kibilizi DH, Nyanza DH Kabutare DH, Gitwe DH/ Ruhango District, Remera Rukoma DH, Nyamata DH, Rwamagana PH, Rwinkwavu DH, Kiziguro DH, Mibilizi DH. At each district hospital, the following participants were invited: Hospital DG, Hospital DAF, Procurement officer, accountant, and the IRS focal person. The PMI-EVOLVE Rwanda Rwanda_ Abt Associates (MoH/RBC Partner for IRS) also attended to that workshop.

5.3. Research and Monitoring

LLIN Durability Monitoring

LLIN durability monitoring were performed for the 36 months post LLINs distribution respectively in Bungwe, Masaka and Kinazi in May - June 2023 for the bednets distributed in February-March 2020 and in Mubuga in June 2020 for bed nets distributed in June 2020. The following parameters were assessed: Loss of LLINs, physical deterioration of nets, bio-efficacy of nets on susceptible mosquitoes reared at insectary and wild anopheles collected from field. The samples for assessing the insecticide content were sent to the Laboratory of CDC-Atlanta. The final report is expected before the end of 2023.

Efficacy Testing of TRILED Mosquito Repellent Lights

Efficacy testing of “TRILED Baesten” mosquito repellent light against wild mosquito species was conducted from 16-26 January 2023. The product tested is a mosquito repellent light emitted by Led-Lamp Bulb traded under the name of “TRILED Baesten” and manufactured by SZ Logic System Co, Ltd, Shenzhena, Guangdong, China and provided by Gamba Multi Service® Ltd, representative of V-TAC Italia in Africa. In fact,

the evaluation was performed for two consecutive weeks, in four community houses randomly selected from RBC entomological sentinel site of Kabuye village, Jabana Sector of Gasabo district. The testing houses were voluntarily offered by local community members, familiar with entomological surveys. The collections were conducted inside and outside the houses and following a latino square rotation. This small-scale evaluation targeted to achieve two main specific objectives:

- To measure the efficacy of TRILED Baesten mosquito repellent light against wild mosquito's species in the study site;
- To compare the efficacy provided per treatment (only in, only outside, both inside and outside, control) in preventing mosquito bites in the study site.

The field evaluation of Triled Repellent Light® product showed a better protection against wild mosquito bites while the lights are fixed inside and outside houses. The significant reduction was respectively 59.1%, 31.2% and 39.1% for total Anopheles, culicines or non-anopheles and mosquitoes (Culicidae) in general. The second option of placing the light only outside was better than placing the light inside houses. The wide marketing and distribution of Triled repellent light may contribute to supplement the core vector control interventions such as LLINs and IRS and to optimize the fight against malaria transmission in Rwanda and in the region.

Evaluation of residual efficacy of new insecticides, 2GARDTM and KLYPSON®500WG

A residual efficacy evaluation of 2GARDTM and KLYPSON®500WG, new IRS insecticides, was also conducted for 9 months, from September 2022 to June, 2023, under semi-field conditions using experimental huts of RBC established in Ruhuha, Bugesera, South-Eastern of Rwanda. The trial aimed to evaluate the bio-efficacy and residual period of insecticidal activity of two new WHO registered insecticides, respectively 2GARDTM and KLYPSON®500WG provided by Tagros Chemicals, UPL Corporation Limited, Port Louis- Mauritius. Susceptible mosquito laboratory colony, *Anopheles gambiae* s.s., Kisumu strain reared from national insectarium of RBC were used for bioassay tests. The trial was designed and performed in accordance with the World Health Organization (WHO) standard protocol, 2006, for testing mosquito adulticides used for indoor residual spraying (IRS). This field evaluation of the above two insecticides were conducted one-week post spraying for bio-efficacy and on monthly basis for testing the residual insecticidal activity for each following study arms:

a) Experimental arm 1: 2GARDTM, a wettable powder packed in water soluble bag (WP-SB). It is a mixture of two active ingredients made of Clothianidin 50% belonging to a new class of insecticide, the Neonicotinoid and the Deltamethrin 6.25% (class of

pyrethroids). It was packaged in 100g and diluted in 7.5 liters per sprayer pump and sprayed using a control flow valve (CFV) for covering 250m2.

b) Experimental arm 2: KLYPSON®500WG, a water dispersible granule (WG) with active ingredient made of a mono-molecule of clothianidin 50%, packaged in 150g for covering 250 m2 of surface wall. It was diluted in 7.5 liters of water and sprayed using a sprayer pump equipped with a control flow valve (CFV) with an application dosage of 300 mg of active ingredient per m2.
c) Experimental arm 3: Actellic® (Pirimiphos methyl) as positive control. It is a capsule suspension (CS) 30%, containing 300g of active ingredient per liter that was used for IRS in study site in previous two years 2020/22. The product was packaged in a bottle 833 ml and diluted in 7.5 liters of water for covering 250 m2 with an application dosage of 1 gr of active ingredient per m2. The product was provided by Malaria and Parasitic Diseases Division.
d) Experimental arm 4: Distilled water as negative control.

The findings showed a bio-efficacy of 2 GARDTM and Klypson 500 WG of 100% mortality against susceptible *An. gambiae* s.s, Kisumu strain reported at one-week post spraying of hut walls. Therefore, with the WHO recommended cut off of 80% of mosquito mortality, the residual efficacy period was varying according to the observation time for recording mosquito mortality on Klypson 500WG insecticide. It was 4, 8 and above 9 months respectively at 24, 48 and 72 hours of time for mosquito mortality observations. For 2 GARDTM insecticide, the residual bio-efficacy was above 9 months both for immediate mortality after 24 hours and the delayed mortality observed respectively at 48 and 72 hours post exposure of mosquito on treated hut walls. Moreover, GARDTM insecticide showed in addition to the earlier efficacy at 24 hours, a combination of knock down effect lasting for 5 months above the WHO cut off of 95% for KD effect. The two insecticides evaluated may be planned to be applied for only one IRS round per year in the context of malaria vector control in Rwanda. This round of IRS using the above two insecticides enables to cover the two malaria transmission seasons occurring in Rwanda.

Strategy 2.: Sustain Universal Access to Long Lasting Insecticide Treated Nets (LLINs)

A. Long Lasting Insecticide Treated Nets

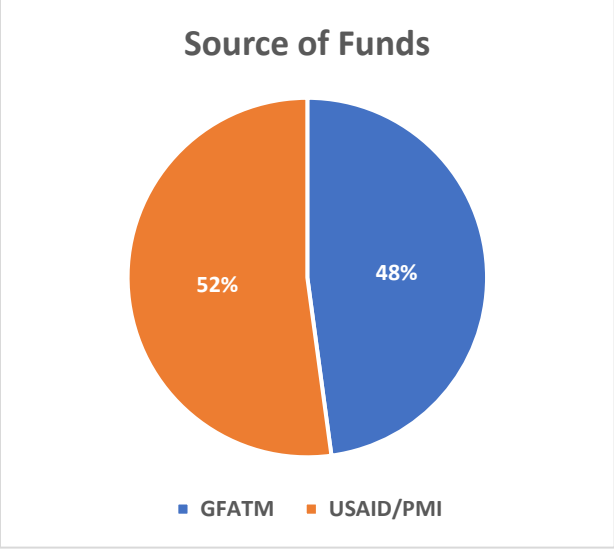
The National Malaria Strategic Plan 2020-2024 and the World Health Organization (WHO) recommend focusing on universal coverage (UC) of the population at risk through Long-Lasting Insecticidal Nets (LLINs). These LLINs are distributed through mass campaigns in households with low and moderate incidence of malaria as well as routine distribution channels focusing on the most vulnerable groups, which include mainly children under five years and pregnant women, countywide.

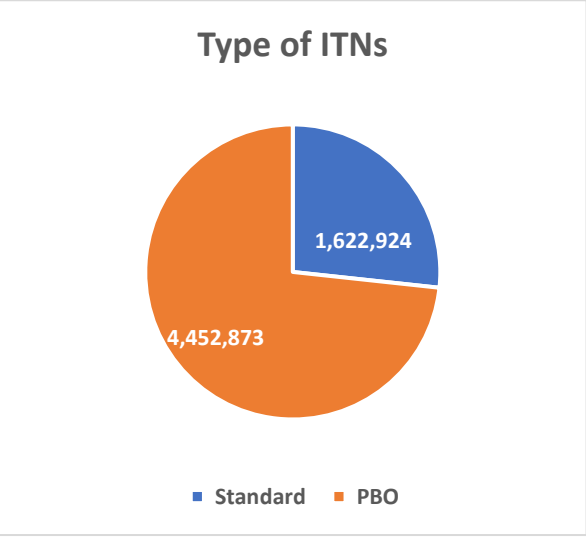
8. LLINs Procurement

From 2021-2022, a total of 6,075,767 rectangular LLINs were procured using Global Fund support through RMS Ltd and USAID/PMI support through GHSC-PSM. Table 13 shows the types of nets and quantities procured.

Table 16: Number of LLINs Procured by Type and Source of Funds

Source of Fund	LLINs Type	Procured	Delivered	Accepted
GF	Standard	1,622,894	1,622,924	1,622,924
GF	PBO	1,084,088	1,084,088	1,084,088
Total GF		2,706,982	2,707,012	2,707,012
USAID/PMI	PBO	3,368,785	3,368,785	3,368,785
TOTAL				6,075,797





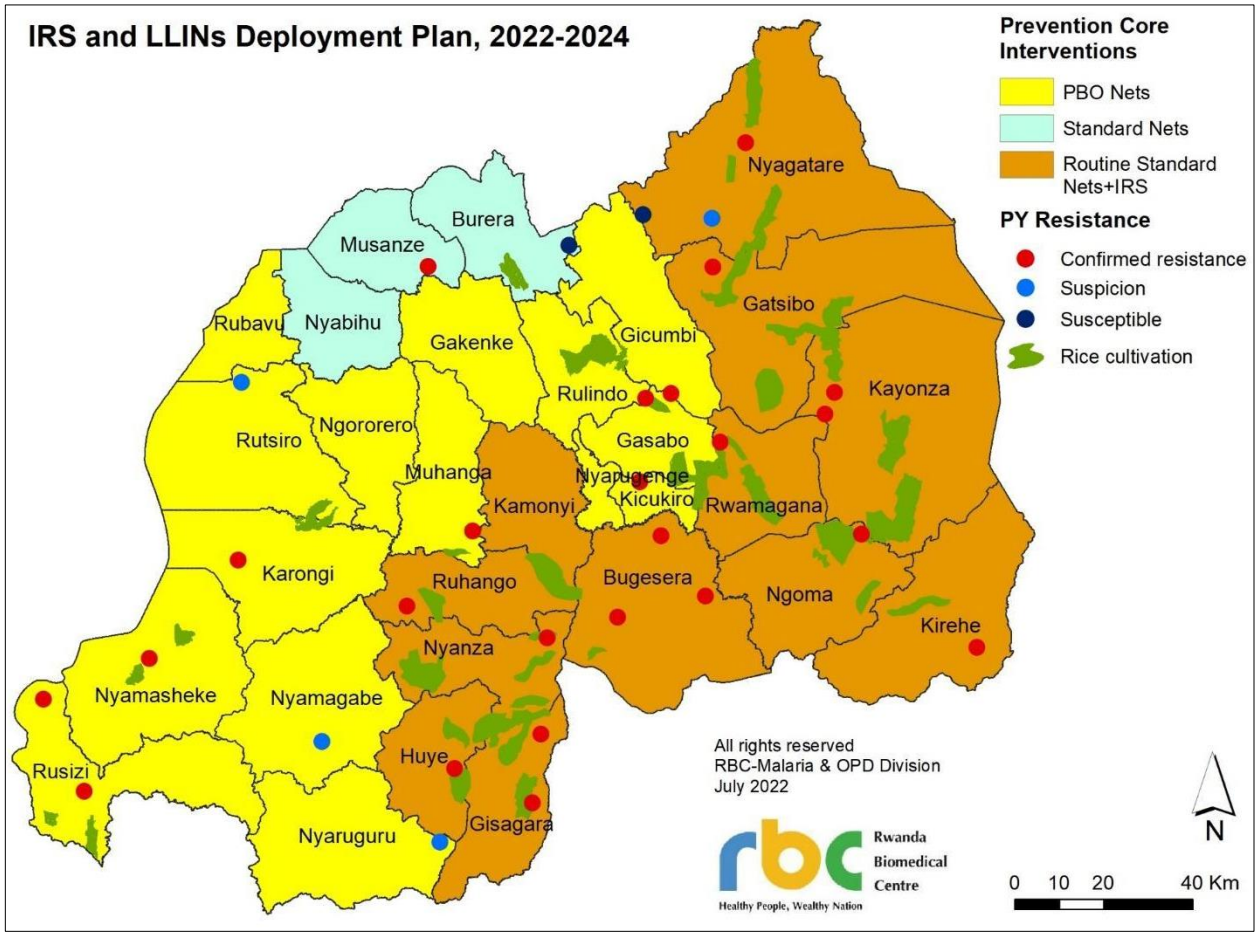
The COVID-19 pandemic has affected the procurement of LLINs on the GF grant. This resulted in the increase of the initial unit price of LLINs in the market which has

implications in terms of protecting the targeted population and also in reaching the indicators as agreed in the RBF for malaria with the Global Fund.

9. Geographical Distribution Plan of LLINs by Type (PBO and Standards)

The MOPDD has prioritized the deployment of one effective preventive measure for the universal coverage of households by district. Thus, LLINs are deployed in 18 non-IRS districts with moderate and low morbidity, 15 districts with moderate to high malaria incidence received PBO nets while 3 districts with low prevalence rate received standard nets. The contracts for the above-mentioned quantity have been signed and the purchase orders have been placed in 2021-2022 to the qualified bidders according to the requirements from RMS Ltd. The delivery and the distribution to health facilities and then to households of 1,622,924 standard LLINs and 4,452,873 PBO LLINs were all done during this fiscal year.

Figure 13: IRS and LLINs Deployment Plan, 2022-2024



n/o	Province	District	Intervention	Types	Distribution Period
1	CoK	Gasabo	ITN	PBO	Q1
2	CoK	Kicukiro	ITN	PBO	Q1
3	CoK	Nyarugenge	ITN	PBO	Q1
4	Western	Karongi	ITN	PBO	Q4
5	Western	Nyabihu	ITN	Standard	Q3
6	Western	Nyamasheke	ITN	PBO	Q1
7	Western	Ngororero	ITN	PBO	Q3
8	Western	Rubavu	ITN	PBO	Q1
9	Western	Rusizi	ITN	PBO	Q1
10	Western	Rutsiro	ITN	PBO	Q4
11	Northern	Burera	ITN	Standard	Q3
12	Northern	Gakenke	ITN	PBO	Q1 & Q4
13	Northern	Gicumbi	ITN	PBO	Q1
14	Northern	Musanze	ITN	Standard	Q3
15	Northern	Rulindo	ITN	PBO	Q4
16	Southern	Muhanga	ITN	PBO	Q4
17	Southern	Nyamagabe	ITN	Standard	FY2021-22
18	Southern	Nyaruguru	ITN	PBO	Q1

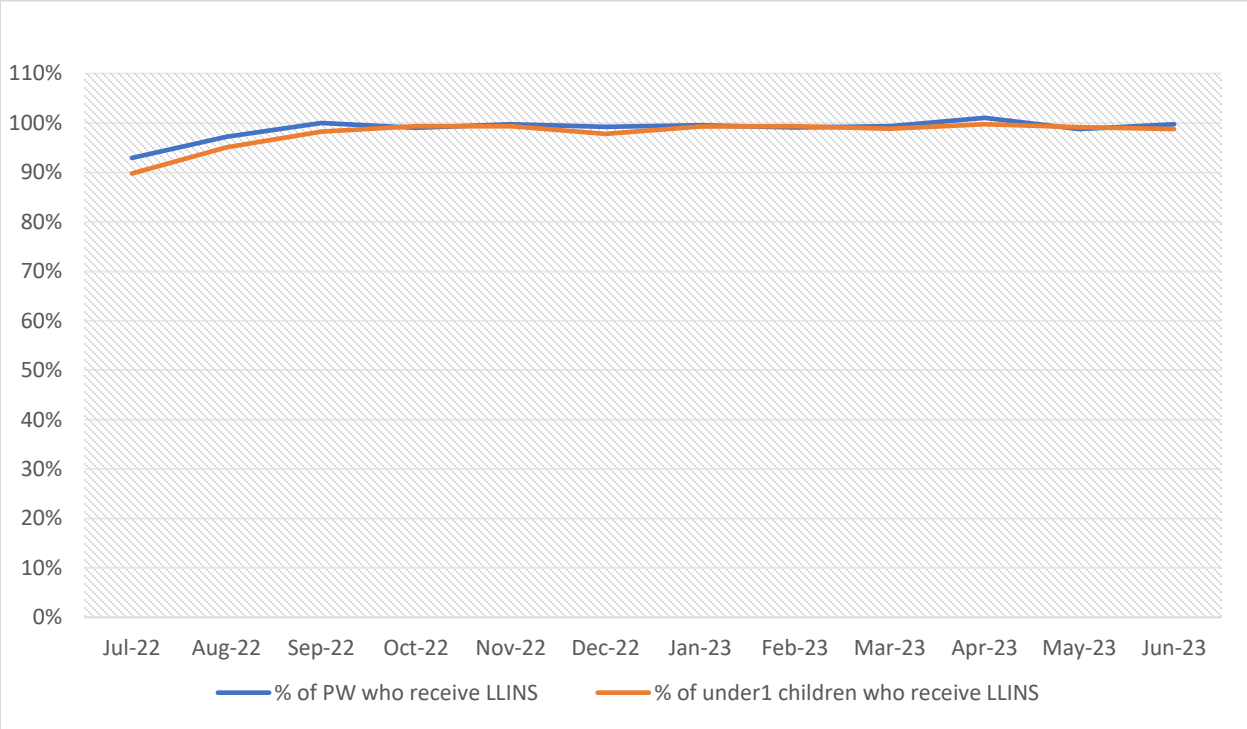
- **LLIN Reception and Quality Control**

From July 2022 through June 2023, RBC trough RMS received a total number of 6,075,767 including those received from USAID/PMI 3,368,785 PBO LLINs and from GoR/GF 1,084,088 PBO LLINs and 1,622,924 Standard LLINs. They all passed physical inspection process inspection was done by the technical team of RBC based on the ISO 2859-1 protocol and the Acceptance Quality Limit (AQL) of 2.5 for major defect and 4.0 for minor defects. The consignments passed the exercise and were recommended for distribution. The received quantity was distributed in 18 districts for the universal coverage of households including 3 districts for Standard and 15 districts for PBO LLINs with the coverage of 96% and the remaining quantity will be added to routine of ANC and EPI distribution in those 18 districts.

- **LLINs Distribution to Pregnant Women and Children Under 1 YO**

The distribution of LLINs to pregnant women and children under one year is part of the ANC and EPI continuous channels that are offered in all Health Centres. The HMIS reports the number of LLINs distributed every month. In this fiscal year, 100% of the pregnant women who came for their first ANC visit (353,466 out of 353,204) and 98% of the children who came for their MR1 (336,199 out of 343,226) received LLINs.

Figure 14: National Coverage of LLINs through ANC and EPI



The national distribution target through routine ANC and EPI which is 95% and above was achieved even though a few stock outs were observed in some districts, due to errors of reporting in HMIS or non-compliance of health facilities to the national guidelines.

- **LLINs Distribution to Households through Mass Campaign**

In addition to the routine LLINs distribution through ANC and EPI services, MOPDD conducted mass distribution campaign in 18 districts for universal coverage.

The preparation of LLINs distribution always begin with the identification of household needs on the basis of which the quantification was elaborated in terms of 1 LLIN for 2 household members or the number of assessed sleeping spaces when it exceeds the number of household members divided by two.
The distribution of LLINs to households was done by health centers and community health workers in collaboration with local authorities using outreach site approach. Communities are called for gatherings in selected sites across districts area to receive LLINs and the communication was done through radio spots and radio talks on RBA as well as usual community communication channels (churches, community forums ….).

- **LLINs Selling in the Private Sector**

In the context of continuous distribution of LLINs to cover special groups, a total of 159,358 LLINs have been procured (first Purchase Order of 80,000 LLINs placed) and will be delivered and distributed in the Fiscal Year 2023/24.

PART II: MALARIA CASE MANAGEMENT

Objective 2: Maintain 100% Prompt Testing & Treatment of All Suspected Malaria Cases in Line with National Treatment Guidelines by 2024

Diagnosis and treatment are primary components in malaria control; the following activities were implemented through program strategies to improve access to early diagnosis and appropriate case management to reduce malaria morbidity and mortality.

In this FY 2022-2023, MOPDD in collaboration with partners are strengthening health care providers in diagnostic testing to ensure that all patients with malaria are properly diagnosed and receive timely and appropriate treatment. All suspected malaria cases are parasitological confirmed by either Malaria Rapid Diagnostic Test or Blood Smear and categorized either as, simple malaria, simple malaria with minor digestive symptoms or severe malaria for the purpose of prescribing appropriate treatment.

Since October 2016, the roll out of Home-based Management of Malaria (HBMm) to all ages enabled Community Health Workers (CHWs) to provide timely treatment in the community for all cases of simple malaria, preventing severe malaria, and limiting malaria transmission. By following early diagnosis and treatment at all levels of health care, all suspected malaria cases were tested and underwent appropriate management according to National Malaria Treatment Guidelines.

Strategy 1: Provide Malaria Diagnosis to all Suspected Malaria Cases at all Levels

1. Distribution of the Integrated Malaria Control Guidelines

In this Fiscal Year, the MOPDD with the support of PMI Impact Malaria (IM) printed and distributed 164 copies of the Rwanda Malaria Treatment Guidelines to the private health facilities. Two copies were provided per private clinics.

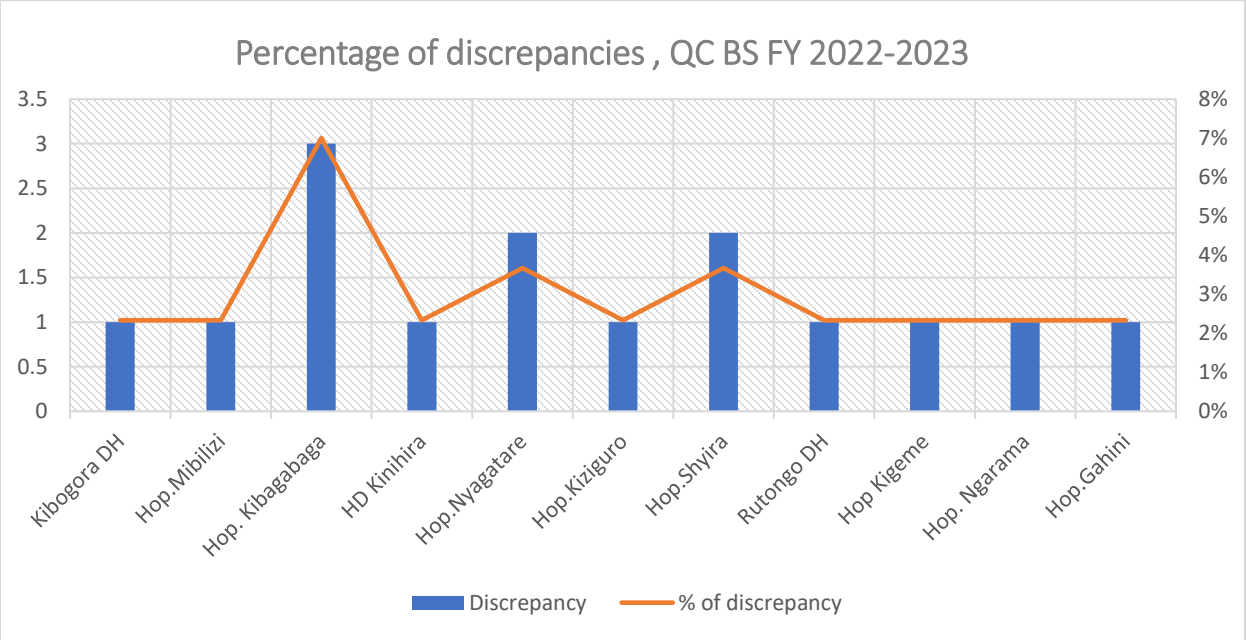
2. Conduct Malaria Microscopy Refresher Training for Targeted Districts

The MOPDD in collaboration with RBC/National Reference Laboratory and implementing Partners organized a training for 40 Lab Technicians from Ngoma and Kirehe Districts on performing malaria microscopy diagnosis with aim to equip lab technicians with skills in malaria microscopy, focusing on differentiation of malaria species and quantification of parasites. In a post-training follow-up conducted from May to June 2023, a total of 450 slides were retested by certified national microscopists (15 slides per HC) and the results showed that sensitivity was 98.2%, while specificity was 94% . The parasite counting and species identification average performance was 80%.

3. Quality Control of Blood Smears at District Hospitals

To ensure the quality of malaria diagnosis in the National Laboratory Network, Malaria Diagnosis External Quality Assurance (EQA) is conducted by RBC/MOPDD in collaboration with the National Reference Laboratory, Parasitology Section.
The EQA includes blinded slide rereading, proficiency testing, and on-site supervision of Hospital Laboratories.
Quarterly evaluation of the quality of thick and thin smear practices, Giemsa staining, and microscopy results are enforced in health facilities. Health center practices are supervised by the District/Provincial Hospital, and District/Provincial Hospitals are supervised by the NRL.

Figure 15: External Quality Control Results at Hospital level, 2022-2023



Among the 50 hospitals in which EQA/QC of blood smears was conducted during the FY 2022-2023, discordant slides result from two observers were noticed in 11 Hospitals, only Kibagabaga Hospital (7%) exceeded the acceptable range. For the remaining 10 hospitals the discordance was within the acceptable range with the overall discordance of 1%. Results over the years from 2016-2017 to 2022-2023 demonstrate that discrepancy remained below the cut off of 5% acceptable range **(Figure 15).**

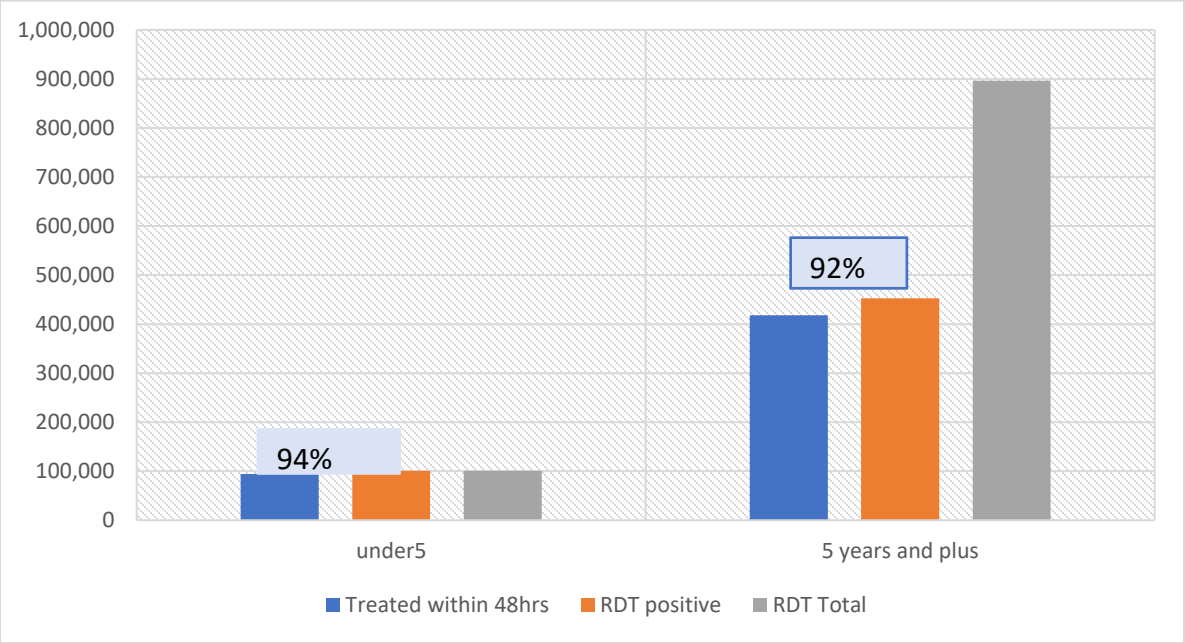
Strategy 2: Strengthen Prompt Access to Diagnosis and Treatment of Malaria

1. Case Management at the Community Level

In 2016, the community case management of malaria was extended to children above five years of age and adults countrywide following the success of the iCCM program.

In FY 2022-2023, 94% of children under five and 92% of children above five and adults sought treatment within 48 hours of onset of symptoms at community level, Figure 16. Patients seeking care at the community were diagnosed by an RDT and treatment provided only when a positive RDT was observed.

Figure 16: Community Malaria Case Management in FY 2022-2023



Since the extension of HBM of malaria intervention to children above five years and adults, there was a steady increase of the proportion of malaria patients seeking care in the community from 13% to 59% in 2015-2016 and 2022-2023 respectively (Figure 16 and 17). During this scale up period, a decline in Severe Malaria Cases and Malaria Deaths was observed (Figure 16).

Figure 17: Impact of Extended HBM on Severe Malaria Cases and Malaria Mortality, 2014-June 2023

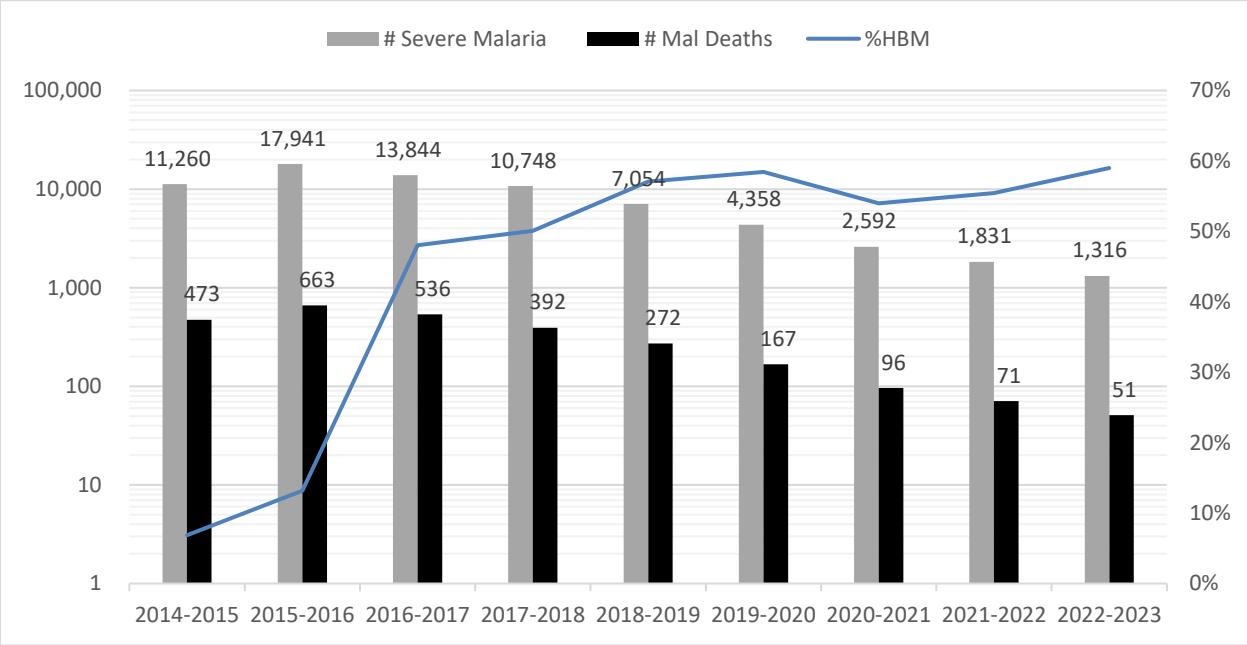
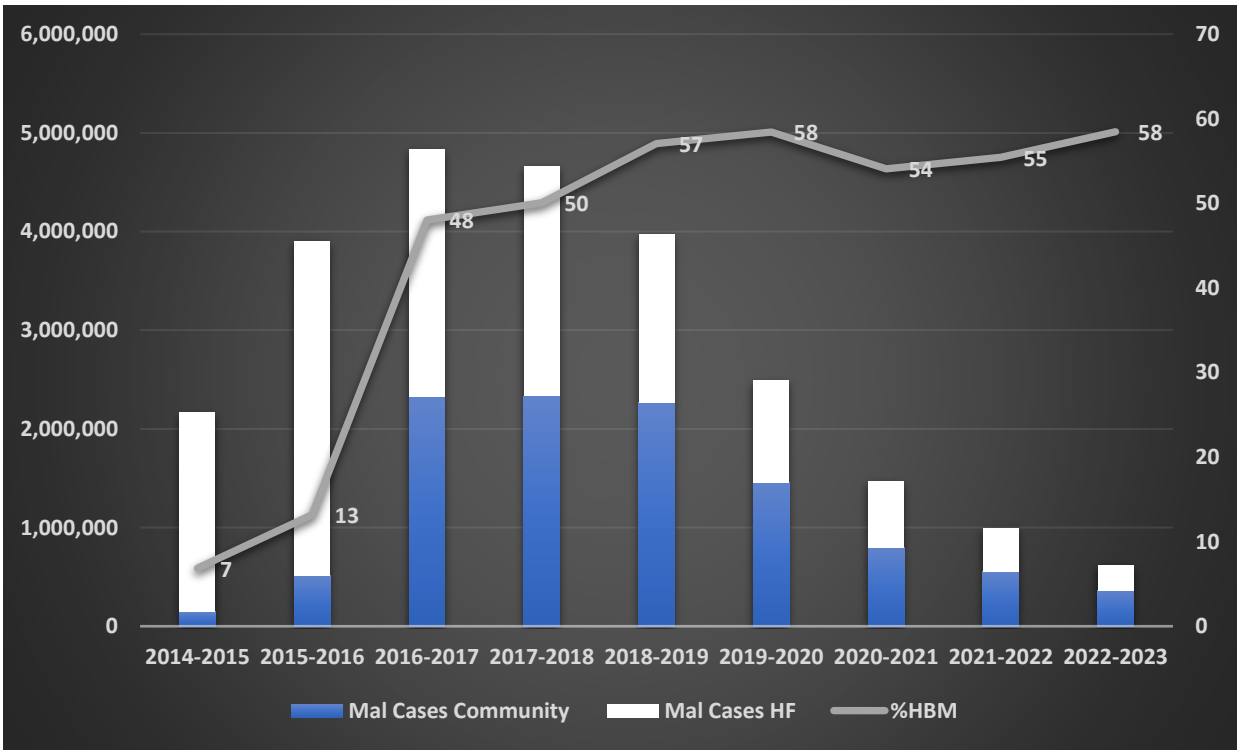
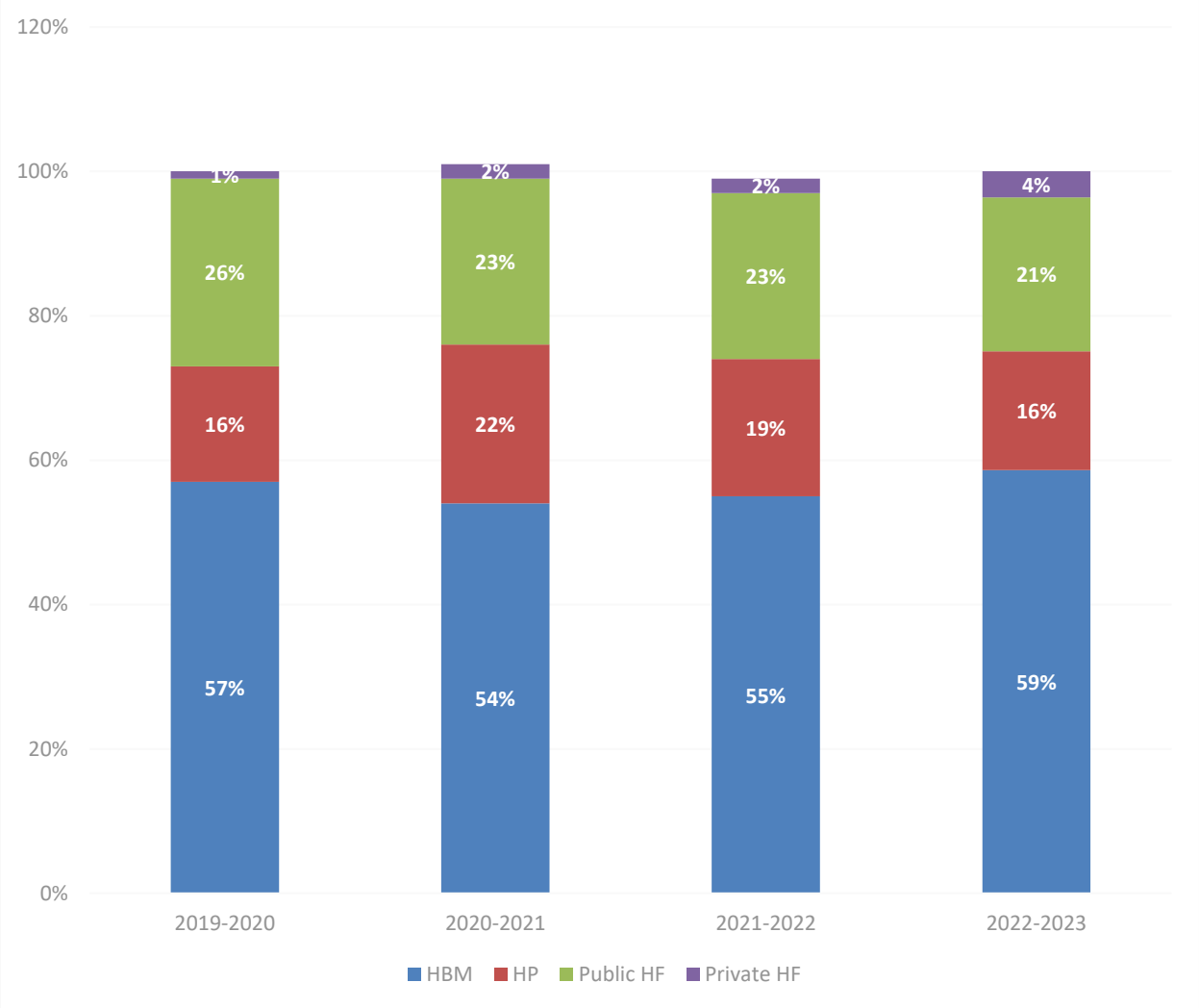


Figure 18: Proportion of Malaria Cases by Level of Service Delivery, 2014-Jue 2023



There is a decrease in severe malaria cases by 28% from FY 2021-2022 to FY 2022-2023 and a decrease in malaria related deaths from 71 to 51 in the same period. The decline in Severe Malaria and Malaria Mortality (Figure 17) indicates that the impact of early diagnosis and treatment on malaria outcome was not compromised. The proportion of malaria cases treated in the community increased from 55% in FY2021-2022 to 58% in FY 2022-2023 (Figure 18) . This small increase is mainly due to the contribution of Health Posts constructed countrywide, a new strategy adopted by the GoR to scale up health services closer to the community and alleviate the workload for the CHWs (Figure 19).

Figure 19: Contribution of Health Facilities and CHWs to Malaria Cases Management, 2019-2023



Strategy 3: Strengthen Prompt and Correct Treatment of Simple Malaria at All Levels Through Training and Supportive Supervision

1. Strengthening of Health Facilities through supportive supervision and trainings

During the FY 2022-2023, MOPDD in collaboration with partners continued to strengthen the delivery of quality malaria services through supportive supervision and Training. During supportive supervision, a total of 962 malaria cases treated at health posts, health centers and hospital levels, including 110 severe cases were reviewed. The Case review revealed gaps in malaria case management among providers at all levels. These findings led to a targeted capacity-building endeavor wherein 127 providers were equipped with necessary skills and knowledge, derived from the assessment outcomes, to effectively address and rectify the identified gaps in their practice.

At the Hospital level, Medical Doctors and Nurses were trained to train HCs on the Integrated Malaria Control Guidelines. At HC level, nurses and CHW supervisors were trained on Integrated Malaria Control Guidelines, while Laboratory technicians were trained on Malaria Diagnosis, Species Identification and Parasites Density Quantification (Table 15).

Table 17: Training of Health Care Providers in Malaria Case Management

SN	Training	Target Group	Achievement
1	Training of Trainers on Integrated Malaria Control Guidelines at Hospital level.	Nurses (1 per Hospital) Doctors (1 per Hospital) CHWs Supervisors (1 per Hospital)	4 Medical Doctors and 2 CHWs supervisors from Kibungo and Kirehe hospitals were trained and were able to adapt training tools for the training of health center.
2	Training of Health Center level Clinicians on Integrated Malaria Control Guidelines	Health Center Nurses (1) Health Center CEHO (1) Head of Health Center (1)	291 health providers from health centers were trained.
4	Training on malaria diagnosis. Species identification and parasites density quantification.	Health Center Laboratory Technicians	40 Health Center lab technicians from Kibungo and Kirehe , District Hospitals were trained.

2. Training of Community Health Workers

In FY 2022-2023, there was an introduction of a Polyvalent Community Health Model, where community health activity will transition from specialized CHWs to polyvalent CHWs who can provide a Comprehensive Community Health Package to the served population. In collaboration with MCCH, CEHO and OPD nurses from HCs in 6 district catchment areas were trained on the Community Health Polyvalent Model. For Malaria Case Management, the team of trainer from Health Center composed of CEHOs and nurses conducted training for ASM and Health Promotion CHWs while also providing a refresher course for Binomes on ICCM (Integrated Community Case Management) and the Management of Malaria Cases in Adults, as indicated in Table 16.

Table 18: Capacity Building of Community Health Workers

SN	Training	Target Group	Achievement
1	Training of CEHO, OPD nurses on iCCM and HBMa Component	CEHO of HCs OPD Nurses in Health Centers (one/HC)	In collaboration with MCCH, **4972** Health Care providers from 18 Districts were trained on ICCM and Community Case Management of Malaria Cases in Adults (HBMa) as a component in Community Health Polyvalent Model.
2	Training of CHWs on iCCM and HBMa	All CHWs from HCs	**36100** CHWs from **327** HCs in 18 Districts were trained on ICCM and Community Case Management of Malaria Cases in Adults (HBMa) as a component in Community Health Polyvalent Model.

3. Implementation of the Therapeutic Efficacy Study (TES)

Monitoring the efficacy of antimalarial medicines is a key component of malaria control. As per the WHO recommendations, national malaria control programs should continue the use of current first-line antimalarial treatments if they still have an Adequate Clinical and Parasitological Response of 95% or greater and that treatment should be monitored at least every 24 months at established sentinel sites. Protecting ACT efficacy for the treatment for *P. falciparum* malaria is among the top national and global public health priorities.

During the previous year, MOPDD in collaboration with partners developed the TES protocol based on the standard of WHO protocol. The study is evaluating the efficacy of AL and Dihydro-Artemisinin-Piperaquine (DHA-PPQ) for the treatment of uncomplicated malaria in three study sites across Rwanda.

Enrollment of study participants started in June 2021, the study teams experienced challenges in enrolling patients due to the decrease of malaria cases seen at Health Facilities. However, strategies were put in place to facilitate patient enrollment which included working closely with Heath Center leaders and CHWs.
The TES implementation is ongoing in the three sites: Masaka, Ngoma and Bugarama with a total of 470 children enrolled out of 528 sample size targeted (Table 19).

Table 19 : Number of Children Screened and Enrolled from June 2021 to June 2023 per Site

TES Study Site	Screened Cases	Enrolled on AL	Enrolled on DP	Total Enrolled	Sample Size Target
Ngoma	459	88	88	176	176
Masaka	366	88	41	129	176
Bugarama	419	88	87	175	176
Total	1,224	264	206	470	528

During this year, 258 children were enrolled in the study across all three sites. Ngoma enrolled 133, Masaka enrolled 51 and Bugarama enrolled 84 for both arms. Ngoma has enrolled 100% of the target sample size , Masaka has enrolled 73%, and Bugarama has enrolled 99%. Overall, enrollment for both arms at the end of this FY is 89.5%.

Strategy 4: Ensure Accurate Quantification and Distribution of Quality Assured Malaria Commodities

4.1. Quality Control of Malaria commodities

MOPDD in collaboration with GHSC/ PSM and Rwanda FDA conducted a quality control of ACTs and Artesunate injection sampled across different supply chain levels including the community. The objective of the activity was to assess the quality of Malaria commodities distributed throughout the supply chain levels. The ACTs and Artesunate injection sample collection was conducted in February 2023 in 8 selected districts (Nyagatare, Kirehe, Burera, Ruhango, Gisagara, Rubavu, Rusizi, and Gasabo) and from the RMS (Central Medical Store) Headquarter representing all five Rwanda provinces. The ACTs and Artesunate injection samples (3,384 tablets of ACTs and 370 vials of Artesunate injection) were sent to the WHO accredited testing Laboratories (SGS – India Private Limited for ACTs and TÜV SÜD PSB Pte Ltd for Artesunate). MOPDD will continue to follow-up the results of these laboratory assessments.

4.2. Quantification and Procurement of Malaria Commodities

Accurate quantification and timely initiation of procurement is key to ensuring that malaria commodities are available at all levels of the supply chain and the stock level is always between the minimum and maximum levels. The malaria commodities procured in FY 2022-2023 are shown in Table 20.

During fiscal year 2022-2023, the MOPDD in collaboration with all CPDS partners conducted an Annual Quantification of Malaria Commodities in order to maintain the tock at the desired level. In addition, regular supply plan reviews were conducted to align the procurement with the changes in consumption of Malaria commodities. The distribution process for malaria commodities followed a systematic approach. These commodities were regularly dispatched to Healthcare Facilities from Central Medical Store (RMS) through the RMS branches. From Health Centers, the distribution extended further to the community level. In situations where necessary, the redistribution of these commodities was also undertaken to guarantee their availability where and when required.

Table 20: Malaria Commodities Procured and Shipments in Pipeline in FY 2022/2023

Product	Quantity Procured	Source of Funds
Received		
Artemether-Lumefantrine 1x6, Blisters	120,000	PMI
Artemether-Lumefantrine 1x6, Blisters	799	GF
Artemether-Lumefantrine 2x6, Blisters	136	GF
Artemether-Lumefantrine 3x6, Blisters	231	GF
Artemether-Lumefantrine 4x6, Blisters	300000	PMI
Artemether-Lumefantrine 4x6, Blisters	589	GF
In pipeline		
Artemether-Lumefantrine 2x6, Blisters	176,790	PMI
Artemether-Lumefantrine 3x6, Blisters	153,840	PMI
Artemether-Lumefantrine 4x6, Blisters	153,840	PMI
Malaria RDTs box of 30 tests	45000	GF

4.3. Validation of RMS Branch Reports and Distribution of Malaria Commodities

The objective of the validation of malaria commodities is to:

- Ensure that the RMS Branches and lower service levels receive the right amount of malaria commodities at the right time.
- Ensure that RMS Branches are given the quantities they need to be stocked according to plan (stock to be between the minimum and the maximum levels) and that they receive feedback on the validation report.
- To ensure e-LMIS data accuracy as the validation exercise is currently based on the information found in e-LMIS.
- Rationalize the quantities available at the RMS store in case of understock. This was done through the redistribution of commodities within districts not only to prevent stock out at RMS but also to avoid expiration of malaria commodities.

During the FY 2021-2022, the validation Antimalarial drugs and other Malaria commodities from all RMS Branches was done through E-LMIS on monthly basis as per the Active Distribution calendar. Emergency requests were validated on request.

4.4. Stock Status of Malaria Commodities, End June 2023

By the end of the FY 2022-2023, the Stock Status of malaria commodities was good; there were no products in stock out, Table 19. However, there was a slight understock of Artemether-Lumefantrine 3x6 at central Medical store (RMS) due to the delayed procurement of this product following the overall decrease in malaria cases observed in the country.

Table 21: Stock Status of Malaria Commodities

Product	RMS HQ	RMS Branches	Qty (HFs)	Stock all Levels	AMC all Levels	MoS all Levels	MOS in Shipment
A/L 1 x 6	105,570	52,410	107,155	265,135	7,498	35.4	0
A/L 2 x 6	1,980	24,868	71,989	98,837	10,958	9.0	16.1
A/L 3 x 6	1,410	811	25,997	28,218	11,535	2.4	13.3
A/L 4 x 6	194,280	63,923	135,249	393,452	27,683	14.2	5.6
Artesunate Inj.	10,458	11,149	13,219	34,826	3,649	9.5	0.0
Quinine Tab	42,700	30,624	136,983	210,307	8,537	24.6	0.0
mRDTs	893,730	101,464	544,101	1,539,295	167,721	9.2	8.0

4.5. Monitoring of Stock Status

The monitoring of Malaria Commodities conducted on a quarterly and monthly basis helped to understand the status of each commodity and calculate the month of stock that allows the program to know if the products are between maximum and minimum required levels (9 months minimum and 12 months' maximum at national level).
In FY 2022-2023, the monitoring allowed the program to plan for redistribution of all Malaria commodities in order to avoid stock out at Central Medical store and to minimize the risk of Stock out in RMS Branches with low stock and expiration in RMS Branches with overstock.

4.6. Challenges

The procurement of Quinine injection and Dihydro-Artemisinin Piperaquine failed due to lack of a WHO Prequalified bidder. MOPD will collaborate with GHSC/PSM to look for the possibility to purchase Dihydro-Artemisinin Piperaquine on PSM funds, while Quinine Tablets and Injection will be phased out due to the limited indication.

PART III: MALARIA SURVEILLANCE AND EPIDEMIOLOGY

Objective 3: BY 2024, Strengthen Surveillance and Reporting for Complete and Timely Accurate Information for Appropriate Decision Making at All Levels

Strategy 1. Strengthen Malaria Routine Surveillance and Epidemic Preparedness and Response (EPR) at All Levels

1. Introduction

Malaria is by far the most common tropical parasitic disease today. Globally, there were an estimated 247 million malaria cases in 2021. The WHO African Region, with an estimated 234 million cases in 2021, accounted for about 95% of global cases.

Rwanda made a remarkable progress towards malaria control in Rwanda during the last five years. However, malaria remains also a major public health challenge, with the entire population at risk.

In Rwanda, malaria surveillance system is integrated into the Health Management Information Systems (HMIS) where the program collects data on malaria epidemiology to provide information for planning, implementing, and monitoring and evaluating malaria control interventions.

The establishment of a robust malaria surveillance and reporting system through strengthening routine IDSR, HMIS and SISCOM reporting systems, improving monitoring and evaluation of the program implementation and promoting the generation and use of evidence to inform malaria programming is essential for the success of this strategic plan.

In addition, population based surveys and operational research such as surveillance of antimalarial drug efficacy and drug resistance, entomological surveillance and vector control monitoring, Malaria Indicator Surveys (MIS), Demographic Health Survey (DHS and other studies are conducted on regular basis to support evidence decision making to fight against malaria

2. Key Malaria Program Indicators

Health facilities reports malaria data on a weekly and monthly basis through IDSR and HMIS while community data are reported monthly through SISCOM system. Key malaria data includes malaria cases, malaria related deaths, malaria inpatients cases (severe malaria), number of testing and treatment.

The program produces trends on key malaria indicators on a monthly basis both at national and district level in order to detect any changes and respond to outbreaks in a timely manner.
Table 20, summarizes the key malaria indicators for FY 2022-2023 compared to previous reporting period:

Table 22: Key Malaria Program Indicators

Nº	Indicators	FY 2020/2021	FY 2021/2022	FY 2022/2023
1	Malaria Incidence per 1,000 persons per year	114	76	47
2	Slide Positivity Rate (%)	27	22	14
3	Uncomplicated Malaria Cases	1,481,698	998,811	622,900
4	Severe Malaria Cases	2,592	1,831	1,316
5	Malaria Deaths	94	71	51
6	Case Fatality Rate (per 100,000 Malaria cases)*	6.5	7.0	8.2
7	Proportion of malaria cases treated at community	54%	55%	58%

Key Malaria Program

38% Reduction of in Malaria Incidence from 2021/2022 to 2022/2023
38% Reduction in Uncomplicated Malaria Cases from 2021/2022 to 2022/2023
29% Reduction in Severe Malaria Cases from 2021/2022 to 2022/2023
28% Reduction in Malaria Deaths from 2021/2022 to 2022/2023
Today, 58% of all malaria cases are being treated at Community Level by CHWs compared to 55% during the FY 2021-2022

3. Malaria Incidence

Malaria incidence has been calculated using the average medium projected population of 2022 and 2023. Data shows that the national malaria incidence in Rwanda reduced from 76 cases per 1,000-person year in FY 2021-2022 to 47 cases per 1,000-person year FY 2022-2023, Figure 20.

Figure 20 : Trends in Malaria Incidence per 1000 Persons Year, 2008-2023

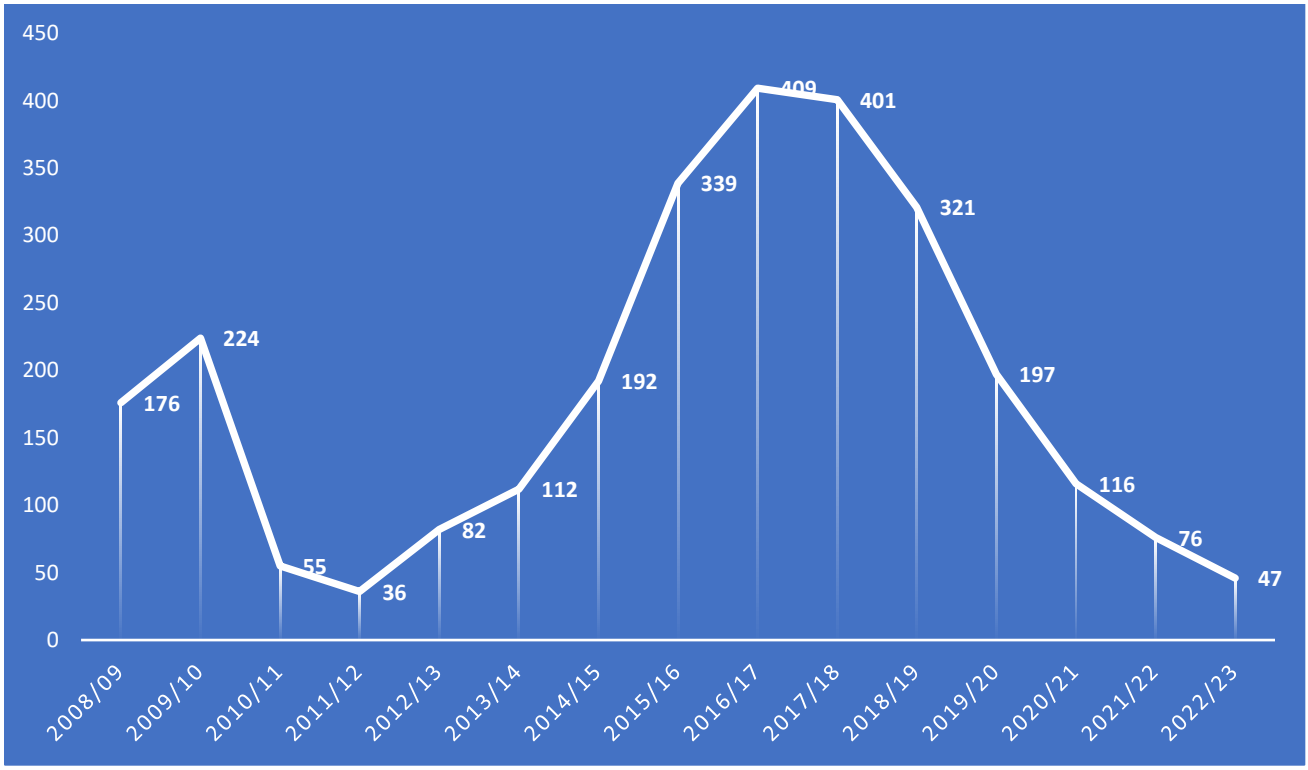
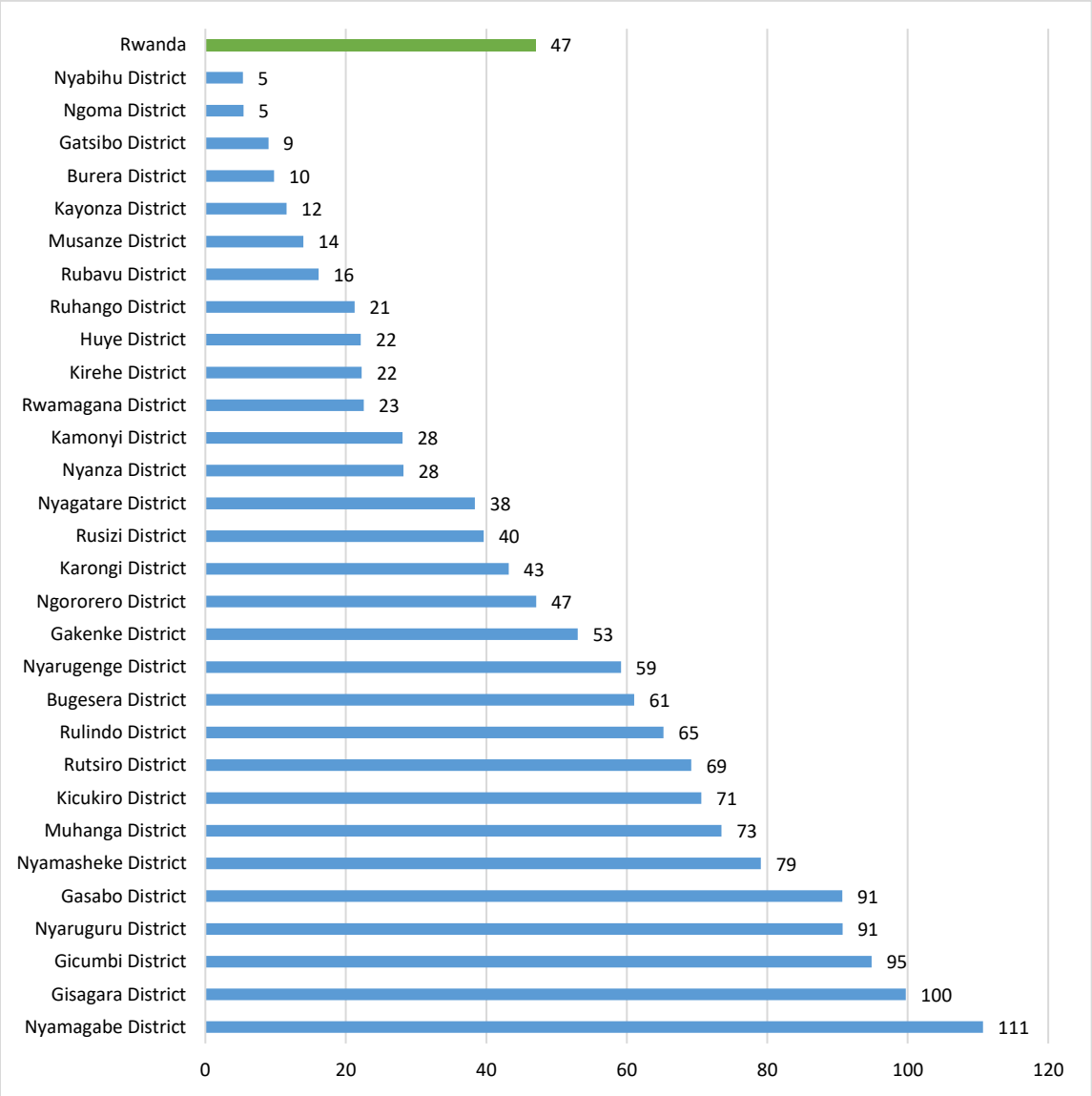
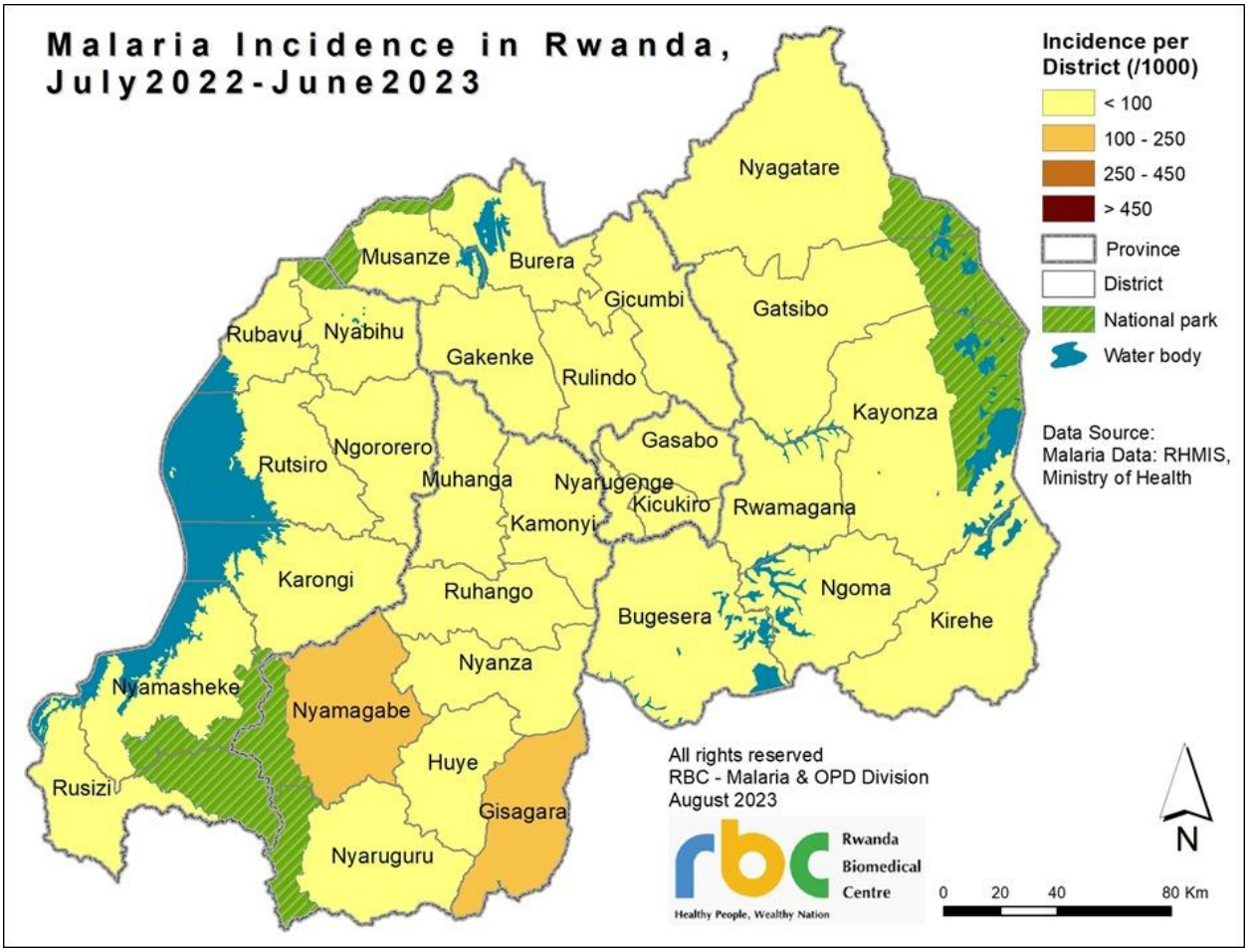


Figure 21 : Malaria Incidence (per 1000) by District, FY2022-23



A total of 29 out 30 districts have reached the incidence ≤ 100 per 1000 in FY2022-23 including those initially in high burden zones (IRS Districts). However, a special attention is required to investigate what is leading to persistent malaria transmission in some hotspots in both IRS and non-IRS districts to accelerate malaria reduction/elimination in Rwanda.

Figure 22: Malaria Incidence (per 1000) by District, FY2022-23



Thirteen districts have incidence above national average of 47 per 1000 persons. Only 2 districts have malaria incidence greater than 100 per 1000 persons during the FY 2022-2023, Figure 21&22 . Districts with malaria incidence greater than 100 per 1000 persons per year are : Gisagara 100 and Nyamagabe 101. None of the districts have malaria incidence greater than 250 per 1000 persons per year compared to four districts during the last FY 2022-2023.

3. Malaria Incidence per Sectors

During the FY 2022-2023, 54 sectors had a malaria incidence greater than 100 cases per 1000 persons compared to 106 in FY 2021-2022. In IRS district 7 sectors with incidence greater than 100 per 1000 persons compared to 44 during the previous FY 2021-2022 with 84% reduction. In non IRS district, we noted 24% reduction of sectors with malaria incidence greater than 100 per 1000 persons per year. (Table 23)

Table 23: Number of Sectors with Malaria Incidence >100 per Type of Interventions

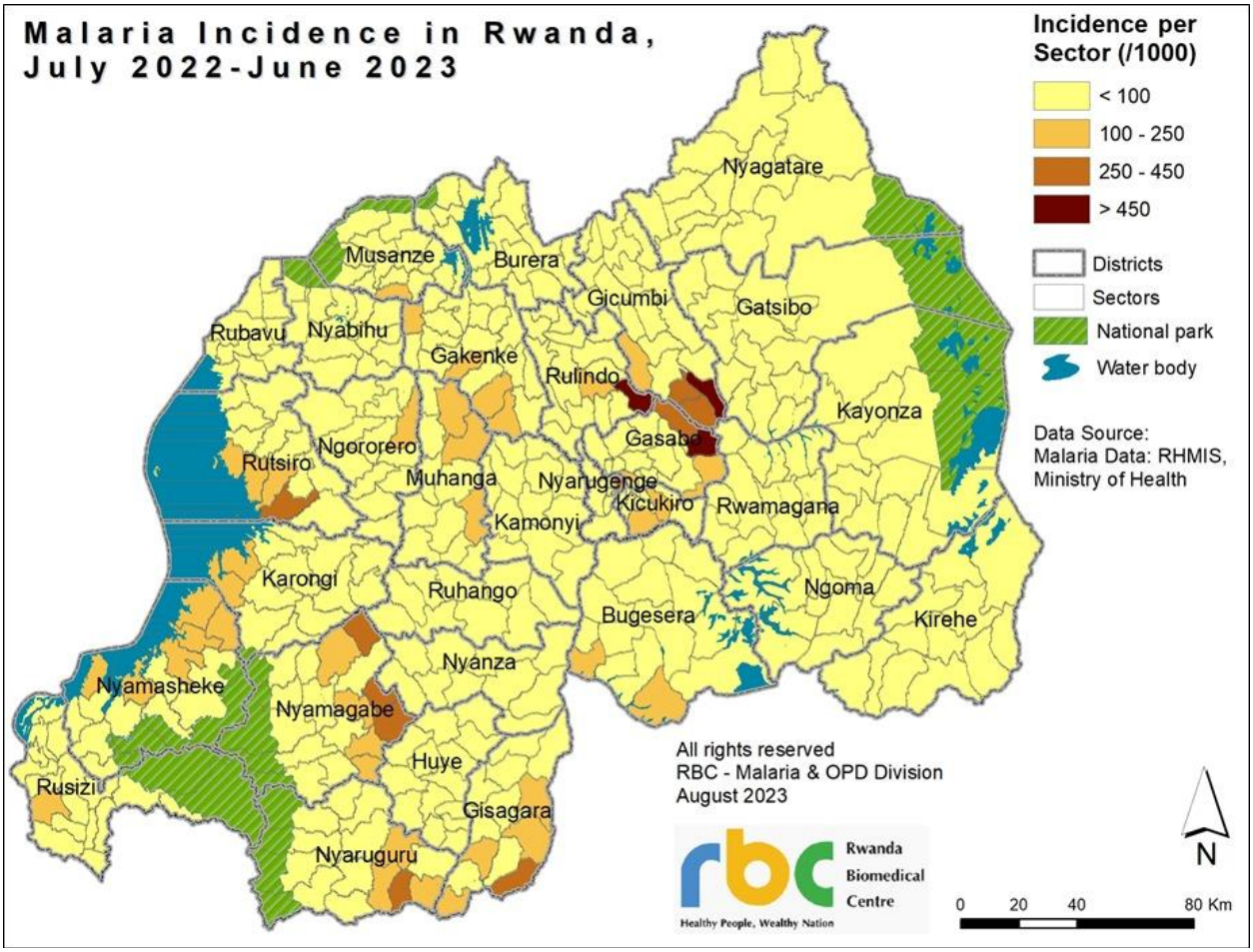
Type of Interventions	FY_2021_2022	FY_2022_2023
IRS	44	7
Non IRS	62	47
Grand Total	**106**	**54**

However, malaria incidence increased in the following sectors during the FY 2022-2023 compared to FY 2021-2022 as per the following table

Table 24: Change in malaria incidence in sectors where malaria incidence is greater by 100 per 1000 persons during the FY 2022-2023

Districts	Sectors	FY 2021_2022	FY 2022_2023	Increase (Points)
Rulindo	Ntarabana	438	501	63
Gicumbi	Rwamiko	266	373	107
Gisagara	Mukindo	268	284	16
Gakenke	Mataba	192	235	43
Gicumbi	Mutete	217	223	6
Gakenke	Ruli	145	211	66
Muhanga	Rongi	141	205	64
Musanze	Nkotsi	81	197	115
Nyarugenge	Muhima	79	186	108
Nyaruguru	Rusenge	177	186	9
Gakenke	Rusasa	87	186	98
Gasabo	Kacyiru	86	167	82
Nyamasheke	Nyabitekeri	123	164	41
Ngororero	Ngororero	128	163	35
Rulindo	Cyinzuzi	83	154	71
Nyamasheke	Mahembe	133	144	12
Karongi	Gishyita	123	143	20
Rusizi	Gashonga	70	105	36

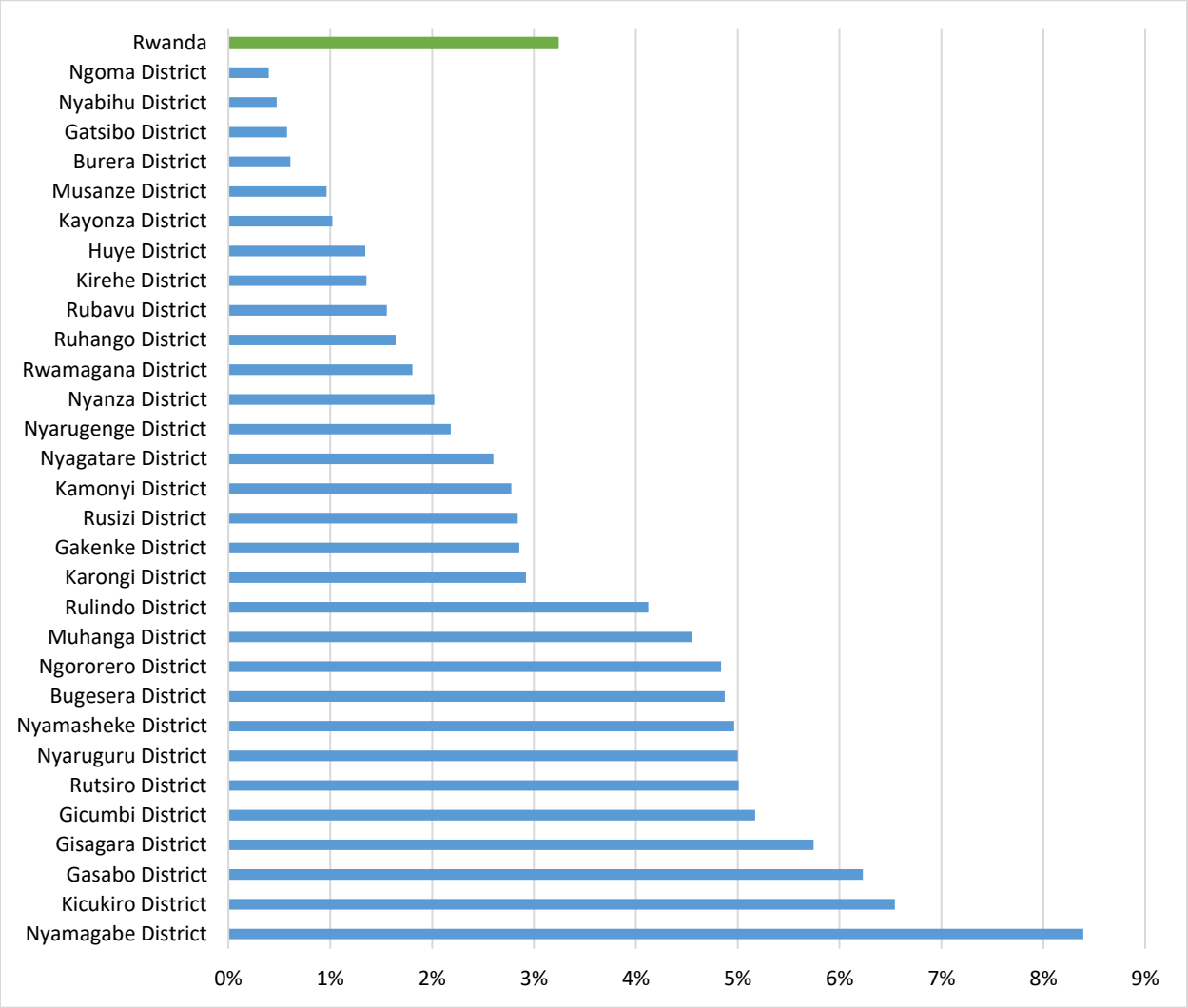
Figure 23: Malaria Incidence (per 1000) by Sector, FY2022-23



4. Malaria Morbidity

During the FY 2022-2023, 622,900 malaria cases were notified both at health facility and community level. Malaria OPD cases represented 3% of all OPD new cases of consultation compared to 5% reported in FY 2021-2022. About sixty percent of malaria cases were treated at community level and 16% percent were treated at health posts. The proportional morbidity of malaria varies across districts from less than 1% in Nyabihu and Burera districts to 8% in Nyamagabe and Kicukiro districts, Figure 24.

Figure 24: Malaria Proportional Morbidity by District in the FY 2022-2023



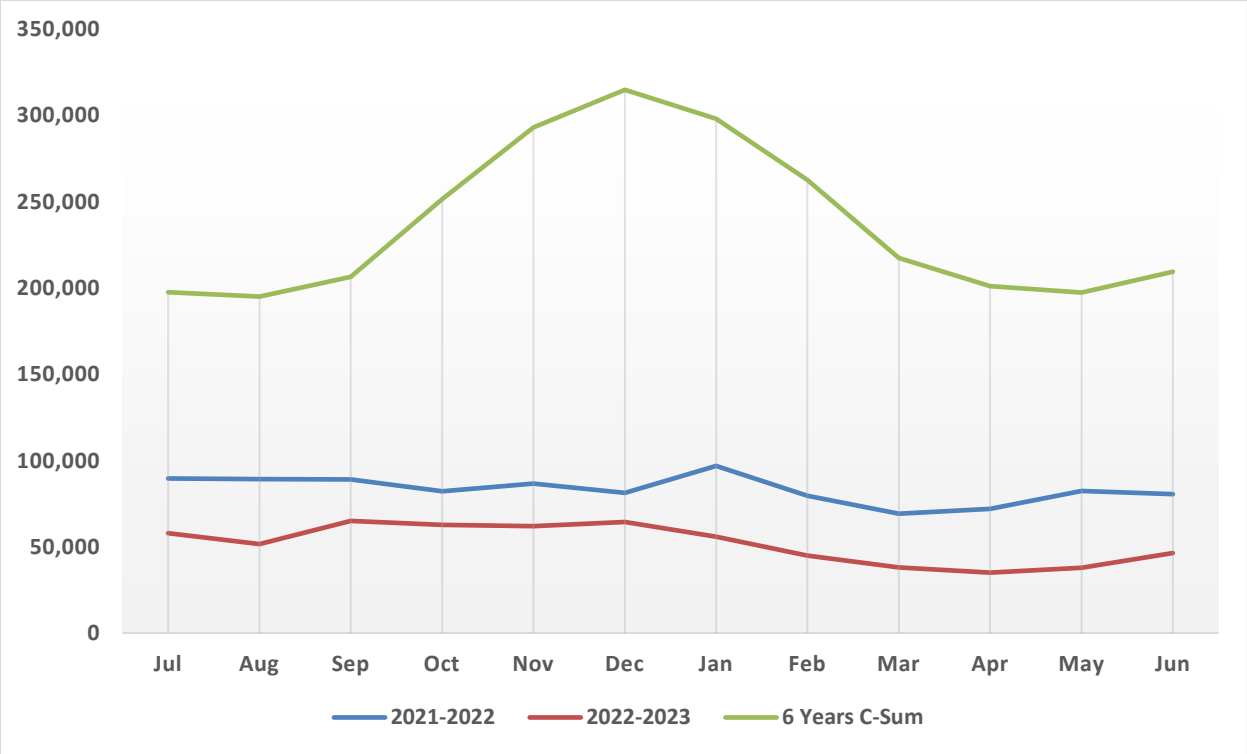
5. Malaria Test Positivity Rate

During the FY 2022-2023 at total 4,585,163 of lab tests were performed compared to 5,449,644 in FY 2021-2022, representing a decrease of 16% of lab tests. This includes 2,764,862 blood smears and 1,820,301 RDTs. The number of RDTs done by community health workers was 1,002,930 representing 22% of all malaria tests performed. The overall slide positivity rate was 14% compared to 22% for last fiscal year. The positivity rate was 5% for Blood Smears and 26% for RDT. At community level, the test positivity rate was 36%. The Annual blood examination rates (ABERs) was 35% compared to 42% during the last FY 2021-2022

6. Trends in Uncomplicated Malaria Cases

From July 2022 to June 2023 a total of 622,900 outpatients were reported compared to 998,811 during the FY 2021-2022, representing a decrease of 38%. Malaria cases treated at the community level represent 59% of all cases. The private health facilities account for 22,324 (4%) and health posts accounted for 190,784 (16%). Children under five years accounted for 100,956 malaria cases (16%) and pregnant women 3,507 (0.56%).
Figure 23 shows the monthly trends of malaria cases of FY 2022-2023 compared to FY 2021-2022 and the monthly average cases for the last 6 years using the C-sum method. We noticed a reduction of malaria cases during the FY 2022-2023 compared to the last 6 years (Figure 25).

Figure 25: Monthly Malaria Cases from 2021 to 2023



Note: The 6 years average was calculated using the C-Sum method

Strategy 4. Strengthen Severe Malaria Notification and Malaria Death Audits

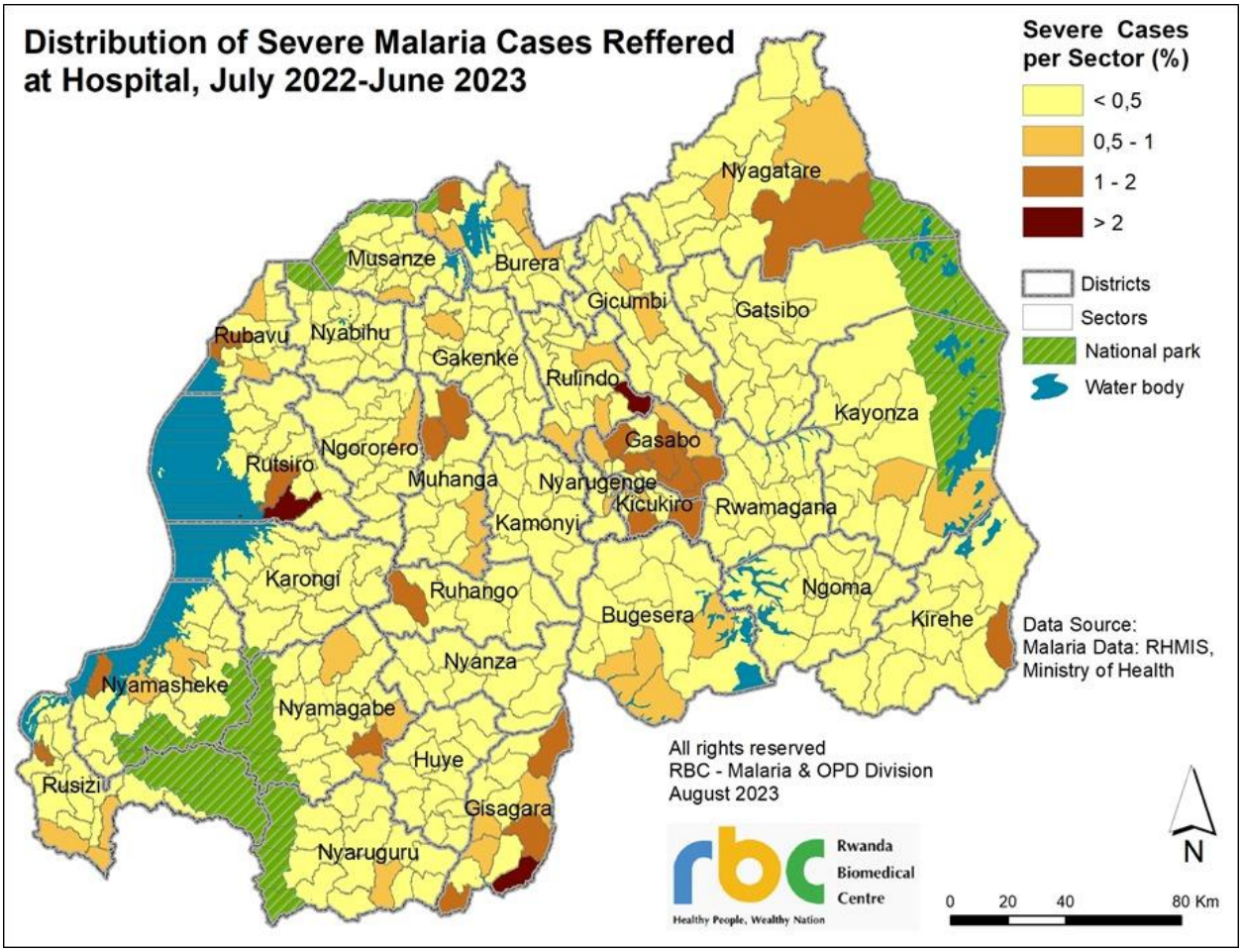
1. Severe Malaria Cases

Over the reporting period, 1,316 cases of severe malaria were reported by hospitals. level compared to 1,831 reported in the FY 2021-2022, representing a 28% reduction of severe malaria cases. This indicates that interventions such as home-based treatment of children and adults that contributed to early diagnosis and treatment have been successful in decreasing the number of severe cases and consequently the number of malaria deaths. The free treatment of poor people in Ubudehe Category I and II also removed the financial barriers for access to health care. The number of severe cases was referred by health centers to hospitals were 803 as per table below. The majority of severe cases are from Gisagara, Gasabo, Rulindo, Rusizi Burera and Rutsiro districts. There is a variation of severe malaria cases by sectors within a district as per the figure 26.

Table 25 : Number of severe malaria cases referred to hospitals per districts, FY 2022-2023

Districts	Severe cases	%		Districts	Severe cases	%
Gisagara	75	9%		Nyaruguru	21	3%
Gasabo	74	9%		Nyagatare	19	2%
Rulindo	54	7%		Nyarugenge	17	2%
Rusizi	47	6%		Ngororero	16	2%
Burera	44	5%		Kamonyi	13	2%
Rutsiro	44	5%		Musanze	12	1%
Gicumbi	39	5%		Karongi	11	1%
Kicukiro	38	5%		Kayonza	11	1%
Muhanga	37	5%		Ruhango	10	1%
Nyamagabe	35	4%		Nyanza	9	1%
Nyamasheke	35	4%		Gatsibo	8	1%
Rubavu	35	4%		Huye	7	1%
Bugesera	31	4%		Nyabihu	4	0%
Gakenke	25	3%		Rwamagana	4	0%
Kirehe	25	3%		Ngoma	3	0%
Total	**803**	**100%**				

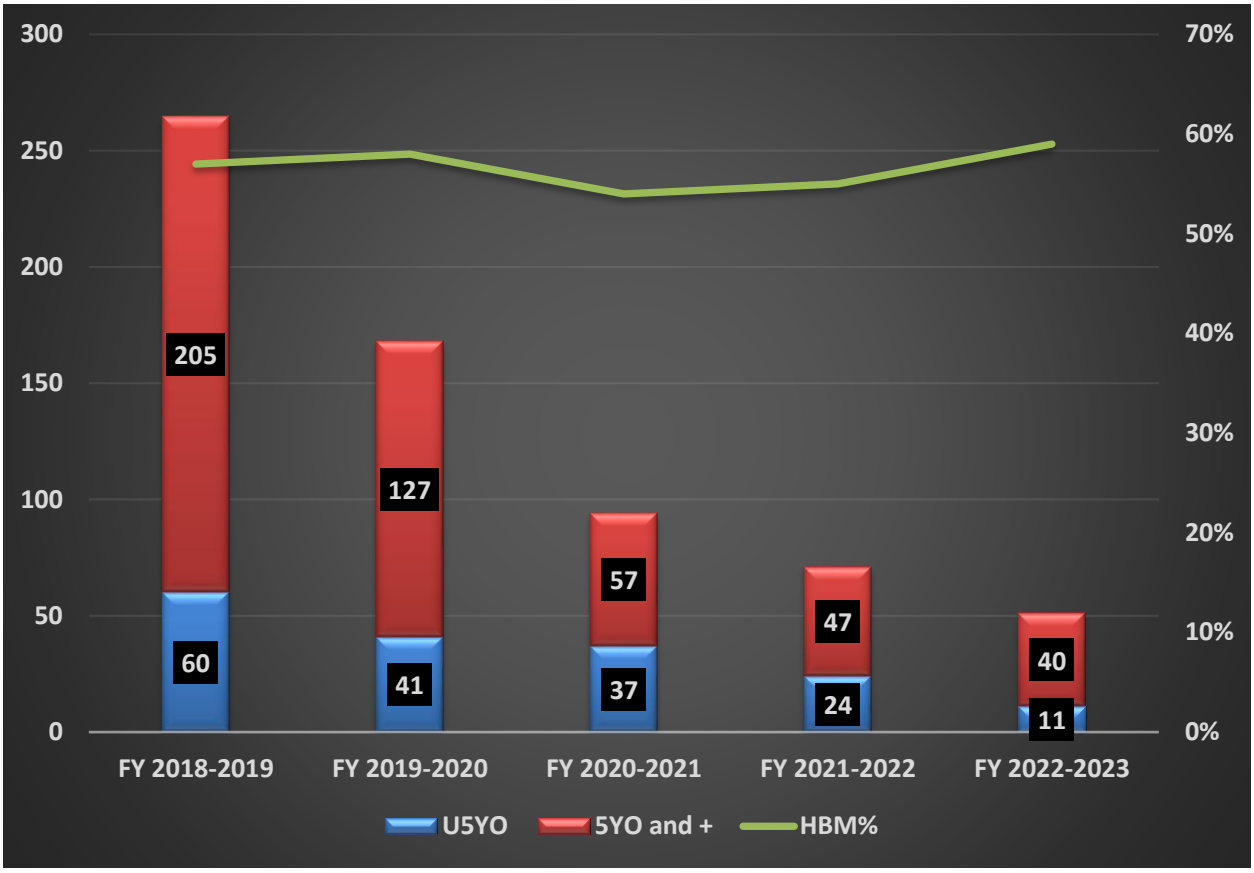
Figure 26: Distribution of Severe Malaria per Sector, FY2022-2023



2. Malaria Mortality

Over the FY 2022-2023, 51 malaria deaths were recorded following hospitalization for severe malaria compared to 71 deaths in the FY 2021-2022 representing a 28% of Malaria Deaths reduction. The number of malaria deaths was 11 among under 5Years (22%). Report from malaria deaths audit shows that 73 % had severe malaria cerebral form and 18% severe malaria anemic form. The decrease in malaria deaths may be a result of the malaria HBM interventions and free treatment of malaria for Category I and II of Ubudehe and the quality of care at health facility level.

Figure 27: Malaria Related Deaths per Age Groups, FY2022-2023



Strategy 5. Improve Reporting from the Private Sector and Sustain Public Sector Reporting

1. Capacity Building

a. Integrated Supportive Supervision and Mentorship

Supportive supervision and mentorship of health providers at the facility level is a continuous activity aiming to strengthen the delivery of quality malaria services. The supportive supervision is led by hospital-based malaria supervisors in collaboration with RBC/MODD Supervisors and implementing partners guided by the national integrated supportive supervision tools.

Malaria Program carried out the malaria integrated supportive supervisions (ISS), in collaboration with its partners (Ingobyi Activity and Impact Malaria), in targeted health facilities.

The ISS aimed at assessing availability of tools, policy and guidelines, materiel and commodities, LLINS availability and SBC tools for both Malaria and NTDs.

District hospitals in collaboration with malaria implementing partners conducted quarterly supportive supervision at all health centers and communities at least once an year per facility. During this Fiscal year 2022-2023, the integrated supportive supervision was performed in two rounds and in the first round. A total of 18 hospitals, 65 health centers, 17 health posts and 7 RMS branches and 98 community health workers were assessed.
The ISS revealed that 80% of hospitals perform blood smear where their results include parasite species records and parasites quantification, 90% of have quality control results of blood smear, 80% have bench aids, 90% have updated Malaria diagnosis SOP. Malaria cases and deaths were notified at 80% on weekly basis through IDSR in last three months. Ninety percent of hospitals conduct also a monthly data validation meeting at hospital level and 60% conduct malaria quarterly coordination meetings where the hospitals and all health centers discuss on malaria issues.
At Health Center level, 80% conduct monthly data validation meeting and 86% of CEHO participated in monthly data validation meeting for CHWs.

Ninety six percent of CHWs have treatment algorithm, 94% have community malaria RDT algorithm, 78% have malaria treatment registers and 94% malaria drugs stock files well filled. The head of health facilities requested the District and Hospital to create the platform for Health Post Managers where all Health issues will be shared.

b. Data Quality Review Meeting

Malaria Program in collaboration with the Hospitals organized data quality review meetings to improve data quality and the malaria data use to improve service delivery and malaria surveillance. The number of participants was 791 composed mainly by Director General of the Hospital or his/her delegate, M&E team at the Hospital, Head of health centers, the data managers, C-EHOs and nurse in charge of OPD services at health center level and.
Triangulation of malaria indicators and scorecards analysis were the focus of the meeting. The triangulation of related reported data element showed the following data quality issues: The data quality review and validation meeting conducted have shown a concordance of 75% between fever cases and malaria diagnostic tests, 93% malaria cases and positive tests and 62% between malaria cases and consumed ACTs.

The root causes of discrepancies were related to the counting errors, incompleteness of data source document, misunderstanding of some malaria indicators, combination of ACTs and irregularity in conducting data validation meeting.
The taken recommendations to minimize those errors are to improve the completeness of data source document, reinforce the monthly recheck the quality of data before data entry and before the closure of the HMIS system as well as conduct data validation meeting regularly.

c. Data quality Assessment/Audit at community level

The data quality assessment was carried out with the objective of identifying the various data quality issues at the health facility and community level and determining how to solve them. This activity was performed in two sessions during which 30 Districts of the country were visited, 93 health centers, 186 cells, 374 villages and finally 546 community health workers visited. The data quality assessment consisted to verify whether the data reported in the SIS Com system on malaria cases treated positive tests and distributed ACTs are those found in the source data documents (registers of community health workers).
Discrepancies between the data source documents from community health workers and the reports transmitted on the malaria cases was 3%, 4% on positive tests and 11% on ACTs distributed to patients by community health workers.

d. Malaria Data Quality Assurance

To ensure the quality of Malaria indicators reported in HMIS by health facility and community, every sixth day of the month, MOPPD generate and analyze the data for the data quality verification. The analysis report is shared with to all concerned health facilities in order to correct the data before closing HMIS and SISCom systems. The second extraction and analysis of this data is carried out and shared with HFs between the 11th and 14th day of the same month to check if the corrections were made.
Despite the effort of the government and partners, COVID-19 hindered the quality of services including data reporting process due to overwhelmed of health care provider's staff.During this year the reporting rate was 92.5% at hospitals, 99.5% at health centers, 70% at health posts and 47% at private health facilities.
The on-time reporting was 88.6% at health centers, 86.% at hospitals.

e. Malaria Death Audit

During the FY 2022-2023, 67 malaria deaths were reported into HMIS. The program conducted malaria deaths audits in two round and 51 were confirmed as deaths due to malaria and 11 among under 5Years (22%).

Strategy 6. Develop and Implement an Operational Research Agenda for Malaria

In line with improving the quality of malaria related services, the malaria program regularly conducts research. In this reporting period, the following research projects have been implemented:

Study Title	**Status**
Therapeutic Efficacy Study	Implementation ongoing
Estimating the Malaria Prevention Impact of New Nets: Observational Analyses to Evaluate the Evidence Generated During Piloted New Nets Distribution In Rwanda	Completed and disseminated
Assessing the Durability of Long Lasting Insecticidal Treated Nets (LLINs) 36 months post mass distribution in Rwanda	Completed
Assessment of Malaria Case Management in Rwanda: Health Facility Survey for FY 2021-2022	Completed

PART IV: PROGRAM COORDINATION AND MANAGEMENT

Objective 4: By 2024, Strengthen Coordination, Collaboration, PSM and Effective Program Management

To sustain gains made by Malaria Control Program and its Partners, there is a need for strong coordination and collaboration between different Stakeholders. Advocacy and resources mobilization efforts are very key to cover all program needs and priorities.

From July 2022 to June 2023, the following activities under specific strategies have been implemented in line with strengthening coordination, collaboration, procurement, and supply management, as well as effective program management.

Strategy 1: Mobilization of Adequate Financial Resources

- **Development of Malaria Operational Plan 2024 (MOP 2024) funded by PMI**

In collaboration with the Presidential Malaria Initiative (PMI) and CDC, the Rwanda Malaria Control Program developed and submitted the Malaria Operational Plan 2024 (MOP 2024) amounting to $19 million to cover key malaria control interventions as per the National Strategic Plan 2020-2024.

- **Participation to National Planning for Action Plan for FY 2023-2024**

In FY 2022-2023 Malaria control programme participated in the Action Plan (AP) development process coordinated by the Ministry of Finance (MINECOFIN) and the Ministry of Health (MOH). During the planning sessions for AP FY 2023-2024 a total of 5,968,854,499 RWF as direct support to malaria program to cover direct programme needs including LLINs, IRS, integrated vector control, case management, etc..

Additional resources mobilized during FY2022/23 include $3,370,119.45 from END Fund to support NTDs survey, research projects, donation of Praziquantel and Albendazole/Mebendazole for MDA of Soil-Transmitted Helminthiasis and Schistosomiasis, MDA digitalization, and M&E for NTDs, a total of 7,561,109 USD from WHO to support NTDs programme in terms of donation of Praziquantel and Albendazole/Mebendazole for MDA and 150,000 USD to support Malaria programme in terms of Technical Assistance and capacity building.

- **Participation to the global PMI meeting in November 2022 in Seattle, Washington**

In October 2022 Rwanda Malaria Control Programme attended the US President Malaria Initiative and National Malaria Programme Leadership Meeting. The meeting took place Seattle, Washington and involved global PMI team and National Malaria Programmes from 27 PMI supported countries. In this meeting Rwanda presented the Impact of Scaling Up Community Case Management to all ages.

- **Coordination of the Global PMI Coordinator Visit in Rwanda**

In November 2022, the USAID/PMI Global Malaria Coordinator, Dr David Walton, visited the Rwanda Ministry of Health. The visit focused on understanding PMI malaria programming and support in Rwanda by engaging with USAID Mission and Ministry of Health leadership, PMI in-country teams, the Rwanda malaria control program, and implementing partners, and by observing key malaria control interventions taking place at the national, sub-national, and district levels in Rwanda.

Dr David Walton, USAID Team and RBC/MOPDD Staff Visiting Entomology Lab, Kicukiro

- **Participation to the World Health Summit in October 2022, in Berlin, Germany**

The this World Health Summit (WHS) discussed different health topics and Rwanda NTDs programme presented the national experience in Schistosomiasis control: Moving to Action through the Kigali Declaration

Strategy 2: Strengthen the Intra- and Inter- sector Collaboration and Coordination for Malaria Control at All Levels

From July 2022 to June 2023, two (2) Malaria Technical Working Group Meetings were organized to discuss key malaria control program issues including the need for new malaria first line treatment options, the new LLINs distribution plan based on evidence on PBO and G2 Nets impact, etc.
In this line, the protocol of Pyronaridine–Artesunate (Pyramax) Safety, tolerability, and effectiveness in Rwanda: A single arm, open-label Study was developed and waiting for implementation.

Strategy 3: Synchronization and Alignment of Malaria Commodities Procurement and Supply Management

The program procurement plan FY2022/23 was developed to guide all program commodities procurement. Anti-malaria drugs, diagnostic tests, LLINs, Insecticides for IRS, IRS materials, etc. were procured based on the program needs.

The process was guided by comprehensive malaria commodities need assessments and timely implementation procurement plans to avoid stock outs, expiries, or delays in implementation of key malaria interventions such as IRS or LLINs mass distributions.
Regular data and supply chain review meetings were organized to inform adjustments in quantities to be procured.

PART V: SOCIAL BEHAVIOR CHANGE COMMUNICATION

Objective 5: By 2024, 85% of the Population Will Have Correct and Consistent Practices and Behaviors towards Malaria Control Interventions

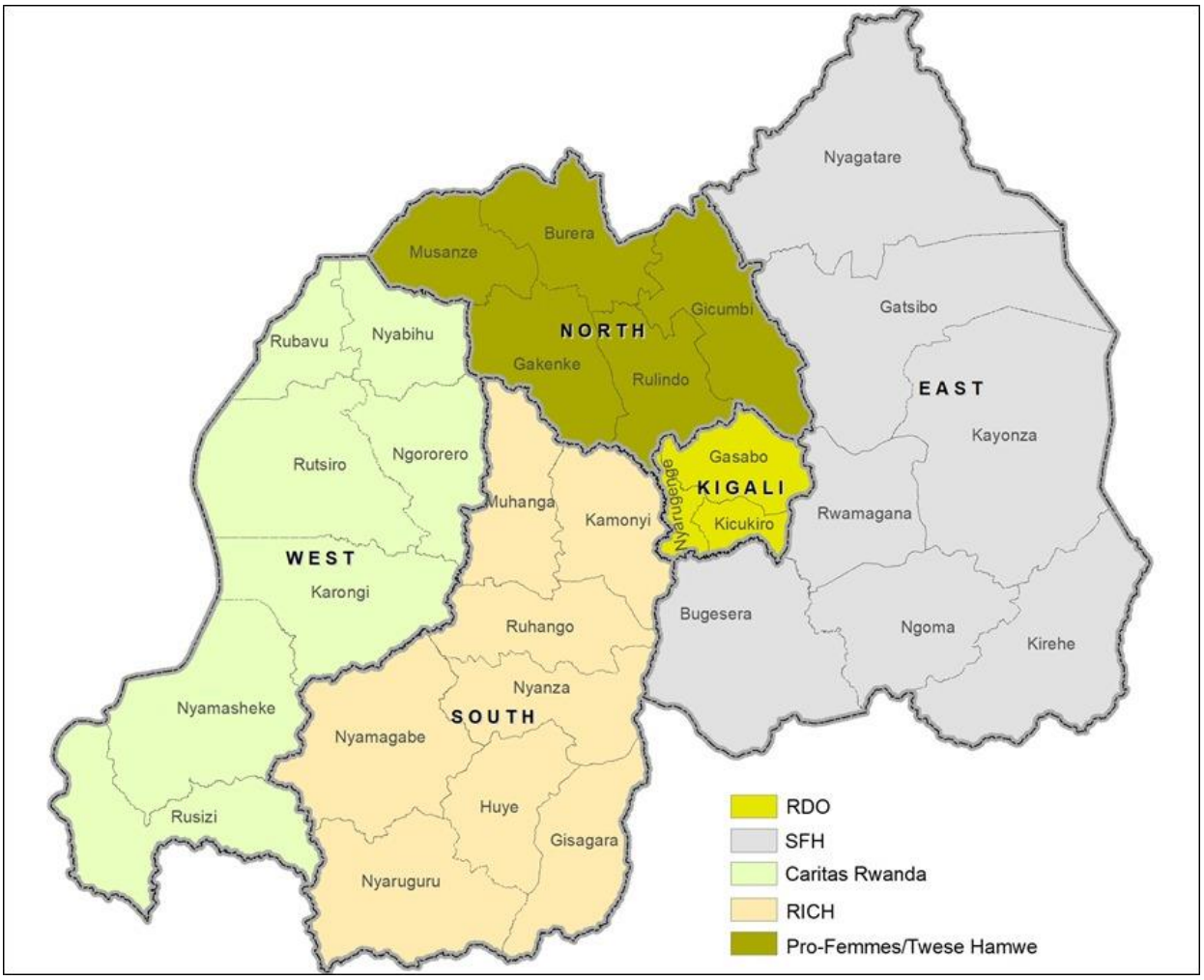
1. Introduction

In collaboration with partners, the Ministry of Health/RBC/MOPDD, using the Matchbox findings of March 2021 have conducted the need assessment, mapping of hotspot and situational analysis among high-risk groups to orient the specific interventions being implemented in the context of malaria. From the assessment a total number of 766,647 persons among high-risk groups were identified. These vulnerable groups include Rice Farmers, Fishermen, Mining workers, truck drivers, Health Care Providers, Students at School, Hotels Staff and Clients, Female Sex Workers, Motorcyclists, Cross-border trades, Seasonal Workers, People with disabilities and travelers, etc.

No	High risk groups	Province					
		Southern	Western	Eastern	Northern	City of Kigali	Total
1	Femele sex workers (FSWs)	5 992	4 856	6 560	3 478	10 687	31 573
2	Motorcyclist	5 227	4 431	5 037	4 243	18 938	37 876
3	Cyclist	4 241	6 412	9 033	3 999	10 791	34 476
4	People with disability (PWDs)	38 309	35 207	37 567	20 494	9 600	141 177
5	Seasonal workers	38 271	5 227	7 670	4 817	8 104	64 089
6	Cross borders traders	101	97 354	2 213	905	-	100 573
7	Truck Drivers	187	985	472	587	1 372	3 603
8	Rice Farmers	29 252	12 522	31 133	-	2 542	75 449
9	Miners	7 760	10 610	4 820	6 978	6 560	36 728
10	Student In Bording Schools	56 803	43 709	46 430	34 825	17 019	198 786
11	Health care Providers	2 985	2 608	3 046	2 146	13 142	23 927
12	Staff in Hotels and Lodge	936	1 812	1 672	4 804	2 984	12 208
13	Fishermen	1 364	1 315	2 587	823	93	6 182
	Total						**766 647**

SBC Strategy 2022-2024 was established to guide targeted interventions, furthermore in this reporting period the Social and Behavior Change (SBC) activities on malaria prevention and control were guided by the Health Promotion Policy mainly building on the principles of community participation, health education, access to health services, advocacy, and partnerships, to ensure acceptability, usage and thus sustainability of key interventions including LLINs, IRS and early case management and integrated malaria vector control at all levels. As per recent findings and recommendations from the Malaria Program Mid Term Review 2022, it was noted that there is a need to increase community

awareness and ownership regarding malaria control intervention for sustainability. The implementation has been done through different partners and Seven Civil Society Organizations (CSOs) deployed countrywide: five CSOs implementing malaria SBC activities per province targeting general population and two CSOs (RNGOF and ASSOFERWA) implementing SBC activities targeting all Malaria identified high risk groups countrywide:



Deployment of five CSOs implementing Malaria SBC activities per province in General population

2. Strengthen the Malaria SBC Framework

During the year 2022-2023, MOPDD in collaboration with malaria implementing partners and stakeholders developed the Malaria SBC strategy which serves as guidance to effectively implement SBC interventions. Additionally, Malaria Program and partners conducted different district malaria strategic meetings targeting high risk groups and

general population on malaria prevention and control interventions to increase awareness around malaria disease burden with total of 1,960 participants were reached, to call for support and appropriation and ultimately engage community members to address the gaps identified.

3. Increase Awareness on the Communities' Role in Malaria Prevention and Control

During the FY2022-2023, Malaria social behavior change strategic interventions were conducted from Provincial to community levels, to promote community ownership in malaria prevention and control which is considered as a key aspect to fast track the ongoing "***Zero Malaria Starts with Me/Kurandura Malariya Bihera Kuri Njye***" Slogan.
In the same context, different interpersonal communication (IPC) through community existing platforms (Umuganda, Inteko z'Abaturage) were conducted where challenges were discussed by all concerned parties plotting channels and solutions for both short and long term. Using the scorecard as a comprehensive tool to measure Malaria key performance indicators: the coverage of LLINS in ANC and EPI programs as well as malaria incidence, severe malaria cases, HBM and the proportion of suspected Malaria cases that receive parasitological test at community level, the Community mobilization such as outreach campaigns and supervisions were conducted and reached the 153,221 people. At health facility level, the SBC targeted supervisions were helpful to address the problems identified by score cards.

To increase community awareness and ownership about malaria prevention and control interventions, the following SBC activities were implemented: Radio and TV talk shows 15, educative audio and video spots 21, radio sketches 15, Urunana radio soap opera six (6) episodes, and six umuhoza radio magazine programs. There was also production and dissemination of IEC materials including Flex banners 12, Pull up banners 20, Tear drops: 20, T-shirts 2,160, stickers with message :8,000, Flyers: 350.

4. Increase Advocacy for High Level Support to Sustain Malaria Prevention and Control Interventions

This year has been remarkable in advocating for malaria prevention and control. Stakeholders at all levels are committed to achieve the Government's goal as far as malaria prevention and control is concerned, by including malaria prevention and control measures in their routine agenda. The RBC-MOPDD in partnership with Civil Society Organizations (CSOs) successfully organized the World Malaria Day at National level on 25th April 2023, held in Bukure Sector, Gicumbi District, whereby 4,200 Rwandan joined the rest of the World to celebrate World Malaria Day (WMD) with a Theme "Time to

deliver: invest, innovate, implement" and the theme at national level was "**Zero Malaria Starts with Me"**.

The celebration of the World Malaria Day in Rwanda was an opportunity of combined efforts to mobilize the populations on roles of the community and all stakeholders in malaria prevention and control at all levels. And to join the global effort to control malaria and to highlight the need for continued investment and sustained political commitment for malaria prevention and control.

Photo: Celebration of the WMD 2023, Gicumbi

5. Promote Community Engagement in Malaria Prevention and Control Interventions

SBC activities implemented by CSOs generated outstanding contributions with regards to Malaria prevention and control, leading to outcomes such as early diagnosis and treatment at community level. Malaria messages on malaria prevention and control were disseminated through various communication channels. The disseminated messages focused on creating awareness on the role of community in malaria prevention and control, including sleeping under Long Lasting Insecticides Nets (LLINs), use of mosquito

repellents, households' environmental hygiene to eliminate peri-domestic mosquito breeding sites and seeking early treatment. In addition to this, implementing partners in collaboration with RBC /MOPDD through SBC conducted a training on Integrated Vector Management (IVM) for key stakeholders at sector level and peer educators among high-risk groups, whereby a total number of 837 participants have been trained. Despite the achievements, there are some challenges encountered during this fiscal year such as the social marketing of inaccessibly for adapted preventive tools repellents and LLINs.

Table 26: KEY SBC MALARIA ACTIVITIES IMPLEMENTED, FY2022-23

No	Malaria SBC Activities Implementation			
	Activities	**Target**	**Reached**	**%**
1	Organize the SBC meeting interventions for Malaria prevention and control at district level	65	65	100%
2	Conduct annual review meetings at district level	348	344	99%
3	Conduct Training on IVM at Sector level	125	125	100%
4	Organizing targeted Malaria IEC sessions and supervisions at community level through existing community platforms	24	25	104%
5	Conduct community mobilization on Malaria prevention and control in hot spots using mobile sound system	33	33	100%
6	Organize Radio and TV talk shows	15	15	100%
7	Production and Airing radio spots on (LLIN utilization, Malaria Early treatment, environmental management and HBM)	5	5	100%
8	Production of IEC materials: # of Banners	12	12	100%
	# of Pull up banners	20	20	100%
	# of Tear drops	20	20	100%
	# of T-shirts	1161	1161	100%
	# of Stickers	12	12	100%
	# of Flyers	350	150	43%
9	Quarterly Supportive supervisions to Hotels/Lodges on Malaria prevention and control	28	26	93%
11	Supervision of Malaria Case Finding, analysis and supply chain Management of Malaria commodities in Hotspots (at Community Level)	8	8	100%

Activities	Target	Reached	%	Activities
12	Organize and conduct Outreach Awareness raising campaigns in malaria high burden sectors on LLINs Hanging and use, on early care seeking	52	76	146%
13	Edutainment activities, competitions (poems, debates, sports competitions) to involve youths on Malaria prevention and control	16	17	106%
14	Conduct Supportive supervision at Health posts level targeting malaria high incidence	26	26	100%
15	District Malaria Strategic meeting targeting high risk groups	987	963	98%
16	Conduct need assessment, mapping of hotspot and situation analysis among high-risk groups	2	2	100%
17	Organize a 3 days' workshop of peer educators among high-risk groups on Malaria Prevention and IVM	727	712	98%
18	Organize Outreach Awareness raising campaign in hotspot for Malaria high risk groups	20	20	100%
19	Production of educative videos on Malaria prevention and control	19	16	84%
20	Produce and disseminate educative radio sketch on Malaria prevention and control	15	15	100%
21	Organize annual SBC advocacy meeting	120	140	117%

PART VII: FINANCING THE MALARIA AND NTDs PROGRAMS

1. Introduction

The financing of Malaria Strategic Plan becomes a high priority for the GoR. The MSP is funded by the Government of Rwanda, the Global Fund for HIV & AIDS, TB and Malaria Results Based Financing (GF), the US President's Malaria Initiative and END Fund.

Through SMART FMIS (Integrated Financial Management Information System), data of the actual financial report were generated given that HRTT captured so far budget and expenditures of the reporting period. To facilitate the collection of financial information for this year's report, a separate data collection process was adopted using for Global Fund grant and Government contribution; and from the approved Malaria operational plan for PMI.

2. Public and External Funding Sources for Malaria Program

Below a summarized table illustrates the malaria budget by source of funding with: PMI followed by GoR, Global Fund for Fiscal year 2022-2023. The current total expenditures are amounting to USD **71,240,248**which represents 94% of total budget of USD **75,706,071**.

Table 27: Malaria Budget and Expenditures by Source of Funds, FY2022-2023

Budget Execution per Source of Funds, FY2022-23						
Funding Sources	**Opening Balance in USD**	**Initial Approved Budget in USD**	**Budget Approved in USD**	**Expenditures in USD**	**Variance in USD**	**Performance Rate in %**
GLOBAL FUND	11,054,762	11,436,866	22,491,628	22,491,628	0	100%
PMI		19,000,000	19,000,000	19,000,000	0	100%
GoR		34,004,128.11	34,214,443	29,748,620	4,465,824	87%
Total	**11,054,762**	**64,440,994**	**75,706,071**	**71,240,248**	**4,465,824**	**94%**

3. Government Expenditures by MTEF Chapter for Fiscal Year 2022-2023

The total GoR contribution to malaria expenditures is USD 34 214 443, from this budget the total expenditures are USD 29 748 620 represents 87 % of total budget.

As presented in Table below, of the total expenditure was allocated to: (i) Compensation of employees, (ii) Use of goods and services, (iii) Subsides (iv) Grants (v) Social assistance; (vi) Other expenditures; (vii) Inventory and (viii) Fixed tangible non-financial Assets MTEF Chapter.

Table 28 : Government Expenditures by MTEF Chapter for FY2022-2023

MTEF Chapter	Approved Budget for FY 2022-2023 in USD	Revised Budget for FY 2022-2023 in USD	Committed Amount FY 2022-2023 in USD	Budget Balance end June 2023 in USD	Performance rate in %
21 Compensation of employees	17 198 693	17 152 155	15 079 044	2 073 111	88%
22 Use of goods and services	6 250 397	6 351 786	5 198 937	1 152 848	82%
25 Subsides	918 686	930 232	852 363	77 870	92%
26 Grants	2 016 023	2 127 739	2 037 500	90 238	96%
27 Social assistance	2 770 239	2 708 405	2 692 819	15 586	99%
28 Other expenditures	1 850 399	1 832 855	1 449 606	383 248	79%
33 Inventory	20 771	20 771	20 771	-	100%
34 Fixed tangible non-financial Assets	2 978 921	3 090 501	2 417 578	672 922	78%
Total	**34 004 128**	**34 214 443**	**29 748 620**	**4 465 824**	**87%**

4. Global Fund Contribution to Malaria Program

For the Global Fund contribution, the budget for the year 2022–2023 was USD 11 436 866, revised to USD 22,491,628 using the opening balance from last Fiscal year 2021-2022; Out of this budget revised, a total of USD 22 491 628 have been spent 100 % of total budget for MALARIA National Strategic Plan.

Table 29: Global Fund Expenditures by NSP Budget Categories for July 2022 to June 2023

Cost Category	Opening Balance in USD	Approved Budget in USD	Revised Budget in USD	Committed Amount in USD	Budget Balance in USD	Performance Rate in %
1.0 Human Resources (HR)	118 698	1 202 507	1 321 205	1 334 926	- 13 721	101%
2.0 Travel related costs (TRC)		3 279 970	3 279 970	3 639 551	- 359 580	111%
3.0 External Professional services (EPS)		42 000	42 000	14 533	27 467	35%
5.0 Health Products - Non-Pharmaceuticals (HPNP)	9 570 423	4 875 590	14 446 014	14 446 014	-	100%
7.0 Procurement and Supply-Chain Management costs (PSM)		720 543	720 543	786 161	- 65 618	109%
10.0 Communication Material and Publications (CMP)	1 365 641	279 072	1 644 713	1 644 713	0	100%
13.0 Payment for results		1 037 184	1 037 184	625 730	411 453	60%
Total	**11 054 762**	**11 436 866**	**22 491 628**	**22 491 628**	**0**	**100%**

5. PMI Expenditures for the Fiscal Year 2022-2023

The PMI contribution for malaria expenditures went specifically to malaria preventive intervention and to malaria case management interventions. The budget for preventive interventions was spent mainly on the procurement of LLINs and IRS. The total budget of USD 19 000 000 was executed at 100%.

6. Conclusion

The overall Malaria Budget execution for Fiscal year 2022-2024 is at 94%.

PART VIII: MALARIA PERFORMANCE FRAMEWORK

A. Impact Indictors

ITEMS	INDICATORS	Baseline	Year of Baseline	2022-2023 Targets	2022-2023 Results	%
Goal	**Impact Indicators**					
By 2024, reduce malaria morbidity and mortality by at least 50% of the 2019 levels.	Annual Parasite Incidence per 1,000 persons	321	2018-19	156	47	100%*
	Inpatient malaria deaths per 100,000 persons per year	2.1	2018-19	1.5	0.6	100%*
	Number of confirmed malaria deaths	264	2018-19	198	51	100%*

B. Coverage and Outcome Indictors

ITEMS	INDICATORS	Baseline	Year of Baseline	2022-2023 Target	2022-2023 Results	%
Objective 1:	**Coverage Indicators**					
By 2027, at least 85% of population at risk will be effectively protected with preventive interventions	Proportion of structures in targeted areas that received indoor residual spraying (IRS) during the reporting period	98%	2018-19	98%	99%	100%*
	Proportion of population protected by indoor residual spraying within the last 12 months in targeted districts	98.%	2018-19	85%	98%	100%*
Objective 2:	**Outcome Indicators**					
Objective 2: All suspected cases are promptly tested and treated in line with national guidelines	Proportion of suspected malaria cases that receive a parasitological test at public sector health facilities	NA	2018-19	95	100%	100%**
	Proportion of suspected malaria cases that receive a parasitological test at the community level	NA	2018-19	95	100%	100%*
	Proportion of confirmed malaria cases that received first-line antimalarial treatment according to national guidelines at public sector health facilities	100%	2018-19	99	99%	100%
	Proportion of confirmed malaria cases that received first-line antimalarial treatment according to national guidelines at the community	100%	2018-19	100	100%	100%*

Note:

* The percentage were greater than 100%
**The number of tests was greater than the number of fever cases due to some tests performed with no documentation of fever by Clinicians. This is a new indicator and more efforts needed to improve documentation of fever

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