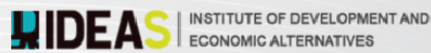




World Health
Organization



BASELINE SURVEY REPORT OF SOIL-TRANSMITTED HELMINTHS PREVALENCE IN PAKISTAN

April 2017

Prepared by Interactive Research & Development

In partnership with

World Health Organization; The Indus Hospital; Institute
of Development and Economic Alternatives; and Evidence Action

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Abbreviations

AJK	Azad Jammu & Kashmir
DHHS	Department of Health and Human Services
FATA	Federally Administered Tribal Areas
GB	Gilgit-Baltistan
ICT	Islamabad Capital Territory
IDEAS	Institute of Development and Economic Alternatives
IEC	Information Education and Communication
IRD	Interactive Research & Development
KPK	Khyber Pakhtunkhwa
MDA	Mass drug administration
OHRP	Office for Human Research Protections
OOSC	Out of school children
STH	Soil transmitted helminths
TIH	The Indus Hospital
WHO	World Health Organization

Executive Summary

Pakistan's first national survey of soil-transmitted helminths (STH) utilized the World Health Organization's (WHO) sentinel school and ecological zone strategy. One school was selected for every 300,000 children aged 5-10 years in each of the ecological zones of Pakistan. Mobile lab teams with technical and non-technical members were deployed in the four provinces (Punjab, Sindh, Balochistan and Khyber Pakhtunkhwa (KPK)) as well as the territory of Azad Jammu & Kashmir (AJK). A total of 77 schools across the country were approached and 5188 parents consented to their child's stool to be analyzed for STH. Anthropometric measurements (e.g. height and weight) were collected from children; concomitantly, these children were interviewed to assess their knowledge about hygiene and sanitation practices. Information about hygiene and sanitation infrastructure was also collected and analyzed from all 77 schools, as well as the households of the 3995 children who provided stool samples suitable for parasitological analysis.

On the basis of the collected and analyzed parasitological data, the weighted prevalence of STH in the different ecological zones ranged from 0% to 37.5%. The ecological zone with the highest weighted prevalence was found to be the Northern Dry Mountains (37.5%), which covers parts of northern KPK, northern Federally Administered Tribal Areas (FATA) and Gilgit-Baltistan (GB), followed by the Barani Lands (25.3%), which covers parts of northern Punjab, Islamabad Capital Territory (ICT), and two non-contiguous regions of KPK. Other ecological zones were found to have significantly lower levels of infection, ranging from 12.2% in the Wet Mountains, which covers all of Azad Jammu & Kashmir (AJK) and parts of north eastern KPK, to 0% in the Western Dry Mountains, which covers north-eastern Balochistan, southern FATA and central KPK. All three forms of STH (roundworm, whipworm and hookworm) were identified, although hookworm was identified only at low levels.

Following the WHO classification of intensity of infection, the majority of infections were of light intensity. The Northern Dry Mountains was the region with the highest levels of moderate or high intensity infections: 13.6% of the population in this ecological zone had moderate or high roundworm infections; and 1.63% had moderate or high whipworm infections. Overall, 1.25% of the sampled population had moderate or heavy intensity roundworm infections, 0.12% had moderate or heavy intensity whipworm infections, and 0.1% had moderate or heavy intensity hookworm infections.

The findings from this nationwide survey indicate that STH appears to be focused in selected regions of the country. While the overall weighted prevalence of any form of STH across Pakistan is low (6.9%), there are regions where prevalence is significantly higher. Northern regions of Punjab have high prevalence, with Rawalpindi and Gujrat representing the areas of highest prevalence (56% and 31% respectively). STH is endemic across northern regions of KPK, with highest prevalence around the district of Swat (37%). Much of the southern region of Pakistan have very low levels of infection, with the notable exception of the Karachi area where prevalence reaches 20%. The survey also revealed that hygiene and sanitation infrastructure and basic hygiene practices (such as handwashing with soap) at schools and households across all areas were poor.

This first national survey of STH provides important information to guide the Government of Pakistan's strategy for combating STH. The WHO recommendation is that children in areas where the prevalence of any form of STH is 20-50% at baseline should have annual deworming and children in areas with >50% prevalence should be dewormed twice a year. In accordance with WHO-recommended strategies, annual school-based mass drug administrations are warranted in only selected areas of the country: regions of northern Punjab, within the Barani Land; regions of northern KPK within the Northern Dry Mountains, Wet Mountains and Northern Irrigated Plains; the vicinity of Karachi in the Dry Western Plateau; regions of western GB, within the Northern Dry Mountains; and regions of northern FATA within the Northern Dry Mountains. Only limited areas in southern AJK, within the Wet Mountains, and southern Balochistan, within the Dry Western Plateau, exceed the WHO-recommended threshold for warranting MDA. Only a very focused area, in the vicinity of Rawalpindi and Islamabad, was identified as warranting biannual MDAs. To sustain the impact of deworming activities and reduce the rates of reinfection, efforts will also need to be made to develop the water and sanitation infrastructure and to improve hygiene-related knowledge and practices amongst communities in endemic areas.

1. Introduction

The soil-transmitted helminths (STH), particularly roundworms (*Ascaris lumbricoides*), whipworms (*Trichuris trichiura*), and hookworms (*Necator americanus* or *Ancylostoma duodenale*), are a group of parasitic nematode worms which cause infections in the human alimentary tract through contact with eggs or larvae. STH is transmitted by eggs (*A. ascaris* and *T. trichiura*) or larvae (hookworm) that are passed in the faeces of infected people. Adult worms live in the intestine where they produce thousands of eggs each day (1). In areas that lack adequate sanitation, these eggs contaminate the soil. There is no direct person-to-person transmission, or infection from fresh faeces, because eggs passed in faeces need about three weeks to mature in the soil before they become infective. Since these worms do not multiply in the human host, re-infection occurs only as a result of contact with infective stages in the environment (2).

STH is prevalent in tropical and sub-tropical environments, in moist and warm soil, especially in areas with improper sanitation and inadequate supply of water. About 1.5 billion people are infected with STH globally (2) and an estimated 840 million children are in need of STH treatment (3). Worm infections interfere with nutrient uptake; can lead to anemia, malnourishment and impaired mental and physical development; and pose a serious threat to children's health, education, and productivity.(2) Infected children are often too sick or tired to concentrate at school, or to attend at all.

1.1. Epidemiology in Pakistan

Several studies have been conducted in Pakistan to determine STH burden with the limitation that none of the studies follow the World Health Organization (WHO) recommended methodology of STH prevalence estimation, or their focus area was limited. Between 1964 and 2015, there have been about 27 studies reporting STH prevalence in various areas of Pakistan. These studies have reported hookworm prevalence ranging from 0% (4-6) to 6.1% (7); roundworm prevalence ranging from 1.3% (4, 8) to as high as 96.1%(9) and whipworm prevalence between none(5, 6) to as high as 19.1% (10).

Most of the studies were either hospital based or single city surveys. Province-wise, Sindh was only represented by several studies done in Karachi where prevalence of roundworm ranged from 1.3% in healthy toddlers (4) to 16.5% in 1-5 year olds.(5) Between 1968 and 2005, Punjab had studies conducted in major cities of Lahore (11, 12), Faisalabad (13) and Rawalpindi (14) with hookworm prevalence in a mixed population at 9.8%, roundworm at 15.5% and whipworm at 2.8%. The capital city of Islamabad which borders the city of Rawalpindi in Punjab also reportedly had a prevalence of roundworm between 5.8% in a mixed population (7) to 12.8% in children up to 12 years of age (15). The six studies conducted in AJK province reporting roundworm prevalence ranging from 13.5% in primary school children (6) to 3.8% in under 15 year olds in Muzaffarabad (16) and 51.7% in the Bagh region (8). For Gilgit-Baltistan (GB), Nishiura et al reported prevalence of roundworm in villages between 80-97% (9), whereas another study in Skardu city reported a prevalence of 35% for roundworm and 93% for whipworm (17). An unpublished study from FATA's Khurram Agency reported a prevalence of 0.6%, 31% and 7.8% for hookworm, roundworm and whipworm respectively in a mixed population (16). To date, no published studies have been conducted in Balochistan province.

With only data from small surveys conducted in single studies, it was necessary to conduct a nationwide survey to determine the burden and intensity of STH in Pakistan. This survey followed WHO guidelines and used the sentinel school method and ecological zones to determine prevalence (18).

1.2. Rationale and Objectives

According to WHO estimates, 21.7 million school age children in Pakistan are infected with STH, along with 9.3 million preschool-age children (19). However, prior to implementing any large-scale deworming program, it was necessary to determine the geographical distribution of STH in Pakistan. The information from the survey findings would be used to provide epidemiological baseline data and help the government of Pakistan decide on the most appropriate preventive chemotherapy strategy (Table 1) (18). The aim of this survey is to report the prevalence and intensity of STH in Pakistan and to provide information upon which informed decisions can be taken about the most appropriate strategy to pursue for combatting STH in Pakistan.

Table 1 WHO Treatment Criteria based on STH prevalence

Category	Prevalence of any STH infection at baseline	Control Strategy	
		Preventive Chemotherapy	Additional Interventions
Schools in high-risk areas	$\geq 50\%$	Treat all school age children (enrolled and non-enrolled) twice a year	<ul style="list-style-type: none"> - Improve sanitation and water supply - Provide health education
Schools in low-risk areas	$\geq 20\%$ and $< 50\%$	Treat all school age children (enrolled and non-enrolled) once a year	<ul style="list-style-type: none"> - Improve sanitation and water supply - Provide health education

When the prevalence of any STH infection is under 20%, large-scale preventive chemotherapy interventions are not recommended. Affected individuals should be treated on a case-to-case basis

2. Survey Methodology

In order to meet study objectives, Interactive Research & Development (IRD) partnered with The Indus Hospital (TIH), Institute of Development and Economic Alternatives (IDEAS) and Evidence Action to conduct the 1st National STH Prevalence Survey of Pakistan. Details of the partners are in Annexure 4

2.1. Study design, geographic area and study population

In 2016, it was estimated that Pakistan has a population of 202 million making it the seventh most populous country in the world (20). Pakistan's population is divided into four provinces. The most populous province is Punjab (46%), followed by Sindh (28%), Khyber Pakhtunkhwa (14%), and Balochistan (7%), along with the autonomous territory, Gilgit Baltistan (0.7%); the disputed territory, Azad Jammu and Kashmir (1.5%) and a group of Federally Administered Tribal Areas (FATA) (2%) and Islamabad Capital Territory (0.6%). Over 60% of Pakistanis live in rural areas with nearly 32% of the population less than 15 years of age.

The survey was designed as a school-based cross-sectional study and conducted between August and December 2016 throughout Pakistan except FATA and GB. Details in section 2.2.

2.2. Sampling Strategy

District and School Selection

WHO's sentinel site approach was used to estimate the baseline prevalence STH infection. Schools were considered sentinel sites and the number of sentinel sites per ecological zone (21) was calculated on the basis of children population estimates of 5-10 years old (18). This approach was based on the assumption that STH prevalence gathered from a limited number of sentinel schools, would be sufficient to generalize the prevalence in the entire ecological zone (18). Features and description of each ecological zone are in Annexure 3.

Ecologically, Pakistan is divided into nine agro-ecological zones (21); some that span across multiple provinces. Once the required number of sentinel sites was determined for each ecological zone, selection of sentinel schools was done in two stages. In the first stage, a listing of all divisions and districts within an ecological zone was created. Then their geographical accessibility and dispersion was assessed. All efforts were made to best represent the country. Zone I is reserved for the banks of the Indus River and thus not included in the sampling strategy.

Lists of public primary schools maintained by Government Education Departments were used for the selection of schools. Only government schools having a cumulative enrolment of more than 60 children in the primary classes were considered for inclusion. In the public sector, schools in Pakistan have usually been single-sex, under the belief that households would feel uncomfortable sending their girls to a co-educational school (22). Both male and female single-sex schools as well as co-educational ones were selected to ensure representation. One school for every 300,000 children was selected within each district.

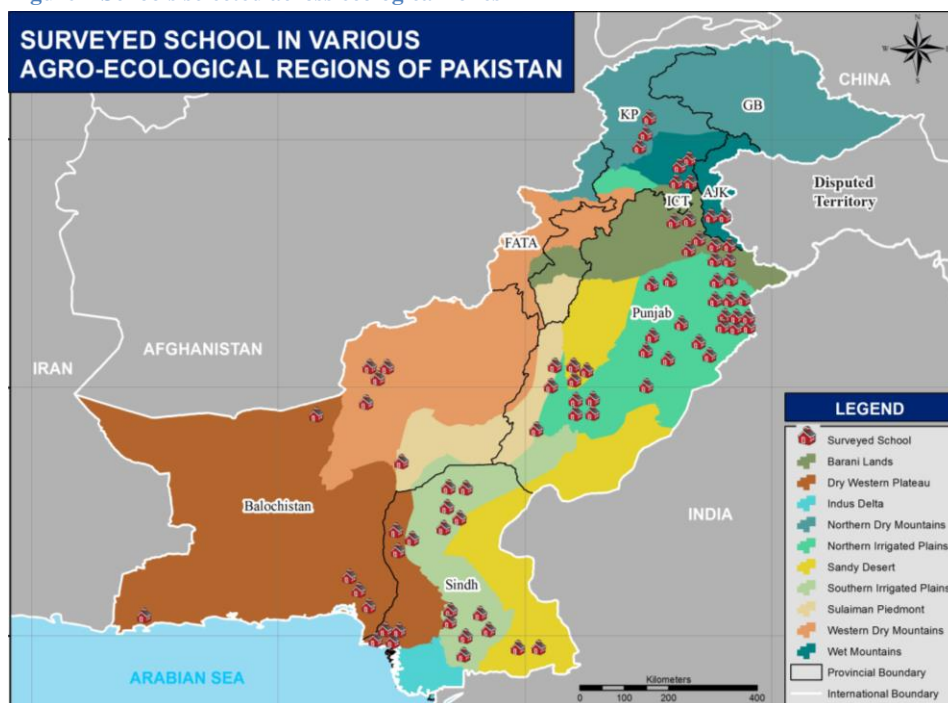
Participant Selection

Once a school was selected, a total of 60 children from class 5 (9-10 year old age bracket) were randomly-selected on the day the study team visited the school. If the class 5 group did not have sufficient children giving assent, then children from other grade years were selected randomly – the team systematically worked their way down the grade years until 60 children were selected. After experience from the first few schools, the strategy was changed slightly to sample more than 60 children since many children did not provide stool samples or their parents refused.

2.3. Sample Size

A total of 75 sentinel schools were identified for the survey across 35 districts targeting 4,500 children. However, since the FATA could not be part of the survey due to security concerns, nor could Gilgit-Baltistan due to severe landslides and flooding during the time of the survey, slight modifications were made and finally 77 schools were sampled across 35 districts. (Annexure 2). It is important to note that ecological-zone wise, both FATA and GB were represented by districts in the adjacent provinces of Balochistan and KPK. (See Figure 1)

Figure 1 Schools selected across ecological zones



2.4. Data Collection Instruments

Three types of forms were used for collection information, i.e. school information; child information and household information as follows:

Table 2 Brief on data collection instruments

Forms	Frequency	Aspects Covered	Respondent
School Information Questionnaire	Conducted in each selected school	<ul style="list-style-type: none"> School enrolment information School infrastructure School sanitation facilities 	Staff from school administration: <ul style="list-style-type: none"> Headmaster/ Headmistress/ Principal Head teacher Teacher Clerk/ documentation officer
Child Questionnaire	Conducted with every student selected in each school	<ul style="list-style-type: none"> Child anthropometric measurements Child hand washing practices 	<ul style="list-style-type: none"> Child himself/herself

Forms	Frequency	Aspects Covered	Respondent
Child Household Questionnaire		<ul style="list-style-type: none"> Household information including primary construction material of the house, number of family members and sanitation facilities Household hand washing practices 	<ul style="list-style-type: none"> Child's parent/ guardian OR most knowledgeable member of the household

2.5. Training and Field Procedures

Recruitment and Training of field teams

In order to facilitate with language and comfort level of teams, field teams were recruited from the provinces they would be responsible for surveying. The technical team members were trained and selected by a consultant parasitologist from Kenya identified by Evidence Action who has several years' experience in STH surveys and Kato-Katz technique for counting eggs. The technical team as well as quality control officers from the Indus Hospital lab were trained by him in reading STH eggs using the Kato-Katz methodology. The non-technical team members were trained on data collection, interviewing and data entry techniques by program persons. Details of training objectives are attached in Annexure 6.

Field work

Field work started in Aug 2016 and ended in Dec 2016. Survey activity cycle was two days per school. The first day consisted of attaining permission from the school authorities, setting up the mobile lab for stool analysis, attaining information on school facilities, identifying children and attaining their assent. Once assent was attained, information regarding the location of their home as well as a few questions on their hand hygiene and washing facility access were asked. A child's anthropometric indices (height, and weight) were also measured. An ID number was allocated to each child and used to mark his or her sample containers and corresponding information (e.g. child & child household questionnaire). Subsequently this ID number was used during the recording process by the technologists.

At the end of the school day, the teams organized the children into groups and accompanied the children to their homes to attain informed consent from the child's parent and explain to the parent and child on how to put the stool samples into the container provided. One field member was responsible for going to the homes of approximately 10 children. This strategy was easier to achieve with the 6-person team in rural areas where the children lived closer to school and one another. However, in urban areas, children did not necessarily come from nearby areas nor lived close to one another. Additional persons from the community needed to be recruited for the field activity. These community facilitators were also used for collecting the samples in some areas.

Permission for anthropometric measurements was taken from the school authorities since these activities are a routine part of school health activities. For those children whose parents did not give consent, their child and anthropometric information was not utilized in the results.

Instructions to parents and child on sample collection

At the child's home, the parent and the child were given verbal instructions on stool collection emphasizing the importance that the child should defecate in the morning before going to school on the newspaper provided. The

spatula provided should be used to scoop a small quantity of stool sample off the newspaper into the plastic bottle provided. Emphasis was given on ensuring that the stool is fresh, and not contaminated with urine or dirt.

Stool Samples collection and helminth determination

On the 2nd day, stool samples were either collected from the homes by the field team in the morning or if the parent agreed, the child or the parent brought the sample to the school. In certain areas, it was deemed necessary to seek the services of community facilitators for facilitating with the field work due to community acceptability and safety concerns. This was adopted in areas where the difference in language and/or dialect was large and made it difficult for the teams to communicate effectively with the locals. In larger cities, if the children lived in far off areas, these services were also availed for sample collection.

On day 2, stool samples were generally brought in before the start of school or within an hour or two of the start of school. The mobile lab set up on the school premises was usually ready for sample collection before or within 20 to 30 minutes of the start of the school. The process of analyzing the samples started as soon as the samples were received. Stool samples were analyzed using the Kato-Katz procedure according to WHO guidelines (23). The stool sample was sieved through a wire mesh and the sieved faeces was scraped off and deposited on a 1.5 mm thick template with a 6 mm hole that is placed on a microscope slide. The template was removed carefully to leave behind approximately 41.7 mg of faeces on the slide. The faecal material was covered with a glycerine-methylene blue soaked cellophane and left to clear for a minimum of 20 minutes, then examined under a microscope.

Two slides (A and B) were created for each sample and were read by separate technicians. The total number of eggs of each STH species in the sample was counted systematically using tally counters and recorded on parasitology forms. The mean total number of eggs was expressed as eggs per gram (EPG) of faeces. The slides were read within 30-60 minutes of preparation.

Helminth eggs were identified by their characteristics features. An average of both readings was used as the final egg count. Intensity was calculated for each species by multiplying the average egg count by a factor of 24* to provide the number of eggs per gram of stool (EPG). Infection intensities were classified as light, moderate or heavy based on the EPG calculations according to the WHO criteria. (Table 3)

Table 3 Infection intensity definitions by species

Type of Worms	Light intensity infections	Moderate intensity infections	Heavy intensity infections
<i>A.lumbricoides</i> (Roundworm)	1 - 4,999 epg	5,000 - 49,999 epg	50,000 epg and above
<i>T. trichiura</i> (Whipworm)	1 - 999 epg	1,000 - 9,999 epg	10,000 epg and above
Hookworm	1 - 1,999 epg	2,000 - 3,999 epg	4,000 epg and above

Once the data was analyzed in the mobile lab, the teams preserved 10% of the slides for monitoring purposes. The stool containers, newspapers, fecal specimens etc. were disposed of by burning. This was done either by the team members on their own or with the assistance of school support staff.

*Factors differ by the size of the template. A factor of 24 is used for a 41.7 mg template; factor of 20 for a 50mg template and factor of 50 for a 20 mg template.

Quality Control

Effective quality control mechanism was developed to ensure the quality of the collected data. To ensure consistency and adequate quality of work, a team from the Indus Hospital lab comprising of three persons were dedicated for monitoring and evaluating each of the team field's performance.

Monitoring visits in the field started immediately after the initiation of the survey. These visits helped in identifying and subsequently resolving any procedural (technical or field) issues at an early stage of data collection. The monitors checked some of the slides during their monitoring visits and verified the egg counts with that of the egg counts determined by technical team members.

For quality control of the parasitological data, 10% of the analyzed slides from all schools were sent via courier to the Indus Hospital Lab for an external quality check. The egg count of the team was compared with that of the technical monitors at Indus for whipworm as well as roundworm and found to be comparable. Hookworm could not be checked since they clear after 60 min of the slide being prepared.

An internal quality check was also performed, to prevent an under or over estimation of sample eggs count. About 10% of the slides (about 5 or 6) at each sentinel site were cross examined. Each technician checked the other's analyzed slide without prior knowledge of the count obtained by the other to ensure consistency in the eggs count. The results were then shared by both the technicians with one another.

2.6. Data Entry

Each member of the field team was provided with an android tablet for online data entry. Some paper forms were also available with the field staff for backup purposes. This method allowed for very rapid determination of results. The school, child and household questionnaires were programmed using SurveyCTO-Open Data Kit (ODK), version v2.21. The filled digital forms were transmitted on a daily basis[†] into the SurveyCTO cloud server and accessed by the program team in Karachi. Data were downloaded periodically and cleaned. Egg count data by the lab technicians was also transmitted to the program team electronically and entered into Microsoft Excel for calculation.

2.7. Data Analysis

Geostatistical Analysis

Weighted prevalence was necessary to account for the potential effect of clustering and for any unequal selection probabilities due to the sampling methodology used. Sampling weights were calculated for ecological zones, provinces and districts; and used to estimate survey prevalence. Each cluster (e.g. ecological zone or district, etc.) was weighted according to its size to calculate weighted point prevalence. Taylor linearization method was used to estimate the 95% confidence interval. On the basis of the weights, survey prevalence was estimated using svyset and svy:proportion commands in STATA 14. Heat maps was made using ArcGis.

Formulas as follows:

Sampling weights for ecological zones:

The sampling weight assigned were inverse of the selection probability of a unit

$$\text{Selection probability of a child in each ecological zone} = \frac{\text{selected districts}}{\text{total district}} * \frac{\text{selected schools } \dagger}{\text{total schools } \dagger}$$

Sampling weights for Province:

The sampling weight assigned were inverse of the selection probability of a unit.

^{††} Dependent on 3g internet connection in the field

$$\text{Selection probability of a child in each province} = \frac{\text{selected districts}}{\text{total district}} * \frac{\text{selected schools} \dagger}{\text{total schools} \dagger}$$

Sampling weights for Districts:

The sampling weight assigned were inverse of the selection probability of a unit.

$$\text{Selection probability of a child in each district} = \frac{\text{selected schools} \dagger}{\text{total schools} \dagger}$$

Sampling weights for Overall:

The sampling weight assigned were inverse of the selection probability of a unit.

$$\begin{aligned} &\text{Selection probability of a child in each province} \\ &= \frac{\text{selected schools} \dagger}{\text{total schools}} * \frac{\text{selected districts} \dagger}{\text{total} \dagger} * \frac{\text{selected ecozones} \dagger}{\text{total ecozones} \dagger} \end{aligned}$$

†Only those schools were selected who have ≥60 cumulative number of children of class 3 to 5

Heatmaps of the weighted prevalence were created using ArcGIS 10.4. Weighed prevalence data was formatted into spatial table in order to make it accessible in ArcGIS Environment. A point coverage shape file with desired projection was made in the ArcGIS Environment. After creating the point coverage shapefile that was consistent in all aspects, attributes such as weighted prevalence were interpolated spatially using ArcGIS. Inverse Distance Weighted (IDW) interpolation technique was selected since it explicitly makes the assumption that areas that are close to one another are more alike than those that are farther apart. To predict a value for any unmeasured location, IDW interpolation gave greater weights to points closest to the prediction location, and the weights diminished as a function of distance. The IDW created grid/cell raster surface that was reclassified into different classes.

Parasitology Measures

For each child, the presence or absence of infection or multiple infections with each and any STH was gauged by the detection of eggs in the stool sample. Intensity of each or any infection of STH was calculated by averaging egg count of the two separate slides and multiplying it by 24 to give a standard measure of eggs per gram (EPG). Infections were classified as light, moderate or heavy according to WHO thresholds (24).

Statistical Package for Statistical Analysis (SPSS) software was used for statistical analysis. Mean (SD) or median (IQR) was computed for child's age and total number of eggs of each STH species as appropriate. ANOVA/Kruskal-Wallis test was applied to assess significant difference in number of eggs among ecological zones. Overall and ecological zone-wise prevalence of each STH species and its intensity was computed. Multiple marginal independence was tested between ecological zone and STH species. P-value<0.05 was considered significant.

School, Child and Household Descriptives

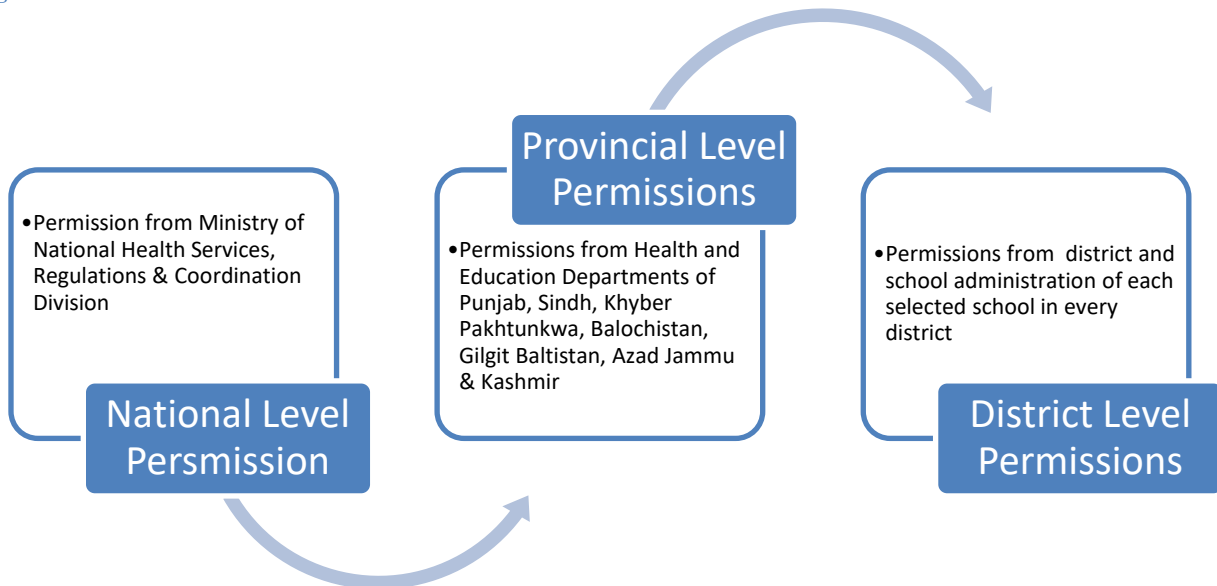
Descriptive statistics of the school, child and house characteristics were also calculated using SPSS for overall as well as individual provinces or territories. Standard WHO questions regarding drinking water source, toilet facilities and handwashing were asked (25). For school and households, water sources were defined as unimproved if the main source of drinking-water was from an unprotected dug well; an unprotected spring, a cart with a tank/drum; a water tanker; or from surface water like rivers, lakes, streams. Sanitation facility was defined as unimproved if human excreta was not flushed into a piped sewer system; an open pit latrine without a slab; a bucket or open fields were used (25). Frequency and percentage was reported for categorical variables like house construction material, percentage of households with improved water and sanitation as well as soap usage and self-reported handwashing practices. Mean and standard deviation were reported for continuous variables such as parental years of school completed, and child's age, child's anthropometric index, BMI-for-age percentile, was calculated using the CDC's BMI percentile calculator. Percentiles were categorized as follows: underweight (those less than the 5th percentile); normal (5th percentile to less than the 85th percentile); overweight (85th to less than the 95th percentile) and obese (equal to or greater than the 95th percentile) (26).

2.8. Ethical Considerations

Policy development and administrative responsibilities for health and education are the purview of the provincial governments in Pakistan, and involve the bureaucracy as well as the political offices. Prior to survey activities, the federal and provincial secretaries were brought on board to build political capital and support.

Systematic engagement with key policy and administrative representatives took place by the partners (The Indus Hospital, IRD and IDEAS) where the objectives of an STH deworming initiative and the need for a prevalence survey was discussed. Once broad-based political support at the Federal and Provincial Education and Health Secretariat level was achieved, administrative level permissions were secured. Written permission for the school survey was taken from provincial ministries. Figure 2 diagrams the process flow followed at the national, provincial and district level for securing governmental permissions.

Figure 2 Process Flow – Government Permissions



Ethical approval was given by the Institutional Review Board (IRB) of Interactive Research & Development (IRD) covering the survey protocol, informed consent, and data collection instruments. The IRB is registered with the U.S. Department of Health and Human Services (DHHS) Office for Human Research Protections (OHRP) with registration number IRB 00005148 (effective through Dec 09, 2017). Informed written consent was sought from each school principal, the parents of the child as well as assent from each child providing samples. Homes of children who did not assent to be part of the survey were not visited.

On the second day, all students in the school were provided with mebendazole tablet donated by WHO as anthelmintic treatment; whether they provided a stool sample or not. School administration was asked to distribute tablets among the children. The response of the school administration in helping distribute the mebendazole was overwhelming. Majority of the school administration were willing to distribute the tablets except for all 4 schools in the district of Multan and 1 school in Karachi. In Multan, both the district education office as well as the school administration did not agree to distribution of prophylactic anti-helminths citing fear of side effects and who would take responsibility whereas in Karachi, only one out of the four schools refused to allow anti-helminth distribution. All of the field teams were provided with a copy of the End User Certificate issued to The Indus Hospital by WHO to show the authenticity of the tablets. A total of 17,100 tablets were distributed as part of the schools surveyed for this activity

A poster with a superhero character, Captain Striker, was designed by the team for distribution at school. Each school was provided with approximately an average of three posters (Annexure 7). Each child was also provided with a cap with the Captain Striker logo for participating in the survey.

3. Results

3.1. Prevalence of STH Infections

Overall, 5253 children were targeted and households approached for participation. Majority of the parents consented to their child participating in the survey (5188; 98.8%). However, samples were not received from 786 children (15%); or were either too small (54; 1%) or contaminated (182, 3.5%). So a total of 4166 stool samples were analyzable (80.3%) out of the 5188 households that consented to participate. The prevalence/intensity analysis was performed on 4166 samples whereas analysis of data from other components of the survey (child anthropometric measurements; child hygiene knowledge and practices, and household information) was based on 3995 children due to information missing from one or more of the component parts which did not allow the data to be matched to individual children.

The weighted prevalence of any STH in the different ecological zones ranged from 0% in the Western Dry Mountains to 37.5% in the Northern Dry Mountains (Table 4) The Western Dry Mountains was the only ecological zone where no STH was identified.

Figure 3 Flow chart of children enrolled and samples collected

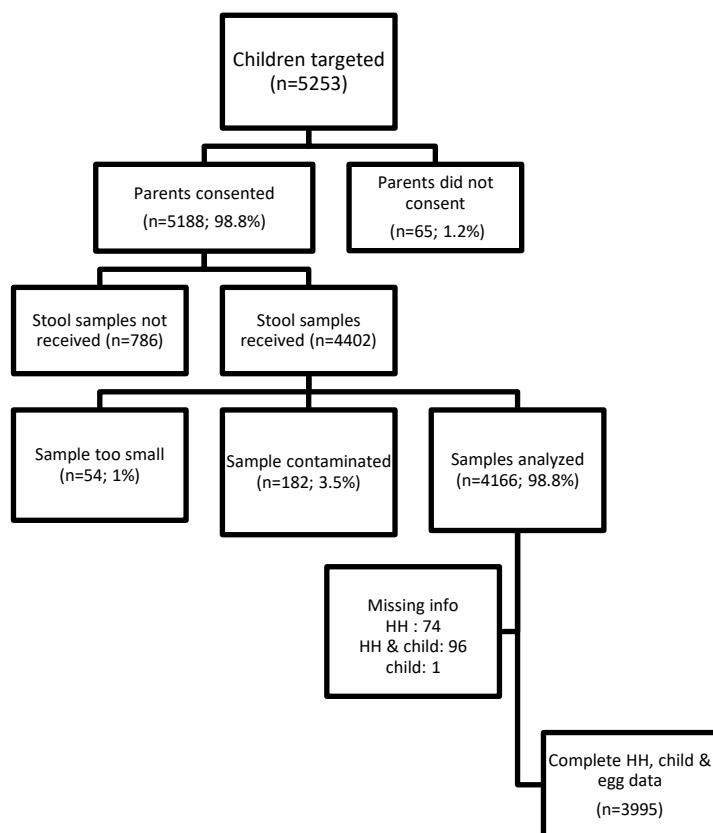


Table 4 Weighted Prevalence of STH by Ecological Zones

Ecological Zones	Any STH	Weighted Prevalence (95% CI)		
		Hookworm	Roundworm	Whipworm
Southern Irrigated	2.4% (1.3-4.2)	2.4% (1.3-4.2)	0.0%	0.0%
Sandy Deserts	2.3% (1.4-3.8)	2.3% (1.4-3.8)	0.0%	0.0%
Northern Irrigated Plain	1.7% (1.1-2.5)	0.5% (0.2-1.1)	0.7% (0.3-1.3)	0.7% (0.4-1.4)
Barani Lands	25.3% (21.3-29.7)	0.2% (0-1.7)	25.1% (21.1-29.5)	1.0% (0.4-2.5)
Wet Mountains	12.2% (9.0-16.5)	2.4% (1.1-4.9)	7.1% (4.7-10.7)	7.1% (4.7-10.7)
Northern Dry Mountains	37.5% (30.8-44.7)	0.0%	23.4% (17.8-30)	27.2% (21.2-34.1)
Western Dry Mountains	0.0%	0.0%	0.0%	0.0%
Dry Western Plateau	5.3% (3.7-7.6)	0.9% (0.4-2.2)	4.6% (3.1-6.7)	1.1% (0.5-2.4)
Sulaiman Piedmont	1.8% (0.5-7)	0.0%	1.8% (0.5-7)	0.0%
Overall	6.9% (5.5-6.7)	1.1% (0.7-1.3)	4.9% (4.4-5.8)	2.2% (1.9-2.8)

Parasitological data collected from each ecological zone allowed for the estimation of STH prevalence for each province/territory (Table 5). KPK province had the highest weighted prevalence of any STH infection (25.7%) followed by AJK (8.7%). Prevalence of STH in the other provinces/territories was low overall, although specific regions within certain provinces/territories exhibited higher prevalence.

Province	Weighted Prevalence (95% CI)			
	Any STH	Hookworm	Roundworm	Whipworm
Balochistan	1.1% (0.5-2.6)	0.0%	0.9% (0.3-2.3)	0.7% (0.2-2)
Punjab	6.2% (5.2-7.3)	0.6% (0.4-1.1)	5.2% (4.4-6.2)	0.6% (0.4-1.1)
KPK	25.7% (21.5-30.3)	1.6% (0.7-3.5)	15.5% (12.2-19.5)	17.4% (13.9-21.6)
Sindh	4.2% (3.2-5.6)	2.3% (1.5-3.3)	2.2% (1.4-3.2)	0.3% (0.1-0.9)
AJK	8.7% (4.5-15.8)	1.0% (0.1-6.6)	5.8% (2.6-12.3)	5.8% (2.6-12.3)
Overall	6.9% (6.2-7.7)	1.1% (0.8-1.4)	4.9% (4.2-5.5)	2.2% (1.8-2.7)

The data obtained from each ecological zone was used to generate predictive prevalence maps. Analysis of the predictive prevalence map for Pakistan indicates that STH is not widespread throughout the country (Figure 4). Much of the southern region of Pakistan is free of STH, with the notable exception south-western Sindh, centered around the Karachi area and extending into a limited area in south-eastern Balochistan. STH is mostly confined to northern areas of the country, with the highest prevalence focused in the area around Rawalpindi and Islamabad. Predictive prevalence maps for each province/territory are shown in Figure 5 and Figure 6.

[‡] While the ecological zone approach that was applied for this survey allowed for the estimation of STH prevalence across the entire country, the data presented in this table corresponds only to provinces which were represented within the sampling process. No schools were included in FATA and Gilgit-Baltistan.

Figure 4 Weighted Prevalence of STH - Pakistan

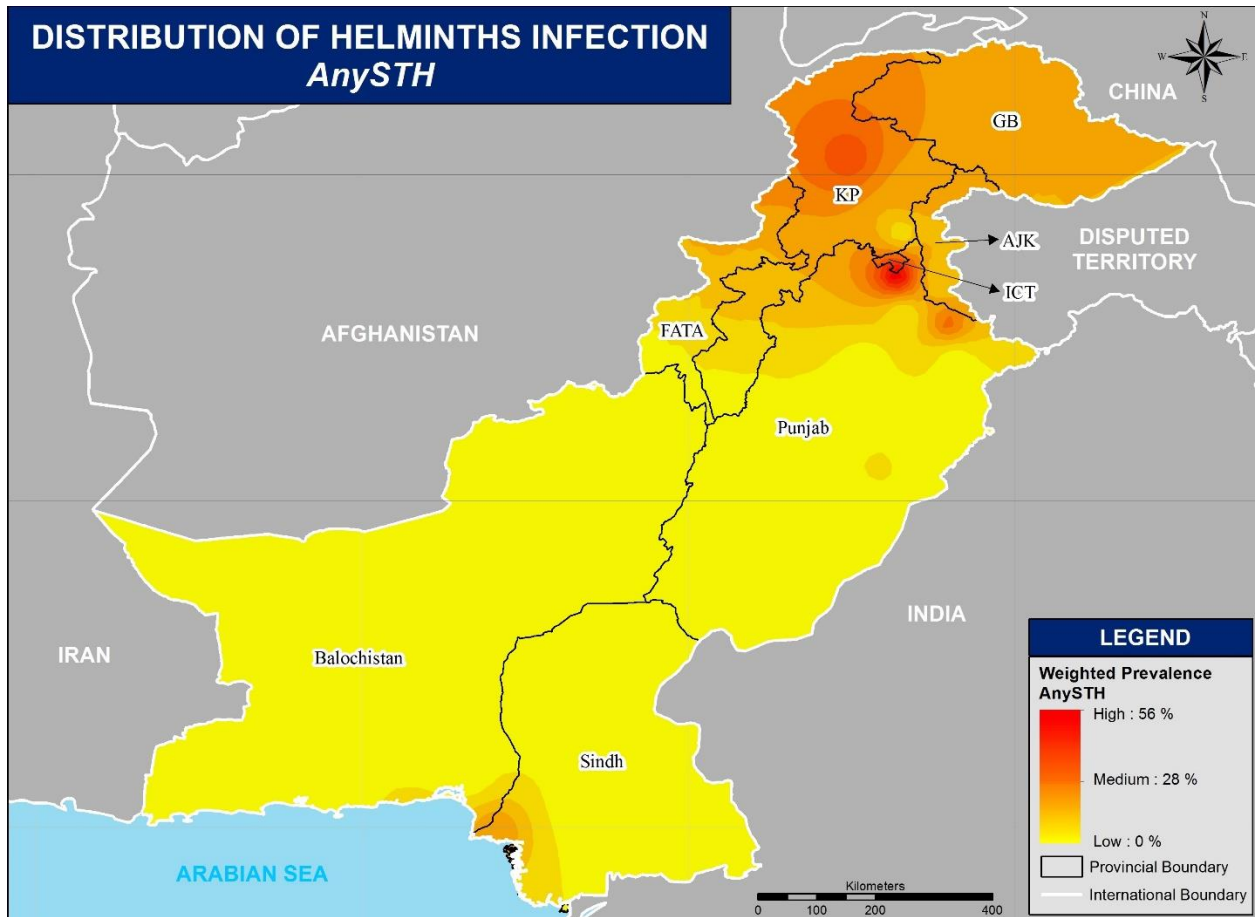
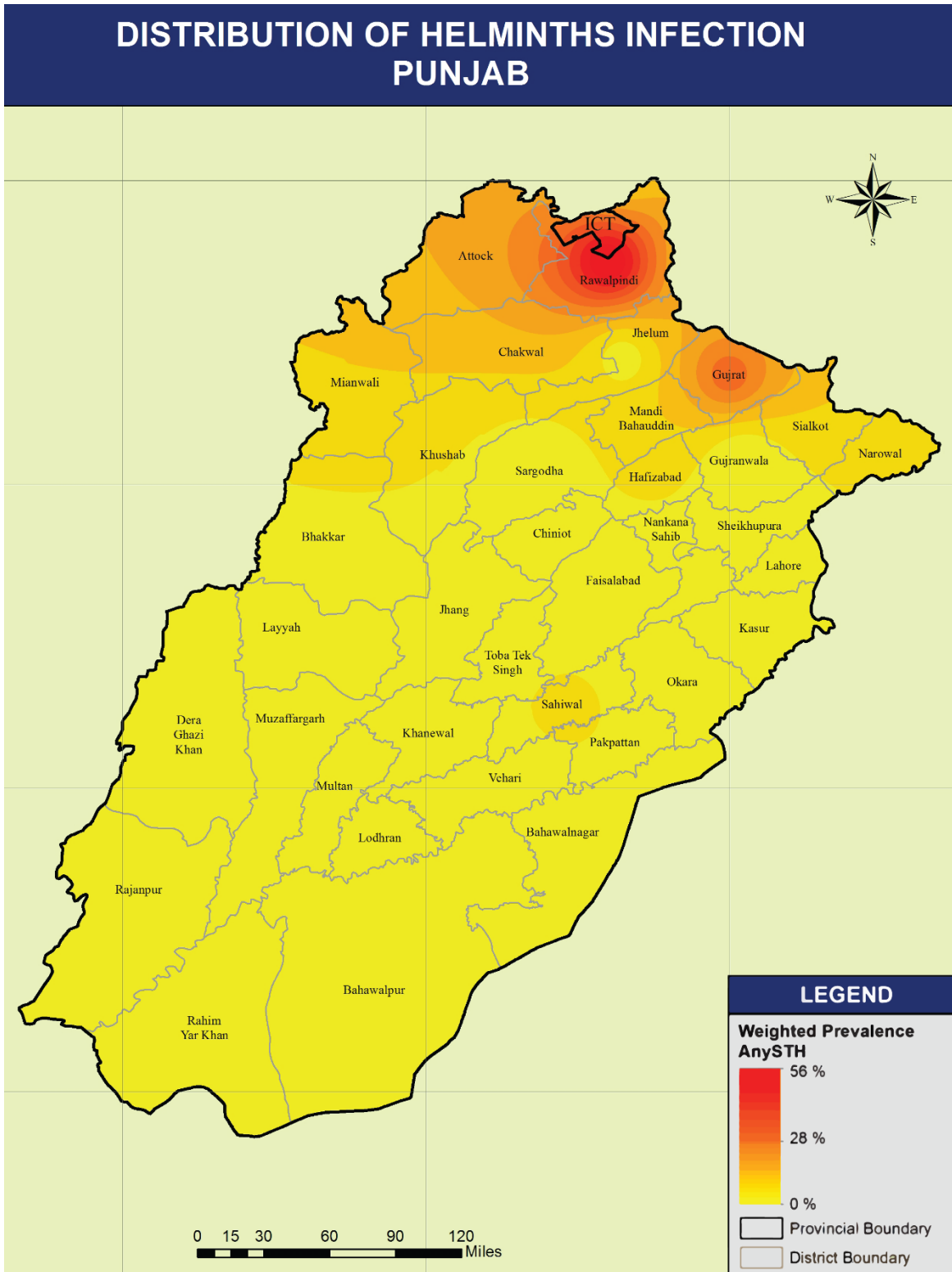
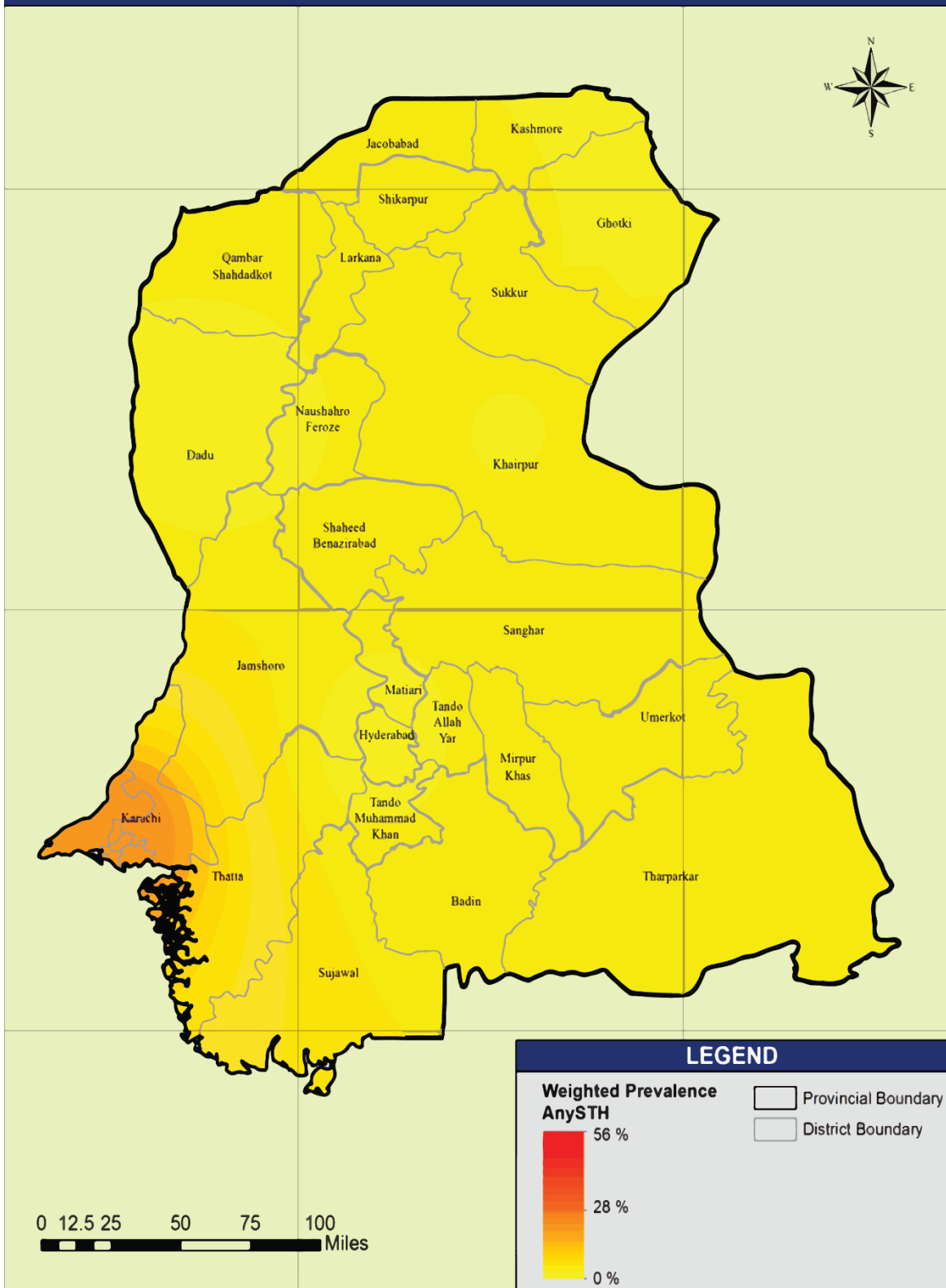


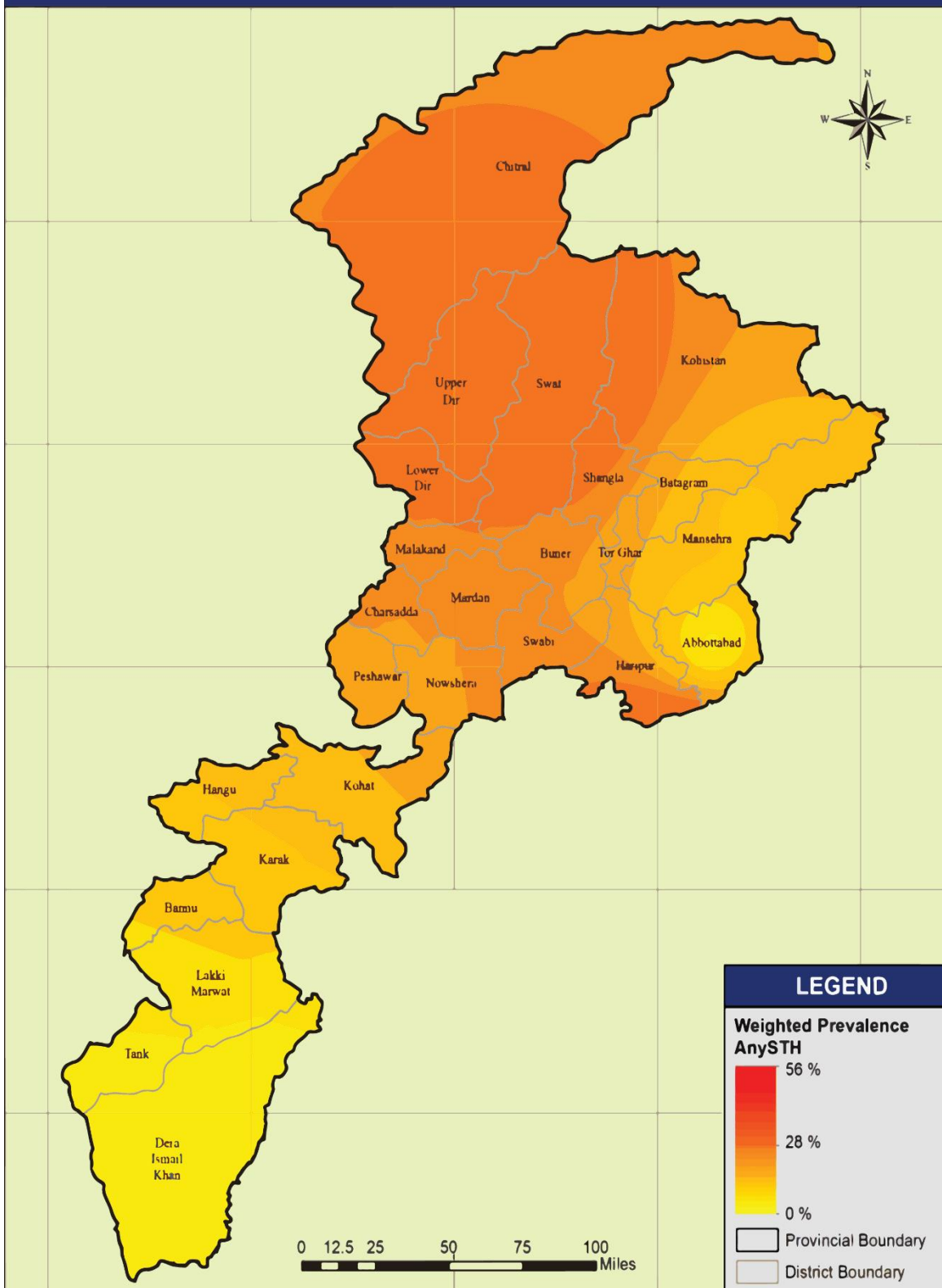
Figure 5 Weighted prevalence of helminth infections, by province



DISTRIBUTION OF HELMINTHS INFECTION SINDH



DISTRIBUTION OF HELMINTHS INFECTION KHYBER PAKHTUNKHWA



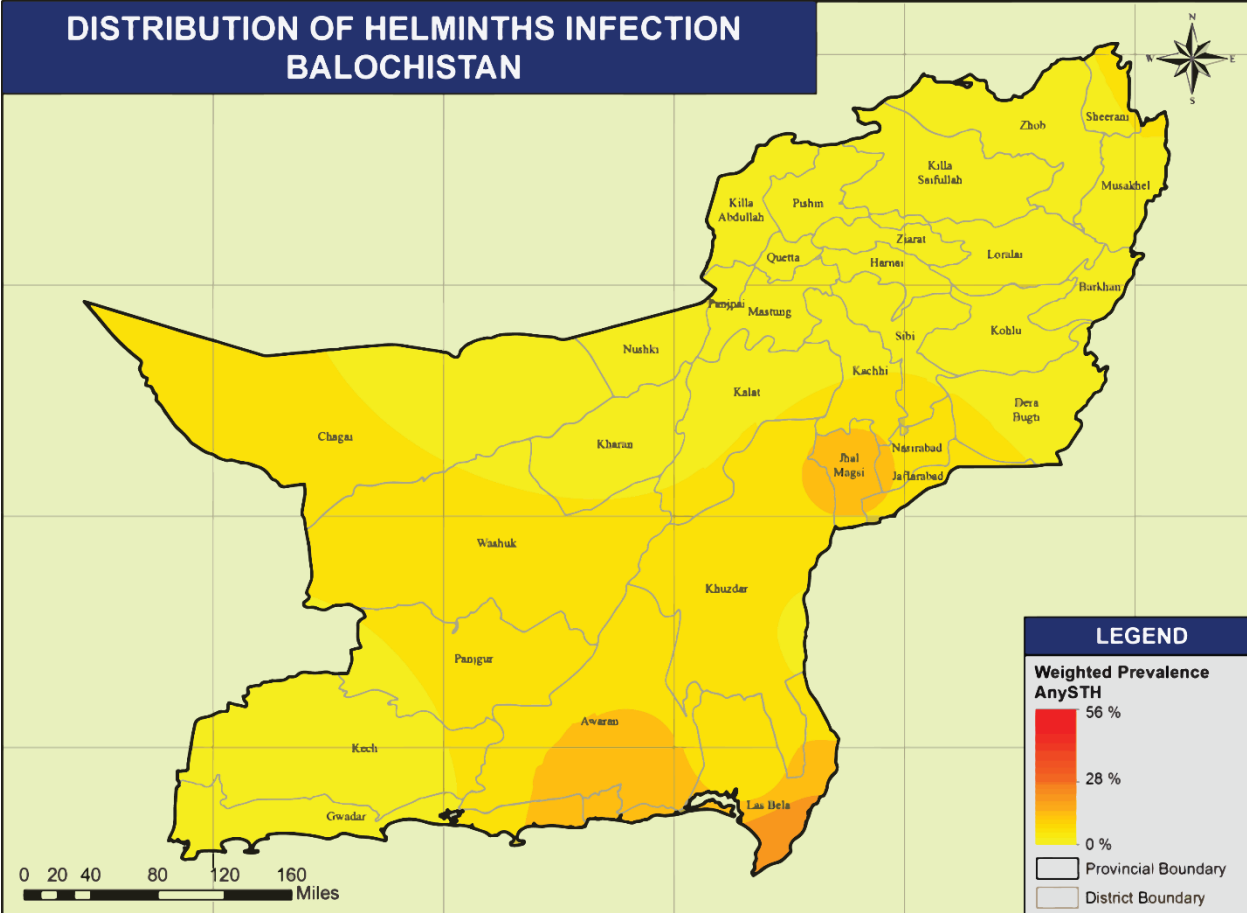
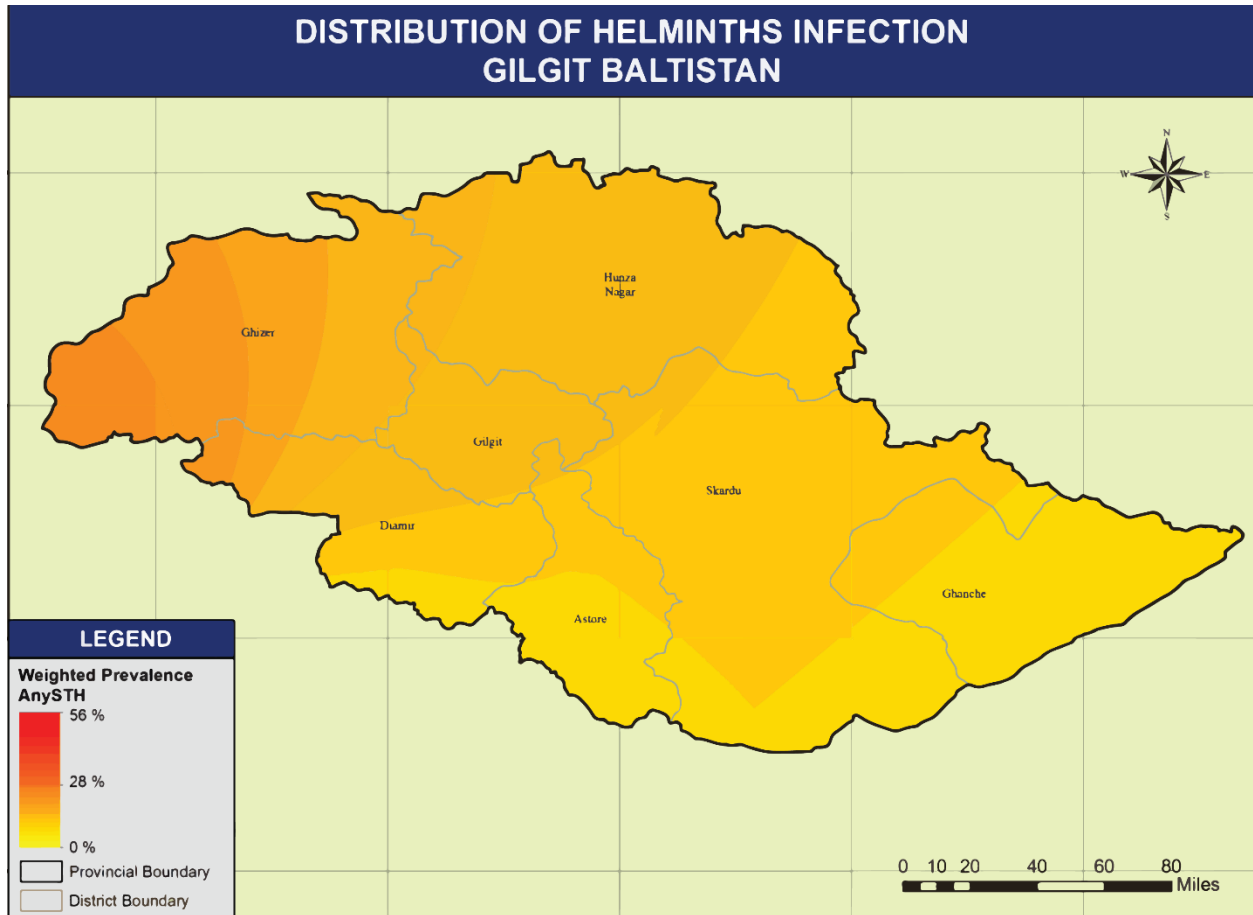
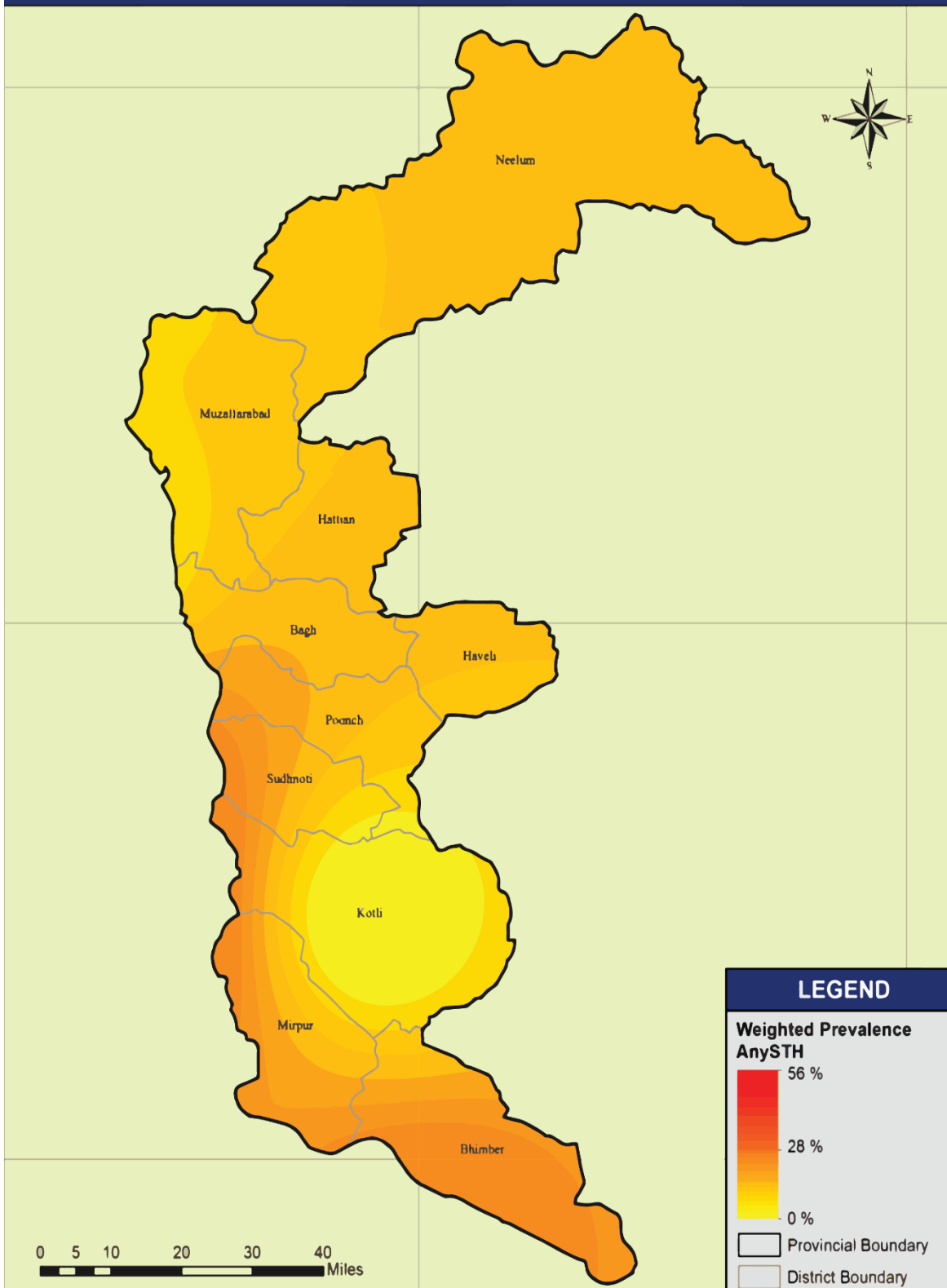


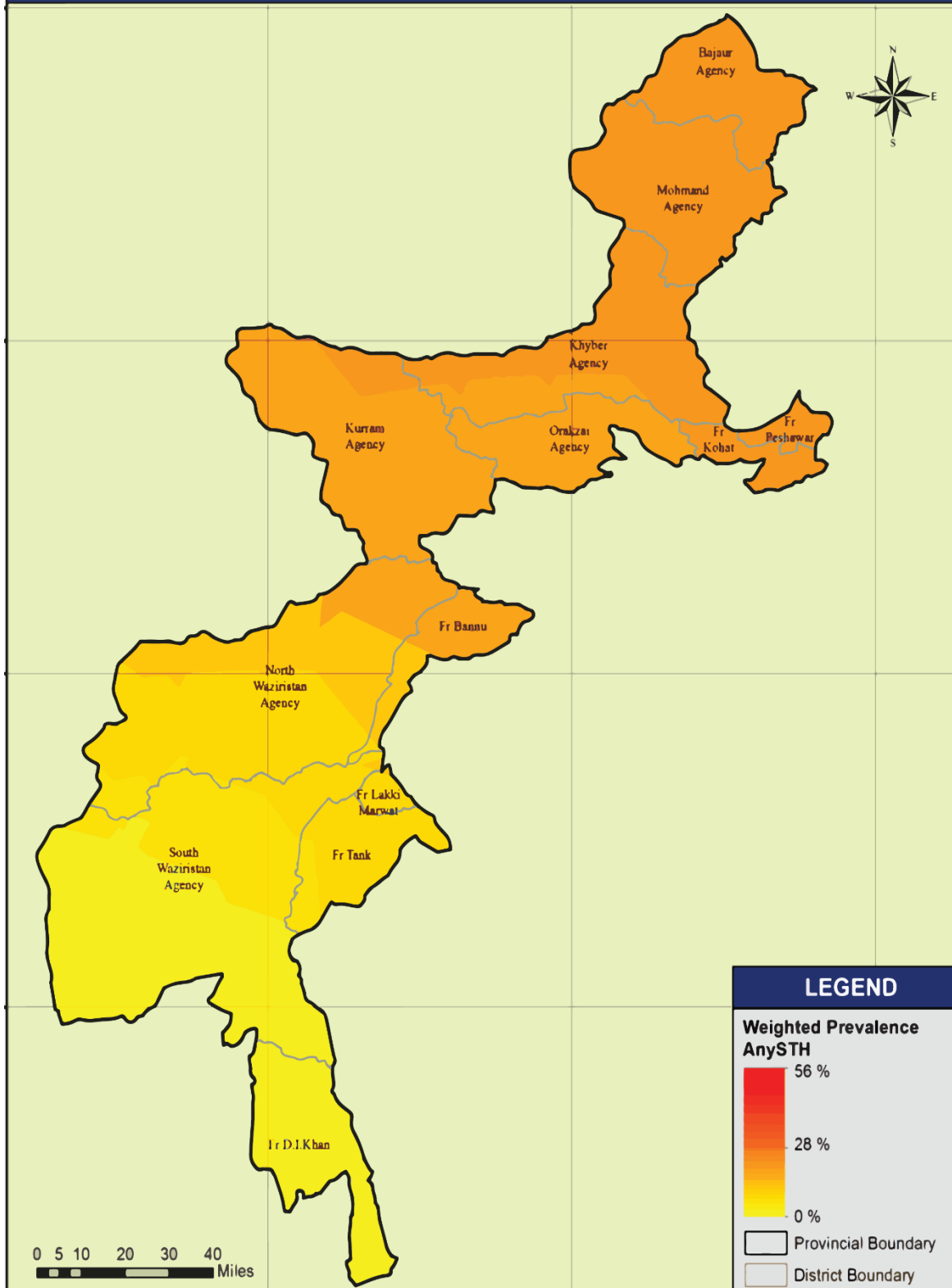
Figure 6 Weighted prevalence of helminth infections, GB, AJK and FATA



DISTRIBUTION OF HELMINTHS INFECTION AZAD JAMMU & KASHMIR



DISTRIBUTION OF HELMINTHS INFECTION FEDERALLY ADMINISTERED TRIBAL AREAS

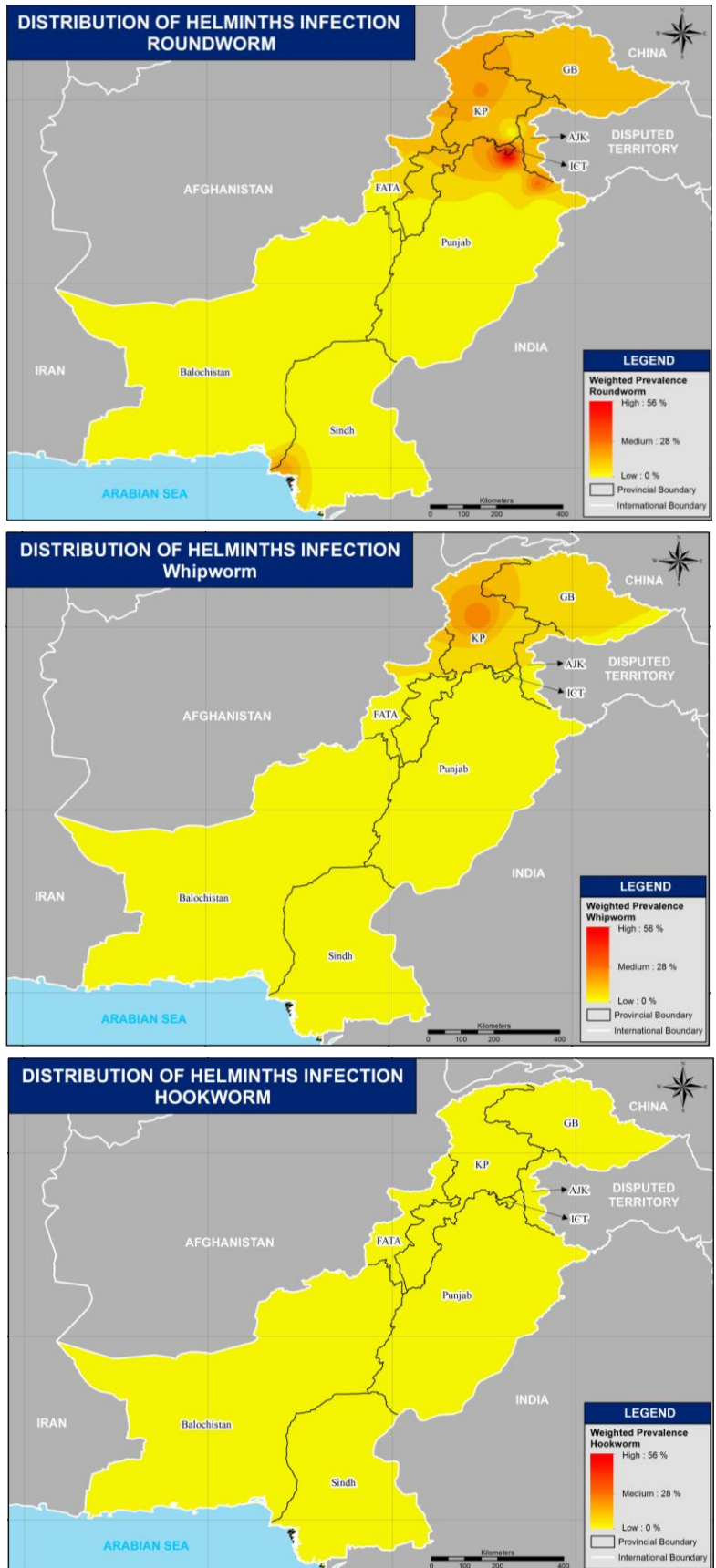


All three forms of STH (roundworm, whipworm and hookworm) were identified. Roundworm was most prevalent in the Northern Dry Mountains (23.4%) and Barani Lands (25.1%); whipworm most prevalent in the Northern Dry Mountains (27.2%) and Wet Mountains (7.1%); and hookworm most prevalent in the Wet Mountains (2.4%), Southern Irrigated (2.4%) and Sandy Desert (2.3%) [Table 4].

On a provincial/territory level, KPK had the highest prevalence of roundworm (15.5%) and whipworm (17.4%); [Table 5]. Hookworm was the least prevalent form of STH, with Sindh representing the province with the highest hookworm burden (2.3%). The predictive prevalence of roundworm, whipworm and hookworm across Pakistan is shown in Figure 7. Predictive prevalence maps of roundworm, whipworm and hookworm for each province/territory are in Annexure 13 through Annexure 18.

WHO recommendations for preventive chemotherapy are based on STH prevalence (Table 1). To assist with identifying areas that fall within the WHO thresholds for annual or biannual mass drug administration (MDA), maps were developed using the calculated weighted prevalence for each ecological zone (Figure 8 through Figure 10). These maps indicate that, in accordance with WHO-recommended treatment strategies, annual MDAs are warranted in only selected areas of the country. On a district level, MDAs are warranted in: sixteen districts in KPK (Chitral, Upper Dir, Lower Dir, Swat, Kohistan, Batagram, Shangla, Buner, Torghar, Swabi, Mardan, Malakand, Charsadda, Nowshera, Peshawar and Haripur); five districts of Punjab (Rawalpindi, Gujrat, Attock, Chakwal and Jhelum); ICT; six districts in Sindh (Karachi Central, Karachi East, Karachi South, Karachi West, Korangi and Malir); one district in Balochistan (Las Bela); four districts in GB (Ghizer, Diamir, Gilgit and Hunza Nagar); four districts in AJK (Bhimber, Mirpur, Kotli and Sudhnoti) and three agencies in FATA (Bajaur Agency, Mohmand Agency and Khyber Agency). Only a very focused area, in the vicinity of Rawalpindi and Islamabad, was identified as warranting biannual MDAs.

Figure 7 Distribution of hookworm, roundworm and whipworm, Pakistan



Districts with the highest prevalence were Rawalpindi (56.3%) and Gujrat (31.1%) in Punjab, Swat (27.2%) in KPK, and Karachi division (20.5%) in Sindh (Annexure 5). All four of these districts are large populous cities and these findings may reflect poor sanitation and water facilities.

Figure 8 Weighted prevalence according to WHO treatment thresholds - Pakistan

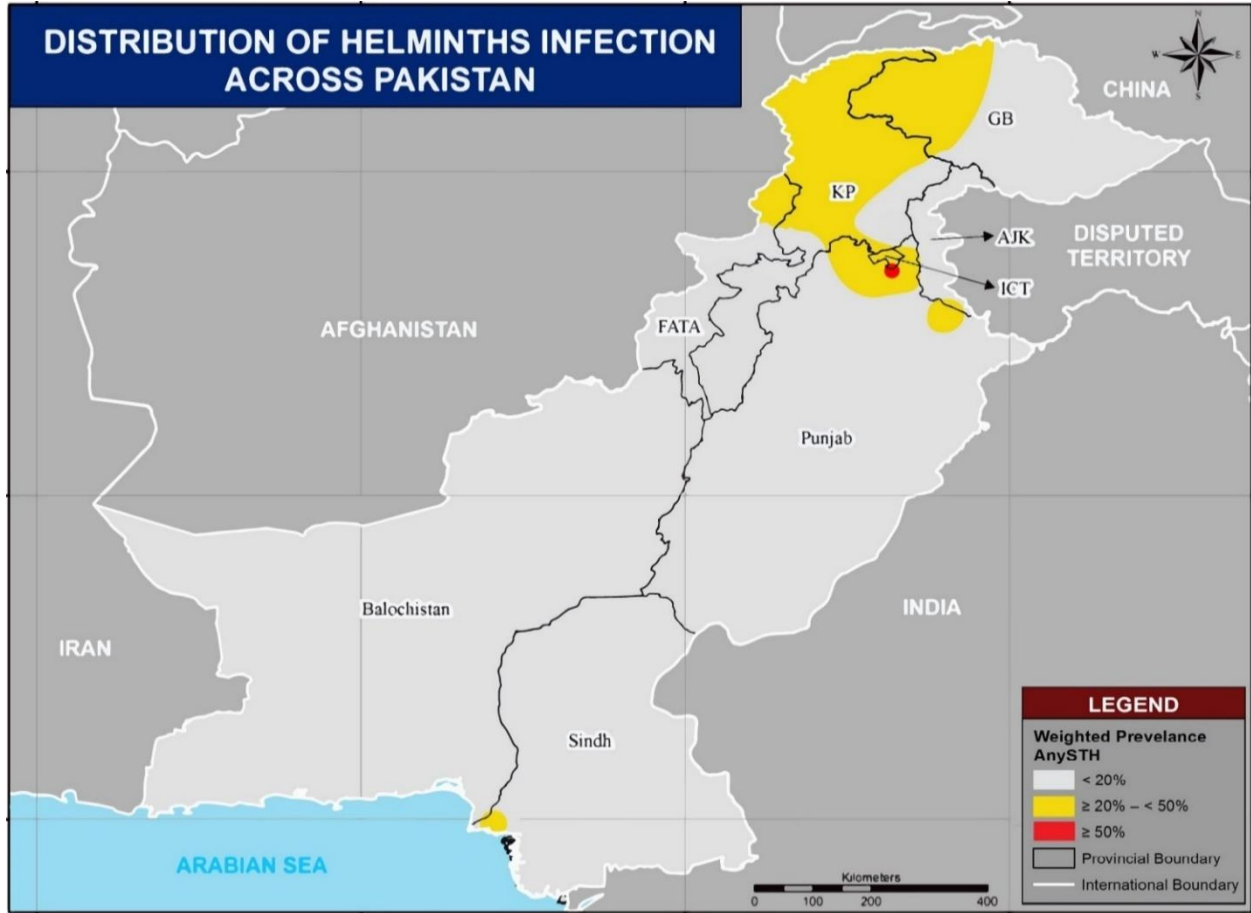
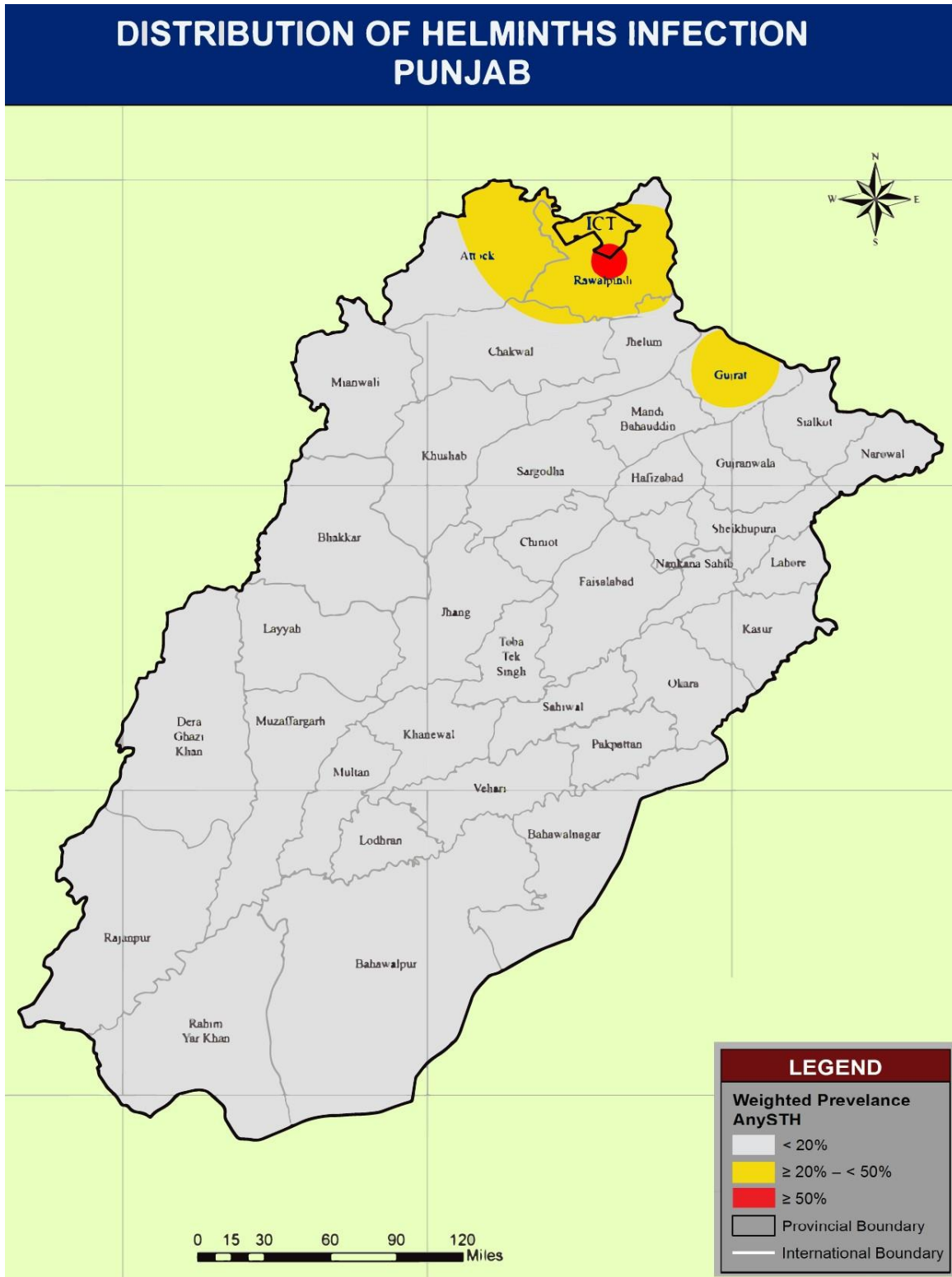
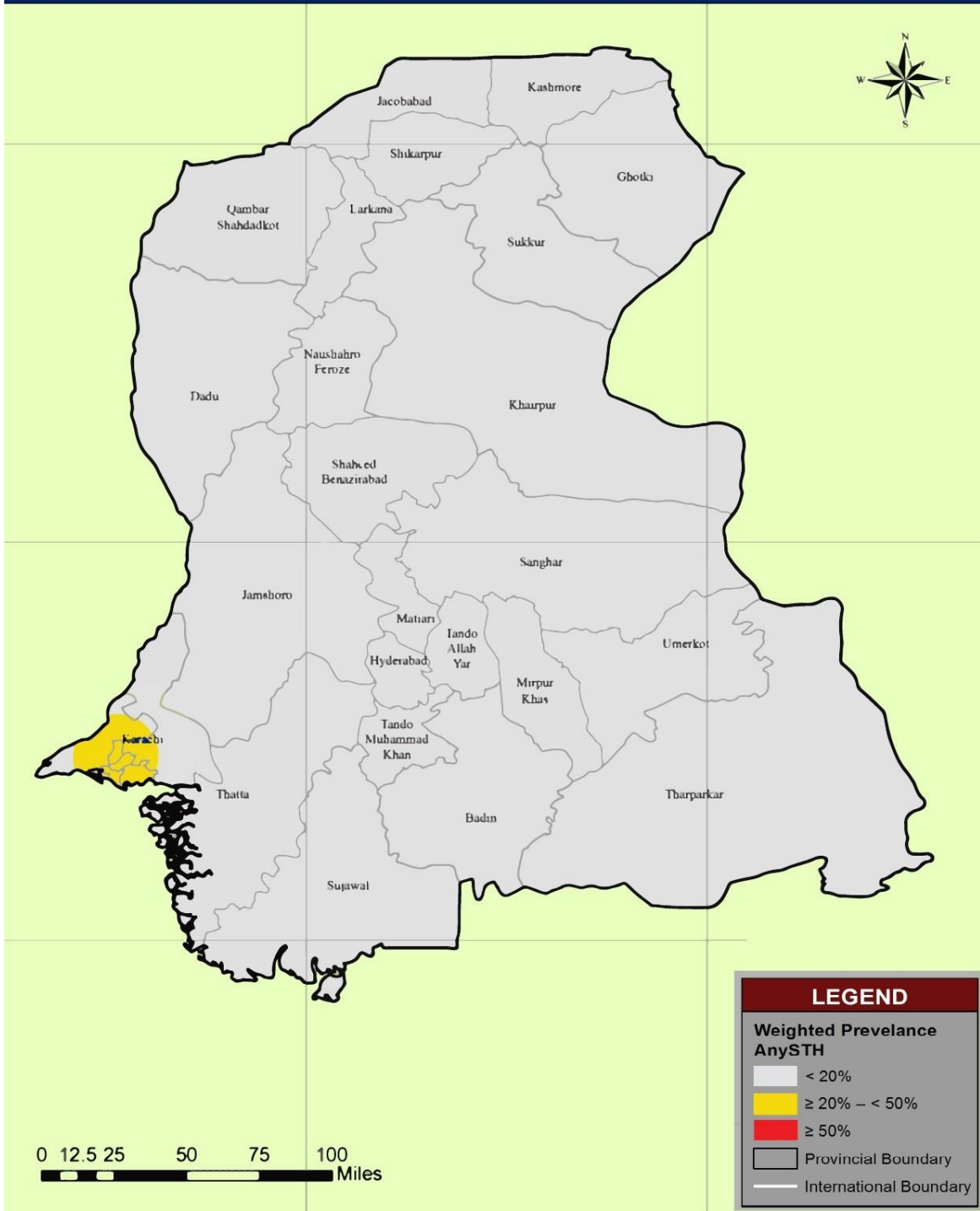


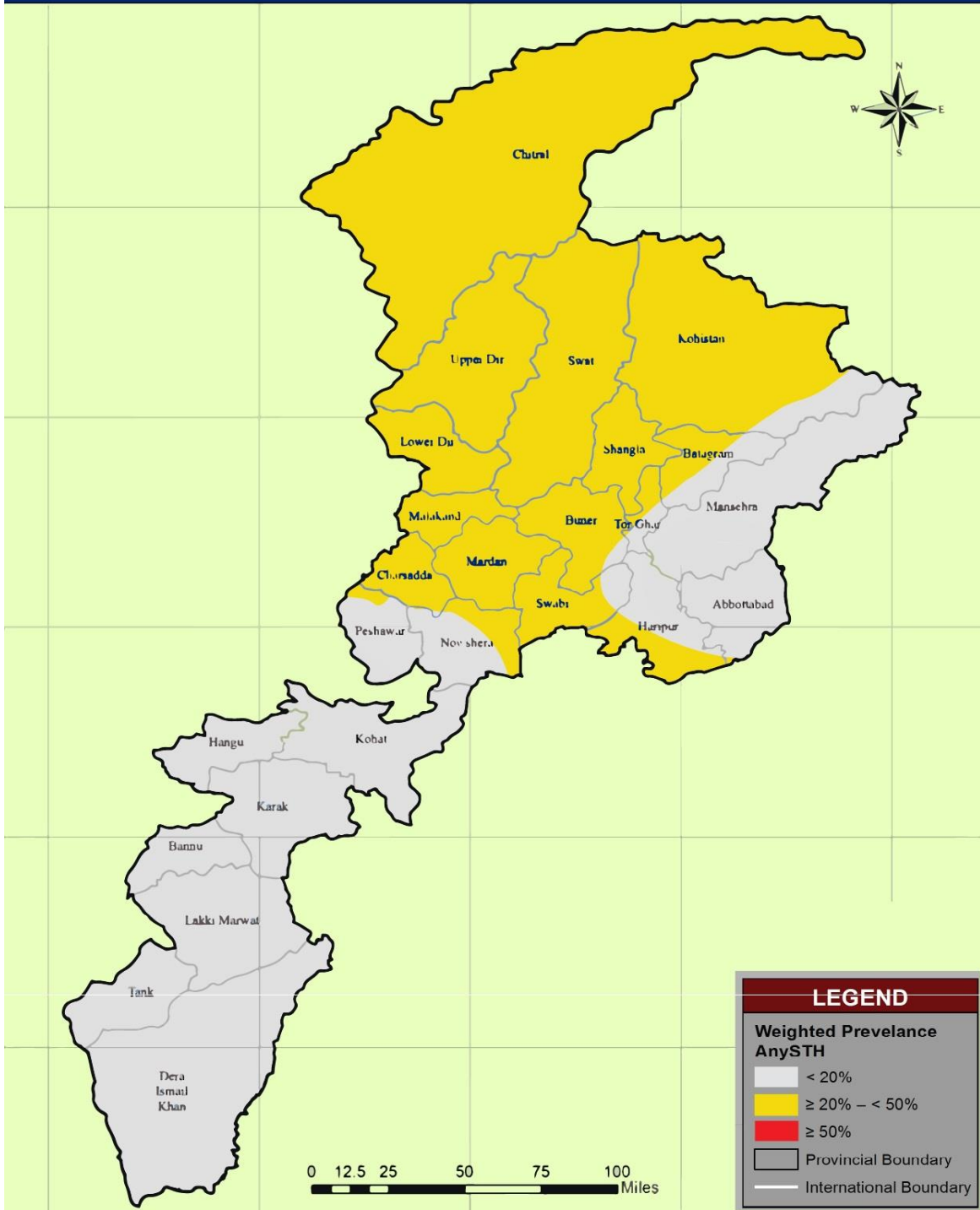
Figure 9 Weighted prevalence according to WHO treatment thresholds – provinces



DISTRIBUTION OF HELMINTHS INFECTION SINDH



DISTRIBUTION OF HELMINTHS INFECTION KHYBER PAKHTUNKHWA



DISTRIBUTION OF HELMINTHS INFECTION BALOCHISTAN

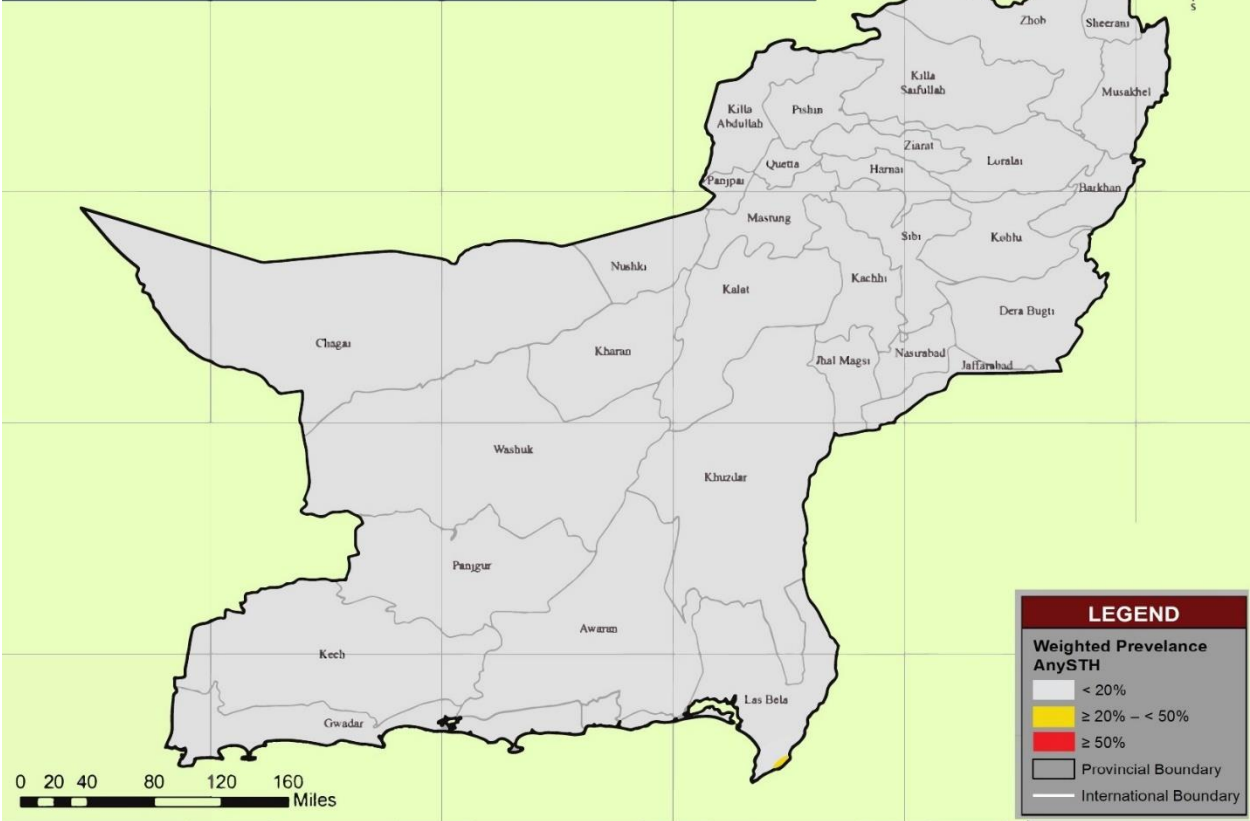
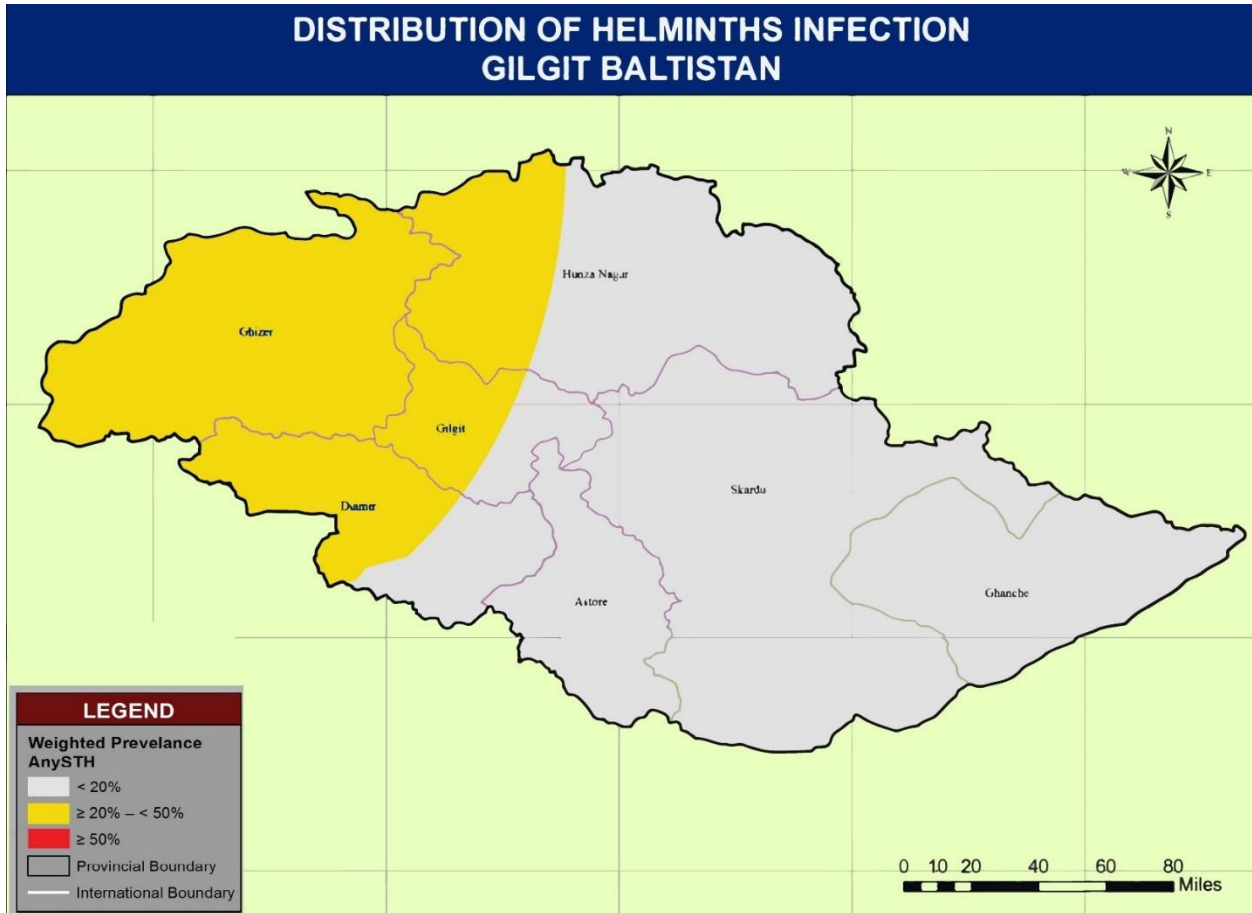
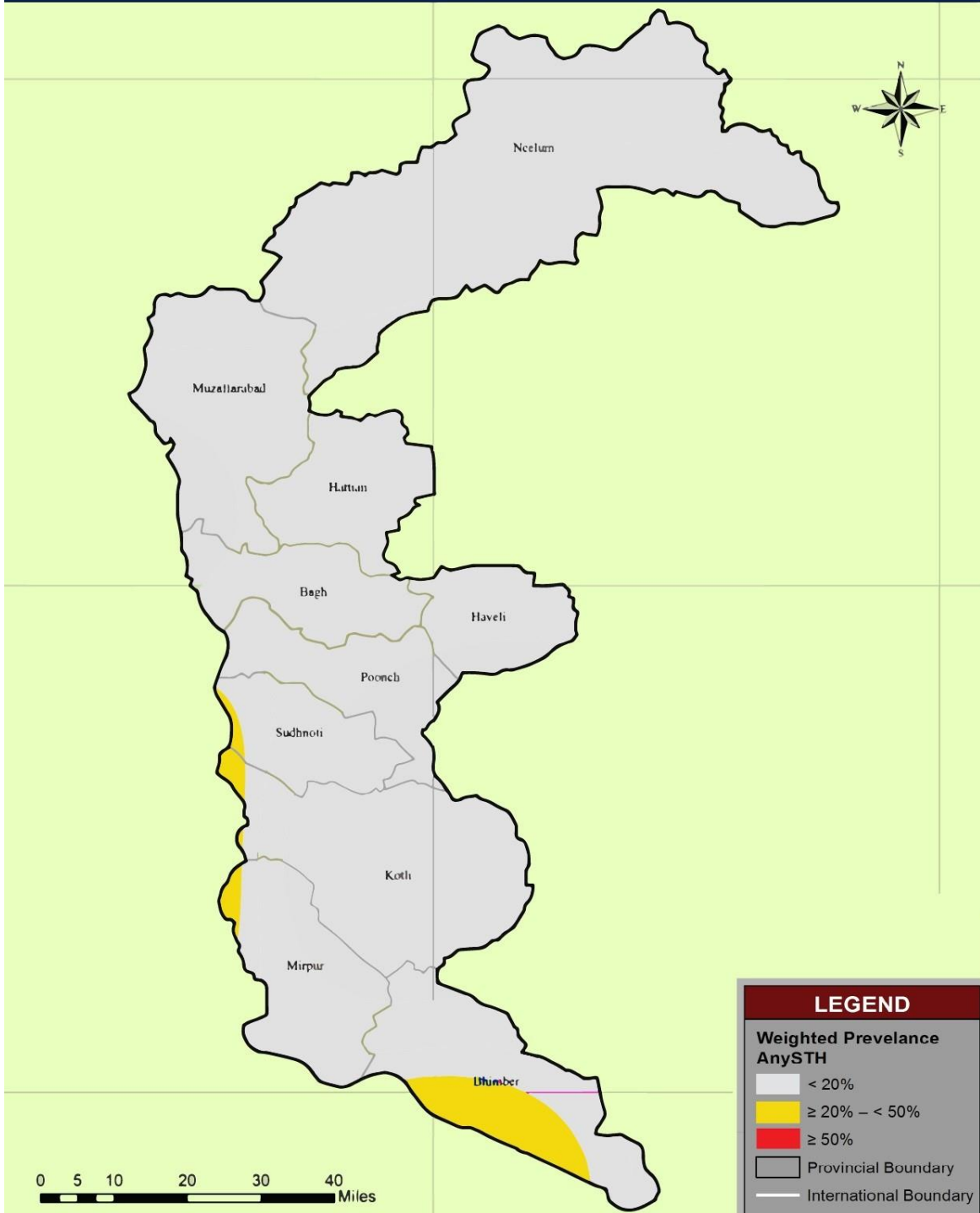


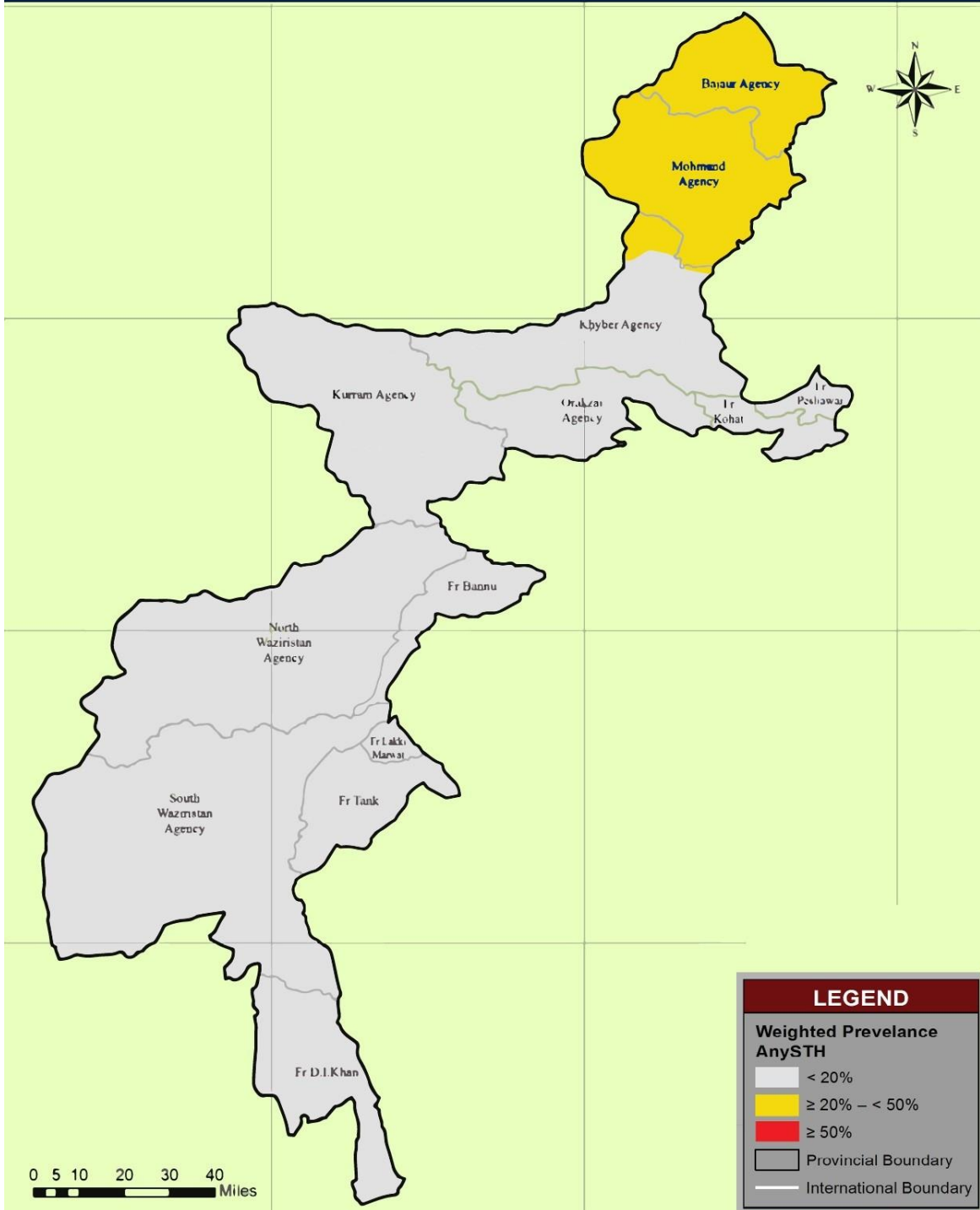
Figure 10 Weighted prevalence according to WHO treatment thresholds, GB, AJK and FATA



DISTRIBUTION OF HELMINTHS INFECTION AZAD JAMMU & KASHMIR



DISTRIBUTION OF HELMINTHS INFECTION FEDERALLY ADMINISTERED TRIBAL AREAS



3.2. Intensity of STH Infection

The intensity of STH infection is an important health indicator as moderate and heavy intensity infections are associated with significant morbidity in the affected children. Following the WHO classification of intensity of infections (Table 3), the majority of STH infections were of light intensity (Table 6). The Northern Dry Mountains was the region with the highest levels of moderate or high intensity infections. In this ecological zone, 13.6% of the sampled population had moderate roundworm infections (there were no recorded cases of heavy roundworm infections in this ecological zone), and 1.63% had moderate or high whipworm infections. The level of moderate roundworm infections in the Wet Mountains was also notable (4.4%).

Table 6 Percentage of children with light, moderate or heavy STH infections, by ecological zone

Ecological Zones	Intensity Level	Hookworm	Roundworm	Whipworm
Southern Irrigated	Light	1.7%	0.0%	0.0%
	Moderate	0.0%	0.0%	0.0%
	Heavy	0.2%	0.0%	0.0%
	Mean epg (SD)	29 (493)	0	0
	Range	0-10,512	0	0
Sandy Desert	Light	2.0%	0.0%	0.0%
	Moderate	0.2%	0.0%	0.0%
	Heavy	0.2%	0.0%	0.0%
	Mean epg (SD)	19 (230)	0	0
	Range	0-4,752	0	0
Northern Irrigated Plains	Light	0.4%	0.5%	0.7%
	Moderate	0.1%	0.1%	0.0%
	Heavy	0.0%	0.0%	0.0%
	Mean epg (SD)	4 (106)	22 (232)	1 (9)
	Range	0-3,888	0-7,890	0-180
Barani Lands	Light	0.2%	24.1%	1.0%
	Moderate	0.0%	1.0%	0.0%
	Heavy	0.0%	0.0%	0.0%
	Mean epg (SD)	1 (28)	239 (1,714)	0 (5)
	Range	0-564	0-24,036	0-108
Wet Mountains	Light	2.4%	3.4%	6.8%
	Moderate	0.0%	4.4%	0.3%
	Heavy	0.0%	0.0%	0.0%
	Mean epg (SD)	11 (123)	550 (2,695)	15 (99)
	Range	0-1,944	0-28,644	0-1,404
Northern Dry Mountains	Light	0.0%	9.8%	25.5%
	Moderate	0.0%	13.6%	1.1%
	Heavy	0.0%	0.0%	0.5%
	Mean epg (SD)	0	2,344 (6,771)	412 (4,743)
	Range	0	0-44,400	0-64,212
Western Dry Mountains	Light	0.0%	0.0%	0.0%
	Moderate	0.0%	0.0%	0.0%
	Heavy	0.0%	0.0%	0.0%
	Mean epg (SD)	0	0	0
	Range	0	0	0
Dry Western Plateau	Light	0.9%	3.1%	1.3%
	Moderate	0.0%	1.5%	0.2%
	Heavy	0.0%	0.0%	0.0%
	Mean epg (SD)	1 (7)	315 (2,662)	6 (98)
	Range	0-96	0-36,600	0-2,136
Sulaiman Piedmont	Light	0.0%	1.8%	0.0%
	Moderate	0.0%	0.0%	0.0%
	Heavy	0.0%	0.0%	0.0%
	Mean epg (SD)	0	16 (140)	0
	Range	0	0-1,440	0
Overall	Light	0.9%	3.7%	2.1%
	Moderate	0.05%	1.2%	0.1%
	Heavy	0.05%	0.0%	0.02%
	Mean epg (SD)	8 (199)	215 (1,994)	20 (997)
	Range	0-10,512	0-44,400	0-64,212

Parasitological data obtained from each ecological zone allowed for the estimation of intensities of infection for each form of STH in each province/territory (Table 7). The majority of roundworm infections were classified as light, with KPK accounting for the highest incidences of moderate roundworm infections (8.8% of children exhibited moderate roundworm infections), followed by AJK (4.8% of children exhibited moderate roundworm infections). There were no identified cases of heavy roundworm infections. Whipworm and hookworm infections were overwhelmingly light in classification; some cases of moderate and heavy intensity infections were identified for both forms, but were few in number.

Table 7 Percentage of children with light, moderate or heavy STH infections, by province

Province	Intensity Level	Hookworm	Roundworm	Whipworm
Punjab	Light	0.6%	4.9%	0.6%
	Moderate	0.05%	0.3%	0.0%
	Heavy	0.0%	0.0%	0.0%
	Mean egg (SD)	3 (86)	59 (799)	0 (7)
	Range	0-3,888	0-24,036	0-180
Sindh	Light	1.8%	1.4%	0.4%
	Moderate	0.1%	0.8%	0.1%
	Heavy	0.2%	0.0%	0.0%
	Mean egg (SD)	22 (369)	160 (1,906)	3 (70)
	Range	0-10,512	0-36,600	0-2,136
KPK	Light	1.6%	6.7%	16.6%
	Moderate	0.0%	8.8%	0.5%
	Heavy	0.0%	0.0%	0.3%
	Mean egg (SD)	9 (109)	1,447 (5,254)	209 (3,321)
	Range	0-1,944	0-44,400	0-64,212
Balochistan	Light	0.0%	0.9%	0.7%
	Moderate	0.0%	0.0%	0.0%
	Heavy	0.0%	0.0%	0.0%
	Mean egg (SD)	0 (0)	4 (69)	0 (6)
	Range	0	0-1,440	0-96
AJK	Light	1.0%	2.9%	4.8%
	Moderate	0.0%	4.8%	1.0%
	Heavy	0.0%	0.0%	0.0%
	Mean egg (SD)	1 (7)	498 (1,882)	21 (143)
	Range	0-72	0-10,448	0-1,404
Overall	Light	0.9%	3.7%	2.1%
	Moderate	0.05%	1.2%	0.1%
	Heavy	0.05%	0%	0.02%
	Mean egg (SD)	8 (199)	215 (1,994)	20 (997)
	Range	0-10,512	0-44,400	0-64,212

3.3. Polyparasitism

The number of children coinfecting with two or more forms of STH was analyzed. Incidences of coinfections were highest in the Northern Dry Mountain ecological zone, where 13.0% of the children were coinfecting with two forms (all roundworm and whipworm coinfections), followed by the Wet Mountains, where 4.4% of children were co-infected with two forms (all roundworm and whipworm coinfections) and 0.3% were coinfecting with all three forms. On a provincial/territory level, KPK exhibited the highest incidences of coinfections, with 8.8% of children coinfecting with 2 forms and 0.3% co-infected with three forms. Overall, 5.8% of the sampled population were infected with one form of STH, 1.15% co-infected with two forms, and 0.02% co-infected with all three.

3.4. Characteristics of the Schools Surveyed

Coverage

A total of 77 government schools were covered of which 50% were from Punjab followed by Sindh (26%), Balochistan (12%), KPK (9%) and AJK (3%). None of the schools from GB were able to be covered because of the inaccessibility of the province due to heavy rainfall and land sliding. FATA schools were not enumerated because of the security concerns. However, GB and FATA's epidemiological data was represented because their ecological zone extended into the adjacent provinces (Figure 1).

School characteristics

Majority of the respondents providing school information questionnaire were either principals (90%) or teachers (9%). Of the 78^s visited schools across four provinces and one autonomous territory, 56% were mixed schools with both boys and girls enrolled (Table 8). Over two-third of the schools were primary schools covering from kindergarten through class 5 while the remaining were from kindergarten through middle school (class 8) or higher.

School Infrastructure and Sanitation Facilities

Over 93% of the schools had improved drinking water source, i.e. either a tube well/ borehole (46%) or piped water facility into the school building (38%). There was only one school in Balochistan where there was no drinking water facility. Punjab was the only province with almost 90% improved toilet facilities with a flush latrine that poured into a covered space. In other provinces, 45% of Sindh schools and 60% of Balochistan schools had either toilet system that flushed excreta to open space or had no facilities. Over 71% of KPK schools flushed excreta to open space and another 14% had no facilities. Overall, water for handwashing was reported to be available in 78% of the schools and not available in 17% of the schools. Soap availability ranged from 15% in Sindh schools to 59% in schools in Punjab.

Previous deworming activity had occurred in only two provinces (46.2% of surveyed schools in Punjab and 100% in KPK). Almost all the teachers were willing to help in the prophylactic deworming tablet distribution at the end of the survey (97.4%) to their pupils.

3.5. Characteristics of the Households Surveyed

Parental Schooling

Overall education levels were low among the parents of the children surveyed. Mothers had approximately 2.6 years of schooling whereas fathers had 4.4 years. The least number of years of schooling were of parents from KPK (0.8 ± 2.0 years among mothers and 1.4 ± 2.0 years among fathers). Generally, fathers from Sindh and Balochistan had more years of schooling (6 vs 6.8 years respectively) than those from the other provinces (Table 9).

Water and Sanitation Facilities

Over 90% of the households in Punjab, Sindh and KPK had improved drinking water source whereas 75% of those from Balochistan and AJK had an improved drinking water source. Purifying drinking water was not a norm in the households with only 3.2% of households using a water purification method. The most common purification method was boiling water (82.8%) (Table 9).

Nearly 27% of the households did not have toilet facilities in KPK, followed by 10.8% in Punjab, 8.7% in AJK and 5% in Sindh. Sindh households had the most improved toilet facilities with a pour system into a covered area (75%) followed by Punjab (52.7%). Even though soap was available in over 95% of the households, its use is very erratic.

^s Stool samples were collected from 77 schools, but school characteristic surveys were conducted at 78 schools.

Only 30% of the adult respondent stated they had used soap to wash their hands, 35% before eating and 16% after eating (Table 9).

Table 8 Characteristics of school surveyed

School Characteristics	Overall n=78	Punjab n=39	Sindh n=20	KPK n=7	Balochistan n=10	AJK n=2
Students sampled per school, median (IQR)	66 (60 – 73)	66 (60 – 75)	61 (60 – 70)	67 (66 – 69)	74 (65 – 80)	66 (65 – 67)
School type						
Girls single sex school	11 (14.1)	8 (20.5)	1 (5)	0 (0)	2 (20)	0 (0)
Boys single sex school	23 (29.5)	17 (43.6)	1 (5)	0 (0)	5 (50)	0 (0)
Co-education	44 (56.4)	14 (35.9)	18 (90)	7 (100)	3 (30)	2 (100)
Classroom range						
KG – Class 5	50 (64.1)	19 (48.7)	17 (85)	7 (100)	5 (50)	2 (100)
KG – Class 7	1 (1.3)	1 (2.6)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
KG – Class 8	14 (17.9)	9 (23.1)	1 (5)	0 (0%)	4 (40)	0 (0%)
KG – Class Matric (Class 10)	10 (12.8)	9 (23.1)	0 (0%)	0 (0%)	1 (10)	0 (0%)
KG – Class Intermediate (Class 12)	2 (2.6)	1 (2.6)	1 (5)	0 (0%)	0 (0%)	0 (0%)
Class 1- Class 5	1 (1.3)	0 (0%)	1 (5)	0 (0%)	0 (0%)	0 (0%)
Drinking water source						
Unimproved (includes no water source)	5 (6.4)	0 (0%)	0 (0%)	0 (0%)	5 (50)	0 (0%)
Improved	73 (93.6)	39 (100)	20 (100)	7 (100)	5 (50)	2 (100)
Toilet facilities						
Latrine with flush/pour system into covered area	51 (65.4)	35 (89.7)	11 (55)	1 (14.3)	4 (40)	0 (0%)
Latrine which flushes excreta to open space / open pit	18 (23.1)	3 (7.7)	6 (30)	5 (71.4)	3 (30)	1 (50)
No facilities/ use the fields	9 (11.5)	1 (2.6)	3 (15)	1 (14.3)	3 (30)	1 (50)
Students per toilet	87	82	89	75	114	100
Water available for handwashing						
Yes	61 (78.2)	35 (89.7)	17 (85)	4 (57.1)	4 (40)	1 (50)
No	13 (16.7)	3 (7.7)	2 (10)	2 (28.6)	5 (50)	1 (50)
Sometimes	4 (5.1)	1 (2.6)	1 (5)	1 (14.3)	1 (10)	0 (0%)
% with soap available for handwashing–reported by school admin						
Yes	31 (39.7)	23 (59)	3 (15)	2 (28.6)	3 (30)	--
No	33 (42.3)	7 (17.9)	16 (80)	2 (28.6)	7 (70)	1 (50)
Sometimes	14 (17.9)	9 (23.1)	1 (5)	3 (42.9)	0 (0%)	1 (50)
% with deworming activity	25 (32.1)	18 (46.2)	0 (0%)	7 (100)	0 (0%)	--
% where teachers will help with deworming tablet distribution **	76 (97.4)	39 (100)	18 (90)	7 (100)	10 (100)	2 (100)

3.6. Characteristics of the Children Surveyed

The mean age of enrolled children was 8.9 years. The ratio of girls to boys was 2:3. Approximately, one-third of the children were underweight in Punjab, Sindh and Balochistan. Children in KPK and AJK were nutritionally better off with 13.1% and 5.8% of children underweight, respectively (Table 10). Children were chosen from nearly all the primary classes (class 1 to 6) with nearly half from classes 3 and 4.

Child hand washing practices

Almost all children (98%) reported to have soap available in their homes. Of these 91% claimed to have used soap on the day of the survey or a day before. Usage was low with less than half the children using it before eating (45%); used soap after defecating (41%); after playing outside (19%). Pica in the form of licking or eating soil existed in only 7% of the children. Generally, 57% of the children stated that they used soap the most often for cleaning hands. The lowest usage of soap was reported by children in KPK (2.9%) and AJK (3.8%). Nearly half the children in Sindh (51.4%) and Balochistan (46.2%) stated that they walked or played bare footed outside the house (Table 10).

** The exact narration of question asked by school administration is “will the teachers be able to help in the distribution of deworming tablets to children”

Table 9 Household characteristics of surveyed children by province

Household Characteristics	Overall n=3995	Punjab n=2165	Sindh n=979	KPK n=374	Balochistan n=373	AJK n=104
Primary Construction Material of house						
Roof						
Tile/Asbestos/Concrete	3423 (85.7)	1802 (83.2)	821 (83.9)	372 (99.5)	336 (90.3)	92 (88.5)
Metal Sheet	190 (4.8)	139 (6.4)	13 (1.3)	0 (0)	36 (9.7)	2 (1.9)
Straw/ Thatched	55(1.4)	55 (2.5)	0 (0)	0 (0)	0 (0)	0 (0)
Mud	326 (8.2)	169 (7.8)	145 (14.8)	2 (0.5)	0 (0)	10 (9.6)
Floor						
Cement/Tile/Granite/wood	3316 (83)	1766 (81.6)	817 (83.5)	342 (91.4)	313 (84.1)	78 (75)
Mud/sand	671 (16.8)	392 (18.1)	162 (16.5)	32 (8.6)	59 (15.9)	26 (25)
cow dung	7 (0.2)	7 (0.3)	0 (0)	0 (0)	0 (0)	0 (0)
Household size, Mean \pm SD						
18 years and above	7.8 \pm 3.0	7.9 \pm 3.1	7.3 \pm 2.3	8.5 \pm 3.0	7.7 \pm 2.9	9.4 \pm 4.4
Below 18 years	3.3 \pm 1.5	3.3 \pm 1.6	3.4 \pm 1.5	3.0 \pm 1.1	3.4 \pm 1.2	3.3 \pm 1.8
Parental Years of Schooling	4.5 \pm 2.2	4.6 \pm 2.2	4.0 \pm 1.6	5.5 \pm 2.3	4.2 \pm 2.2	6.1 \pm 3.1
Mother	2.6 \pm 3.7	2.5 \pm 3.5	3.2 \pm 3.8	0.8 \pm 2.0	3.8 \pm 4.7	1.3 \pm 2.3
Father	4.4 \pm 4.4	3.9 \pm 4.2	6.0 \pm 4.2	1.4 \pm 2.3	6.8 \pm 5.2	2.4 \pm 3.4
Drinking water source						
Unimproved	392 (9.8)	192 (8.9)	53 (5.4)	19 (5.1)	102 (27.4)	26 (25)
Improved	3602 (90.2)	1973 (91.1)	926 (94.6)	355 (94.9)	270 (72.6)	78 (75)
Toilet facilities						
Latrine with pour system into covered area	1995 (49.9)	1140 (52.7)	742 (75.8)	2 (0.5)	74 (19.9)	37 (35.6)
Latrine which flushes excreta to open space	1449 (36.3)	741 (34.2)	112 (11.4)	270 (72.2)	284 (76.3)	42 (40.4)
Open pit	159 (4)	51 (2.4)	79 (8.1)	0 (0)	13 (3.5)	16 (15.4)
No facilities/ use the fields	391 (9.8)	233 (10.8)	46 (4.7)	102 (27.3)	1 (0.3)	9 (8.7)
% HH purify drinking water	128 (3.2)	57 (2.6)	59 (6)	3 (0.8)	9 (2.4)	0 (0)
Purification method used						
Strain through cloth	4 (3.1)	0 (0%)	3 (5.1)	1 (33.3)	0 (0%)	0 (0%)
Boiling water	106 (82.8)	50 (94.3)	45 (76.3)	2 (66.6)	9 (100)	0 (0%)
Adding alum or chlorine to water	2 (1.6)	0 (0%)	2 (3.4)	0 (0%)	0 (0%)	0 (0%)
Filtering water	12 (9.4)	3 (5.3)	9 (15.3)	0 (0%)	0 (0%)	0 (0%)
Don't recall	4 (3.1)	4(7.0)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Self-reported presence of soap in HH	3893 (97.5)	2132 (98.5)	932 (95.2)	371 (99.2)	362 (97.3)	96 (92.3)
Used soap today or yesterday	3731 (95.8)	2095 (98.3)	924 (99.1)	294 (79.2)	333 (92)	85 (88.5)
Soap used for						
Washing clothes	951 (25.5)	246 (11.7)	597 (64.6)	15 (5.1)	87 (26.1)	6 (7.1)
Bathing self	1960 (52.5)	824 (39.3)	821 (88.9)	91 (31)	199 (59.8)	25 (29.4)
Washing hands after peeing	1155 (31)	623 (29.7)	320 (34.6)	87 (29.6)	76 (22.8)	49 (57.6)
Washing hands after defecating	1118 (30)	666 (31.8)	254 (27.5)	113 (38.4)	83 (24.9)	2 (2.4)
Washing hands before eating	1309 (35.1)	690 (32.9)	385 (41.7)	99 (33.7)	123 (36.9)	12 (14.1)
Washing hands after eating	600 (16.1)	178 (8.5)	290 (31.4)	13 (4.4)	97 (29.1)	22 (25.9)

Table 10 Characteristics of the child interviewed in survey

Characteristics	Overall n=3995	Punjab n=2165	Sindh n=979	KPK n=374	Balochistan n=373	AJK n=104
Age in years, Mean ±SD	8.9 ±1.5	9.3±1.3	8.1±1.4	9.3±1.2	8.2±1.6	8.0±1.6
% girls	40.6	37.1	46.2	50.3	33.8	49.0
Child BMI centiles						
Normal	2442 (61.1)	1302 (60.1)	546 (55.8)	285 (76.2)	223 (60.1)	86 (82.7)
Underweight	1317 (33.0)	780 (36)	356 (36.4)	49 (13.1)	126 (34)	6 (5.8)
Overweight	152 (3.8)	62 (2.9)	30 (3.1)	32 (8.6)	17 (4.6)	11 (10.6)
Obese	82 (2.1)	21 (1)	47 (4.8)	8 (2.1)	5 (1.3)	1 (1)
CHILD HANDWASHING PRACTICES (self-reported)						
% with soap present in house	3907 (97.8)	2142 (98.9)	925 (94.5)	374 (100)	362 (97.3)	104 (100)
Used soap today or yesterday	3638 (91.1)	2038 (95.1)	909 (98.3)	281 (75.1)	334 (92.3)	76 (73.1)
Child used soap for						
Washing clothes	485 (13.3)	10 (0.5)	402 (44.2)	0 (0%)	73 (21.9)	0 (0%)
Bathing self	1504 (41.3)	433 (21.2)	762 (83.8)	55 (19.6)	212 (63.5)	42 (55.3)
Washing hands after urinating	1241 (34.1)	690 (33.9)	341 (37.5)	73 (26.0)	119 (35.6)	18 (23.7)
Washing hands after defecating	1504 (41.3)	974 (47.8)	255 (28.1)	133 (47.3)	117 (35)	25 (32.9)
Washing hands before eating	1636 (45.0)	966 (47.4)	351 (38.6)	112 (39.9)	190 (56.9)	17 (22.4)
Washing hands after eating	984 (27.0)	333 (16.3)	452 (49.7)	10 (3.6)	187 (56)	2 (2.6)
Washing hands after playing	700 (19.2)	263 (12.9)	285 (31.4)	50 (17.8)	89 (26.6)	13 (17.1)
Other activities	17 (0.5)	16 (0.8)	1 (0.1)	0 (0%)	0 (0%)	0 (0%)
What used most to clean hands with						
Nothing	26 {0.7}	16 {0.7}	1 {0.1}	6 {1.6}	3 {0.8}	0 (0%)
Water	1665 {41.7}	768 {35.5}	356 {36.4}	357 {95.5}	85 {22.8}	99 {95.2}
Soap	2276 {57}	1379 {63.7}	597 {61}	11 {2.9}	285 {76.4}	4 {3.8}
Ash	8 {0.2}	2 {0.1}	6 {0.6}	0 (0%)	0 (0%)	0 (0%)
Soil	20 {0.5}	0 (0%)	19 (1.9)	0 (0%)	0 (0%)	1 {1}
Walk bare feet when playing or walking outside house						
Yes	1089 (27.3)	386 (17.8)	503 (51.4)	20 (5.3)	172 (46.2)	8 (7.7)
No	2123 (53.2)	1380 (63.7)	277 (28.3)	227 (60.7)	159 (42.7)	80 (76.9)
Sometimes	782 (19.6)	399 (18.4)	199 (20.3)	127 (34)	41 (11)	16 (15.4)

4. Discussion

The findings of Pakistan's first national STH prevalence survey indicate that Pakistan is a country in which many areas have low overall STH prevalence, though there are some at-risk areas where prevalence exceeds WHO treatment thresholds. Much of the southern region of Pakistan has very low levels of STH, with the notable exception of the Karachi area in south-western Sindh. STH is mostly confined to northern areas of the country, with the highest prevalence focused in the area around Rawalpindi and Islamabad.

This sampling strategy for this national survey was designed based on ecological zones rather than provinces/territories. Ecological zones are geographical areas that are homogenous in terms of climate, humidity, vegetation and soil, important factors for the transmission of STH. Prevalence was highest in the Northern Dry Mountains (37.5%) where valley soils are deep and clayey and most of the area is conducive to animal grazing. This zone covers much of northern KPK, extending into northern FATA and Gilgit-Baltistan. Within the Northern Dry Mountains, prevalence was highest in the northern expanses of KPK. Barani Lands, the ecological zone with the second highest prevalence (25.3%) covers parts of northern Punjab, ICT and two non-contiguous regions of KPK. Within the Barani Lands, prevalence was highest in the northern region of the ecological zone, which seems conducive to STH with an average monthly rainfall of 200 mm in the summer and was lower in its southern part which is semi-arid and hot with 85 mm of rain in the summer. The next most prevalent ecological zone showed a steep drop compared to the Northern Dry Mountains and Barani Lands: the Wet Mountains, which covers all of AJK and extends into northern regions of KPK, had an overall STH prevalence of 12.2%. Within this ecological zone, the prevalence was highest in the areas bordering the Barani Lands, corresponding to the southern and south-western regions of AJK, and extending into Haripur and surrounding districts of KPK. There was another steep drop in prevalence of STH in the fourth most prevalent ecological zone: the Dry Western Plateau, which covers the southern regions of Balochistan, extending into the western regions of Sindh, had an overall STH prevalence of only 5.3%. While the Dry Western Plateau covers a large geographical area, STH within this ecological zone was confined to the vicinity of Karachi.

The use of ecological zones as a sampling strategy is vital since it has allowed consideration of the soil conditions that STH flourish in. Depending only on provincial boundaries would have muted estimates of prevalence. For example, the prevalence of any STH in Punjab is 6.2% overall but when we break Punjab into ecological zones, Punjab's Sandy Desert has approximately 0.5% prevalence, which increases in Punjab's Northern Irrigated Plains to 8.9% as the districts moves geographically north into Punjab's Barani Lands that have the highest prevalence in the city of Gujrat (31%) and Rawalpindi (56%). This approach will allow for targeted interventions in the most populous province of Pakistan.

It is difficult to compare these findings with the past single city surveys since most of the latter used either a direct smear method or some other stool examination method. The only other study that used Kato-Katz method was Nishuara et al's in Gilgit-Baltistan. They found prevalence of roundworm in GB villages to be in the high 80s and 90's using the Kato-Katz method. We were not able to survey GB but our findings in the Northern Dry Mountains zone were one of the highest in Pakistan (37.5%).

Apart from climatic reasons that are conducive to STH, Barani Lands and Northern Dry Mountains ecological zones are in areas of poor water and sanitation. For example, in KPK almost 71% of the school and household toilet facilities flush excreta into either an open space or an uncovered pit in comparison to only 34% in Punjab or 11% in Sindh. Similarly, the self-reported use of soap in KPK is much less than that of other provinces. Importantly, some of the highest prevalence was also found in larger cities reflecting poverty amongst the urban poor and poor water and sanitation facilities. The urban areas of Islamabad, Rawalpindi and Gujrat, all in the Barani Lands in northern Punjab, have the greatest prevalence. In the case of the Dry Western Plateau, which covers a large geographical area spanning Balochistan and Sindh, STH prevalence was only high in Karachi, the most populous city in Pakistan. This suggests that poor hygiene and sanitation practices amongst the urban population in this ecological zone is a major contributing factor to the high prevalence. Not all of the populous urban areas, however, exhibited high prevalence. Many of the most populous districts of Pakistan were represented in this national survey, with most exhibiting low prevalence, including Lahore (2.4%), Faisalabad (0%), Multan (0.4%), Hyderabad (0%) and Gujranwala (0%). However, it is

noted that not all large urban areas of the country were represented in this national survey. Given the finding that the worm burden in the Dry Western Plateau, which covers a large expanse of Balochistan and Sindh, is confined to the vicinity of Karachi raises that possibility that the predictive prevalence maps may not fully represent the STH prevalence in highly populated urban areas that were not included in the sample. For example, no schools in Peshawar in KPK, or any of the neighboring districts, were included. If the hygiene and sanitation conditions in Peshawar are similar to Karachi, Rawalpindi and Islamabad, it's considered likely that prevalence may exhibit a spike in Peshawar.

While no wide-scale deworming programs targeting school-age children have been implemented in Pakistan, there have been small-scale programs in selected areas. It was noted that all the schools surveyed in KPK had been dewormed previously, as were 45% of the schools surveyed in Punjab. All four schools surveyed in Gujrat district reported previous deworming (Annexure 5), yet the prevalence in this district was amongst the highest reported (31% overall prevalence). Two schools were surveyed in Rawalpindi, one of which reported previous deworming, yet the overall prevalence was 56.3%. There is no information available about the number of rounds of deworming implemented in these areas, their consistency, nor their coverage. The fact that deworming has been conducted in these areas means that the survey may not be a 'true' baseline for at least 8 of the 16 districts surveyed in the Punjab and all three of the districts surveyed in KPK.

Although there has been limited focus on deworming school-age children in Pakistan, there have been wide-scale deworming programs targeting preschool-age children. Across Pakistan, mebendazole has been distributed to preschool-age children since 2013, with in excess of 14 million children treated in 2013 (27) in excess of 15 million treated in 2014 (28), and in excess of 11 million treated in 2015 (19). Reported coverage for these programs have been very high: in excess of 90%, according to official reports. To take account of younger children in primary schools having been previously dewormed as part of these preschool deworming programs, the survey reported here preferentially sampled older children who would not have benefitted from the preschool deworming programs which began in 2013 (44.3% of the children included in the survey were from class 4 or 5, and would have been too old to have benefited from the preschool programs; only 14.8% were from class 1, who would have received mebendazole the previous year). Furthermore, the proportion of children in class 1 and class 2 who had STH infection was 5.4% and 4.8% respectively. In classes 4 and 5, the proportion with STH infection increased to 9% and 9.3% respectively. Due to the sampling strategy employed, the existing deworming programs targeting preschool-age children since 2013 has limited impact on the findings of the baseline survey for school-age children.

Although not widespread throughout the country, there are regions with sufficiently high prevalence of STH that indicate that mass deworming programs should be conducted. In accordance with WHO-recommended strategies, annual MDAs are warranted in only selected areas of the country: regions of northern Punjab, within the Barani Land; regions of northern KPK within the Northern Dry Mountains, Wet Mountains and Northern Irrigated Plains; the vicinity of Karachi in the Dry Western Plateau; regions in western GB, within the Northern Dry Mountains; regions of northern FATA within the Northern Dry Mountains. Limited areas in southern AJK, within the Wet Mountains, and southern Balochistan, within the Dry Western Plateau, exceed 20% prevalence. Only a very focused area, in the vicinity of Rawalpindi and Islamabad, was identified as warranting biannual MDAs. For sustaining the impact of deworming activities and to reduce the rates of reinfection, effort will also need to be made to develop the water and sanitation infrastructure and to improve hygiene-related knowledge and practices amongst communities in endemic areas.

5. Recommendations

With a baseline established through this survey, Pakistan now has the opportunity to design a targeted deworming program in infected areas and use the baseline to gauge the effectiveness of future deworming activities on reducing prevalence. The predictive maps developed by this study will serve to inform programmatic decisions regarding what areas are most in need of treatment. The national survey has identified areas with sufficiently high prevalence of STH to warrant pursuing MDAs. In accordance with WHO-recommended strategies we recommend that annual school-based MDAs should be prioritized in regions of northern Punjab, Islamabad, regions of northern KPK and the vicinity of Karachi. Regions in western GB, northern FATA and southern AJK also exceed 20% prevalence, so annual school-based MDAs should also be considered in these regions. While the vicinity of Rawalpindi and Islamabad was identified as warranting biannual MDAs, due to the fact that this is a very focalized area and the prevalence only slightly exceeds the WHO threshold of 50%, we recommend commencing annual deworming – this will allow the authorities in that region to learn how to plan and conduct deworming campaigns, and if needed, biannual strategies can be considered in the future.

Following the WHO treatment thresholds, the number of administrative units identified as warranting MDAs is quite limited (40 districts, including Islamabad Capital Territory). In geographical terms, this is a small proportion of the country, but in population terms the target number of beneficiaries is large, with these areas having a combined estimated population of 17 million children in the 5-15 year age group. There are additional districts that are on the cusp of the WHO treatment thresholds (i.e. areas just below 20%) which provincial governments may decide warrant inclusion in deworming programs. We recommend that the provincial governments study the data from this national survey to develop a deworming strategy based on the districts that are predicted to benefit from MDAs.

In areas where STH is endemic, a school-based approach for mass deworming provides an easy way to reach large numbers of children through existing infrastructure rather than creating new channels of distribution. By leveraging freely-donated deworming medication, generously donated by pharmaceutical companies through the WHO specifically for school-age children, the cost of mass school-based deworming programs is less than USD 0.50 per child annually, including delivery costs. For a school-based program, it is important to consider school-age children who are not enrolled at school. It is estimated that 25 million school-age children are out-of-school (OOSC), i.e. nearly 23% of school-age children in Pakistan (29). In absolute number terms, Punjab contributes to nearly 52% of these children, followed by Sindh (25%), KPK (10%), Balochistan (7%), and AJK (2%). The lowest proportion (22.5%) of out-of-school children are in the primary age group (5-9 year olds) and the proportion jumps to 52% by middle school and 84% by higher secondary school (15-16 year olds); (Annexure 19; across districts break-down of OOSC is in Annexure 20). With such a large proportion of children out-of-school, strategies have to be utilized to ensure these children also participate and benefit from deworming activities. Similarly, it is also important to consider children attending non-government schools since it is estimated that nearly 32% enrollment is in private schools, 2% in religious schools and 0.5% in other type of schools. (Table 11; Annexure 21 and 22).

Province	Public	Private	Madressa	Other
KPK	71.7	26.1	1.6	0.6
Punjab	61.8	35.1	2.0	1.0
Sindh	64.4	33.2	1.9	0.5
Balochistan	88.6	8.0	3.2	0.3
ICT	58.4	40.4	1.1	0.0
Pakistan	65.1	32.4	2.0	0.5

Given the poor hygiene and sanitation infrastructure at schools and households, combined with poor hygiene practices, such as handwashing with soap, efforts should be made to make improvements in water and sanitation infrastructure and to improve hygiene-related knowledge and practices amongst communities in endemic areas. This would help to sustain the impact of deworming by reducing the rates of reinfection over time.

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Annexures

Annexure 1 Pakistan Population (2012 est.) and administrative units

Administrative Unit	Population (2012 est.)	Area (km square)	Density (per square km)	Population Proportion (%)	Ecological Zones
Punjab (Province)	91,379,615	205,344	445.01	46.30	III. Sandy Desert IV. Northern Irrigated Plains V. Barani Lands X. Sulaiman Piedmont
Sindh (Province)	55,245,497	140,914	392.05	27.99	II. Southern Irrigated III. Sandy Desert IX. Dry Western Plateau
Khyber Pakhtunkhwa (Province)	26,896,829	74,521	360.93	13.63	V. Barani Lands VI. Wet Mountain VII. Northern Dry Mountains
Balochistan (Province)	13,162,222	347,190	37.91	6.67	VIII. Western Dry Mountains IX. Dry Western Plateau X. Sulaiman Piedmont
Federally Administered Tribal Areas	3,930,419	27,220	144.39	1.99	VIII. Western Dry Mountains VII. Northern Dry Mountains
Azad Jammu & Kashmir	2,972,501	13,297	223.55	1.51	VI. Wet Mountain
Gilgit Baltistan	1,441,523	72,971	19.75	0.73	VII. Northern Dry Mountains
Islamabad (Federal Capital Territory)	1,151,868	906	1,271.38	0.58	V. Barani Lands
Pakistan	197,361,691	782,363	223.79		

Annexure 2 Sentinel schools needed per ecological zone and targeted districts selected

Ecological Zones	Est Population	Est Population (5-10 yr old)	Sentinel schools needed*	Sentinel schools surveyed	Districts targeted
Southern Irrigated	19,985,745	2,238,404	7	7	Hyderabad, Badin, Mirpurkhas, Shikarpur
Sandy Desert	27,368,663	3,065,289	10	10	DGK, Khairpur, Muzaffargarh, Tharparkar
Northern Irrigated Plains	64,475,217	7,221,224	24	25	Sarghoda, Lahore, Faisalabad, Multan, Sheikhpura, Gujranwala, Nowshera, Okara, Sahiwal, Toba Tek Singh, Vehari
Barani Lands	17,577,377	1,968,667	7	8	Rawalpindi, Gujrat, Jhelum
Wet Mountains	14,0492,000	1,623,104	6	6	Abbotabad, Kotli, Mansehra
Northern Dry Mountains	8,850,000	991,200	4	3	Swat,
Western Dry Mountains	9,790,000	1,096,480	4	4	Quetta, Mastung
Dry Western Plateau	28,966,749	3,244,275	11	12	Lasbela, Karachi, Nushki, Gawadar, Dadu
Sulaiman Piedmont	3,748,618	419,845	2	2	Rajanpur, Jhal Magsi
	189,592,369	21,234,344	75	77	

Annexure 3 Description of ecological zones of Pakistan

Pakistan has been divided into agro-ecological zones (21) based on physiography, climate, land use and water availability. Description of the zones are as follows:

Zone I: Indus Delta. The climate is arid tropical marine. The mean monthly summer rainfall is 75 mm and winter rainfall less than 5 mm. The mean daily temperature is between 34 °C and 40 °C in summer and between 19 °C and 20 °C in winter. The soils are clay and silty. Rice, sugar cane, banana and pulses are the major crops.

Zone II: Southern Irrigated Plain, the Lighter Indus Plain. The climate is arid and subtropical. The mean monthly summer rainfall is 18 mm in the north and 45 to 55 mm in the south. The soils are silty and sandy loam but the upper areas of the flood plain are calcareous loamy and clayey. Cotton, wheat and sugar cane are grown on the left bank of the Indus and rice, wheat and gram on the right bank.

Zone IIIa: Sandy Desert (a). The maximum rainfall is 300 mm. The soils are sandy and loamy fine sand. The land is used for grazing.

Zone IIIb: Sandy Desert (b) - sand ridges and dunes. The rainfall is between 300 and 350 mm. The soils are sandy and loamy fine sand. The land is used for grazing.

Zone IVa: Northern Irrigated Plain (a) - Flood Plains and Bar Uplands. The climate is semi-arid to arid. The mean annual rainfall is 300 to 500 mm in the east and 200 to 300 mm in the southwest. The soils are sandy, loam-clay and loam. The canal irrigated crops are wheat, rice, sugar cane, oilseed and millets in the north and wheat, cotton, sugar cane, maize, citrus and mangoes in the centre and south.

Zone IVb: Northern Irrigated Plain (b) - alluvial valleys of Peshawar and Mardan. The climate is semi-arid. The mean monthly rainfall is 20 to 30 mm. The soils are silty clays and clay loams. The main crops are sugar cane, maize, tobacco, wheat, berseem, sugar beet and orchards.

Zone V: Barani (rainfed) Lands. This covers the Salt Range and the Potwar Plateau. In the North the mean monthly rainfall is 200 mm in summer and 35 to 50 mm in winter. The climate in the Southern part is semi-arid and hot. The mean monthly rainfall is 85 mm in summer and 30 to 45 mm in winter. The main crops are wheat, millet, oilseed and pulses.

Zone VI: Wet Mountains - Heavy Mountains. The mean monthly rainfall is 235 mm in summer and 116 mm in winter. The soils consist of silt loams to silty clays. A small area is under rainfed agriculture but most of it is under forest.

Zone VII: Northern Dry Mountains. The mean monthly rainfall is 25 to 75 mm in winter and 10 to 20 mm in summer. The valley soils are deep and clayey. Most of the area is used for grazing.

Zone VIII: Western Dry Mountains. They are composed of barren hills with steep slopes. The mean monthly rainfall is 95 mm in summer and 63 to 95 mm in winter. The soils in the valleys are deep and loamy. Most of the land is used for grazing. On part of the loamy soils wheat and fruit crops are grown.

Zone IX: Dry Western Plateau - mountainous areas. The mean monthly rainfall is 37 mm in summer. The coastal belt receives a sea breeze. The land is used mainly for grazing. Melons, fruit crops, vegetables and wheat are grown where water is available.

Zone X: Sulaiman Piedmont. The climate is arid and hot. The mean monthly rainfall in summer is 13 mm. Soils are loams in gently sloping areas but clayey further away. Main crops are wheat, millet and gram.

Annexure 4 Survey Partners

Interactive Research and Development (IRD)

IRD is a global health delivery and research organization based in UAE. Founded in Karachi, Pakistan in 2004, today IRD works in 15 countries and has regional offices in Karachi, Dhaka, Jakarta and Johannesburg. IRD programs are designed to build an ecosystem of care that offers a range of health programs cross cutting infectious diseases, NCDs, maternal and child health, surgical care and mental health - right from when a child is born to adulthood. The IRD team leverages process and technology innovations to address global health delivery gaps, including the use of health market innovations such as social business models to engage private providers in lung health and diabetes care. By taking advantage of the latest technology innovations IRD, has been able to execute large scale programs that enable efficiencies in mass screening, data collection, monitoring and evaluation, link healthcare providers to patients, improve patient treatment compliance and program quality in real time.

For the prevalence survey, IRD provided input in the form of technical as well as logistical support. Technical support encapsulates technical oversight of the survey by Principal and Co-Principal Investigators. Logistical support involves arrangement of the survey equipment, selection of the field teams and program management staff. Additionally, IRD has taken the lead in seeking government permission in the province of Sindh, Balochistan and autonomous territories of Azad Jammu & Kashmir, and Gilgit Baltistan.

The Indus Hospital (TIH)

TIH and its network of hospitals is the only initiative of its kind in Pakistan providing specialized medical care in an impressive, state-of-the-art health center completely free to people in dire need of help. Its network is spread over several campuses and provinces. In Karachi, the Korangi Crossing campus is a tertiary health care center which to date has served almost 2 million patients with services worth Rs 4 billion. Other campuses in Sindh include the PIB Campus, and Children's Cancer Hospital in Karachi and a hospital in Badin. In Punjab, the management of TIH is running the Recep Tayyip Erdogan Hospital in Muzaffargarh upon the request of the government of Punjab and the Al Ghazi Trust Hospital in Bhong. The Indus Hospital runs on a consistent flow of donations and monetary support in the form of Zakat, Donation and Equipment from philanthropists, institutions and organizations. With a strong emphasis on innovation and research, The Indus Hospital has also established a successful partnership with IRD, a research and service organization committed to saving lives through improvements in global health. The Indus Hospital and IRD have established the joint Indus Hospital Research Center, IHRC for targeted efforts focused towards improving health in communities and low-income households.

For the prevalence survey, The Indus Hospital has provided input in form of training technical and non-technical staff members that went into the field, along with providing monitoring support to oversee the survey activities.

Institute of Development and Economic Alternatives (IDEAS)

IDEAS was established in June 2012 with a vision to strengthen the economic and social foundation of democracy in Pakistan by producing rigorous quality research. IDEAS brings considerable research and policy expertise in the domain of education in Pakistan. The objective is to identify, through research, pivotal opportunities of policy reform, both in terms of feasibility and impact, and subsequently use that knowledge for advocacy and policy engagement. IDEAS envisions research to be innovative, multidisciplinary and rigorous and believes in policy engagement that is strategic, consistent and long-term.

For the prevalence survey, IDEAS is primarily involved in seeking permissions by the government in the provinces of Punjab and Khyber Paktunkhwa due to its widespread presence in these provinces. IDEAS has also helped in identification of key stakeholders in the provincial governments, including those in the provincial bureaucracy, political parties and key informants in the advisory arena.

Evidence Action

Evidence Action's Deworm the World Initiative works toward a world where all at-risk children have improved health, access to education, and better livelihoods as a result of being free from parasitic worms. Evidence Action provides customized technical assistance to governments in Africa and Asia to launch, strengthen, and sustain large-scale school-based deworming programs. Evidence Action provides technical expertise to build government capacity for deworming and has a proven track record of supporting program implementation at scale in a variety of contexts. Specific areas of technical assistance include prevalence surveys, policy and advocacy, drug coordination and management, training and distribution cascade, community sensitization and mobilization, monitoring and evaluation, and program management and planning.

For the prevalence survey, Evidence Action's Deworm the World Initiative coordinated with different partners to ensure the effective implementation of the survey. This involved coordination with stakeholders for sampling design, providing trainings material and financial support.

Annexure 5 Weighted prevalence based on ecological zones and province

Province	Ecozone	District	School Surveyed	Any previous deworming activity	Weighted prevalence			
					HK hookworm	AS roundworm	TR whipworm	Overall
Balochistan	Dry Western Plateau	Gwadar	1	No	0% (0-0)	0% (0-0)	0% (0-0)	0% (0-0)
	Dry Western Plateau	Lasbela	3	No	0% (0-0)	1.5% (0.4-6)	2.3% (0.7-6.9)	2.3% (0.7-6.9)
	Dry Western Plateau	Nushuki	1	No	0% (0-0)	0% (0-0)	0% (0-0)	0% (0-0)
	Western Dry Mountains	Mastung	1	No	0% (0-0)	0% (0-0)	0% (0-0)	0% (0-0)
	Western Dry Mountains	Quetta	3	No	0% (0-0)	0% (0-0)	0% (0-0)	0% (0-0)
	Sulaiman Piedmont	Jhal Magsi	1	No	0% (0-0)	5.4% (1.3-19.5)	0% (0-0)	5.4% (1.3-19.5)
			10		0% (0-0)	1% (0.3-2.3)	0.7% (0.2-2)	1.1% (0.5-2.6)
KPK	Wet Mountain	Abottabad	2	Yes	0% (0-0)	2.4% (0.6-9.2)	7.2% (3.3-15.2)	7.2% (3.3-15.2)
	Wet Mountain	Mansehra	2	Yes	5.6% (2.5-12)	12.1% (7.2-19.9)	8.4% (4.4-15.4)	12.1% (7.2-19.9)
	Northern Dry Mountains	Swat	3	Yes	0% (0-0)	23.4% (17.8-30)	27.2% (21.2-34.1)	27.2% (21.2-34.1)

Province	Ecozone	District	School Surveyed	Any previous deworming activity	Weighted prevalence			
					HK hookworm	AS roundworm	TR whipworm	Overall
			7		1.6% (0.7-3.5)	15.5% (12.2-19.5)	17.5% (13.9-21.6)	18.5% (14.8-22.7)
Punjab	Sandy Desert	Dera Ghazi Khan	2	No	0% (0-0)	0% (0-0)	0% (0-0)	0% (0-0)
	Sandy Desert	Muzaffargarh	3	No	0.5% (0.1-3.7)	0% (0-0)	0% (0-0)	0.5% (0.1-3.7)
	Northern Irrigated Plains	Faisalabad	1	Yes	0% (0-0)	0% (0-0)	0% (0-0)	0% (0-0)
	Northern Irrigated Plains	Gujranwala	2	Yes	0% (0-0)	0% (0-0)	0% (0-0)	0% (0-0)
	Northern Irrigated Plains	Lahore	6	No	0% (0-0)	0.6% (0.2-2.4)	1.8% (0.8-4)	2.4% (1.2-4.8)
	Northern Irrigated Plains	Multan	4	No	0.4% (0.1-2.9)	0% (0-0)	0% (0-0)	0.4% (0.1-2.9)
	Northern Irrigated Plains	Okara	2	No	0% (0-0)	0.9% (0.1-6.1)	0% (0-0)	0.9% (0.1-6.1)
	Northern Irrigated Plains	Sahiwal	1	No	7.7% (3.2-17.3)	0% (0-0)	0% (0-0)	7.7% (3.2-17.3)
	Northern Irrigated Plains	Sargodha	2	Yes	0.8% (0.1-5.5)	0% (0-0)	0% (0-0)	0.8% (0.1-5.5)

Province	Ecozone	District	School Surveyed	Any previous deworming activity	Weighted prevalence			
					HK hookworm	AS roundworm	TR whipworm	Overall
	Northern Irrigated Plains	Sheikhupura	3	Yes	0% (0-0)	3.2% (0.8-11.9)	3.2% (0.8-11.9)	3.2% (0.8-11.9)
	Northern Irrigated Plains	Toba Tek Singh	2	Yes	0% (0-0)	1.7% (0.4-6.6)	0.8% (0.1-5.8)	1.7% (0.4-6.6)
Punjab	Northern Irrigated Plains	Vehari	1	No	0% (0-0)	0% (0-0)	0% (0-0)	0% (0-0)
	Barani Lands	Gujrat	4	Yes	0% (0-0)	31.1% (25.1-37.7)	0% (0-0)	31.1% (25.1-37.7)
	Barani Lands	Jhelum	2	Yes	0% (0-0)	2.8% (1-7.1)	1.4% (0.3-5.4)	2.8% (1-7.1)
	Barani Lands	Rawalpindi	2	Yes in 1 school	1.6% (0.2-10.4)	56.3% (43.9-67.9)	3.1% (0.8-11.8)	56.3% (43.9-67.9)
	Sulaiman Piedmont	Rajanpur	1	No	0% (0-0)	0% (0-0)	0% (0-0)	0% (0-0)
			38		0.5% (0.2-0.9)	5.5% (4.6-6.6)	0.7% (0.4-1.1)	6.2% (5.2-7.3)
Sindh	Southern Irrigated	Badin	2	No	2.6% (0.8-7.7)	0% (0-0)	0% (0-0)	2.6% (0.8-7.7)
	Southern Irrigated	Hyderabad	2	No	0% (0-0)	0% (0-0)	0% (0-0)	0% (0-0)
	Southern Irrigated	Mirpur Khas	2	No	3.7% (1.4-9.4)	0% (0-0)	0% (0-0)	3.7% (1.4-9.4)

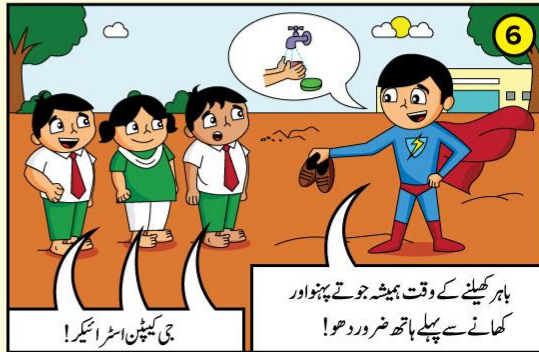
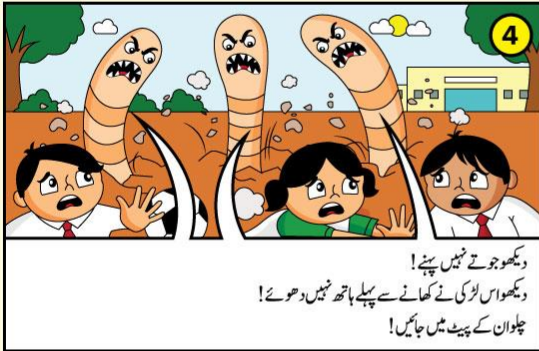
Province	Ecozone	District	School Surveyed	Any previous deworming activity	Weighted prevalence			
					HK hookworm	AS roundworm	TR whipworm	Overall
	Southern Irrigated	Shikarpur	2	No	2.7% (1-7)	0% (0-0)	0% (0-0)	2.7% (1-7)
	Sandy Desert	Khairpur	3	No	2.2% (0.8-5.7)	0% (0-0)	0% (0-0)	2.2% (0.8-5.7)
	Sandy Desert	Tharparkar	2	No	3.5% (1.3-9)	0% (0-0)	0% (0-0)	3.5% (1.3-9)
	Dry Western Plateau	Dadu	3	No	0.5% (0.1-3.5)	0% (0-0)	0% (0-0)	0.5% (0.1-3.5)
	Dry Western Plateau	Karachi	4	No	1.8% (0.4-6.9)	20.5% (14-29.1)	4.5% (1.9-10.3)	20.5% (14-29.1)
			21		2% (1.3-3.1)	2.1% (1.4-3.2)	0.5% (0.2-1.1)	4% (3-5.3)
AJK	Wet Mountain	Kotli	2	No	1% (0.1-6.6)	7.7% (3.9-14.7)	5.8% (2.6-12.3)	7.7% (3.9-14.7)
			2		1% (0.1-6.6)	7.7% (3.9-14.7)	5.8% (2.6-12.3)	7.7% (3.9-14.7)
PAKISTAN			77		0.9% (0.7-1.3)	5.1% (4.4-5.8)	2.3% (1.9-2.8)	6.2% (5.5-7.0)

Annexure 6 Training Team Structure and Training Overview

There were 4 sets of teams. Table 2 below highlights the distribution of field teams. It is to noted here that the field teams were distributed on the provincial level and not on the ecological zone level because of the cost and cultural advantages in arranging teams.

Four sets of teams were trained. Each team comprised of six members (three technical and three non-technical). Team member was selected after a rigorous selection process and one of the team members was nominated as the team supervisor as well. Those with previous survey work experience were given preference. Technical members were chosen by the consultant parasitologist after the culmination of the training. Training objectives were as follows:

Learning objectives of field teams
<p>Technical team learning objectives:</p> <ul style="list-style-type: none">• To understand the Kato-Katz technique• To be able to identify intestinal parasites by genus and species• To prepare Kato Katz slides• To quantify eggs by Kato-Katz method• To complete the parasitological forms accurately• Equipment management• Maintenance of high standards of lab protocol <p>Non-technical team learning objectives:</p> <ul style="list-style-type: none">• To develop an understanding of the entire survey process from start to finish• To know the team structure, duties of technical and non-technical team members and quality control• Preparation work including inserting the school ID number on the registration form and all socio-economic questionnaires with the school ID number, preparation of all polyester bags that will be given to the children including placing inside each bag a newspaper slip, info flyer spoon etc.• Knowledge of how to liaise with teachers, head teachers and parents in schools• Understands and carryout protocols designed to maintain integrity of the program• Ensure high quality and accurate data is collected• Assist with data entry and management• Assist with logistical preparation for each school visits.• Selecting kids, anthropometry, obtaining parental consent, filling of household and socio economic questionnaires on Day 1• Sample handling and transportation back to technical team on Day 2



	District				School		
School Form Serial Number	D	D	D	-	S	S	S

STH Prevalence: School Information

School Location Details	
<p>1. GPS Coordinates</p> <p>Elevation (Meter) __ __ __ __ </p> <p>Latitude N __ __ .____ __ __ __ </p> <p>Longitude E 0 __ __ .____ __ __ __ </p>	
<p>2. Picture of School</p> <p>Guidelines: Pictures of the school must be taken from the main gate with school board insight.</p>	
<p>3. Province/Autonomous Territory Name 1~Baluchistan 2~KP 3~Punjab 4~Sindh __ </p> <p>5. Gilgit Baltistan 6. Azad Kashmir</p>	
<p>4. District Name</p> <p> __ __ __ </p>	<p>District Code:</p>
<p>5. School Name</p>	<p>School EMIS Code</p>
<p>5.1 School Name if changed</p>	
<p>5.2 School EMIS Code if Changed</p>	
<p>6. School address(include school address and directions with nearest landmark, followed by Village, Mauza, Union Council, and Tehsil):</p>	
<p>7. Name of the respondent</p> <p> __ </p> <p> __ __ </p>	
<p>8. Respondent's Designation</p> <p>1~Headmaster/ Headmistress/ Principal 2~Head Teacher 3~Teacher</p> <p>4~Clerk/ Documentation Officer Other Specify _____ __ </p>	
<p>9. School Contact Number 1: __ __ __ __ __ __ __ __ __ __ </p> <p>School Contact Number 2: __ __ __ __ __ __ __ __ __ __ </p> <p>School Contact Number 3: __ __ __ __ __ __ __ __ __ __ </p>	
<p>10. Email:</p>	

11. Date of visit (DD-MMM-YYYY)	_ _ - _ _ - _ _ _ _
12. Interviewer Name	

6. Instruction for Research Staff

- Inform the school principal about the visit and provide letters of support
- Take consent from school principal and obtain signature where necessary
- Inform school principal of purpose of survey and what is required in terms of space and school lists
- Obtain a school list of children in class 5 along with their addresses. Ask staff on best way to find the child's homes
- If class 5 does not have enough students, select from class 4, and downwards
- Set up station for anthropometry and handing of stool collection containers

B. Information on School(Interview school principal or administrator)	
	Questions & Filters
B1	Type of school: 1~Girls 2~Boys 3~ Mixed _ _
B2a	Total male students enrolled in Primary (from Nursery/ KG to Class 5): _____
B2b	Total female students enrolled in Primary (from Class Nursery/KG to Class 5): _____
B3	Total number of teachers currently teaching Primary Classes (from Class Nursery/KG to Class 5): _____
B4a	Lowest Class Level: _____ B4b) Highest Class Level: _____
B5	<p>What is the source of drinking water in the school? [<i>School may penay kay paani ka zariya?</i>](Multiple Responses Allowed)</p> <p>1~Piped water into school building _ _ </p> <p>2~Piped water to school plot _ _ </p> <p>3~Public tap _ _ </p> <p>4~Tubewell/borehole _ _ </p> <p>5~Protected dug well _ _ </p> <p>6~Unprotected dug well _ _ </p> <p>7~collected rainwater _ _ </p> <p>8~bottled water _ _ </p> <p>9~cart with small tank/drum _ _ </p> <p>10~tanker trunk _ _ </p> <p>11~surface water (river, lake, stream, etc) _ _ </p> <p>Other specify_____</p>

B6	<p>What kind of toilet facility does the school have? <i>[School may bathroom/toilet kis qisam ka hai?]</i> (Multiple Responses Allowed)</p> <p>1~Flush/ pour flush <input type="checkbox"/></p> <p>2~Pit latrine with slab <input type="checkbox"/></p> <p>3~Pit latrine without slab/open pit<input type="checkbox"/></p> <p>4~Composite toilet<input type="checkbox"/></p> <p>5~Bucket<input type="checkbox"/></p> <p>6~Hanging toilet where falls into river/sea<input type="checkbox"/></p> <p>7~No facilities / Use the fields/beach<input type="checkbox"/></p> <p>Other specify _____<input type="checkbox"/></p>
B7	<p>How many toilet facilities does the school have for students? <i>[School may talib ilim kay liye kitnay bathrooms hain?]</i> _____</p>
B8	<p>Is there water available for washing hands after toilet use? <i>[Kya bathroom kay baad haath dhonay kay liye Paani meyasar hai?]</i></p> <p>1~No 2~Yes 3~Sometimes <input type="checkbox"/></p>
B9	<p>Is soap available for washing hands after toilet use? <i>[Kya bathroom janay kay baad haath donay ka sabun mayasar hai?]</i></p> <p>1~No 2~Yes 3~Sometimes<input type="checkbox"/></p>
B10	<p>Has there ever been a deworming activity in school? <i>[School may paet ka kiray khatam karne ki koe karawai hui hai?]</i></p> <p>1~No 2~Yes 3~Don't Know<input type="checkbox"/></p>
B11	<p>Will the teachers be able to help in distribution of deworming tablets to the children? <i>[Kya teacher humaree madad kar saktay hai paet kay kiray marnay ki tablet bachoo ko denay mai?]</i></p> <p>1~No 2~Yes 3~Don't Know<input type="checkbox"/></p>

Interview completed

Signature of interviewer: _____

Annexure 9 Child Form

	District				School				Child		
Child Form Serial Number	D	D	D	-	S	S	S	-	C	C	C

STH Prevalence: Child Form

Date of assessment:	_ _ - _ _ - _ _ _ _ _
	dd mm yyyy

Child Assent Form

Asalamalaikum. Mera naam _____ hai aur may Indus Hospital may kaap karta hoon. Hum ek jaeza kar rahai hai Pakistani bachoo may paet kay kiroo par. Hum chahatay hai kay aap bhi is may hissa banay. Mey aap say kuch sawal karo ga aur aap ka wazan aur lambaan napoo ga. May aap kay saath aap kay ghar bhi jaoo ga. Waha mein aap ki walid ya walida say ijaazat loon ga aap ki potty ka namoona ley kar peet kay keero ka jaiza leyna mai. Namoonay kay liye aap ko ek chooti see katoree doon ga.

Aap is survey may hissa leyna say mana kar saktay hai ya koi sawaal ka jawab agar nahee dehna ho to nad eh. Magar may chahoo ga day aap is survey may hamare madat karay takay humay pata challay kay kitnay school kay bachoo may pait kay kiray hai.

Kya aap survey may hissa leygay? Yes / No Kya aap ko koe sawaal puuchna hai?

Signature of interviewer: _____

CHILD AGREES TO BE INTERVIEWED ~ 1 CHILD DOES NOT AGREE TO BE INTERVIEWED ~ 2 →END

⏏

Name of Child
Father Name
Mother Name

Address with landmarks (include home address and directions with nearest landmark, followed by Village, Mauza, Union Council, Tehsil and District):

Household Contact Number 1: |__| |__| |__| || |__| |__| |__| || |__| |__| |__| || |__| |__|

Household Contact Number 2: |__| |__| |__| || |__| |__| |__| || |__| |__| |__| || |__| |__|

Household Contact Number 3: |__| |__| |__| || |__| |__| |__| || |__| |__| |__| || |__| |__|

Gender	Date of Birth (if known)						How old are you? <i>[Umar]</i>	Which class are you in school? <i>[Ap kaunsi class may ho?]</i>	Height (cm)	Weight (kg) (one decimal place)
	d	d	m	m	y	y				
1 F										
2. M										

[THIS PAGE MUST BE PRINTED AND RETAINED IN RECORDS] After filling this up, the child moves to questionnaire station

Interview Status: 1~ Completed 2~ Incomplete 3 Refusal |__|

Stool Collected : 1~Collected 2~ Not collected 3~ Refused to give sample |__|

C	Child Hand washing Practices		
Q.No	Questions & Filters	Code	Ans
C 1	Do you have soap in your household? [Kya aap kay ghar may sabun hai?] 1~Yes 2~No → skip to question C4		__
C 2	Have you used soap today or yesterday? [Kya aap sabun aaj ya kal istamaal kiya hai?] 1~Yes 2~No → skip to question C4		__
C3	When you used soap today or yesterday, what did you use it for? (Multiple Responses Allowed) [Aap nay kaal ya aaj jub sabun istamaal kiya, to kis kaam kay liye kiya?] IF FOR WASHING HANDS IS MENTIONED, PROBE WHAT WAS THE OCCASION, BUT DO NOT READ THE ANSWERS. [Agar jawab ayye ka haath donay kay liye, to puchay kis kay baad haath doya? Jawab nahee pahrna hai] (DO NOT READ THE ANSWERS, ASK TO BE SPECIFIC, ENCOURAGE "WHAT ELSE" UNTIL NOTHING FURTHER IS MENTIONED AND CHECK ALL THAT APPLY) [Jawab nahee paray, puchay ka puree baath bataee. Puchay "aur kuch kay liya sabun istamaal kiya" aur jo jo jawab ayee un ko tick kar de]	1~Washing clothes __ 2~Bathing self __ 3~Washing hands after peeing __ 4~Washing hands after defecating..... __ 5~Washing hands before eating __ 6~Washing hands after eating..... __ 7~Washing hands after playing __ Other (specify) _____	
C4	What do you use most to clean your hands with? [Aap haath donay may kis ka istamaal sub say zaida kartay ho?]	1~Nothing 2~Water 3~Soap 4~Ash 5~Soil Other, Specify _____ __	
C5	What time of the day do you usually defecate? [Umuman aap kab potty/pakhana kartay ho?]	1~Morning 2~Afternoon 3~Night 4~ No set time [koe ek waqt nahee] __	
C6	Before coming to school today, did you defecate? [Aaj school aanay say pehlay, aap ney potty ki thi?]	1~ Yes 2~ No → go to q C8	__

C7	What was available to you to immediately clean your hands with? (Multiple Responses Allowed) <i>[foran haath saf karnay ka liye kya mujuud tha?</i>	1~Nothing <input type="checkbox"/> 2~Water <input type="checkbox"/> 3~Soap <input type="checkbox"/> 4~Ash <input type="checkbox"/> 5~Soil <input type="checkbox"/> 6~paper <input type="checkbox"/> Other, Specify _____ <input type="checkbox"/>
C8	Do you eat or lick soil, mud, etc? <i>[Aap mithi kaathay ya chaatay ho?]</i>	1~ Yes 2~No 3~Sometimes <input type="checkbox"/>
C9	Do you walk bare feet when playing or walking outside your house? <i>Aap nagay par kheltay ho ya ghar kay bahar chaltay ho?</i>	1~ Yes 2~No 3~Sometimes <input type="checkbox"/>
C10	By observation: What shoes is the child wearing right now?	1~barefoot 2~chappals 3~sandals/open shoes 4~closed shoes <input type="checkbox"/>

End of child interview: Thank child and inform him/her that someone from the team will be coming to his house to seek permission from parents and give instructions on sample collection

Bachay ka shurkiya ada karo aur batao kay team kay saath koe un kay ghar jae gay ijaazat leyna aur sample leynay ka teriqa leyna.

STH Prevalence: Child Household Form

	District				School				Child		
Child Form Serial Number	D	D	D	-	S	S	S	-	c	c	c

7. Instruction for Research Staff

- Accompany child to household for attaining permission from parents/guardians
- State purpose of visit and obtain consent
- Explain procedure for stool collection in container and that someone will come to the house to collect the stool
- Enquire if they would like a team member to collect the stool from the home or they would be able to send it with the child.

D. Household Information (TO BE ASKED OF CHILD'S PARENT OR HOUSEHOLD ELDER OR THE MOST KNOWLEDGABLE MEMBER OF THE HOUSEHOLD)

Q.No	Questions & Filters		Code	Ans
D 1	What is the primary construction material used to build the house (Interviewers observation)	a. Walls	Brick/Cement blocks/stone 1 Mud 2 Plank/Metal sheets 3 Straw 4 Other(specify) _____	
		b. Floor	Cement/Tile/Granite/wood 1 Mud/sand 2 Cow dung [ghobar] 3 Other (specify) _____	
		c. Roof	Tile/Asbestos/Concrete 1 Metal Sheet 2 Straw/ Thatched 3 Other (Specify) _____	
D2	Total number of persons 18 years or over in the household? [18 saal or zaeed umar kay kitnay log rehtay hai ghar mai?] _____			
	Guideline: Household comprises of the number of persons that share food from a common food pot in a dwelling			
D3	Number of children and young persons less than 18 years in the household? [Kitnay bachay or nau jawan 18 saal ki kum umar kay rehtay hai ghar mai?] _____			
	Guideline: Household comprises of the number of persons that share food from a common food pot in a dwelling			

D4	<p>What is the source of drinking water in your house? [<i>Peenay ka paani ka kya zariya hai?</i>] (Multiple Responses Allowed)</p> <p>1~Piped water into house <input type="checkbox"/></p> <p>2~Piped water to home compound <input type="checkbox"/></p> <p>3~Public tap <input type="checkbox"/></p> <p>4~Tubewell/borehole <input type="checkbox"/></p> <p>5~Protected dug well <input type="checkbox"/></p> <p>6~Unprotected dug well <input type="checkbox"/></p> <p>7~collected rainwater <input type="checkbox"/></p> <p>8~bottled water <input type="checkbox"/></p> <p>9~cart with small tank/drum <input type="checkbox"/></p> <p>10~tanker truck <input type="checkbox"/></p> <p>11~surface water (river, lake, stream, etc) <input type="checkbox"/></p> <p>Other specify _____ <input type="checkbox"/></p>
D5	<p>What kind of toilet facility do members of your household usually use? [<i>Aap aur dusray gharanay kay fard umuman kis khisam ka bathroom istamaal kartay hai?</i>] (Probe to understand if the sewerage is into a tank or sewage system or into open space)</p> <p>1~latrine with flush/pour system into piped sewage system / pit latrine/ septic tank [<i>flush wala ya jo sewerage line mai jae</i>]</p> <p>2~Latrine which flushes excreta to open space in or nearby environment [<i>latrine jo sewerage line ya septic tank say na mila ho</i>]</p> <p>3~hole in ground / open pit [<i>zameen may ghara ya khula khadda</i>] <input type="checkbox"/></p> <p>4~No facilities / Use the fields [<i>koi latrine nahee / khaet ya pararho may</i>]</p> <p>Other specify _____</p>
D6	<p>What is the language commonly spoken in the home? [<i>Ghar may kaunsi zabaan bholee jatee hai?</i>] (Multiple Responses Allowed)</p> <p>1~Urdu <input type="checkbox"/></p> <p>2~Punjabi <input type="checkbox"/></p> <p>3~Pashto <input type="checkbox"/></p> <p>4~Sindhi <input type="checkbox"/></p> <p>5~Baluchi <input type="checkbox"/></p> <p>6~Brahui <input type="checkbox"/></p> <p>7~Saraiki <input type="checkbox"/></p> <p>8~Hindko <input type="checkbox"/></p> <p>9~Kashmiri <input type="checkbox"/></p> <p>Other (Specify) _____</p>
D7	<p>No of Years of schooling completed by child's mother/ female guardian? [<i>Bachay ki ama ne kitnay jamaat taaleem mukamal ki hai?</i>] _____ years</p>
D8	<p>No of Years of schooling completed by child's father/ male guardian? [<i>Bachay ki ama ne kitnay jamaat taaleem mukamal ki hai?</i>] _____ years</p>

E	HAND WASHING PRACTICES
Q.No	Questions & Filters
E1	Do you use any method to clean water to make it safe for drinking? [Aap koe tareeka istamaal kartay hai apnay peenay ka paani ko saaf karnay kay kiye?] 1~Yes 2~No → E3 <input type="checkbox"/>
E1a	IF YES, what do you usually do to the water to make it safer to drink? [Agar han, to kya tehrika?] (Only check more than one response, if several methods are usually used together, for example, cloth filtration and cholrine) 1~Let it stand and settle/sedimentation [panee ko throe dheer chorh deyna takay mithi baet jae] <input type="checkbox"/> 2~Strain it through cloth [kapray kay zariye chann] <input type="checkbox"/> 3~Boil [ubalana] <input type="checkbox"/> 4~Add bleach/chlorine/alum [phikaree ya chlorinie milana] <input type="checkbox"/> 5~Water filter (ceramic, sand, composite) [panee kay filter ka istamaal] <input type="checkbox"/> 88~Don't know → E3 <input type="checkbox"/> Other(specify) _____ <input type="checkbox"/>
E2	When did you treat your drinking water the last time using this method? [Aap ney pichlee bhar ye tareeka kub istamaal kiya tha?] 1~Today 2~Yesterday 3~Over one day ago/less than one week 4~One week ago or more/less than a month ago 5~One month ago or more 8~Don't remember <input type="checkbox"/>
E3	Do you have soap in your household? [Aap kay ghar may sabun hai?] 1~Yes 2~No → End of Interview . THANK YOU. <input type="checkbox"/>
E4	Have you used soap today or yesterday? [Aap nay kal ya aaj sabun istamaal kiya hai?] 1~Yes 2~No → End of Interview . THANK YOU. <input type="checkbox"/>

E 5	<p>For what purpose did you use soap today or yesterday? (Multiple Responses Allowed)</p> <p><i>[Aap nay kaal ya aaj jub sabun istamaal kiya, to kis kaam kay liye kiya?]</i></p> <p>IF FOR WASHING MY OR MY CHILDREN'S HANDS IS MENTIONED, PROBE WHAT WAS THE OCCASION, BUT DO NOT READ THE ANSWERS.</p> <p><i>[Agar jawab ayye kay apna ya bachoo ka haath donay kay liye ya , to puchay kis kay baad haath doya? Jawab nahee pahrhna hai]</i></p> <p>(DO NOT READ THE ANSWERS, ASK TO BE SPECIFIC, ENCOURAGE "WHAT ELSE" UNTIL NOTHING FURTHER IS MENTIONED AND CHECK ALL THAT APPLY)</p> <p><i>[Jawab nahee paray, puchay ka puree baath bataee. Puchay "aur kuch kay liya sabun istamaal kiya" aur jo jo jawab ayee un ko tick kar de]</i></p>	<p>1~Washing clothes <input type="checkbox"/></p> <p>2~Bathing self <input type="checkbox"/></p> <p>3~Bathing children <input type="checkbox"/></p> <p>4~Washing children's hands <input type="checkbox"/></p> <p>5~Washing hands after peeing <input type="checkbox"/></p> <p>6~Washing hands after defecating <input type="checkbox"/></p> <p>7~Washing hands after cleaning child <input type="checkbox"/></p> <p>8~Washing hands before feeding child <input type="checkbox"/></p> <p>9~Washing hands before preparing food <input type="checkbox"/></p> <p>10~Washing hands before eating <input type="checkbox"/></p> <p>11~Washing hands after eating <input type="checkbox"/></p> <p>Other (specify) _____</p>
E6	<p>Do we have permission to look for worms in your child's stool sample?</p> <p><i>[Kya humay ijaazat hai aap kay bachay key pakhanay may paet kay kirrho ka moayza karay?]</i></p>	<p>1~No →end of interview 2~Yes <input type="checkbox"/></p> <p>Other, Specify _____</p>
E7	<p>Will someone in your home or the child be able to bring or send child's stool to school tomorrow morning?</p> <p><i>[Kya aap kay ghar say kal subha saweray koe katori lay kar school aa sakta hai?]</i></p>	<p>1~No 2~Yes 3~Maybe <i>[shayed]</i> <input type="checkbox"/></p>

Thank you. End of Survey. Let parent/guardian know what time you will come to collect stool sample.

Annexure 11 Lab Technician Egg Count Form

	District				School		
School Form Serial Number	D	D	D	-	S	S	S

Date: _____ Name of Lab Technician: _____

Indicate by circling: A SLIDES or B SLIDES

Reporting Form: Lab Technician Egg Count

Slide ID	Child ID (DDD-SS-ccc)	HK egg count	AS egg count	TR egg count	Note
01					1~ No sample 2~ Sample too small 3~ stool not readable
02					
03					
04					
05					
06					
07					
08					
09					
10					
11					
12					
13					
14					

Annexure 12 Quality Control Form

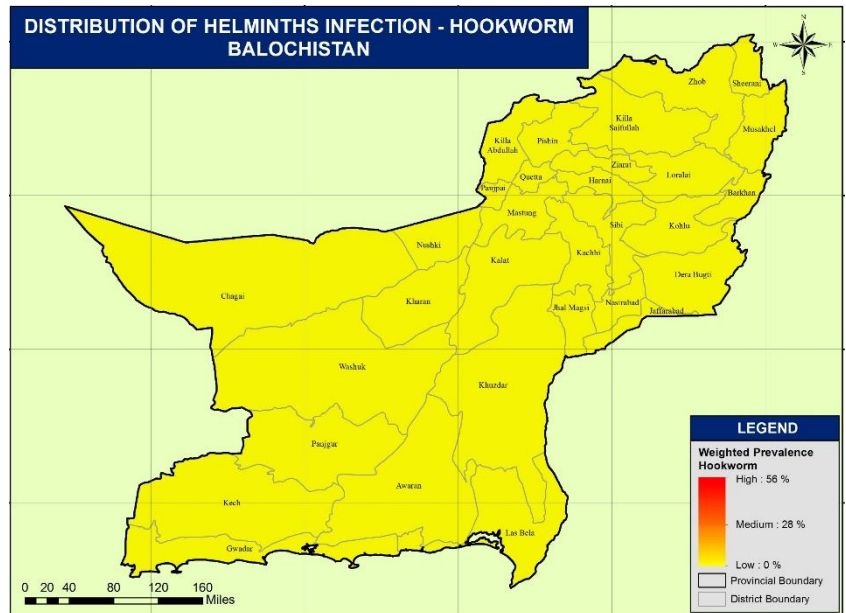
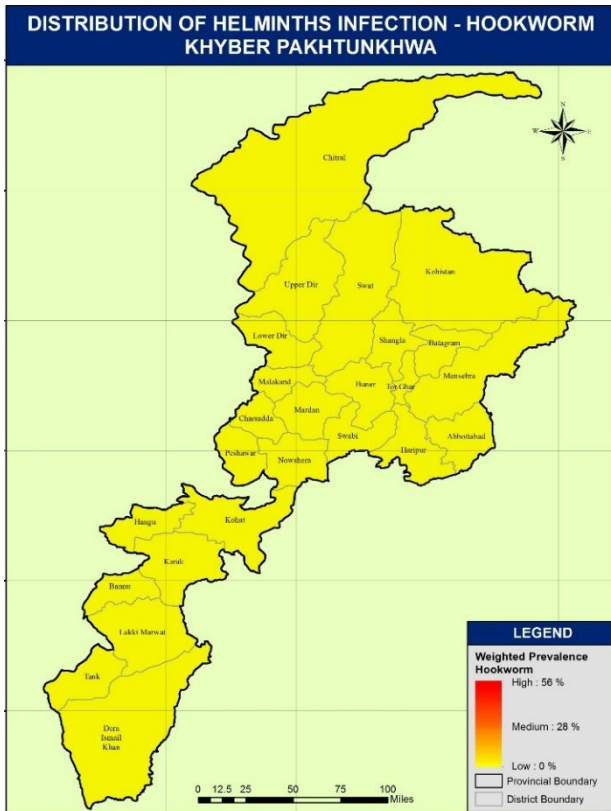
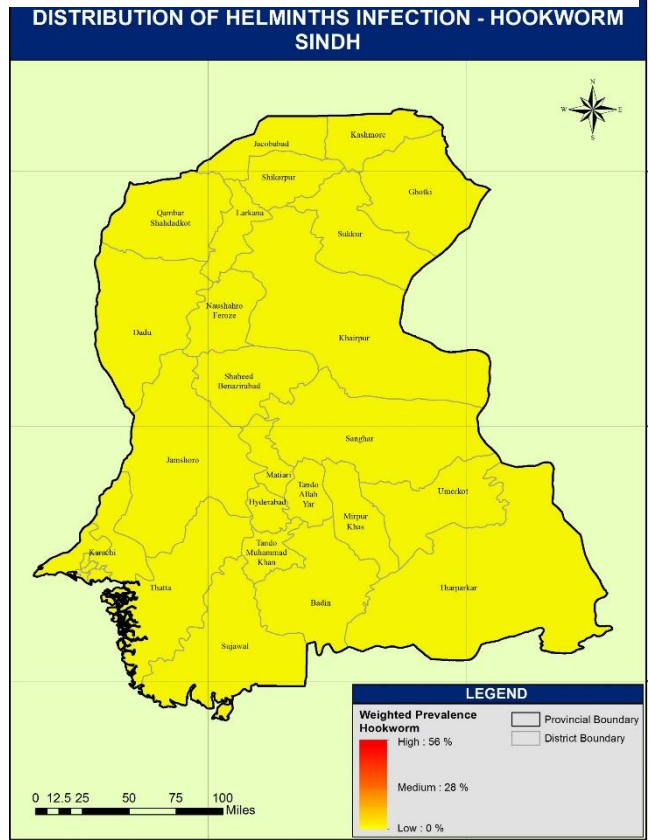
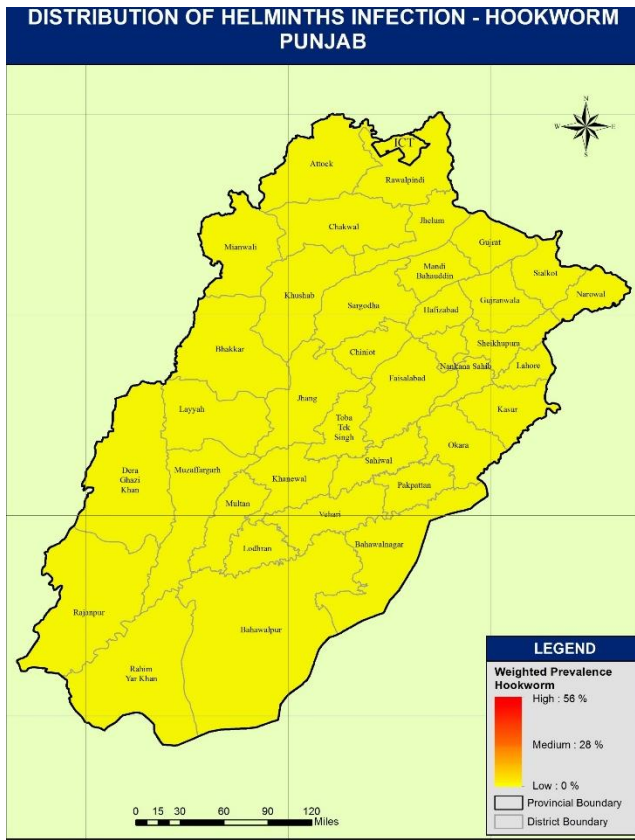
Reporting Form: Quality Control 10%

Date: _____ Name of Senior Microbiologist: _____

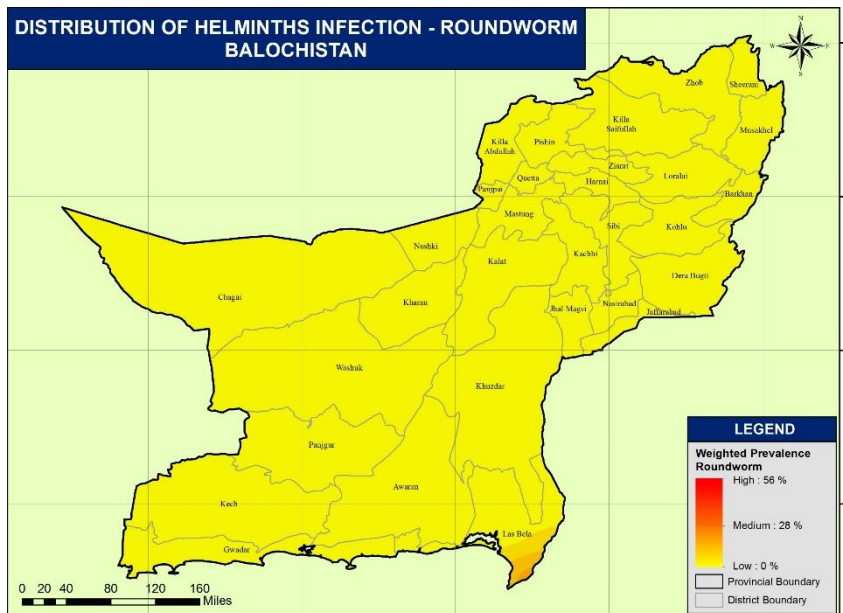
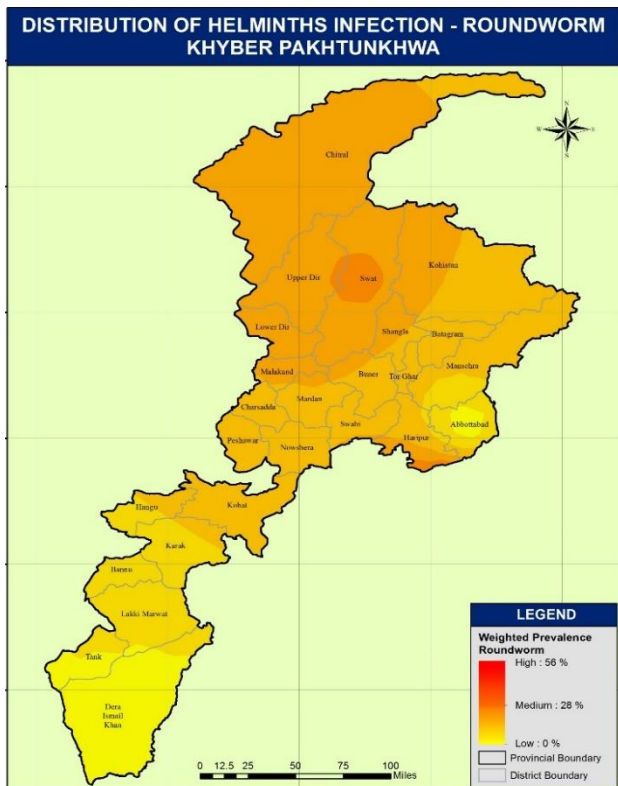
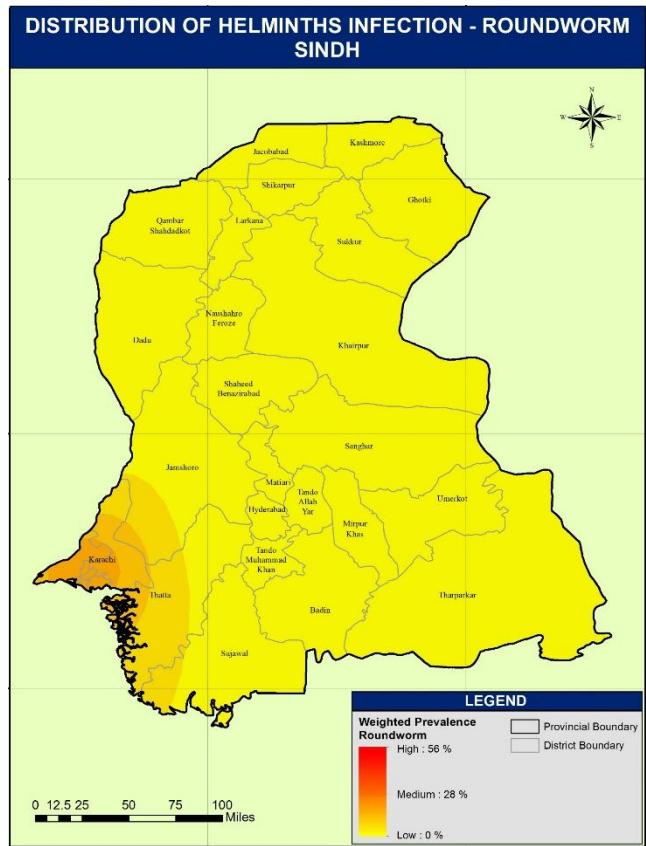
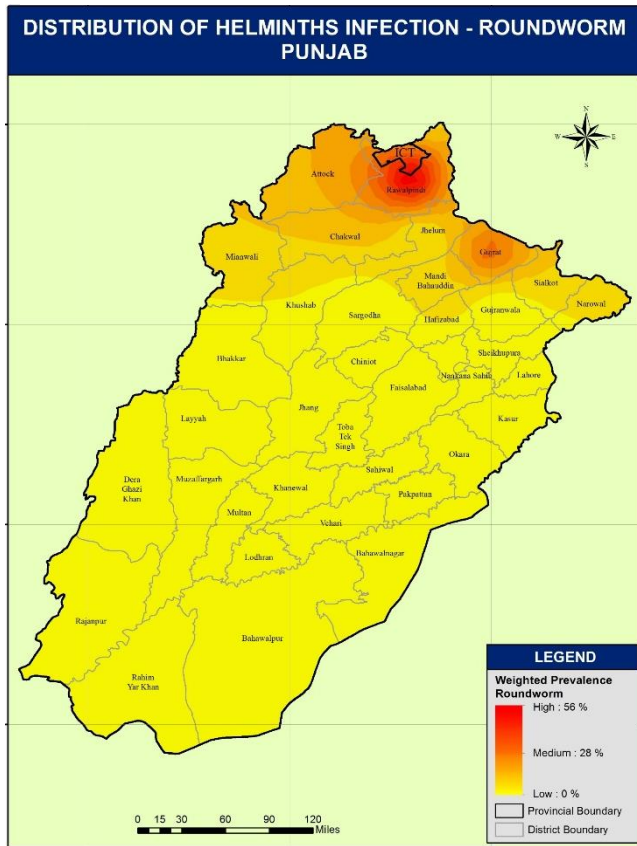
Instructions: This form is to record all QC activities relation to 10% random control. When selecting the slides, record the name of the technician originally reading. Read he slide and then record the original technicians counts. Rectify problem with technician and sample if results differ more than $\pm 15\%$ egg count or slide positivity.

School ID	Slide ID	Original Technician		HK egg count	AS egg count	TR egg count	1. Same slide 2. New slide from sample
			QC				
			Original				
			QC				
			Original				
			QC				
			Original				
			QC				
			Original				
			QC				
			Original				
			QC				
			Original				
			QC				
			Original				
			QC				
			Original				

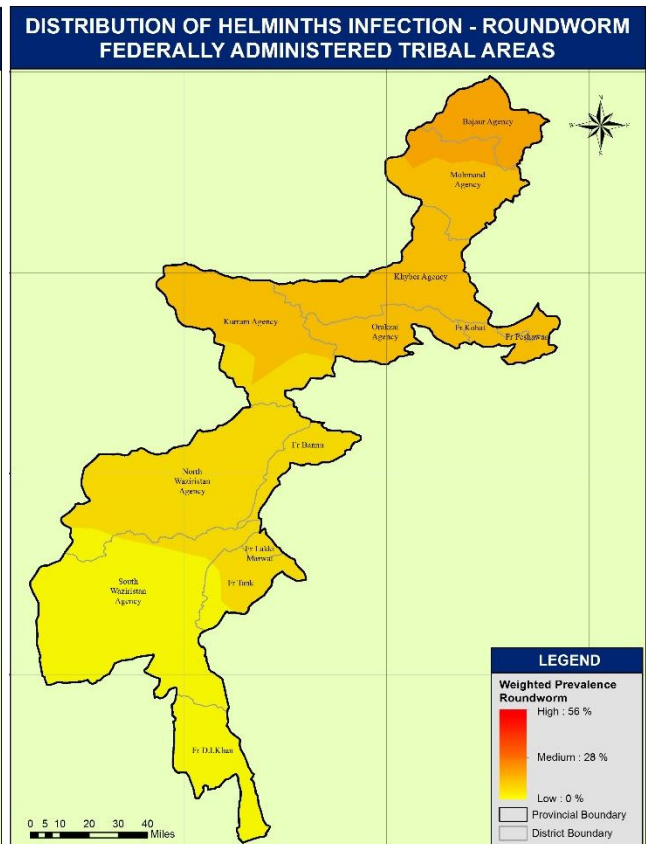
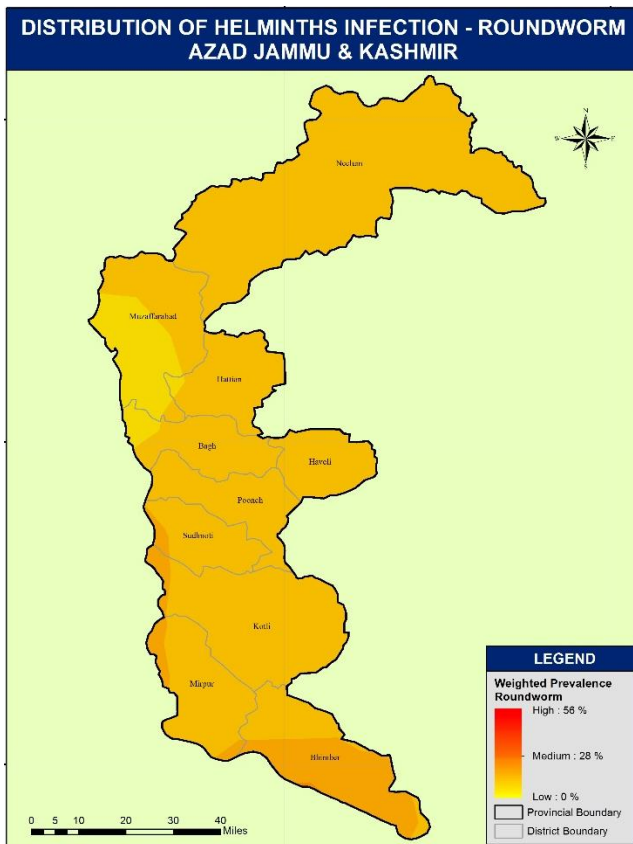
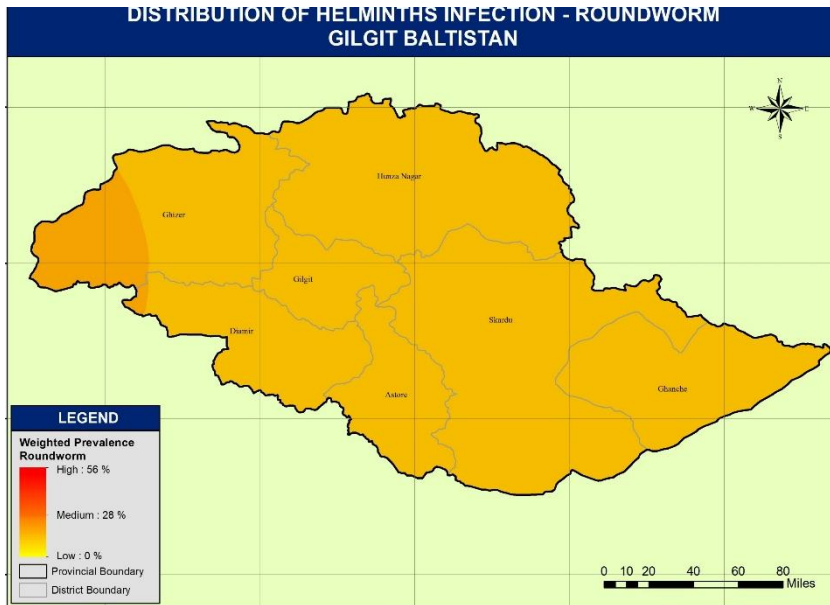
Annexure 13 Predictive Prevalence of Hookworm Infection, by Provinces



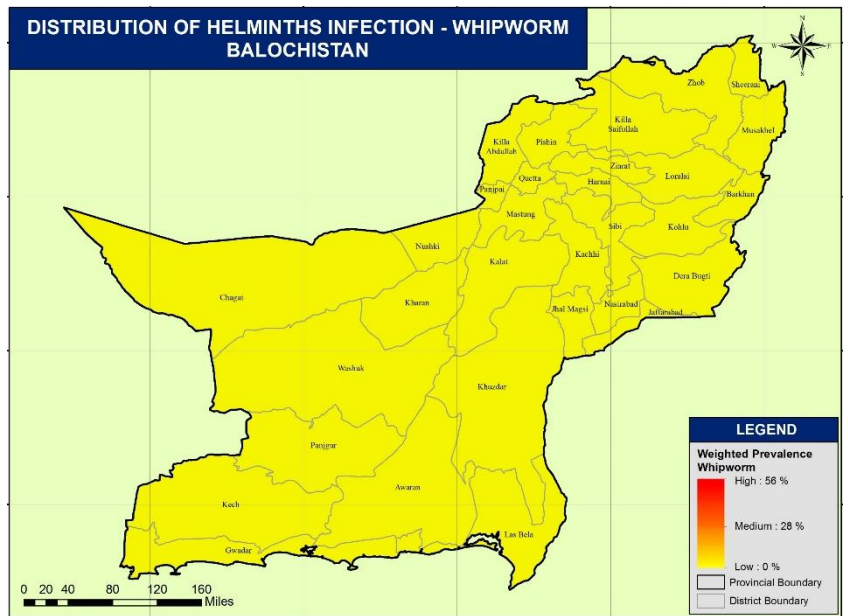
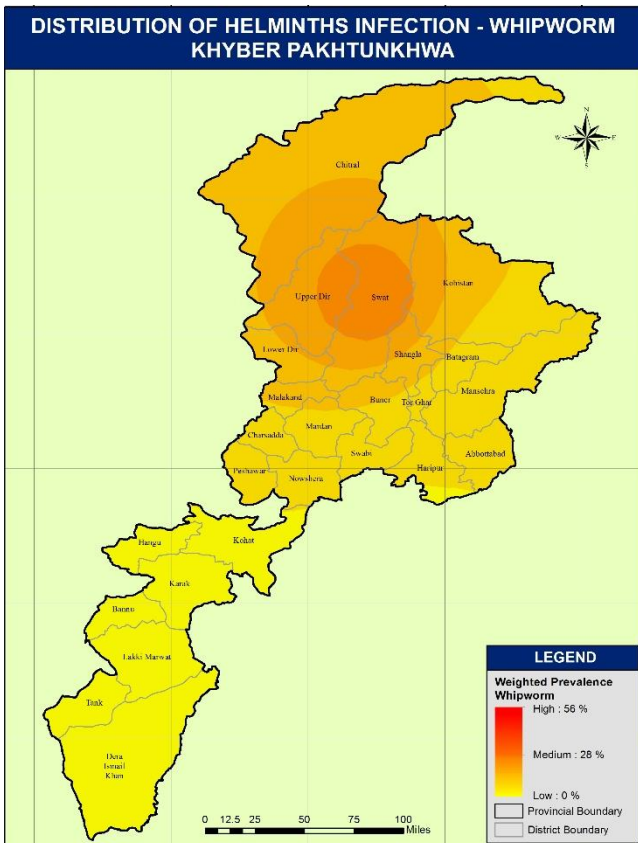
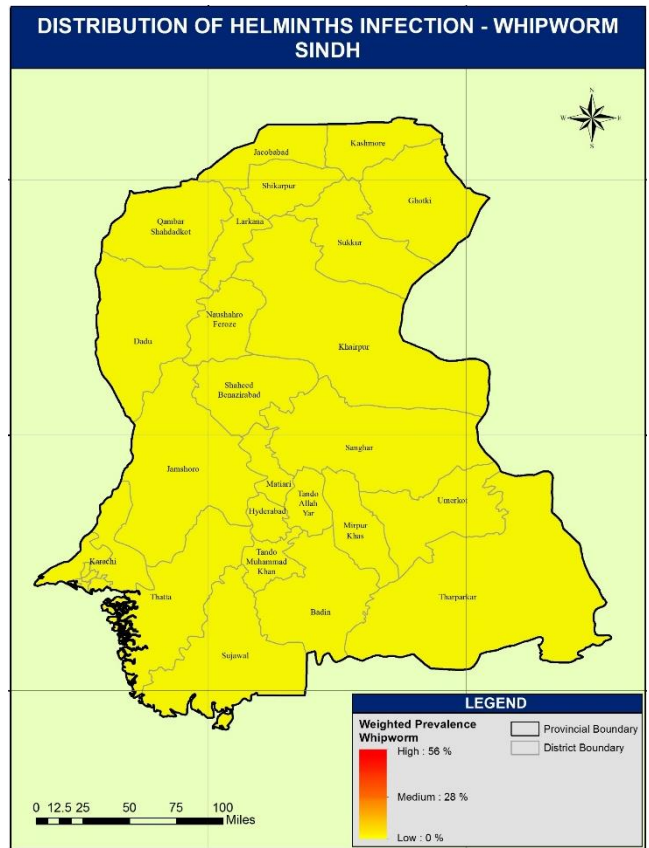
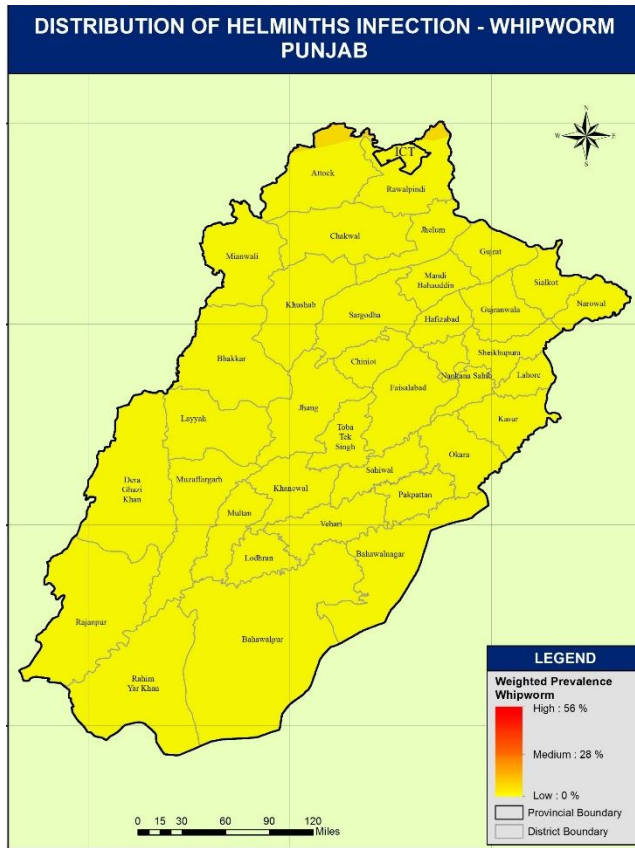
Annexure 15 Predictive Prevalence of Roundworm Infection, by Province



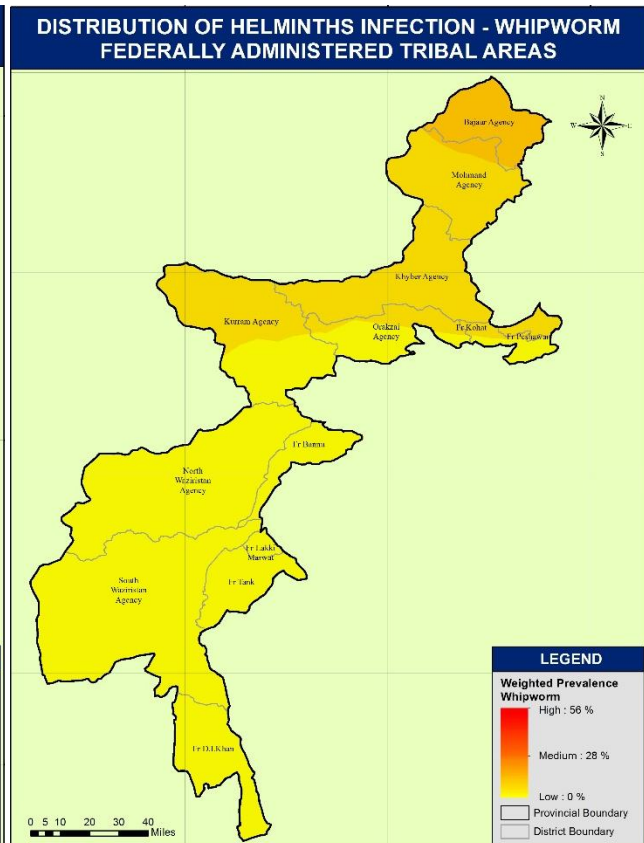
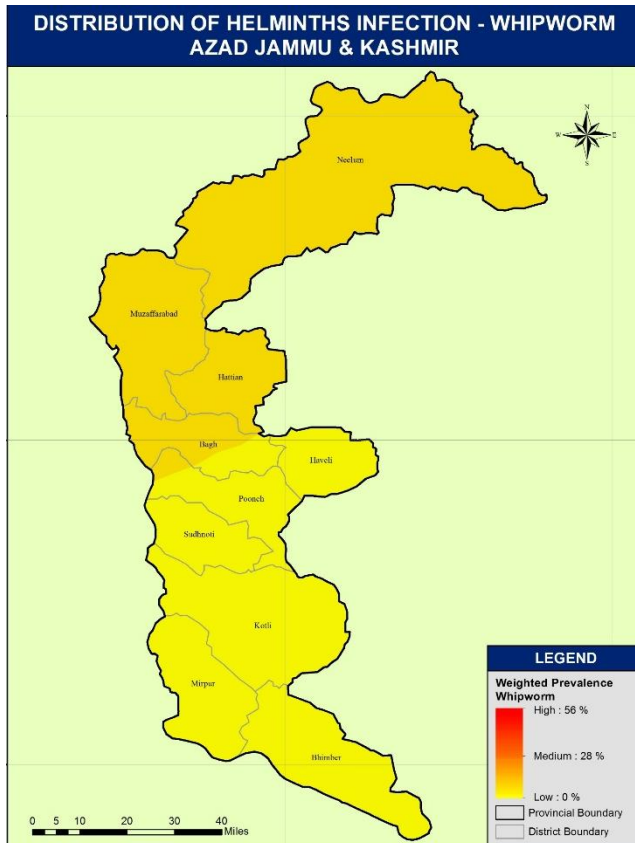
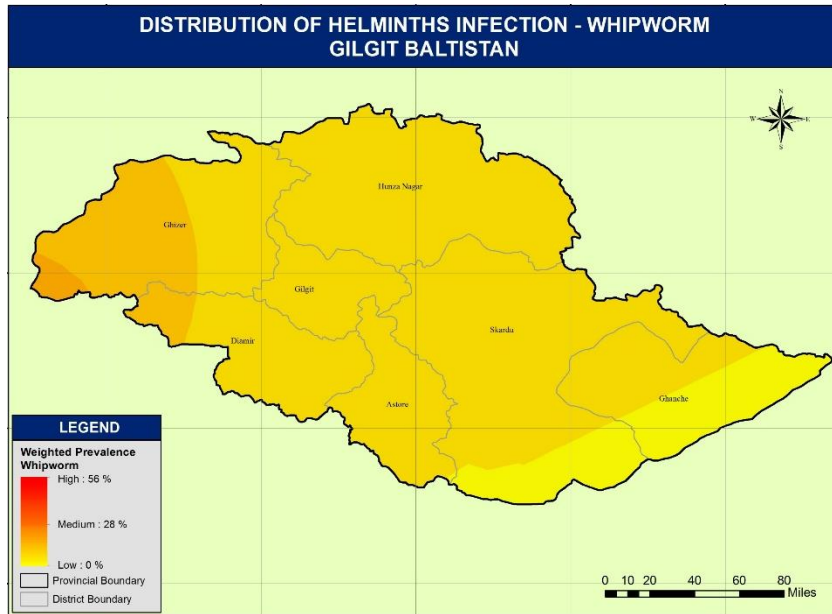
Annexure 16 Predictive Prevalence of Roundworm Infection, GB, AJK and FATA



Annexure 17 Predictive Prevalence of Whipworm Infection, by Province



Annexure 18 Predictive Prevalence of Whipworm Infection, GB, AJK and FATA



Annexure 19 Pakistan estimates of out-of-school- children by school level

National estimates of OOSC by level					
Level	Age group (years)	Population	Enrolment	OOSC	
				Number	%
Primary	5-9	22,670,715	17,574,849	5,095,866	22.5
Middle	10-12	12,781,300	6,119,197	6,662,103	52.1
High	13-14	8,520,866	2,835,326	5,685,540	66.7
Higher sec.	15-16	8,934,989	1,356,825	7,578,164	84.8
Total (5-16 years)		52,907,870	27,886,197	25,021,673	47.3

Source: Alif, A. (2014). 25 million broken promises: the crisis of Pakistan's out-of-school children.

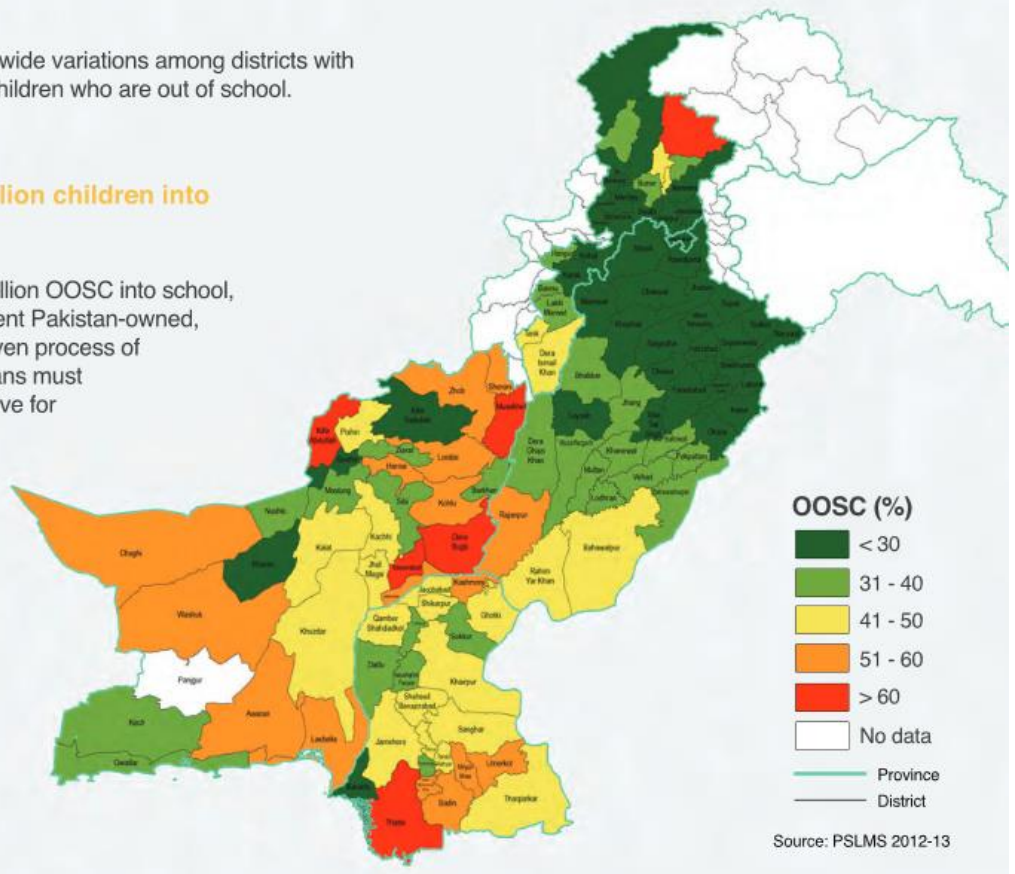
Annexure 20 Pakistan Out-of-school-children, by district

OOSC by district

Across Pakistan there are wide variations among districts with respect to the number of children who are out of school.

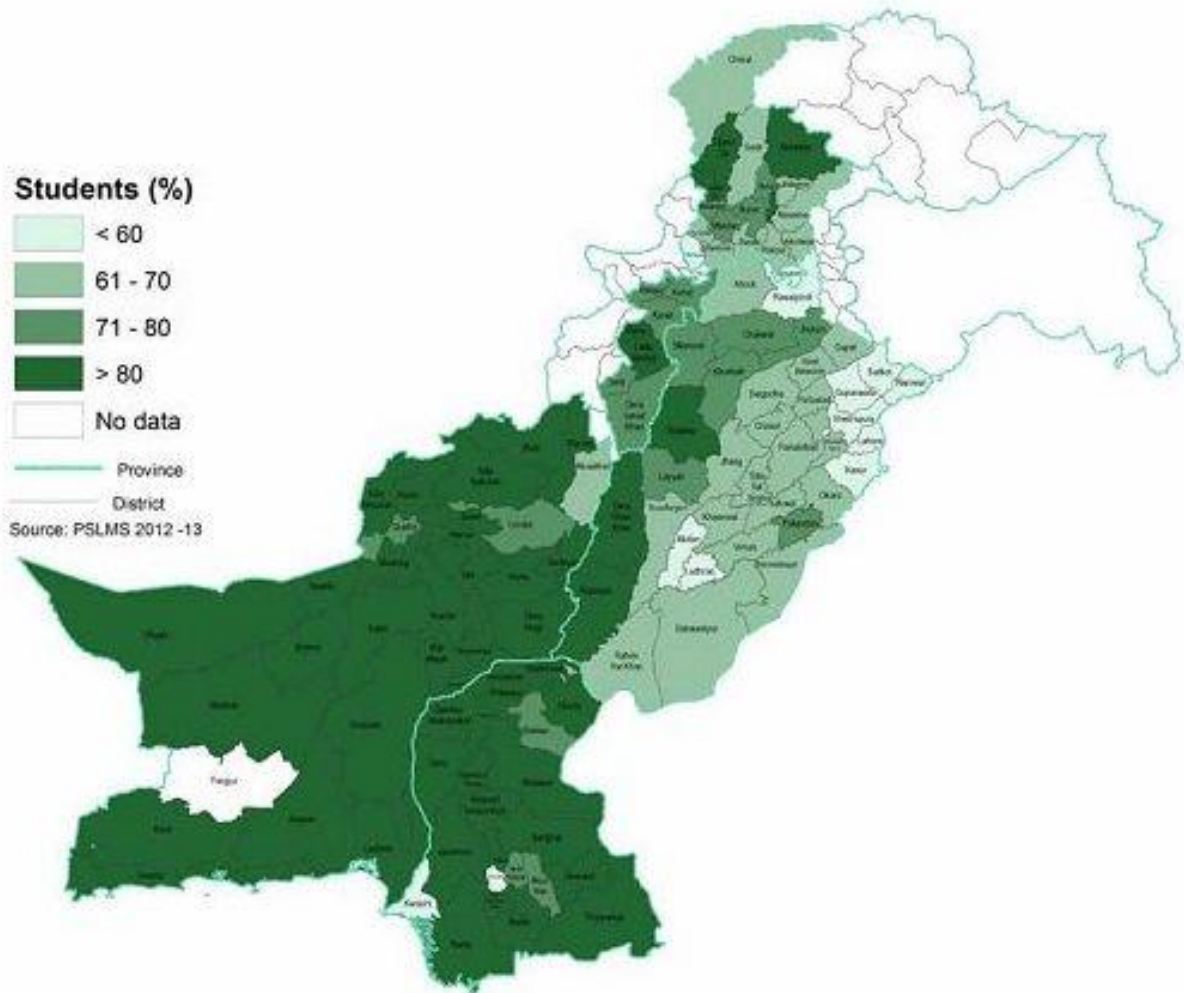
How do we get 25 million children into school?

To get Pakistan's 25.02 million OOSC into school, a concentrated and coherent Pakistan-owned, Pakistan-led, Pakistan-driven process of reform is required. Politicians must generate a national narrative for education, establish clear and ambitious targets, and transform the data regime to pave the way for a determined leadership to address an issue on which the future of 200 million people depends.



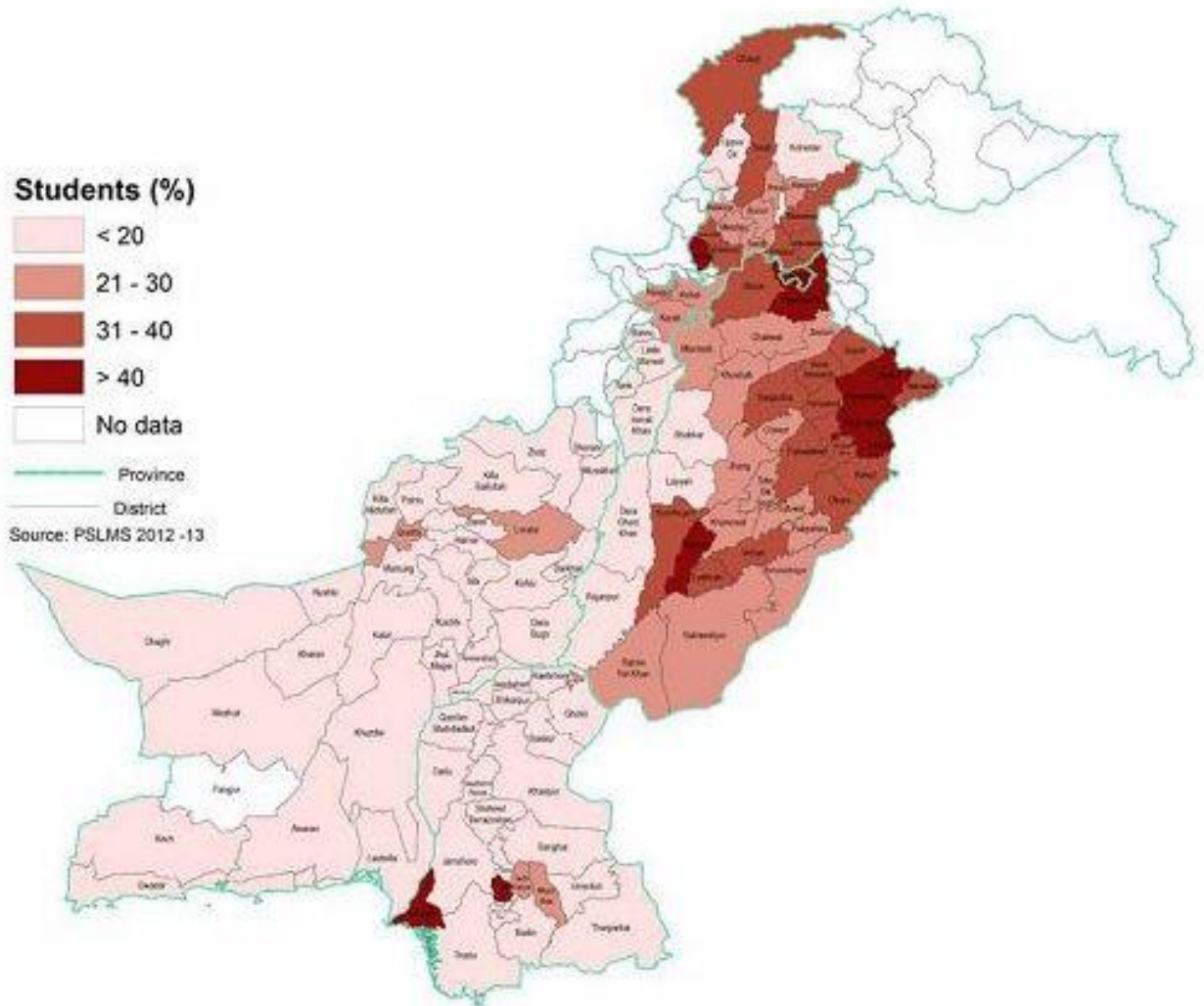
Alif, A. (2014). 25 million broken promises: the crisis of Pakistan's out-of-school children.

Annexure 21 Percentage of 5 to 16 year old students attending government school, by district



Alif, A. (2014). 25 million broken promises: the crisis of Pakistan's out-of-school children.

Annexure 22 Percentage of 5 to 16 year old students attending private school, by district



Alif, A. (2014). 25 million broken promises: the crisis of Pakistan's out-of-school children.