TENKE FUNGURUME MINING

INTEGRATED MALARIA CONTROL PROGRAM

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BRIEF OVERVIEW OF THE PRIMARY FUNDER

- TENKE FUNGURUME MINING:
- Lualaba Province.
- ~180 Km NW of Lubumbashi.
- 70 Km E of Kolwezi.
- TFM covered surface: ~1 600 Km2.
- Largest private investment in DRC.
- Production of Cu and Co started in 2009.
- Subsidiary of China Molybdenum (CMOC) since November 2016.
- Components : 80% CMOC, 20% Gecamines.

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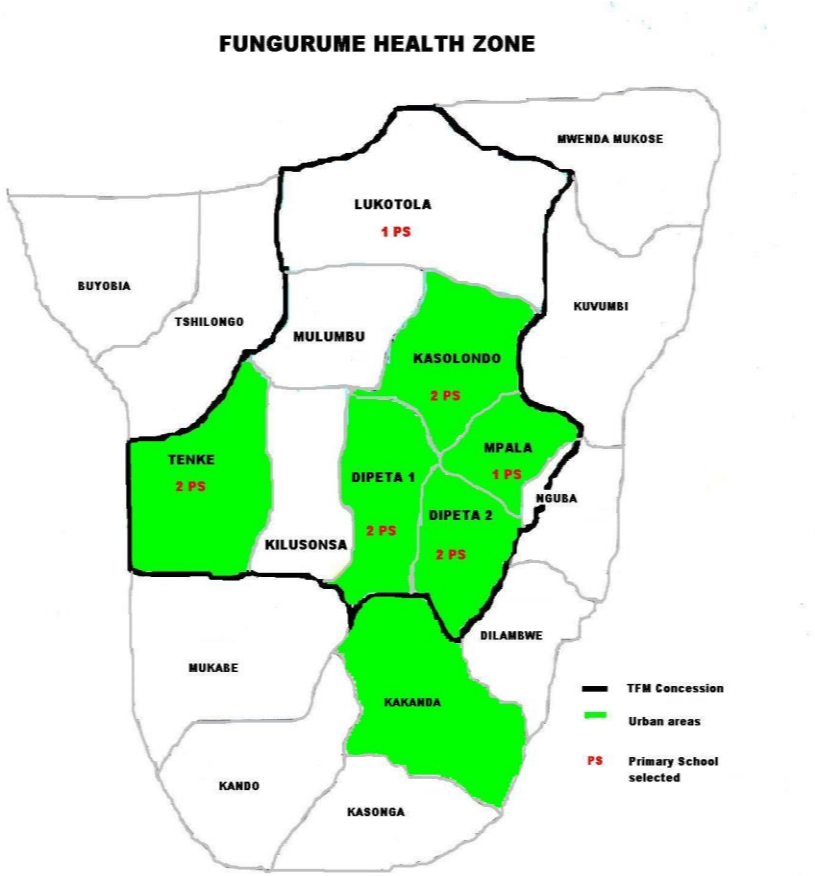
TENKE FUNGURUME MINING AND THE FUNGURUME HEALTH ZONE



- Population = >380,000 people and TFM Households: ±75%.
- Agents and contractors = ~ 10 000.
- 18 health areas, 12 of which are in the concession.
- > 60% of medical visits were malaria-related, confirmed with microscopic and/or RDT diagnosis.
- No vector control program in the area before TFM.

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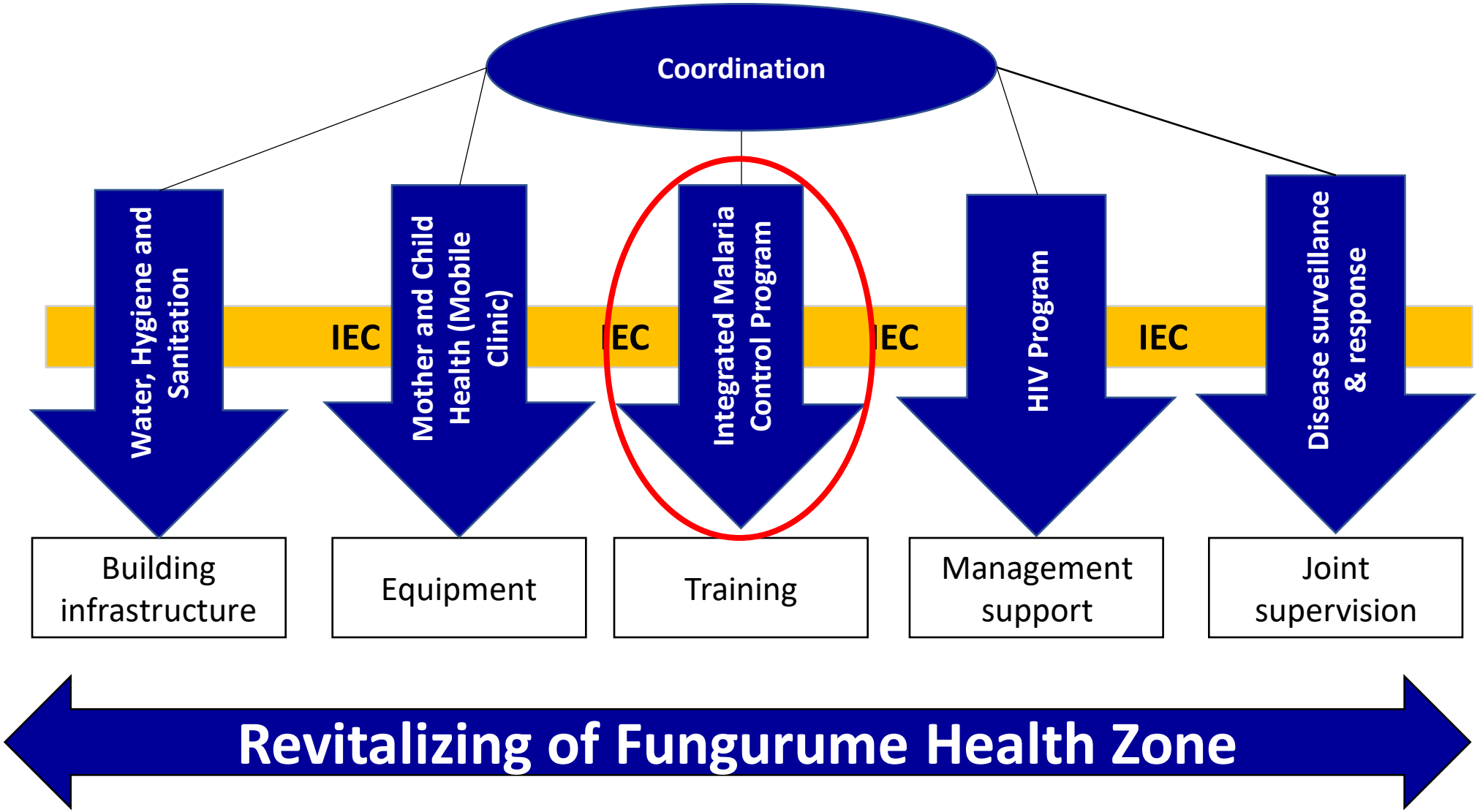
THE 5 AXES OF THE COMMUNITY HEALTH PROGRAM IN THE FUNGURUME HEALTH ZONE



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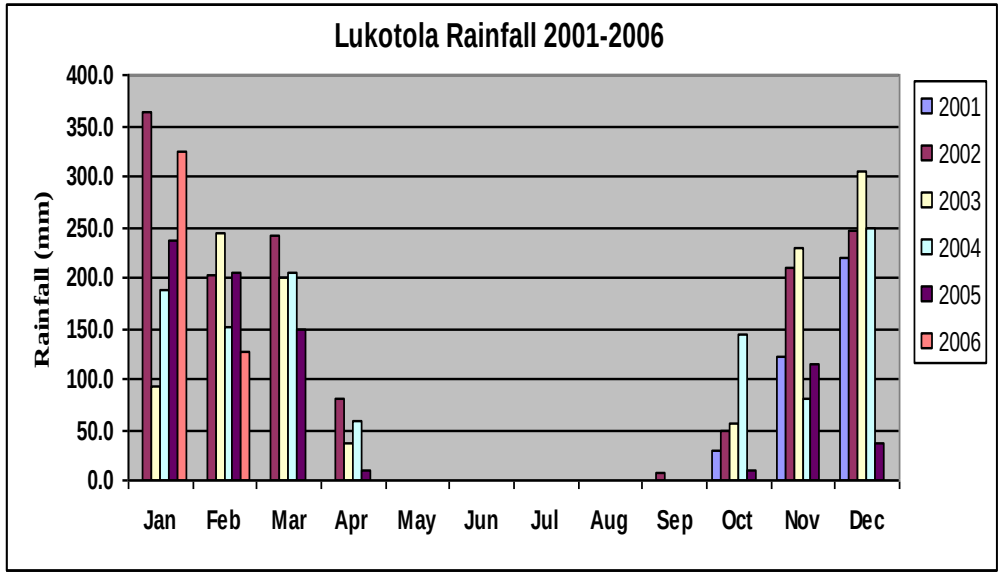
MALARIA RISK IN THE AREA

- 2 seasons: (dry and rainy).
- Suitable climate for vectors.
- Endemicity of Malaria.



- Year-round transmission with seasonal fluctuations :

  Oct-Nov: 1st rains (transmission increases).
  Dec-Feb: Intense rainfall (high transmission).
  Mar-Apr: Last rains (high transmission).
  May-July: Cold season, dryness (transmission decreases).
  August-September: Hot season, dryness (lowest transmission).

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CHRONOLOGY OF THE PROGRAM DEVELOPMENT

- **June 2006:** Development of vector mapping through an initial vector survey :
  - Main Vector: *An. gambiae s.s.*
  - Secondary vectors: *An. coustani , An. funestus*
  - 18 species of anopheles in total to date

- **Oct 2006**: Vector control program protocol

- **Mai 2007**: Workplace vector control program begins

- **Mai 2007**: 1st school-based prevalence survey among 6 to 12-year-old students (n=536): 77% prevalence

- **Mai 2007**: 1st sensitivity tests: *An. gambiae* et *An. funestus*
  - No resistance to DDT, bendiocarb, malathion, deltamethrin
  - Soil and water examination (negligible traces, no trace of DDT)

- **Oct 2008**: Start of the program itself: 1st IRS and LLIN distribution campaign

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INTEGRATED MALARIA CONTROL PROGRAM

- 5 pillars, all integrated, with design and implementation based on scientific evidence

Mosquito vector adult + larvae

Parasites

QC, HF data and Prevalence Surveys

IEC

- 2 components: workplace and community
- Robust program monitoring and evaluation with impact indicators (incidence, prevalence)

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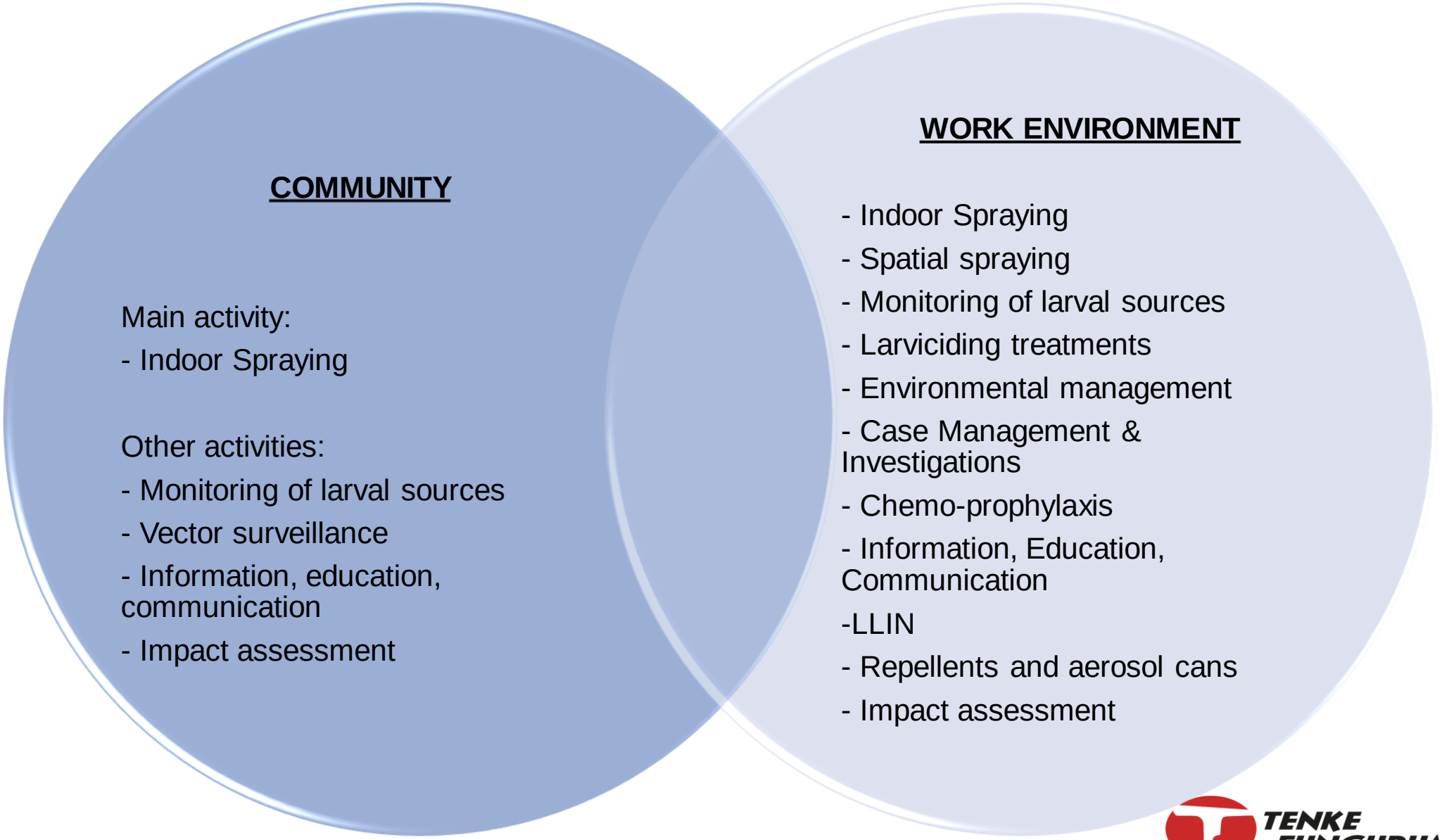
SUMMARY OF ACTIVITIES CONDUCTED



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INDOOR RESIDUAL SPRAYING (IRS)

- Indoor residual spraying on household walls
- Reduces/prevents indoors transmission
- Lethal effect on endophilic vectors
- Reduction of vector density

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IRS CAMPAIGN

Implementation

- Mapping; enumeration of structures
- Supply: equipment, insecticide (duty free), PPE
- Recruitment, training: spray operators, field supervisors, mobilizers
- Job descriptions and SOPs
- Logistics: Vehicles in good condition
- Timing: before the beginning of the rainy season
- Insecticides used:
  - ✓ 2008-2010: Pyrethroids (PY);
  - ✓ 2011-2014: Carbamates (PY resistance detected in 2010).
  - ✓ 2014-2018: Organophosphates (OP)
  - ✓ 2019-2020: Neonicotinoids (NN).

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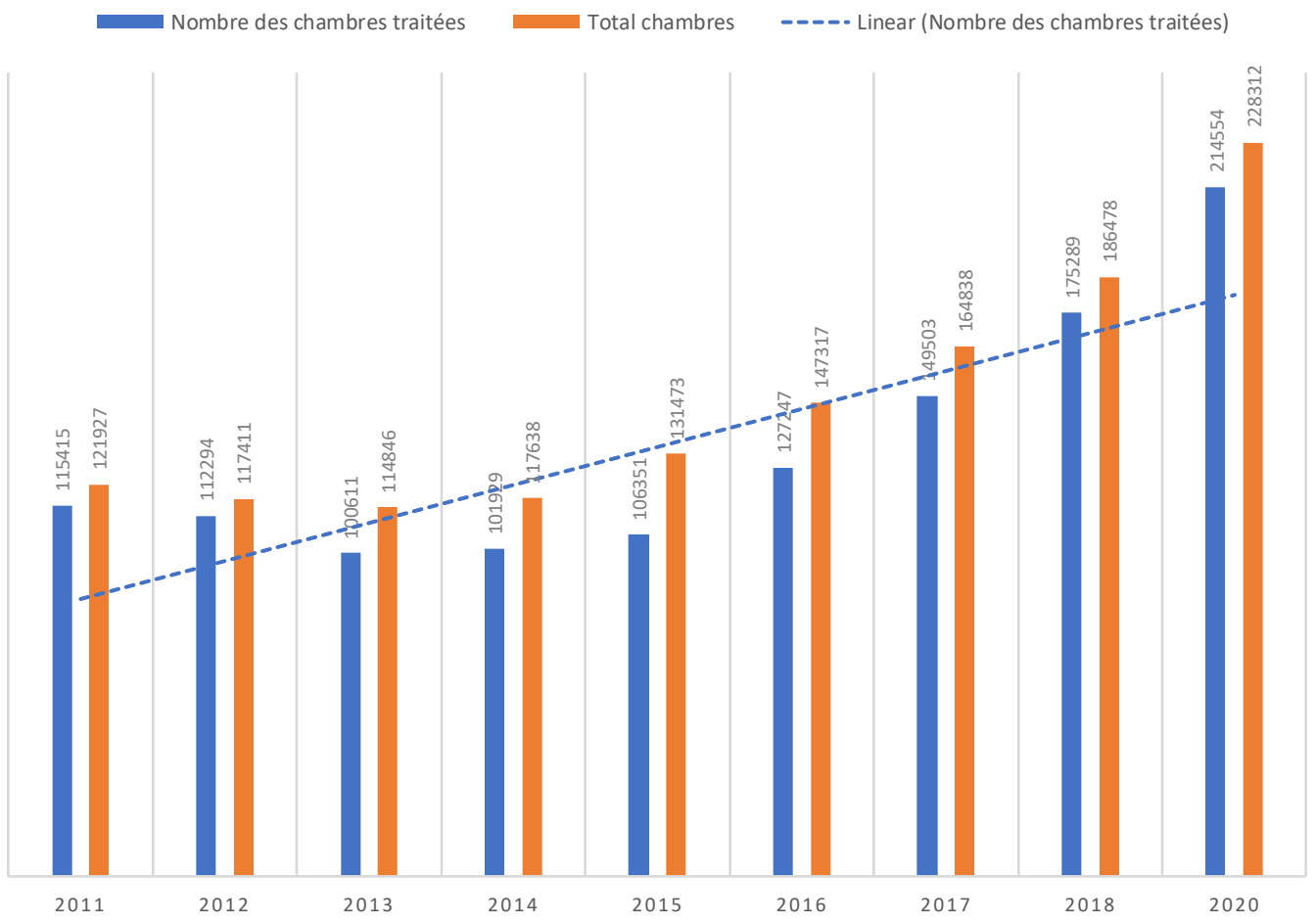
DATA COLLECTION AND ANALYSIS

2 levels in the field: Spay operators + Supervisors

Verification by the data manager + compilation and daily capture

Weekly report: TFM, ZSF, PNLP



Results :

- 2020 Campaign: 62,893 households visited ~ 214,554 rooms sprayed (48,982 rooms in 2008).
- 2008-2020: increase of >338%.
- Coverage in 2020: ~ 93.97%. (WHO:85%)

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MONITORING AND EVALUATION: SUSCEPTIBILITY TESTING

- Entomology laboratory with insectarium
- Females of local mosquitoes, reared in an insectarium
- Insecticide-impregnated filter papers according to the WHO standard protocol
- Tests performed every semester
- Resistance to pyrethroids and DDT already registered

Insecticide	Number of mosquitoes	Number of tests	Dead mosquitoes	% Mortality
Deltamethrin 0.05%	125	5	102	81.6 %
Deltamethrin 0.05% + PBO 4%	100	4	100	100 %
Permethrin 0.75 %	100	4	59	59 %
Permethrin 0.75% + PBO 4%	100	4	90	90 %
Malathion 5 %	150	6	150	100 %
Pirimiphos-methyl 0.25%	100	4	100	100 %
Bendiocarb 0.1 %	100	4	100	100 %
Bendiocarb 0.5 %	100	4	100	100 %
Propoxur 0.1%	200	8	195	97.5 %
DDT 4 %	100	4	26	26 %

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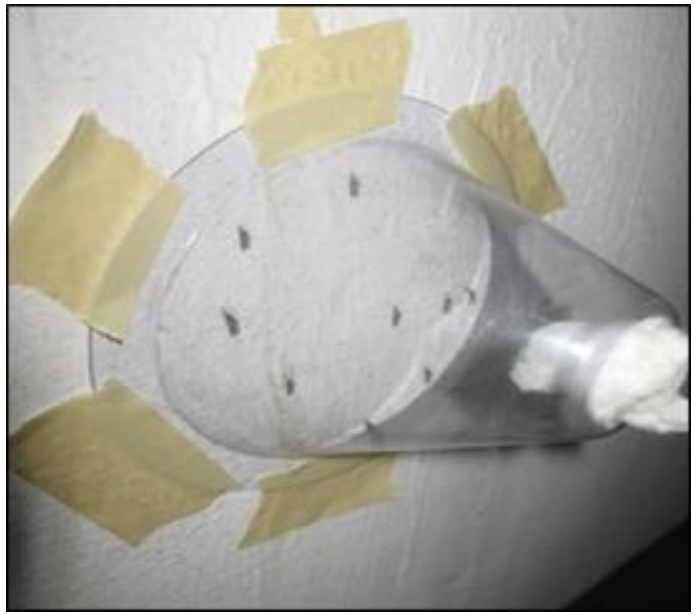
BIOLOGICAL EFFICACY TESTS

Bioassays are performed on the treated walls

- **Goal:** determine the evolution of the insecticide's persistence over time

- Tests conducted with susceptible mosquitoes (30 minutes exposure), each year during and after the IRS campaign

- Tests carried out on the different categories of walls: unfired bricks (33.8%), fired bricks (40.0%), plastered walls (13.7%), plastered and painted walls (12.2%), thatch (0.3%) (2020)



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RESEARCH Open Access

Indoor residual spray bio-efficacy and residual activity of a clothianidin-based formulation (SumiShield® 50WG) provides long persistence on various wall surfaces for malaria control in the Democratic Republic of the Congo

Leonard M. Ngwej[1,2*], Izak Hattingh[1], Godwill Mlambo[1], Emmanuel M. Mashat[1], Jean-Christophe K. Kashala[3], Françoise K. Malonga[2] and Michael J. Bangs[1,4,5]

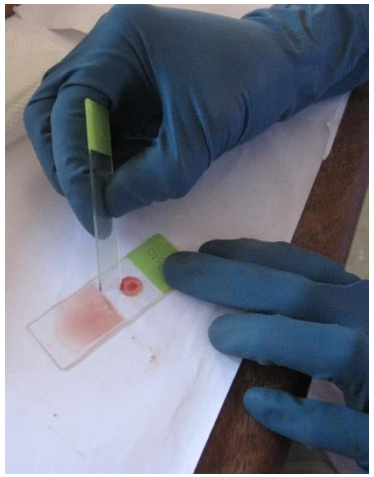
RESEARCH Open Access

Variable residual activity of K-Othrine® PolyZone and Actellic® 300 CS in semi-field and natural conditions in the Democratic Republic of the Congo

Leonard M. Ngwej[1,2*], Emmanuel M. Mashat[1], Clarence K. Mukeng[2], Henri T. Mundongo[2], Françoise K. Malonga[2], Jean-Christophe K. Kashala[3] and Michael J. Bangs[1,4,5]

MALARIA PREVALENCE SURVEYS IN SCHOOLS

- Bi-annual (May & October) school malaria prevalence surveys:
  - ✓ Randomized sampling
  - ✓ Students 6-12 years (primary cycle)
  - ✓ From 2008 to 2019, 66.7% reduction in malaria prevalence
- External quality control of microscopic slides
- Bi-annual visit by an external evaluator



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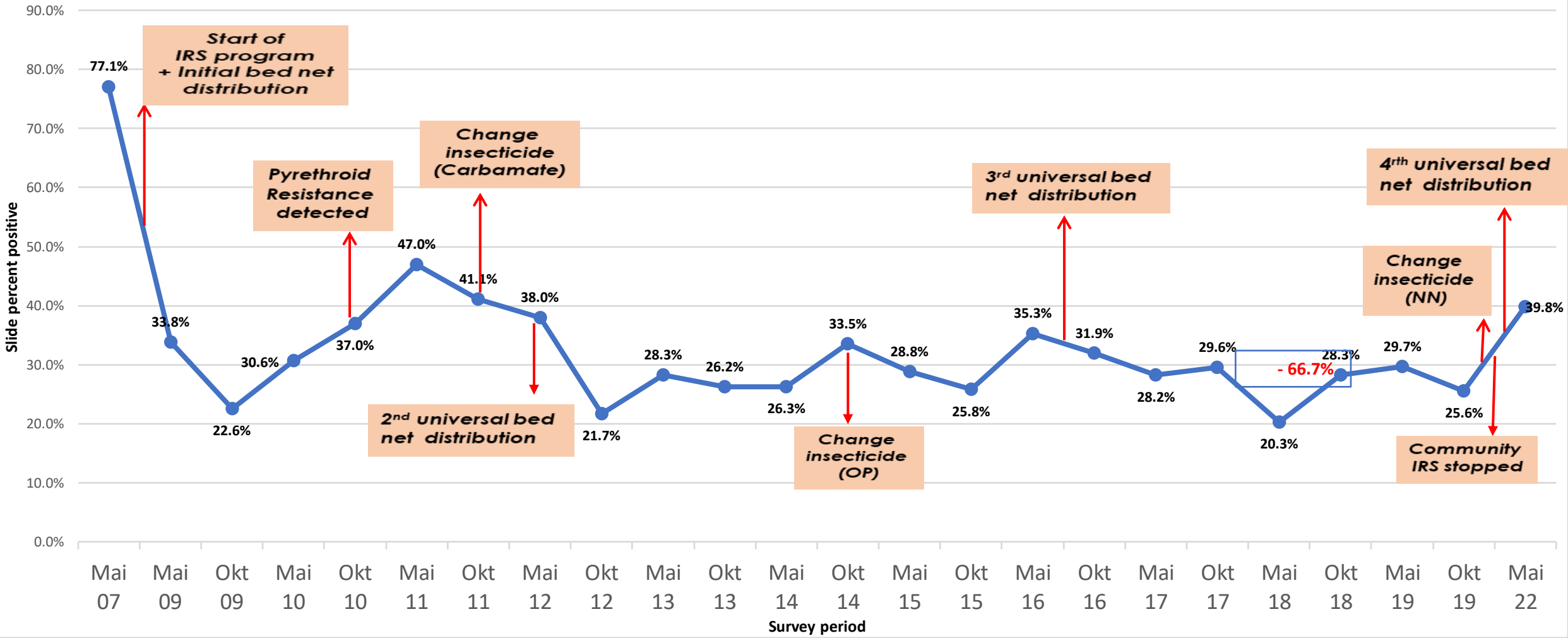
MALARIA PREVALENCE IN SCHOOLS: MAY 2007-MAY 2022*



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PUBLICATIONS AND DOCTORAL THESIS

RESEARCH Open Access

Feasibility and implementation of community-based malaria case management with integrated vector control in the Democratic Republic of Congo

Edouard Kawawa Swana[1,4*], Ghislain Yav Makan[2], Clarence Kaut Mukeng[4], Henriette Ilunga Mupumba[3], Gabriel Mutabusha Kalaba[3], Oscar Numbi Luboya[4] and Michael J. Bangs[4,5]

RESEARCH Open Access

School-based malaria prevalence: informative systematic surveillance measure to assess epidemiological impact of malaria control interventions in the Democratic Republic of the Congo

Edouard K. Swana[1,3,4*], Thierry I. Yav[1,3,4], Leonard M. Ngwej[1,4], Betty N. Mupemba[2], Suprianto[5], Clarence K. Mukeng[4], Izak Hattingh[1], Oscar N. Luboya[3,4], Jean-Baptiste S. Kakoma[3,4] and Michael J. Bangs[4,5]

CONCLUSION

- The TFM program has significantly reduced the incidence of malaria among workers and the prevalence of malaria in the community through the main pillar of IRS.
- High population mobility to non-covered areas causes reinfections.
- The influx of populations in the mining areas increases the number of structures to be sprayed, thus increasing the cost of the intervention.
- Added to this is the increasing cost of insecticides, and a limited number of insecticide classes to use.
- Need for a public-private partnership to continue the program as the cost is becoming increasingly heavy for the company.

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NEW CHALLENGES

- IRS withdrawal following its non-inclusion in the specifications (New mining code)

- The community finds the activity too costly for the money allocated to social programs by TFM

-Malaria upsurge

- Need to find alternative control strategies (Purchase of PBO ITNs considered in the meantime)

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THANK YOU!

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