Kingdom of Cambodia

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National Strategic Plan for Control and Elimination of Neglected Tropical Diseases in Cambodia 2021-2025

JUNE 2020

FORWORD

The National Strategic Plan for Control and Elimination of Neglected Tropical Diseases in Cambodia, 2021-2025 has been developed by the National Helminth Control Program of National Center for Parasitology, Entomology and Malaria Control enable to achieve and/or sustain the elimination of Lymphatic Filariasis and Schistosomiasis mekongi, and to achieve and sustain control of Soil-Transmitted Helminthiasis, Foodborne trematodiasis, Taeniasis/Cysticercosis and Strongyloidiasis stercoralis in Cambodia

The development of 5-years National Strategic Plan based on the national consultation workshop, supported by WHO, of all relevant stakeholders at national and provincial levels from Ministry of Health, Ministry of Rural Development, Ministry of Agriculture, Forestry and Fishery, and Ministry of Education, Youth and Sports, and development partners, and in alignment with the Regional Action Framework for Control and Elimination of Neglected Tropical Diseases in the Western Pacific.

I am, finally, grateful to all stakeholders and development partners for providing inputs in the finalization of the national control and elimination strategic plan, and I strongly hope that all involved institutions at all levels and development partners will fully participate and support the implementation of the activity plan of the National Strategic Plan for Control and Elimination of National Tropical Diseases in Cambodia.

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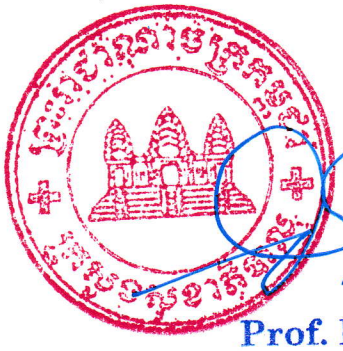

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SECRETARY OF STATE

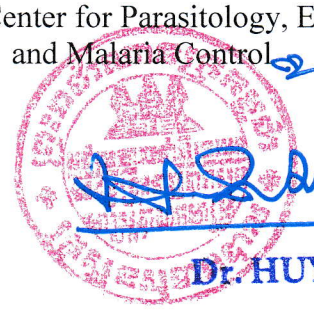
PREFACE

Many parasitic Neglected Tropical Diseases (NTDs) remain transmitted and posed an important public health in Cambodia, including Lymphatic filariasis, Schistosomiasis mekongi, Soil-Transmitted Helminthiasis, Strongyloidiasis stercoralis, Taeniasis/cysticercosis and Foodborne Trematodiasis...etc. The NTDs most heavily affect people living without access to adequate sanitation, basic infrastructure and health services, especially the poorest or marginalized populations. The majority of chronic infectious diseases due to NTDs causes morbidity and mortality, and contribute to significant stigma and discrimination in affected communities.

Since mid-year 90's, Cambodia has been implementing an integrated control and elimination strategy on NTDs, such as preventive chemotherapy, health education, improved sanitation…etc. After 25 years of control and elimination activities, the Lymphatic filariasis has been eliminated as a public health problem, and Schistosomiasis and Soil-Transmitted Helminthiasis prevalence have been remarkably decreased. However, the most marginalized and neglected populations, who are most in need, are still suffering with helminthic NTDs such as Strongyloidiasis, Foodborne Trematodiasis, Taeniasis/cysticercosis…etc.

The National Strategic Plan for Control and Elimination of Neglected Tropical Diseases in Cambodia, 2021-2025 describes vision, goal, objectives, strategy, detailed activity and budget for community empowerment and multi-sectoral collaboration with all relevant stakeholders and ministries at national and provincial levels in the area of human and veterinary health, Environment (water, sanitation and hygiene) and health education.

Director
of National Center for Parasitology, Entomology
and Malaria Control



Dr. HUY REKOL

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Acronyms

ADB	Asian Development Bank
CL-SWASH	Community-Led initiatives to eliminate Schistosomiasis by combining deworming with water, sanitation and hygiene interventions
CNM	National Centre for Parasitology, Entomology & Malaria Control
DEC	Diethylcarbamazine Citrate
FBT	Foodborne Trematodiasis
HMIS	Health Management Information System
ICT	Immunochromatographic Card Test
IU	Implementation Unit
LF	Lymphatic Filariasis
M&E	Monitoring and Evaluation
MDA	Mass Drug Administration
MF	Microfilaraemia
MOH	Ministry of Health
NGO	Non-Governmental Organization
NTDs	Neglected Tropical Diseases
PC	Preventive Chemotherapy
Pre-SAC	Pre-School Age Children
PZQ	Praziquantel
SAC	School-Aged Children
SCH	Schistosomiasis mekongi
SOP	Standard Operational Procedure
STH	Soil-Transmitted Helminthiasis
TAS	Transmission Assessment Survey

ToC	Training of Community
ToF	Training of Facilitators
ToT	Training of Trainers
UHC	Universal Health Coverage
UNICEF	United Nations International Children's Emergency Fund
VHW	Village Health Workers
VMW	Village Malaria Worker
WASH	Water, Sanitation and Hygiene
WCBA	Women of Child Bearing Age
WHA	World Health Assembly
WHO	World Health Organization
WinS	Water, Sanitation and Hygiene in School
WSP	Water Safety Plan

1. BACKGROUND

The Neglected Tropical Diseases (NTDs) are the most common infectious diseases in tropical and subtropical regions, and most heavily affect people living without access to adequate sanitation, basic infrastructure and health services, especially the poorest or marginalized populations. The majority of chronic infectious diseases due to NTDs causes morbidity and mortality, and contribute to significant stigma and discrimination in affected communities worldwide. NTDs are termed "neglected" because the affected population are often the most vulnerable, hard-to-reach populations who often cannot afford appropriate medical services.

Multiple NTDs remain transmitted in Cambodia. NTDs of public health importance in Cambodia and their causal agents, major vectors and intermediate and final hosts are presented in Table 1.

Table 1. Relevant NTDs Control and elimination in Cambodia

Disease	Causal agent	Major vector or intermediate host	Major final host
Lymphatic filariasis	Parasitic helminth	Mosquito	Human
Schistosomiasis mekongi	Parasitic helminth	Freshwater snail (Neotricula aperta)	Human, dog
Soil-transmitted helminthiasis	Parasitic helminth		Human
Foodborne trematodiasis (Opisthorchiasis viverrini)	Parasitic helminth	Freshwater snail, freshwater fish or crustacean	Human
Taeniasis/Cysticercosis	Parasitic helminth	Pig (*T. solium*) Cattle (*T. saginata*) Human (Cysticercosis)	Human (taeniasis)
Strongyloidiasis stercoralis	Parasitic helminth		Human, dogs

These infections continue to cause a variety of public health and socioeconomic consequences to the population of Cambodia as the followings:

- Increased rate of malnutrition, especially among children and women
- Reduced school performance in children
- Reduced productivity in adulthood
- Chronic ill health and liver disease
- Cholangiocarcinoma (Opisthorchiasis viverrini)
- Esophageal varices (Schistosomiasis mekongi)
- Neurological symptoms (Neurocysticercosis), including epileptic seizures
- Disseminated infection and death among immune suppressed (Strongyloidiasis stercoralis)
- The greatest burden of disease for STH occurs among the populations in areas that lack access to clean water and sanitation.
- Moderate to high intensity infections can cause a range of symptoms including diarrhea, abdominal pain, general malaise and weakness, which can then lead to impaired cognitive and physical development.
- The highest rates of infection occur among pre-school aged children, school-aged children, women of childbearing age, and adults in high-risk occupations such as tea-pickers or miners.
- The impact of STH infection on women of childbearing age includes maternal anemia, low birth weight and high infant mortality.

The World Health Organization (WHO) defines universal health coverage (UHC) to mean that all people in need can access primitive, preventive, curative and rehabilitative health services of sufficient quality, without suffering financial hardship. Evidently UHC can only be achieved if all people and communities affected by NTDs receive appropriate health services. In other words, the fight to control and eliminate NTDs is a journey to ensure that the most marginalized and neglected populations, who are most in need, are equitably reached by appropriate health services and no one is left behind.

NTDs are prioritized not only because of the magnitude and impacts of their burden but also because there is accumulated evidence to indicate that effective delivery of one or more of the five public health interventions recommended by WHO to all affected communities will enable broad control, elimination or eradication of the diseases as defined by WHO. Follow, the guideline of WHO, NTDs Control and Elimination in Cambodia have been achieved as remarkable.

WHO recommends periodic treatment with anthelminthic (deworming) medicines, without previous individual diagnosis to all at-risk people living in endemic areas. This intervention reduces morbidity by reducing the worm burden. Therefore, the main strategy to control and elimination helminthic NTDs in Cambodia is preventive chemotherapy, which is regular treatment of the population at-risk (Table 2) with anthelminthics and drugs alone or in combination according to the diseases targeted.

Majority of NTDs are transmitted due to a lack of safe water, proper sanitation and/or hygiene (WASH) in affected families and communities. While preventive chemotherapy can exert immediate impacts in reducing prevalence of infection and morbidity burden, WASH interventions are required to sustain such impacts and further reduce and ultimate eliminate transmission. Clean water and hygiene are also essential for provision of appropriate care and rehabilitation services for those affected by residual morbidities and chronic disabilities due to NTDs. WASH interventions aim at contributing to reductions and ultimately elimination of transmission of such NTDs and also to ensure effective care for those with physical impairments and disabilities due to NTDs.

Table 2. Strategic Plan for NTDs endemic in Cambodia 2021-2025

Disease	Group at risk	NTDs/Helminth Programme Goal		Relevant Year
		Elimination*[1]	Control[1]	
Lymphatic filariasis	The entire population in 6 endemic areas (IUs)	√		2016 (elimination as a public health problem)
Schistosomiasis mekongi	People living along the Mekong river in high risk focal ecological areas	√		2025
Soil-Transmitted helminthiases	Pre-school children, schoolchildren and women of child bearing age (WCBA).		√	–
Foodborne Trematodiasis (Opisthorchiasis viverrini)	Children and adults eating raw food		√	–
Taeniasis/ Cysticercosis	The entire population in endemic communities		√	–
Strongyloidiasis stercoralis	The entire population in endemic provinces/ districts, in particular young children		√	–

*Elimination as a public health problem

[1]. See annex 1.

2. ENDEMIC SITUATION OF NTDS IN CAMBODIA

2.1. *Lymphatic filariasis*

Lymphatic Filariasis (LF) caused by *Wuchereria bancrofti* was endemic in 4 provinces. Cambodia was committed to eliminate LF on par with the Global Programme to Eliminate Lymphatic Filariasis. Mapping of endemic areas with ICT tests as well as microfilaria blood film examinations were completed in 2004. As many as 18 districts in four provinces, namely, Rattanakiri, Stung Treng, Preah Vihear and Siem Reap were identified as the areas with on-going transmission. Figure 1 shows the endemic areas of LF. The estimated population at risk in the endemic districts was around 475,000.

Cambodia successfully achieved elimination of LF as a public health problem through effective annual MDA campaigns and the development of health system capacity for patient care, along with benefits gained from socioeconomic improvements and other interventions against vector-borne diseases and NTDs. Cambodia was validated by the World Health Organization as having achieved LF elimination as a public health problem in 2016 (Khieu et al., 2018). However, there is no guidance yet on post validation surveillance of lymphatic filariasis.

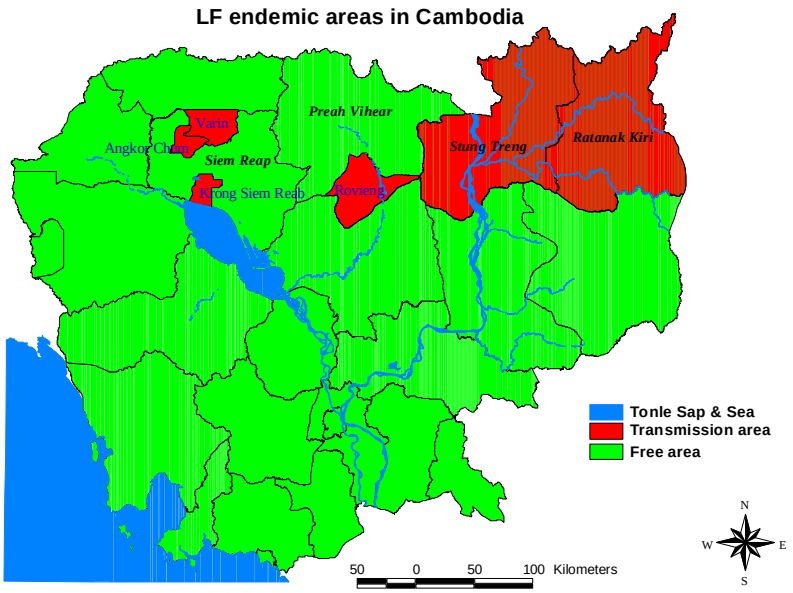


Figure 1. LF endemic areas identified through mapping in Cambodia (2004)

2.2. *Schistosomiasis mekongi*

Schistosomiasis, caused by the blood fluke, *Schistosoma mekongi*, is a public health problem in communities along the Mekong River in Cambodia and Lao People's Democratic Republic. In Cambodia, the distribution of *S. mekongi* is restricted to areas of the Mekong River Basin due to presence of the intermediate host, the snail *Neotricula aperta*, where the transmission occurs mainly around rocky banks of Mekong River during the peak transmission period (February-April, which overlaps with fishing season. About 80 000 Cambodian people are estimated to be at risk of infection, and the worst endemic area is found in the villages along the Mekong river in Kratie province (56 villages) and Stung Treng province (58 villages) where the prevalence among school-age children was up to 70% and 49% in the general population in year 1995 (Figure 2).

The transmission cycle of *S. mekongi* principally involves humans, but some mammals (such as dogs and pigs) have also been implicated as definitive hosts. The freshwater snail *N. aperta* is the intermediate host. Transmission to a human host occurs when cercariae that are released from the intermediate snail hosts penetrate skin of humans in contact with infested water while bathing, washing clothes or fishing.

Figure 2. Schistosomiasis mekongi endemic areas in Cambodia

Infection in children can cause anaemia, stunting, growth retardation, delay of puberty, and impaired cognitive development. Chronic schistosomiasis may lead to intestinal and liver complications such as hepatomegaly and ascites, and even death. Infection is usually acquired in childhood as they have regular contact with water.

Cambodia has been implementing a control strategy using preventive chemotherapy of a single dose of Praziquantel (PZQ) 40 mg/kg annually to the at-risk population above 5 years of age in endemic areas, health education, epidemiological surveillance including sentinel monitoring and spot check surveys and passive cases detection since 1995. During the month of May each year, 80,000 people are targeted, usually with over 90% of reported treatment coverage in the last two decades. Their impacts are evidenced by the marked decrease in severe cases and a substantial decrease of SCH egg burdens in the population at risk from 70% in 1995 to less than 3% in 2019 (Figure 3).

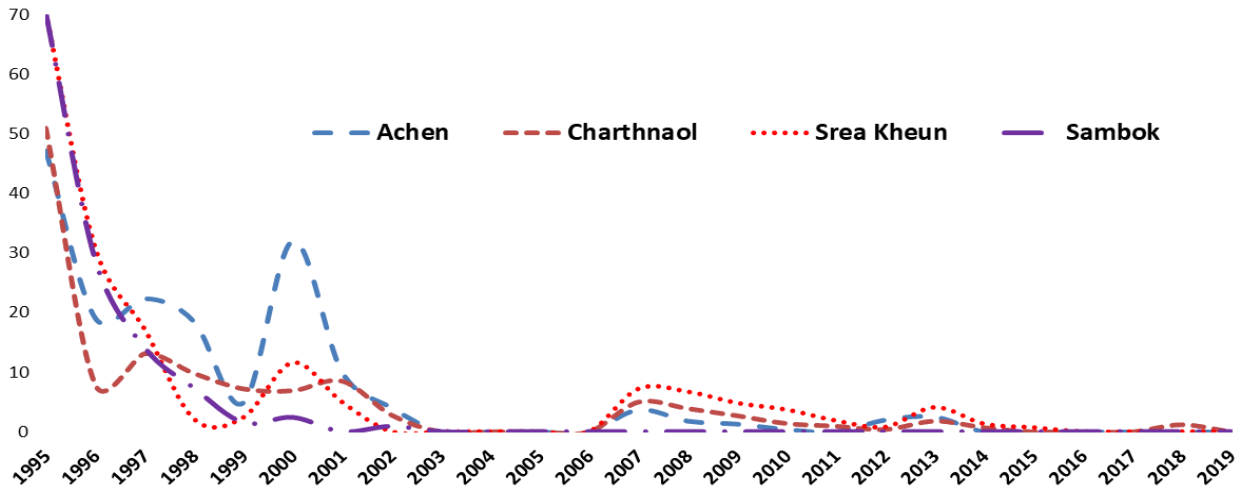


Figure 3. Prevalence of Schistosomiasis in sentinel sites in Kratie province using Kato-Katz method, 1995-2019

In 2016, the World Health Organization (WHO) supported external evaluation of the current status of control of schistosomiasis in Cambodia. The evaluation demonstrated that no heavy-intensity infection has been found in any of sentinel sites and two additional spot-check sites even based on the formalin-detergent method, which was proved to have higher sensitivity than Kato-Katz method. It concluded that annual rounds of MDA targeting the entire at-risk population above 5

years of age since 1995 successfully reduced transmission of *S. mekongi* in Cambodia and elimination of schistosomiasis as a public health problem defined by WHO as the prevalence of heavy-intensity infection (more than 400 eggs per gram) below 1% in all sentinel sites have been achieved (Kirinoki et al, 2020). Also, the prevalence of infection of any intensity reached very low levels.

This success, together with the limited geographical areas of endemicity, encouraged the Ministry of Health in Cambodia to shift its target from the control of the disease to elimination of schistosomiasis (Khieu et al., 2019b) in alignment with the goals and targets set in the WHO Regional Action Framework for Control and Elimination of Neglected Tropical Diseases in the Western Pacific (WHO, 2020) and the WHO Roadmap for Implementation – Accelerating Work to Overcome the Global Impact of Neglected Tropical Diseases (WHO, 2012).

The National Strategic Plan for Elimination of Schistosomiasis (2020-2024) has been developed after the national consultation workshop in 2017 with all relevant stakeholders at national and provincial levels (Kratie and Stung Treng) including representatives from the Ministry of Health, the Ministry of Rural Development, the Ministry of Agriculture, Forestry and Fishery, and the Ministry of Education, Youth and Sports. This action plan describes goal, strategy, detailed activities and budget of multi-sectoral collaboration in the area of human and veterinary health, water, sanitation and hygiene, health education and nutrition (CNM, 2019).

The strategy of elimination of schistosomiasis in Cambodia is composed of (a) universal access to One Health intervention package, namely **preventive chemotherapy** and **treatment and management of animal reservoirs** (where needed), and (b) **community empowerment** through effective risk communications to **improve water, sanitation and hygiene (WASH)** in all high-risk communities using the novel ***Community-Led initiatives to eliminate Schistosomiasis by combining deworming with WASH interventions*** **(CL-SWASH)**.

2.3. *Soil-Transmitted Helminthiasis*

The burden of disease from soil-transmitted helminth (STH) is mainly attributed to their chronic and insidious impact on the health and quality of life of those infected rather than to the mortality they cause. Infections of heavy intensity might cause micronutrient deficiencies and iron deficiency anaemia, resulting to impaired physical growth and cognitive development and leading to poor school attendance and performance among children, reduced work productivity in adults and adverse pregnancy outcomes.

The entire Cambodia is endemic for STH infections, including *Asacries lumbricoides, Enterobius vermicularis, Trichuris trichiura* and hookworms (*Necator amemicanus, Ancylostoma duodenal and Ancylostoma ceylanicum*). Among the target age groups, the prevalence of two common STH species, namely roundworm and hookworm, can reach as high as 70.1% and 86.4% at community or school level, respectively (Sinuon et al., 2003). The national baseline data collected in 2004 showed high prevalence of hookworm (around 75%) and co-infections with other parasite species were very common (CNM, 2004). The total population at risk of STH infection in Cambodia is estimated at around 9 million individuals, consisting of 1,500,000 preschool-aged children (pre-SAC), 3,500,000 school-aged children (SAC) 4,500,000 women of child-bearing age (WCBA) in all 25 provinces.

The deworming program in Cambodia has already been institutionalized in school and community-based systems. Since 2004, school deworming using mebendazole has been implemented twice a year to all SAC in the country as per the national treatment guidelines. pre-SAC and WCBA are treated through health centres twice a year, including those pregnant beyond the first trimester and breastfeeding women (National Task Force for Helminth Control, 2004). Additionally, any pre-SAC, SAC and WCBA who were missed by the outreach deworming campaigns are also reached for treatment by village health volunteers (VHV) and village malaria workers (VMW) during their routine activities to enhance the coverage.

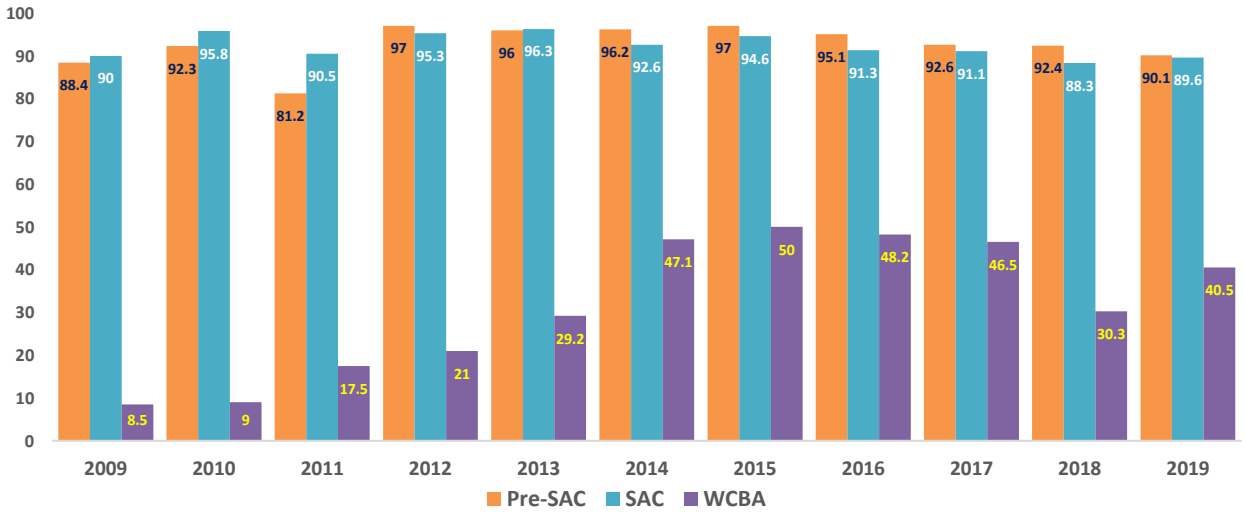


Figure 4. Mass deworming coverage of different risk groups in Cambodia, 2009 – 2019 (Source: CNM – MoH, Cambodia)

CNM/MOH has been collaborating in planning, piloting and scaling up of activities for the control of NTD with WHO, various other developmental partners and NGOs since 2004. The collaborative efforts have facilitated Cambodia to conduct one of the largest deworming programmes in the region at very low cost. Figure 4 presents the extent of recent mass deworming coverage of different risk groups in Cambodia from 2009 to 2019. However, implementation of such activities continues to face a few challenges and require further strengthening, expansion and regular monthly reporting to the national Health Management Information System (HMIS).

The survey was conducted in 2018-2019 to evaluate the impacts made after 15 years of implementing STH control programme in Cambodia (2004–2019). Figure 5 shows the prevalence of STH measured by Kato-Katz method by province and species. The prevalence of ascariasis and trichuriasis has reduced so low that in several areas it would be possible to consider reduction of the frequency of deworming. At the same time, persistently high prevalence of hookworm throughout the country is concerned.

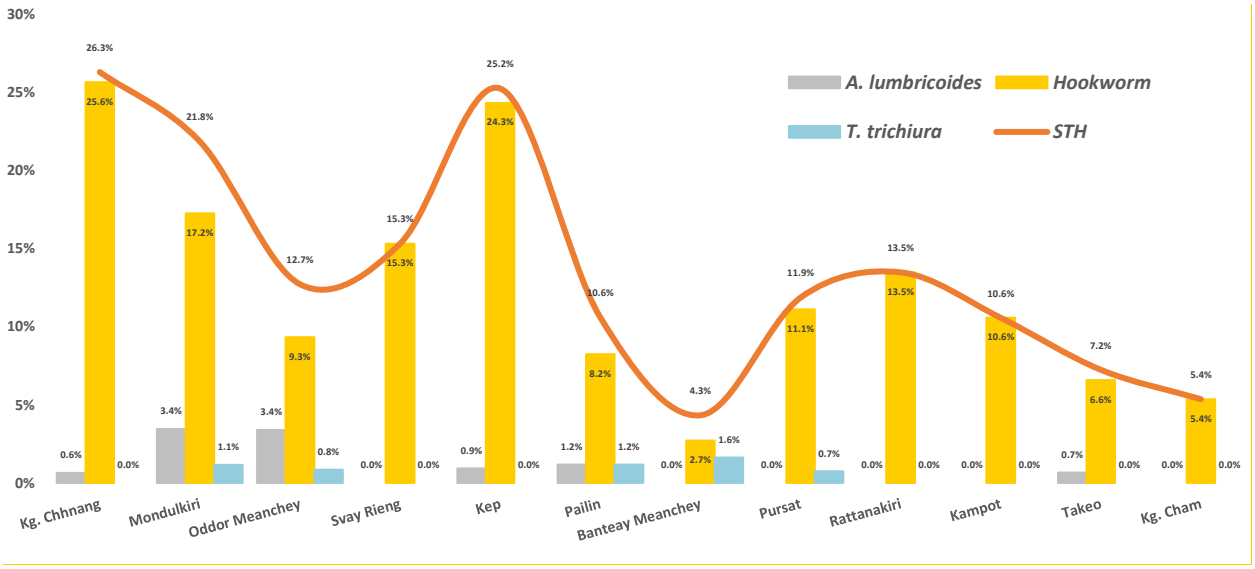


Figure 5. Prevalence of STH measured by Kato Katz method by province, 2018-2019

The main STH control strategy continues to be preventive chemotherapy **preventive chemotherapy** (PC) through semi-annual distribution of anthelminthic to the three below-mentioned groups at risk, free of charge, through large-scale drug distribution. Anthelminthic drug is procured by the Ministry of Health (MoH) for pre-SAC and WCBA and donated from Johnson & Johnson through the World Health Organization (WHO) for SAC.

1. Preschool-age children (pre-SAC): ranging in age from 2 to 5 years old
2. School-age children (SAC): ranging in age from 6 to 14 years old
3. Women in Childbearing Age (WCBA): ranging in age from 15-49 years old.

Through outcomes from the meeting with relevant sectors, National NTDs Program of the Center for Malaria Control, Parasitology and Entomology has reviewed and revised "the Summarized Guideline for Deworming (Mebendazole 500mg/Albendazole 400mg) to the Target Group at Risk in Cambodia" (See annex 2 and detailed of STH guideline) and therefore expanding additional population – in addition to existing coverage – specifically to WCBA, secondary and high school students at public and private schools, and female workers at factories/enterprises across the country.

While PC interventions are effective in reducing morbidity associated with STH infection, PC alone will not be sufficient to achieve elimination of STH as a public health problem. In the long term, improvements in **water, sanitation and hygiene (WASH)**, such as improved access to latrines, and changes to risk behaviours (such as hand washing and use of footwear), are fundamental to further reduce and ultimately interrupt transmission of STH.

2.4. *Foodborne Trematodiasis*

Human infection with Food-Borne Trematodes (FBT) results from ingestion of raw or inadequately processed foods, such as fish, crustaceans, or aquatic plants that contain larvae. In Cambodia, *Opisthorchis viverrini* infection has been reported over the last decades, which might cause serious diseases such as acute bile duct disease, which may lead to bile duct cancer, cholangiocarcinoma (WHO. 2007). Transmission of FBT infections is restricted to areas where humans have the habit of eating raw, salted, pickled, smoked, marinated, dried, partially cooked or poorly processed fish and other aquatic products of animal or vegetal origin. Eating raw freshwater fish is the leading risk factor for FBT infections (Keiser and Utzinger, 2005; Sripa et al., 2003).

In Cambodia, a high prevalence strip seems to run through the center of Cambodia from North to South with lower prevalence provinces in the East and West of the country (Khieu et al., 2019a). In 2014, the NTDs program conducted the survey to assess the prevalence of *O. viverrini* by stool examination with Kata-Katz method in some villages in Kampong Cham, Tbong Khmum and Kampong Thom and Takeo provinces. The total of 981 stool samples were collected from the villagers aged between 2 and 60 years in fourteen villages of these provinces. The result revealed that the prevalence of *O. viverrini* at village level was in the average of 36.8%. More *O. viverrini* infection prevalence surveys were conducted across the country in 2016, which resulted in the nation-wide *O. viverrini* risk map (Figure 6) (Khieu et al, 2020).

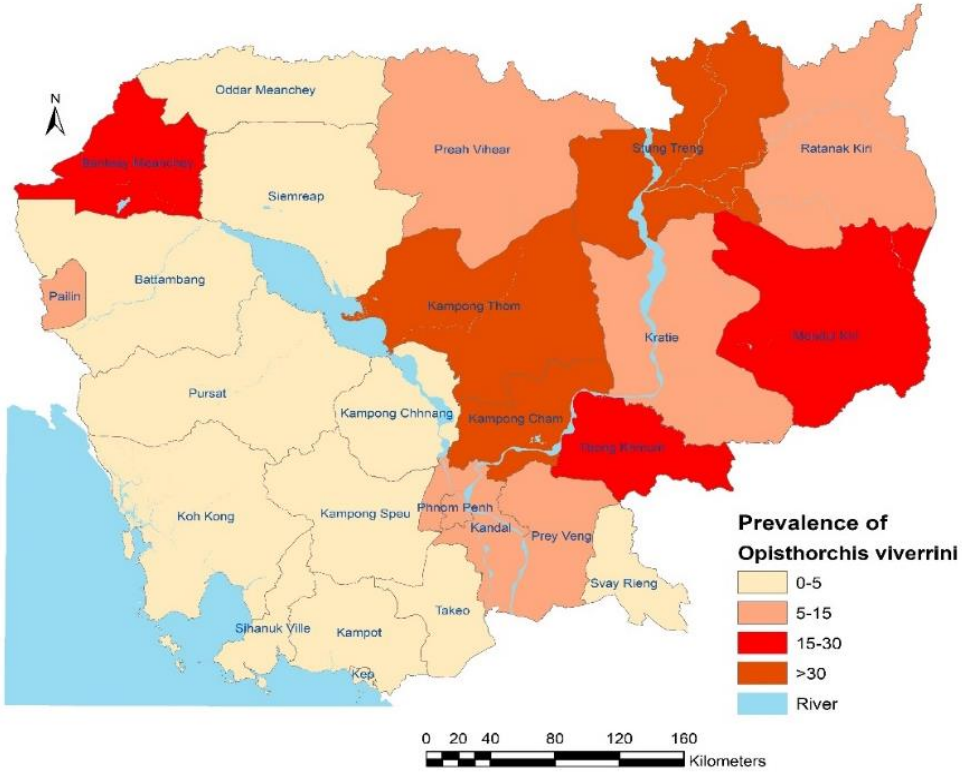


Figure 6. Endemicity mapping of *Opisthorchis viverrini* in Cambodia, 2016

It is likely that the infection occurs in many more provinces than currently thought. Throughout the provinces along the border with Lao PDR, Vietnam and Thailand, the population has risky food consumption habits resembling the neighbouring country. Traditional local dish at high risk of *O. viverrini* infestation include: *Plear Trei* (raw/undercooked fish salad), *Mam Trei* (short-fermented fish), and *Pra-hok* (fish fermented for about 1 year); those are the favourable food for the Cambodian people at the border.

The strategy to control FBT in Cambodia should be composed of (i) **preventive chemotherapy** with praziquantel in the villages with high endemicity of *O. viverrini* (annually in areas >20% prevalence and once in two year in areas with prevalence levels between 5 – 20%), (ii) **clinical treatment of suspected/diagnosed cases** through the health system with praziquantel stocked in health institutions in endemic districts, and (iii) **health education through community engagement** on hygienic eating practices and agricultural production processes in collaboration with animal health and food safety sectors.

2.5. *Taeniasis and Cysticercosis*

Infections with *Taenia solium* are difficult to diagnose. The conventional stool microscopy with the Kato-Katz method fails to detect Taenia species because *T. solium* eggs are excreted only intermittently and are morphologically indistinguishable from those of *T. saginata* and *T. asiatica*. Confirmation of *T. solium* cases requires highly specific copro-DNA methods. Because of these diagnostic difficulties, information on the burden of *T. solium* in Cambodia is still scarce. However, since co-infection of *T. solium* with other parasites is a common thing in South-East Asia, its presence in Cambodia is also suspected.

In 2016, community-based surveys was conducted in three provinces (Koh Kong, Oddar Meanchey and Prey Veng) in Cambodia on the border of Thailand and Vietnam in order to collect the reliable epidemiology data on taeniasis and cysticercosis for national helminth program to organize the control and elimination. The result of 1,282 stool samples analysis with Kato-Katz method showed that the prevalence of *Taenia spp.* at community level was 0.7% on average. Among 1,389 filter blood papers samples collected and tested for serology using ELISA with the antigen and positive control from Korean at Khon Kaen University, Thailand, 13.2% was positive for serology, though interpretation of this results require caution because serological test detect both active and past infections.

The priority to progress control of taeniasis/cysticercosis in Cambodia would be to progress **baseline disease mapping** to better understand distribution and burden of the diseases at

community level nationwide and **pilot implementation of multisectoral interventions**, composed of MDA for human, veterinary public health interventions targeting at pigs and WASH through community engagement, in areas where disease transmission has been identified and evaluation of impacts.

2.6. *Strongyloidiasis stercoralis*

Strongyloides stercoralis is the only soil-transmitted helminth that can replicate within its host, leading to long-lasting and potentially life-threatening infections. Occurring worldwide, it thrives where the climate is warm and sanitation is poor. *S. stercoralis* cannot be easily detected by standard field techniques and its global prevalence is largely underestimated. Strongyloidiasis is arguably the most neglected of neglected tropical diseases. No control strategy currently exists for it. Ongoing control programs against other similar parasites regularly deliver treatment that has little effect on *S. stercoralis*.

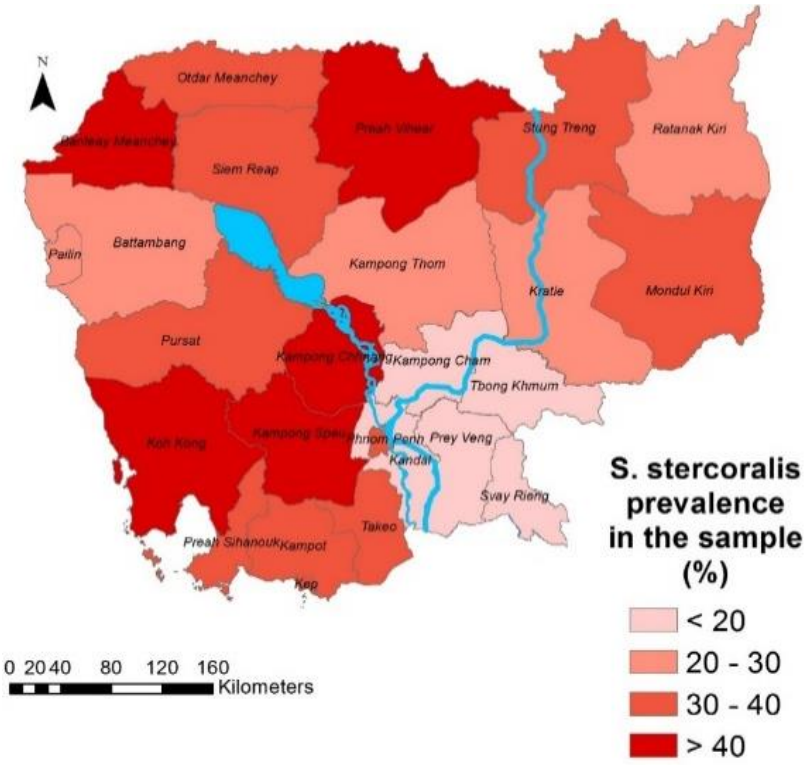


Figure 7. Endemicity mapping of *Strongyloides stercoralis* in Cambodia, 2016

This parasite is a major public health issue in Cambodia, where prevalence rates of up to 40% were recently found (Khieu et al., 2014). We diagnosed, treated and followed-up (over two years) more than 1,200 villagers in rural Cambodia to assess the impact of ivermectin on *S. stercoralis* at community level and assess whether *S. stercoralis* control could be integrated into existing programs. Our results indicate that ivermectin treatment was highly beneficial, with more than 85% of participants testing negative one year after treatment. All ages were at similar risk of acquiring an infection. The effect of community-based treatment was enhanced by increasing village sanitation coverage (Forrer et al., 2018). The detailed *S. stercoralis* infection prevalence surveys were conducted across the country in 2016, which resulted in the nation-wide *S. stercoralis* risk map (Figure 7) (Forrer et al., 2019).

The strategy to initiate control of strongyloidiasis in Cambodia would be to **pilot implementation of preventive chemotherapy using ivermectin** and **health education**, integrated with other preventive chemotherapy interventions where feasible, and evaluation of impacts.

3. National Action Plan of the Integrated NTDs Control and Elimination

3.1. *Vision*

The Cambodia free of selected Neglected Tropical Diseases.

3.2. Goal

The goal of the programme is (i) to achieve and/or sustain elimination of lymphatic filariasis and schistosomiasis, and (ii) to achieve and sustain control of STH, FBT, taeniasis/cysticercosis and strongyloidiasis in Cambodia through an integrated control strategy based on preventive chemotherapy, combined with health education, WASH and veterinary public health interventions where necessary.

3.3. Objectives

The objectives of the programme for individual diseases are as follows:

1) To ensure recrudescence of transmission of **LF** does not happen through regular post-validation surveillance
2) To ensure sustained provision of the minimum package of care for patients with **LF**-associated morbidities and disabilities
3) To interrupt transmission of **schistosomiasis** by 2025 through sustained preventive chemotherapy and effective risk communications to improve water, sanitation and hygiene (WASH) in all high-risk communities using CL-SWASH approach, covering the entire population at risk
4) To sustain annual and semi-annual deworming of all the pre-school age children (Pre-SAC), school age children (SAC) and women of child bearing age (WCBA) at risk for **STH**
5) To conduct preventive chemotherapy and health education through community engagement on hygienic eating practices and agricultural production processes, covering all individuals at risk of **FBT (opisthorchiasis)**
6) To carry out baseline disease mapping of ***T. solium*** **and cysticercosis**, and pilot implementation of multisectoral interventions, composed of MDA for human, veterinary public health interventions targeting at pigs and WASH through community engagement, and evaluate impacts when areas of disease transmission has been identified

7) To pilot implementation of preventive chemotherapy and health education, evaluate impacts for control of **strongyloidiasis** and develop its national control strategy by 2025
8) To improve WASH at schools and communities in high-burden communities of NTDs
9) To ensure sustained supplies of medications and clinical treatment of suspected/diagnosed cases of NTDs through the health system.

3.4. Strategic Pillars, Focus areas of NTDs and Major Programmatic Activities

The goals and objectives are accelerated through four strategic pillars with 7 focus areas, which all contribute to overall health system strengthening, in line with the Regional Action Framework for Control and Elimination of NTDs in the Western Pacific (Annex 3) (WHO, 2020).

– STRATEGIC PILLAR 1: Catalysing coordinated multi-sectoral actions

The principal strategy for the control and elimination of helminthic NTDs in Cambodia remains preventive chemotherapy, which is the large-scale distribution of anthelminthic drugs to population groups at-risk at regular intervals with strong collaboration with the Ministry of Health (EPI and Nutrition programme), the Ministry of Education Youth and Sport, the Ministry of Labour and Vocational Training, (Garments Factory and Industries), the Ministry of Rural Development (Proper sanitation and access to safe water supplies), the Ministry of Agriculture, Forestry and Fishery (management of animal reservoirs e.g. dog, pig, cat, fish…etc. and other NGOs). This strategy alone significantly reduces morbidity attributable to NTDs. Notwithstanding, there is evidence that regular mass treatment when conducted for several years leads to a certain amount of reduction in the community prevalence. This has been demonstrated for LF that can be eliminated as a public health problem in Cambodia by 2016 after 5 consecutive years of MDA with high coverage (>75%) (Khieu et al., 2018) and STH in areas where regular mass treatment has been conducted for several years with high coverage (Box 1).

However, reliance on preventive chemotherapy alone is insufficient to sustain the impacts and eventually interrupt transmission of many NTDs as re-infections is inevitable. Health education is already an integral part of all interventions, but more needs to be done to improve IEC and effect desirable behavioural changes through community engagement and empowerment. Where feasible and when resources permit, sanitation improvement will also need to be attempted.

The National Centre for Parasitology Entomology and Malaria Control, (CNM), which is the institution of the Ministry of Health (MoH), is responsible for the control/elimination of STH, SCH, LF, FBT, strongyloidiasis and other parasitic diseases. The Ministry of Rural Development is responsible for Water Supply and Hygiene and Sanitation. For instance, controlling of STH

requires effective delivery of Vaccination through outreach activities to pre-school children, school-aged children and women of childbearing age who are missing during the Campaign days (May-November) by EPI programme. However, NTDs are often unnoticed by clinical sectors because visible morbidity and disabilities often appear many years after initial infection e.g. Schistosomiasis and Opisthorchiasis…etc. Therefore, provision of treatment and rehabilitation services for people affected with NTDs associated morbidity and disabilities need to be integrated and sustained within the staffs at all health centres throughout the country.

The NTDs Programme Manager at CNM/MoH as a focal points still continue to advocate for NTDs in Cambodia and serve as facilitators to engage relevant sectors and partners and catalyse strong and sustained multi-sectoral partnership (Table 3).

Box 1. Strengthening and encouraging multi-sectoral partnership and commitment through annual stakeholders meeting at national and provincial levels

The NTDs Programme at CNM/MoH is organized NTDs stakeholder meeting in Phnom Penh/Province annually, where relevant officials from the Ministry of Health, the Ministry of Education, Youth and Sport, the Ministry of Rural Development, the programme director and programme managers in CNM, provincial project managers and other involved institutions will gather together, review their programme on-going and revise the annual action plan for control and elimination of NTDs in Cambodia, with technical support from WHO and other relevant partners that working in this field. This meeting also shared the achievement result of NTDs elimination/control by NTDs programme manager in order to accelerate and support activities as well as reinforce the ownership of provincial personnel and research gap.

All partners active in the field of NTD control or involved in activities targeting the same age groups are invited to participate in the planning discussions in most occasions, so as to take maximum advantage of the resources available and of the activities already implemented. For examples, where National Centre for Mother and Child Health/ UNICEF are already providing vitamin A or measles campaign to pre-school children or school children, their logistics are used to provide also deworming to the same age group, thus allowing for covering large number of preschool children at marginal cost. The principal donors and development partners in the NTDs include ADB and WHO.

The above measures are already in place for the areas presently covered and resulted in effective leadership and strong ownership at all levels of the Governmental hierarchy. We consider that it will be relatively easy to apply existing strategies to the areas which are planned to be eliminated such as schistosomiasis.

Table 3. Key programmatic activities, targeted outcomes and their contribution to health system strengthening under STATEGIC PILLAR 1

Key programmatic activities	Target outcomes	Contribution to health system strengthening
1. Strategic planning and programme review		
Annual stakeholder/technical working group meetings to strengthening a multi-sectoral governance mechanism at all levels. Regularly conduct thorough analysis and review of the NTD burden situation, disease distribution, and intervention progress and gaps pertaining to control and elimination of NTDs. Review and update annual operational action plan for NTD in order to improve interventions delivery, timelines and roles and responsibilities of stakeholder at all levels.	Roles and responsibilities clearly defined by multi-sectoral actions. Commitment obtained from all relevant programmes and sectors from the highest political level to the local level.	Health system governance
2. Advocacy and partnership		
Join Annual Conference with Malaria and Dengue control programme to disseminate the information on programme success, challenge and research finding of NTDs and also to enhance collaboration to the participants who are from different ministries, NGOs, Private sectors and all provincial health departments and operational districts	All partners commitment sustained at all level of their coverage areas Increased and sustained resources for control and elimination of NTDs helminth mobilized	Health system governance Health financing for NTDs implementation

– STRATEGIC PILLAR 2: Enhancing intervention and service delivery

Drug distribution interventions are in principle very simple but could become difficult to implement when very large groups of population are targeted in a short time. In Cambodia, all drug distribution interventions progressively scaled up from a pilot phase covering few provinces for a total of 250 000 -300 000 individuals. This sufficiently allowed the MoH/CNM staff to familiarize with the possible problems occurring during the distribution while at the same time the problems could be easily solved due to the relatively small scale of the operation. As the size of the programme progressively increased, the provincial and district managers also became more and more efficient and experienced. The current staffs, both senior and young professionals, have been progressively exposed to programme activities.

Further, some of the senior staffs have significant academic qualifications as well as practical experience in health management. Training of trainers (TOT), targeting at provincial personnel, and training of district personnel targeting at community health staff, education staff and staff of at district-level are carried out as distributors (Box. 2).

For elimination of schistosomiasis, this will be achieved through the CL-SWASH, which is jointly led by the CNM at the Ministry of Health and the WASH team at the Ministry of Rural Development to improve the same purpose using participatory risk communication and management approach; and school health education by integrating teaching curriculum on control and prevention of soil-transmitted helminthiasis; and also improvement of Rural Water Supply, Sanitation and Hygiene (RWSSH); and organize provincial Partners/NGOs consultation meeting to develop joint program and resource mobilization.

However, efforts to strengthening relevant health system components that enable quality assured, efficient, equitable, accountable and sustainable delivery of NTD interventions and services are key to achieve NTD elimination and control strategic effectively and sustainably (Table 4).

Box 2. Health workforce capacity building

With a well written national strategic plan for the elimination of LF, the national programme was launched in 2005. Mass drug administration (MDA) with Diethylcarbamazine citrate and Albendazole was conducted in six implementation units, achieving over 70% epidemiological coverage for five consecutive rounds, from 2005 to 2009.

Effectiveness of MDA was proven with transmission assessment surveys (TAS). TAS 1 carried out in 2010 found that less than 1% of school children had antigenemia. Resultantly MDA was stopped. The prevalence further fell to 0% in TAS 2 (2013) and TAS 3 (2015). Additionally, a separate survey was carried out in one province in 2015 using Brugia Rapid tests, which found one child positive among 1,677 children.

In terms of morbidity management and disability prevention, healthcare workers in 14 provinces developed a line list of lymphedema and hydrocele patients in 2006. This found that many of the patients were over 40 years of age and had been affected by LF for many years before the start of the national LF elimination programme in the country. The national programme subsequently trained healthcare workers and provincial and district staff on morbidity management and disability prevention, and designated relevant health centres to provide care for lymphedema and acute attack. Two reference hospitals were also designated to administer hydrocele surgery.

The list of chronic LF patients was most recently updated and confirmed in 2011–2012, with 32 lymphoedema patients and 17 hydrocele patients. All lymphedema patients had been trained on self-management and all hydrocele patients had been offered free surgery.

Due to the success of the MDA and the development of health system capacity for patient care, along with benefits gained from socioeconomic improvements and other interventions against vector-borne diseases and NTDs, Cambodia was validated by the World Health Organization as having achieved elimination of LF as a public health problem in 2016.

However, validation is not a permanent state and does not represent an end to programme activities. While some activities, such as MDA, may no longer be required, programmes should continue to undertake **post-validation surveillance** so as to help prevent recrudescence of transmission. It is also essential to ensure **the minimum package of care for patients** remains available within the health care system.

Table 4. Key programmatic activities, targeted outcomes and their contributions to health system strengthening under STRATEGIC PILLAR 2

Key programmatic activities	Target outcomes	Contribution to health system strengthening
3. ***Supply and logistics management***		
Ensure regular supplies of Deworming medicines (Mebendazole/Albendazole and Praziquantel) for interventions (MDA) to target groups at risk at all levels through forecasting and planning. Maintain strong collaboration with Health's Central Medical Store/MoH information to procure Deworming drugs outside the donation programme for all the target groups at risk of selected NTDs and ensure timely supplies (on a quarterly basis) and proper management. Ensure efficiency of the supply chain management during procurement, storage and delivery for deworming drugs through standardized recording and reporting and regular monitoring.	Supplies of quality deworming medicines available in time and in sufficient volumes and enough utilized for planned intervention without wastage.	Essential drugs. Health financing for universal coverage.
4. ***Intervention and service delivery***		
The utilization of the existing government structures by following the helminth guideline and policies for selected NTDs interventions including case treatment through the health system, to ensure quality and safety of intervention delivery at all level.	Interventions and services deliver safely and efficiently.	Service delivery and safety.

Key programmatic activities	Target outcomes	Contribution to health system strengthening
Implement the activities setting in the national strategic plan for elimination of schistosomiasis (2020-2024) and STH guideline in Cambodia (2014) in strong collaboration with relevant sectors and authorities and also strengthen referral system for monitoring, reporting and management of adverse events. Training and refreshing training of health workforce at all levels include VHWs to effectively carry out the NTD activities plan, delivery and report interventions. Strengthen capacity of national laboratories for diagnosis and drug quality control and pharmacovigilance, especially as the programmes moves towards elimination. Provide MDA for STH to target group at risk through campaign day with vitamin A, twice a year (May-November) by health centres staffs in collaboration with teachers and MDA (Praziquantel) for Schistosomiasis and Food Borne Trematode to population at risks that carry out by health staffs and VHWs, include follow-up of patients affected by disabilities, and implement MDA coverage evaluation.	National and population at risk coverage targets set in line with global targets achieved for planned interventions and services.	Health workforce.

– STRATEGIC PILLAR 3: Engaging and empowering communities

NTDs are most often found in places with unsafe drinking water, poor sanitation and insufficient hygiene practices. To sustain the reduced prevalence of schistosomiasis and other NTDs through annual rounds of MDA targeting at human population and eventual interrupt the transmission, ensuring adequate sanitation and better hygiene and nutrition practices at each endemic community is essential.

Improvement of WASH has been a consideration for control and elimination of NTDs previously with involvement of the Ministry of Education, Youth and Sports and the Ministry of Rural Development in the national task force and collaboration particularly with the 'WASH in Schools' (WinS) for latrine installation at schools. One of the targets of WinS is latrines in 100% of schools by 2025. Adding to this is the novel *Community-Led initiatives to eliminate Schistosomiasis by combining deworming with WASH interventions* (CL-SWASH) developed in conjunction with WHO (Box 3).

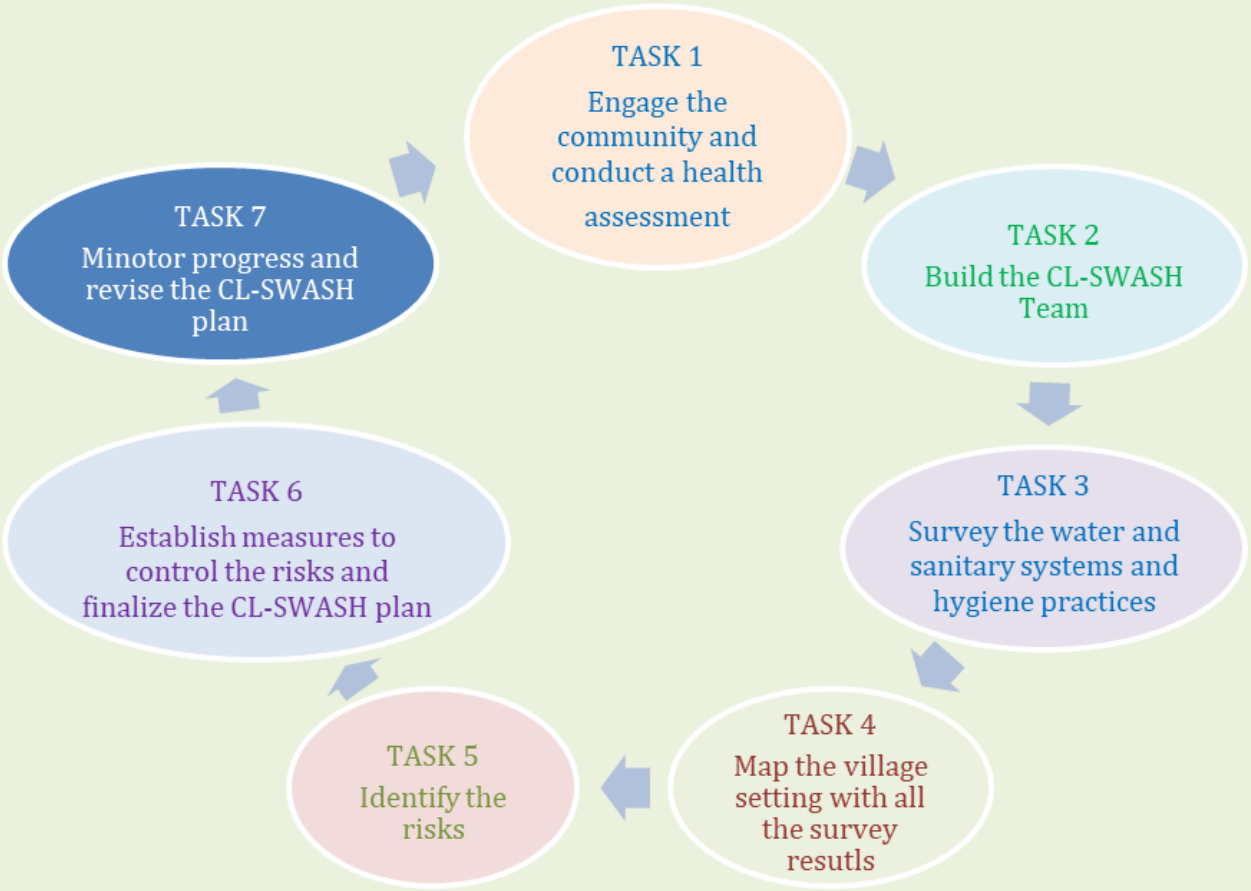
For elimination of schistosomiasis, implementation of CL-SWASH in all 114 endemic communities is targeted. Implementation of the CL-SWASH plan at each endemic community will be jointly led by the Ministry of Rural Development and CNM under the Ministry of Health. Funds have been mobilized to support activities in 12 villages in Kratie province and 4 in Stung Treng province already and this will be further expanded to in both Stung Treng and Kratie provinces. It is also imperative that WinS and CL-SWASH collaborate and complement activities to ensure WASH coverage reaches all 114 villages by providing water supply and sanitation services to communities, rural-area schools, health facilities and public-service institutions (Table 5)

Box 3. Community-Led initiatives to eliminate Schistosomiasis by combining deworming with WASH interventions (CL-SWASH)

The concept of the *Community-Led initiatives to eliminate Schistosomiasis by combining deworming with WASH interventions* (CL-SWASH) was developed in conjunction with WHO. Conventional donor-driven introduction of sanitation facilities often resulted to be unsustainable. To overcome this challenge, it was realized that facilitating community members' discovery and understanding on linkage between inadequate sanitation, water supply and nutrition practices and infection with schistosomiasis is needed to promote their voluntary improvement of their practices.

The Ministry of Rural Development has been leading nationwide scale-up of Water Safety Plans (WSPs) at community level with support of WHO. WSP is a risk management approach to ensure safety of a water supply system, from catchment to consumer, through community participation. It involves setting up an elected community WSP team from community members, who plays a

leading role in community dialogue and tour around the village to conduct risk assessment related to water supply and sanitation. The original six steps recommended by WHO to set up a WSP has been adapted and expanded to seven steps in order to serve the needs of the CL-SWASH initiative by integrating components of control of parasitic infection and nutritional impacts.



Steps to set up a CL-SWASH plan at community level

Using this approach, the CL-SWASH builds on community ownership. It considers that the best outlook to effectively sustain local initiatives is obtained when the stakeholders themselves are the ones who based on informed decisions; trigger the initiative from start by demanding improvement.

The CL-SWASH initiative differs radically from top down and supply driven processes, and aim to build on community ownership and leadership. For schools education have been integrating curriculum on prevention of schistosomiasis and other NTDs.

Implementation of the CL-SWASH plan at each endemic community is jointly led by the Ministry of Rural Development and CNM under the Ministry of Health. Funds have been mobilized to

support activities in 12 villages in Kratie province and 4 in Stung Treng province already and this will be further expanded to all schistosomiasis endemic villages in both Stung Treng and Kratie provinces.

It is imperative that WinS and CL-SWASH collaborate and complement activities to ensure WASH coverage reaches all 114 schistosomiasis-villages by providing water supply and sanitation services to communities, rural-area schools, health facilities and public-service institutions.

The leadership of district and provincial governors are a key factor to facilitate and mobilize resources from people in the community during MDA campaign and CL-SWASH implementation.

Considering the necessity of behavioural change for control of FBT, taeniasis/cysticercosis and strongyloidiasis and successful impacts of CL-SWASH on endemicity of schistosomiasis, similar community engagement approach will be explored for control of these NTDs as well.

Table 5. Key programmatic activities, targeted outcomes and their contributions to health system strengthening under STRATEGIC PILLAR 3.

Key programmatic activities	Target outcomes	Contribution to health system strengthening
5. Health risk communications mobilization and social		
Conduct the CL-SWASH Training of Facilitators (TOF) and Community Training (TOC) to enhance communities' understanding of the link between their hygiene, sanitation, safe water, food preparation practices, transmission of NTDs and the purpose of intervention and elimination. Regular meeting and monitoring with local authorities, community leaders and culturally people in health risk communications including VHWs to strengthen the communication and social mobilization to maximize community participation as well as the achievement of the control or elimination of NTDs and CL-SWASH in their catchment areas.	High risk individuals and communities are aware of social determinants of NTDs situation in their localities High risk individuals and communities are empowered to actively participate in interventions, make necessary improvement in their practices and manage their health risks	Health workforce Service delivery and safety

– STRATEGIC PILLAR 4: Measuring impacts and generating evidence

The Ministry of Health has a functional Health Management Information System (HMIS) in place. NTDs have been incorporated and monitored alongside other conditions through the existing HMIS system such as MDA coverage of STH. However the Programme also monitors progress of implementation. The monitoring and evaluation (M&E) system will therefore be inbuilt into the programme just like other strategic priorities.

Cambodia has a passive reporting system in place to report any serious adverse events following MDA. Systems for reporting serious adverse events established by the pharmaceutical companies and WHO will also be followed.

National Helminth Control Program at National Centre for Parasitology and Entomology has been done numerous surveys on intestinal parasitic infection diagnosis based on the detecting of the worm egg by using the Kato-Katz thick smear technique in order to find out the prevalence and intensity of Schistosomiasis, Soil-transmitted helminth (STH) and other intestinal helminth for the control.

To date, most of referral hospital in Cambodia are rarely implemented the stool examination by using this procedure technique. The laboratory staffs at provincial levels only collaborate with national level during the period when the surveyed were carried out in their areas.

In addition, surveys is planned to evaluate parasitological indicators 2-3 after mass preventive chemotherapy interventions of selected helminth (e.g. STH). National program routinely commits for regular surveys and in addition, to fill identified gaps, funding proposals will be separately submitted to the partners for monitoring and evaluation.

The effective result of annual MDA campaigns, schistosomiasis in Cambodia right now considered within reach to pre-elimination, but for surveillance and verification of elimination of schistosomiasis, the national programme still relies on insensitive Kato-Katz stool examination method for regular epidemiological monitoring of schistosomiasis. Strengthening of **surveillance strategy towards verification of elimination of schistosomiasis** using more advanced diagnostic tools and protocols need to be piloted in the context of operational research. This is the case also for exploration of various options to identify the cost-effective and efficient strategy for regular **LF post-validation surveillance**. **Disease mapping of taeniasis/cysticercosis** and **pilot implementation and evaluation of interventions for control of FBT, taeniasis/cysticercosis and strongyloidiasis** will also be progressed in the context of operational research so as to guide

development of enhanced strategy for control of these diseases both at national and global level too (Table 6)

Close collaboration with animal health sector will also be maintained, focusing on surveillance and control of FBT, taeniasis and cysticercosis. Attention also needs to be focused on strengthening surveillance capacity and improving collection, reporting and management of data in order to continuously monitor the impacts of interventions, ultimately verify interruption of transmission and sustain post-elimination surveillance to help prevent recrudescence of transmission even after elimination goal has been achieved (Box 4).

Box 4. Exploring opportunities for sustainable post-elimination surveillance of Lymphatic filariasis in Cambodia.

Ministry of Health, Cambodia which was validated for having eliminated lymphatic filariasis as a public health problem in 2016, conducted a nationwide serosurvey of tetanus immunity in 2012 to monitor progress towards maternal and neonatal tetanus elimination. During this survey, the conducted sera samples were also tested to measure specific antibody responses to the parasites that cause malaria, toxoplasmosis, lymphatic filariasis, cysticercosis and strongyloidiasis using multiple bead assay with technical support from the United States Centers for Disease Control and Prevention. The results were able to provide nationally representative estimates of the presence and distribution of such parasitic diseases in the country. Encourage by this experience, the Ministry of Health is planning to integrate lymphatic filariasis serological testing in the next tetanus serosurvey as part of post-validation surveillance of lymphatic filariasis.

Encouraged by this success, Cambodia is looking to serve as a model country in the Region to effectively control and eliminate all parasitic diseases of public health importance.

Table 6. Key programmatic activities, target outcomes and their contributions to health system strengthening under STRATEGI PILLAR 4

Key programmatic activities	Targeted outcome	Contribution to health system strengthening
6. *Surveillance, laboratory and health information system*		
Develop SOPs for LF and SCH surveillance, integrated and coordinated with Malaria and Dengue diseases surveillance activities where feasible. Revise SOPs for strengthening the diagnosis and intervention monitoring of relevant Helminthiases with the list of indicators, intended use, methods of specimen collection, detection and diagnosis, interpretation of results, reporting and response algorithm. Strengthening in collaboration the reporting mechanism of MDA coverage with agreed minimum core indicators and reporting protocols for STH with reporting deadline to ensure accurate and timely reporting at all levels up to WHO, by using electronic data system of Department of Plaining. Improve the skills of laboratory and programme staff at all levels to collect data, interpret results accurately, use data for improving programme efficiency and report, and respond promptly, in the context of health system strengthening and available resources.	Establishing and strengthening of LF and SCH surveillance and monitoring capacity at all levels and resources needs identified. Data reporting and sharing improved Capacity of Laboratory and programme staff at all levels strengthened for strategic use of data for improving programme efficiency	Health statistics and information system
7. *Research and innovation*		
Strengthen programme capacity in developing, implementing and documenting operational and implement research to improve programme efficiency and impacts with support of partners Mapping of taeniasis/cysticercosis	Evidence generated through programme implementation and research documented and disseminated Areas of high disease transmission has been identified	Health workforce

4. BUDGET

ACTIVITY*	2021 (USD)	2022 (USD)	2023 (USD)	2024 (USD)	2025 (USD)	TOTAL (USD)
Advocacy and stakeholder meeting at all levels	50,000	50,000	50,000	50,000	50,000	250,000
Social Mobilization and Health Education	200,000	150,000	150,000	200,000	150,000	850,000
Training and refreshing training	100,000	-	100,000	-	100,000	300,000
Mass Drug Administration & Drug Distribution	100,000	100,000	100,000	100,000	100,000	500,000
Monitoring and evaluation	40,000	40,000	40,000	40,000	40,000	200,000
Surveillances & Morbidity Control	50,000	50,000	50,000	50,000	50,000	250,000
Mapping Taeniasis/cysticercosis & Foodborne trematodiasis		250,000				250,000
MDA coverage survey	50,000		50,000		50,000	150,000
Anthelminthic drug efficacy assessment		70,000		70,000		140,000
LF Post-validation surveillance	20,000	20000	20,000	20,000	20,000	100,000
Pilot intervention for Control of Strongyloidiasis stercoralis	100,000	100,000	100,000	100,000	100,000	500,000
Operational Researches	50,000	50,000	50,000	50,000	50,000	250,000
TOTAL	**760,000**	**880,000**	**710,000**	**680,000**	**710,000**	**3,740,000**

*Exclude the budget of activities for the elimination of Schistosomiasis mekongi (CNM, 2019)

5. REFERENCES

CNM. (2004) National Policy and Guideline for Helminth Control in Cambodia, Phnom Penh, Cambodia: National Center for Parasitology, Entomology and Malaria Control, Ministry of Health.

CNM. (2009) Natioal Strategic Plan for Elimination of Schistosomiasis mekongi in Cambodia 2020-2024, Phnom Penh, Cambodia: National Center for Parasitology, Entomology and Malaria Control, Ministry of Health.

Forrer A, Khieu V, Schar F, et al. (2018) *Strongyloides stercoralis* and hookworm co-infection: spatial distribution and determinants in Preah Vihear Province, Cambodia. *Parasit Vectors* 11: 33.

Forrer A, Khieu V, Vounatsou P, et al. (2019) *Strongyloides stercoralis*: Spatial distribution of a highly prevalent and ubiquitous soil-transmitted helminth in Cambodia. *PLoS Negl Trop Dis* 13: e0006943.

Keiser J and Utzinger J. (2005) Emerging foodborne trematodiasis. *Emerging Infectious Diseases* 11: 1507-1514.

Khieu V, Furst T, Miyamoto K, et al. (2019a) Is *Opisthorchis viverrini* Emerging in Cambodia? *Advances in Parasitology* 103: 31-73.

Khieu V, Or V, Tep C, et al. (2018) How elimination of lymphatic filariasis as a public health problem in the Kingdom of Cambodia was achieved. *Infect Dis Poverty* 7: 15.

Khieu V, Sayasone S, Muth S, et al. (2019b) Elimination of Schistosomiasis Mekongi from Endemic Areas in Cambodia and the Lao People's Democratic Republic: Current Status and Plans. *Trop Med Infect Dis* 4.

Khieu V, Schär F, Forrer A, et al. (2014) High Prevalence and Spatial Distribution of *Strongyloides stercoralis* in Rural Cambodia. *PLoS Negl Trop Dis* 8: e2854.

Khieu V, Vounatsou P, Forrer A, et al. (2020) Prevalence and spatial distribution of *Opisthorchis viverrini* in Cambodia. *Prepared for Submission to PLoS Negl Trop Dis*

Kirinoki M, Yajima A, Ohmae H, et al. (2020) Validation of the elimination of schistosomiasis as a public health problem in Cambodia using parasitological and serological indicators. *Submitted to Acta Tropica*

Sinuon M, Anantaphruti MT and Socheat D. (2003) Intestinal helminthic infections in schoolchildren in Cambodia. *Southeast Asian Journal of Tropical Medicine and Public Health* 34: 254-258.

Sripa B, Sithithaworn P and Sirisinha S. (2003) Opisthorchis viverrini and opisthorchiasis: the 21st century review. *Acta Tropica* 88: 169-170.

WHO. (2007) Global plan to combat neglected tropical diseases 2008–2015. Geneva, World Health Organization. (WHO/CDS/NTD/2007.3).

WHO (2012) Accelerating work to overcome the global impact of neglected tropical diseases : a roadmap for implementation. Geneva, World Health Organization.

(https://apps.who.int/iris/handle/10665/70809?locale=ru&null)

WHO. (2020) Regional action framework for control and elimination of neglected tropical diseases in the Western Pacific. (https://iris.wpro.who.int/handle/10665.1/14514)

6. ANNEXES

Annex 1: Definitions of eradication, elimination and control of NTDs

Definitions of eradication, elimination and control of NTDs

WHO recommends using the following practical definitions for the global NTD roadmap targets:

Eradication is the permanent reduction to zero of a specific pathogen, as a result of deliberate efforts, with no more risk of reintroduction. The process of documenting eradication is called certification.

Elimination of transmission (also referred to as interruption of transmission) is the reduction to zero of the incidence of infection caused by a specific pathogen in a defined geographical area, with minimal risk of reintroduction, as a result of deliberate efforts; continued actions to prevent re-establishment of transmission may be required. The process of documenting elimination of transmission is called verification.

Elimination as a public health problem is a term related to both infection and disease. It is defined by achievement of measurable global targets set by WHO in relation to a specific disease. When reached, continued actions are required to maintain the targets and/or to advance the interruption of transmission. The process of documenting elimination as a public health problem is called validation.

Control is the reduction of disease incidence, prevalence, morbidity and/or mortality to a locally acceptable level as a result of deliberate efforts; continued intervention measures are required to maintain the reduction. Control may or may not be related to global targets set by WHO.

Annex 2: National strategy for deworming to control STHs in Cambodia

National strategy for deworming to control STH from the *Summarized Guideline for Deworming (Mebendazole 500mg/Albendazole 400mg) to the Target Group at Risk in Cambodia*

a. STH Deworming Target Groups

a.1. Teachers and students in both public and private schools

- Kindergarten children (both sexes)
- Primary school children (both sexes)
- Secondary school students (both sexes)
- High school students (both sexes)
- Teacher trainees in teacher training institutions (both sexes) in 25 provinces/municipalities across the country

a.2. Communities in all provinces/municipalities

- Pre-school aged children aged 12 to 59 months (both sexes)
- School children who have not taken drugs during drug distribution in school, non-schooled children or children who dropout (both sexes)
- Women of child bearing age from 15 to 49 years (including pregnant women in their second semesters and women after delivery)
  - Women in the communities
  - Women working in the factories or enterprises

b. Timeline of Drug Distribution

b.1. Campaign (Day)

- May and November together with the Vitamin A Campaign (Day)
- Through various Vaccination Campaigns

b.2. Through Public services

- Through consultations at all public health services
- Outreach services by health center staff

c. Types and Dosage for Distribution

- Mebendazole 500 mg/Albendazole 400 mg are drugs that can be easily taken without Consequences
- Dosage
  - Oral Single Dosage for individuals aged 2 years up
  - Chew and take half of the drug (breaking drug into two pieces, 250 mg for Mebendazole and 200 mg for Albendazole) for children aged from 12 to 23 months

d. Drug Delivery Strategy

- Children aged from 12 to 23 months can receive 1 dosage of Mebendazole/Albendazole (drug must be taken during mass campaign) regularly at least once a year through
  - Kindergartens under supervision of teachers and directors concerned with support from health center staff
  - Outreach health services including vaccination, vitamin A, and consultations at public health services

- School children/adults have to receive 1 dosage of Mebendazole (drug must be taken during mass campaign) regularly at least once a year through
  - Schools (public and private) under supervision of teachers and directors concerned with support from health center staff
  - Outreach health services and consultations at public health services

- Women of child bearing age from 15 to 49 years old (pregnant women in their second trimesters, women after delivery, except pregnant women in their first trimesters) can receive 1 dosage of Mebendazole (drug must be taken during mass campaign) regularly at least once a year through
  - Outreach health services including vaccination, vitamin A, family planning service and consultations at public health services
  - Health services in factories or enterprises

The main challenge in Cambodia is (1) to maintain the high level of coverage with mebendazole or Albendazole in SAC, Pre-SAC and WCBA in all areas that had high prevalence of STH and (2), to cover all at risk groups at least once per year integrating with existing campaigns. The specific activities will include:

- TOT training for district and HC staffs in the provinces where mass drug administration (MDA) is implemented;
- Refresher training on STH including training of teachers, who are drug distributors
- Drug procurement and distribution costs to cover pre-SAC during vitamin A campaign;
- Drug procurement and distribution cost to expand from coverage of pregnant and lactating women to coverage of all WCBA;
- Conducting health education campaigns to impart hygienic behavior
- Maintaining linkages and holding forums to share/disseminate information
- Conducting parasitological evaluation surveys, 1 survey for each risk group, every 3 years after intervention.

Annex 3: Strategic pillars and focus areas to accelerate control and elimination of NTDs in Cambodia

NTDs	SP1: Catalysing coordinated multi-sectoral actions		SP2: Enhancing intervention and service delivery					SP3: Engaging and empowering communities		SP4: Measuring impacts and generating evidence	
	a- Strategic planning and programme review	b- Advocacy and partnership	c- Health workforce capacity building	d- Intervention and service delivery				e- Social mobilization	f- Health education	g- Surveillance, M&E	h- Research and innovation
				PC	Case management	WASH	Veterinary public health				
LF	✓	✓	✓		✓					✓	✓
SCH	✓	✓	✓	✓	✓	✓	(✓)	✓	✓	✓	✓
STH	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
FBT	✓	✓	✓	✓	✓	✓	(✓)	✓	✓	✓	✓
Taeniasis/ Cysticercosis	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Strongyloidiasis	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓

SP: Strategic Pillar; NTDs: Neglected Tropical Diseases; PC: Preventive Chemotherapy; WASH: Water, Sanitation and Hygiene; M&E: Monitoring & Evaluation; LF: Lymphatic filariasis; SCH: Schistosomiasis mekongi; STH: Soil-Transmitted Helminthiasis; FBT: Foodborne Trematodiasis