Supplementary appendix

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Supplement to: Local Burden of Disease Household Air Pollution Collaborators. Mapping development and health effects of cooking with solid fuels in low-income and middle-income countries, 2000–18: a geospatial modelling study. Lancet Glob Health 2022; 10: e1395–411.
### Supplementary Information: HAP Stage II (2000–2018)

**Contents**

| Section                                                                 | Page |
|------------------------------------------------------------------------|------|
| 0.0 Guidelines for Accurate and Transparent Health Estimates Reporting (GATHER) Compliance | 2    |
| 1.0 Data                                                               | 2    |
| 1.1 Known issues                                                       | 2    |
| 1.1.1 Countries with no data                                          | 2    |
| 1.2 Model geographies                                                 | 2    |
| 1.3 Data inclusion criteria                                            | 3    |
| 1.4 Summary of included data sources                                  | 3    |
| 1.5 Processing data for modelling                                     | 3    |
| 1.6 Processing areal data for geostatistical modelling                 | 3    |
| 1.7 Data validity                                                      | 4    |
| 2.0 Covariates                                                        | 4    |
| 2.1 Covariate selection                                               | 4    |
| 2.2 Modelling covariates via stacked generalisation                   | 4    |
| 3.0 Geostatistical model                                              | 5    |
| 3.1 Model parameters                                                  | 5    |
| 3.2 Metrics of predictive validity                                    | 6    |
| 3.3 Propagating uncertainty                                           | 6    |
| 3.4 PM$_{2.5}$ exposure and proportional PAFs                          | 6    |
| 3.5 PM$_{2.5}$ dose–response                                          | 7    |
| 4.0 Supplementary figures                                             | 11   |
Guidelines for Accurate and Transparent Health Estimates Reporting (GATHER) Compliance

Supplementary Table 1 provides the Guidelines for Accurate and Transparent Health Estimates Reporting (GATHER) compliance checklist.

1.0 Data

1.1 Known issues

1.1.1 Countries with no data

This analysis does not produce estimates in countries where data did not meet our inclusion criteria due to data availability or quality of cooking fuel use data. We have masked all estimates in countries for which we had no data that we could geolocate below the national level. For cooking fuel use, this included Cabo Verde, Cuba, French Guyana, Equatorial Guinea, Malaysia, Venezuela, and Western Sahara. If data become available from any of these countries, we will include them in the models and share the results.

1.2 Model geographies

This analysis selected 98 countries based on their Socio-demographic Index (SDI). The SDI is a measure of education, fertility, and income. Countries included were in the middle, lower-middle, or low SDI quintiles, with certain exceptions. China and Libya were included despite higher-middle SDI status to create better geographical continuity. Despite the requisite SDI quintiles for inclusion, we excluded the countries of Cabo Verde, Cuba, French Guyana, Equatorial Guinea, Malaysia, Venezuela, and Western Sahara as they had no relevant data available. We also excluded island nations with fewer than 1 million inhabitants, which were the nations of Fiji, Solomon Islands, Maldives, Vanuatu, Samoa, Saint Lucia, Kiribati, St. Vincent and the Grenadines, Grenada, Micronesia, Tonga, Seychelles, Dominica, Marshall Islands, and American Samoa. These countries were typically data-scarce and did not have sufficient geographical continuity for a geospatial analytical approach to be advantageous over a national one.

We subdivided the spatial modelling domain into 18 regions, consisting of groupings of countries. The regions were created in consideration of geographical contiguity and epidemiological similarity between the constituent countries. In the case of China, Mongolia, Nigeria, South Africa, and the combined area of Eritrea, Djibouti, and Yemen, the data exhibited distinct spatial and temporal trends in comparison of their neighbouring countries. Therefore, the aforementioned countries were modelled individually. By creating modelling regions, we were able to account for potential non-stationarity in the relationships between covariates and the outcome across the modelling domain as each region would be modelled independently. Furthermore, subdividing the 98 countries into 18 modelling regions allowed for computational feasibility.

Computational limitations meant that we were unable to account for potential non-stationarity within countries/regions, as we assumed an isotropic and stationary Matérn function (see Section 3.1 for more detail) to model spatial covariance at that level. Assuming stationarity likely introduces bias to the results but would be computationally infeasible to model at the spatial scale required for the scope of
this analysis. Community-level drivers have been observed to account for within-country heterogeneity in solid fuel use, and the spatial correlation introduced by these socioeconomic effects is unlikely to be fully captured by an isotropic process.¹ Comparison of stationary and non-stationary models for other health risk data has previously demonstrated that non-stationary models can increase prediction accuracy, while estimating roughly similar spatial trends.² An inherent irony is that modelling non-stationarity becomes more important as the size of the modelling area increases, while being increasingly computationally intensive on the same axis. The environmental indicators we used as geospatial covariates, such as land use and travel time to the nearest settlement, should explain some of this variation,³,⁴ but additional anisotropic effects may exist as cooking behaviours are understood to correlate with nuanced social patterns.⁵,⁶ We expect that relaxing the assumption of isotropy for modelling cooking fuel use would reveal additional within-country heterogeneity and demonstrate even higher subnational inequalities, and we think this is an important area for future research as additional data become accessible and as the computational power available to researchers continues to increase. Given that most of our results are derived from the aggregation of the geospatial model to administrative units for comparison, an additional area of further investigation could be the use of areal modelling approaches such as locally adaptive conditional auto-regressive (CAR) models, which could relax the assumption of stationarity and potentially reveal discontinuities in the spatial surface that may be smoothed over by our geostatistical model.

1.3 Data inclusion criteria
Sources were only included for modelling if they were representative of the entire population during the time period and across the geographical area of measurement. Furthermore, certain sources were excluded if the associated estimates seemed implausible based on expert review of estimates and comparison with other sources in the same country and time period.

1.4 Summary of included data sources
The household surveys used in modelling solid fuel use are listed in Table 4. Each source is listed with the number of households represented, country, and year. Additionally, the tables provide the number of georeferenced points or spatial areas represented by each source as well as a unique identifier (GHDx ID) which can be used to reference the source via the Global Health Data Exchange (GHDx).² 663 household surveys from 98 countries were included in the solid fuel use model.

1.5 Processing data for modelling
Data corresponding to each georeferenced point were summarised as survey weighted means. For data without corresponding GPS coordinates, data were summarised across the smallest spatial area the data were representative over to produce areal estimates. Household sizes and survey weights were used to produce weighted means of access representative at the individual level. The household sizes and survey weights were further used in a Kish approximation⁴ of an effective sample size for each mean to account for the complex survey design of most of the data used.

1.6 Processing areal data for geostatistical modelling
For areal data, 10,000 locations were randomly sampled from the area using population values from WorldPop⁵ raster to weight the sampled points. K-means clustering was performed over these points to generate integration points (1 point per 1000 WorldPop grid cells encompassing the area) to be used in the modelling. Weights were assigned to integration points as the proportion of the original 10,000 points that entered the k-means cluster. Each of these integration points was assigned the areal mean. The integration points were included in the input dataset for further modelling. In this manner, the
spatial variation of covariates could be leveraged and areal data could be incorporated into the geostatistical model. The above resampling method used is consistent with the resampling conducted in the previously published geospatial modelling of child growth failure.

1.7 Data validity
Following the vetting of indicator string matching, all surveys were systematically reviewed for data quality. Country-specific diagnostic plots were produced for cooking fuel. The estimate for each indicator from each data source was compared to the other available data sources for that country for similar years. If the data source’s estimate was considered implausibly different from other sources, then the source was excluded. Each country-specific diagnostic plot was independently reviewed, considering country and time trends, as well as whether a survey was nationally and/or subnationally representative.

2.0 Covariates
2.1 Covariate selection
The first stage of modelling used 27 covariates, composed of various environmental and social indicators. Each covariate was formatted at a 5 x 5 km resolution from 2000 to 2018. They included travel time to nearest settlement, aridity, diurnal temperature range, frost day frequency, potential evapotranspiration, average daily mean temperature, dependency ratio of dependents to working age adults, distance from rivers or lakes ≥ 50 km², nighttime lights, elevation, agricultural land, enhanced vegetation index, fertility, urban or rural, nutrient yield, irrigation, urban proportion of location, average land surface temperature, precipitation, normalised difference vegetation index, tassled cap brightness, tassled cap wetness, and population. For covariates which were continuous variables, we calculated rolling means using a 5-year window and used the results for modelling. This was conducted to stabilise any shocks in the time-trends of the covariates, aiding in stabilising the time-series predicted from modelling.

In the first stage, for each region, three types of models were fit to the data: generalised additive models, boosted regression trees, and lasso regression. In doing so, we attempted to account for the varying and potentially non-linear relationship between each of the covariates and the outcome indicator. Each of the 23 covariates was used in the boosted regression tree and lasso regression model. To prevent issues with collinearity and optimise performance, covariate selection was performed for the generalised additive model as follows:

Each covariate was regressed against all other covariates in order to identify if a covariate’s variance can be accounted for via a linear combination of the other covariates. A variance inflation factor (VIF) was calculated for each such regression. The covariate corresponding with the independent variable in the regression with highest VIF was eliminated. This procedure was iteratively repeated until all associated VIFs were under 5.

2.2 Modelling covariates via stacked generalisation
As noted above, for each region, three models were fit to the data: generalised additive models, boosted regression trees, and lasso regression. Each model was fit using five-fold cross validation (out-of-sample) as well as on the entire dataset at once (in-sample). Out of sample predictions were generated from each model and logit transformed for subsequent use as covariates in the geostatistical model. The logit transformation was conducted to ensure the covariate and the outcome solid fuel use
sanitation indicator data would be in the same functional space. The in-sample predictions from these “sub-models” were used as covariates when generating predictions using the fitted relationships from the geostatistical model.

### 3.0 Geostatistical model

#### 3.1 Model parameters

\[ C_d | p_{i(d)}, N_d \sim \text{Binomial}(p_{i(d)}, N_d) \forall \text{obs. clusters } d \]

\[
\text{logit}(p_{i,t}) = \beta_0 + X_{i,t} \beta + \varepsilon_{c(i)} + \varepsilon_{n(i)} + \varepsilon_i + Z_i
\]

\[
\sum_{h=1}^{3} \beta_h = 1
\]

\[
\varepsilon_c \sim \text{iid } N(0, \gamma_c^2)
\]

\[
\varepsilon_n \sim \text{iid } N(0, \gamma_n^2)
\]

\[
\varepsilon_i \sim \text{iid } N(0, \sigma^2)
\]

\[
Z \sim GP(0, \sum_{space}^{sp})
\]

\[
\sum_{space}^{sp} = \frac{\omega^2}{\Gamma(v)2^{v-1}} \cdot (kD)^v \cdot K_v(kD)
\]

The coefficients \( X_{i,t} \beta \) for the three stacked sub-models represent their respective predictive weighting in the mean logit link, while the joint error term, \( Z_i \), accounts for any residual spatiotemporal autocorrelation. These residuals, \( Z_i \), are modelled as a three-dimensional space-time Gaussian process (GP) which was centred at zero. The covariance matrix for this GP was constructed from a Kronecker product of spatial and temporal covariance. The spatial covariance, \( \Sigma_{\text{space}} \), is modelled based on a stationary and isotropic Matérn function. For the Matérn function, \( \Gamma \) is the gamma function, \( K_v \) is the modified Bessel function of order \( v > 0, \kappa > 0 \) is a scaling parameter, \( D \) represents the distance (Euclidean), and \( \omega^2 \) is the marginal variance. We defined the scaling parameter, \( k \), as \( k = \frac{\sqrt{8v}}{\delta} \) where \( \delta \) is a range parameter (reflective of the distance where the covariance function is approaching 0.1) and \( v \) is a scaling constant, which is set to 2. This scaling constant, \( v \), has been documented in other analyses to be difficult to fit reliably from data and is generally recommended to be fixed at the aforementioned value of 2.7,8

Our implementation of INLA using the R-INLA software relies on a Gaussian approximation of the full conditional distribution of latent variables, and uses the empirical Bayes approximation for the
hyperparameters. We have tried the full hyperparameter grid integration and CCD integration in various settings and have found our models to be nearly indistinguishable. For the sake of computing resource efficiency (with which we always operate at the margins), we have proceeded with using the empirical Bayes procedure. In a very similar setting with malaria household survey data, other authors compared the INLA results directly with results from Hamiltonian Markov Chain Monte Carlo and found nearly identical results between the two fits.9,10

3.2 Metrics of predictive validity

We assessed model performance based on a five-fold out-of-sample cross-validation framework with spatial stratification. Each fold was derived using a modified bi-tree algorithm11 in order to aggregate datapoints spatially. The algorithm generates recursive partitions in two-dimensional space, alternating horizontal and vertical divisions on the median values of weighted sample sizes of the data until each spatial partition contains data of similar sample size. Constraints on the depth of the recursive partition are derived from the target sample size in each partition, as well as the minimum number of clusters or pseudo-clusters allowed for a given partition. For this analysis, a minimum sample size of 500 was used. We allocated these spatial partitions to five different folds for the cross-validation analysis. Each of these five folds was then excluded in turn while fitting the entire model five times. The withheld data were then compared with model predictions in order to generate the OOS metrics, including the mean error (bias), root-mean-squared-error (RMSE), correlation, and the 95% coverage rate of the predicted intervals (proportion of observed data that fall within the predicted 95% credible intervals). Each metric was produced by aggregating the data and predictions up to different administrative levels (levels 0, 1, 2 as defined by the Database of Global Administrative Areas [GADM]), in order to assess performance at different levels of spatial granularity. These metrics are calculated across all modelling regions and summarised in Supplementary Tables 8-10 and Figures 21a-22.

3.3 Propagating uncertainty

All estimates were generated by taking 1,000 draws of all model parameters from the approximated joint posterior distribution using the inla.posterior.sample() function in R-INLA12,13, yielding 1000 candidate maps from which to summarise the grid-cell- and aggregated-level statistics. For estimates at the grid-cell level, these draws were used directly to generate estimates and uncertainty. Aggregated estimates, in which grid-cell-level estimates were summarised to administrative boundaries, were generated by creating population-weighted averages for each administrative boundary, for each draw. 95% uncertainty intervals around the mean of our estimates were generated.

3.4 PM$_{2.5}$ exposure and proportional PAFs

To estimate the increased health risk from cooking with solid fuels using a dose-specific risk function, we estimated the level of exposure to PM$_{2.5}$ expected for households using solid fuels to cook. WHO’s Global Household Air Pollution (HAP) Measurements database contains 196 studies with measurements
from 43 countries of various pollution metrics in households using solid fuel for cooking. From this database, a model was constructed based on all measurements of PM$_{2.5}$ using indoor or personal monitors. The final dataset included 336 estimates from 75 studies in 43 unique locations. 274 estimates were in households using solid fuels, 47 in households only using clean (gas or electricity) fuels, and 15 in households using a mixture of solid and clean fuels. Before modelling, each datapoint was converted from total particulates to the excess particulate matter in households using solid fuel by subtracting off the predicted ambient PM$_{2.5}$ value in the study location and year based on the GBD 2017 PM$_{2.5}$ exposure model. A model constructed from this database was used as part of the GBD 2019 study to predict the expected incremental PM$_{2.5}$ for every modelled location.

The excess PM$_{2.5}$ exposure that was generated by households primarily using solid fuels for cooking was combined for each location with an updated model from GBD 2019 of geospatially resolved ambient PM$_{2.5}$, calculating the total PM$_{2.5}$ exposure for every modelled location. The ratio of excess household particulates to ambient particulates was estimated as part of this process. To account for overlap in ambient and household particulate exposures in countries with a high dual burden and prevent double-counting, we utilised a proportional PAF approach that was developed for GBD 2017. This method relies on using published PM$_{2.5}$ dose–response curves (see appendix, section 3.5) applied to estimates of the total PM$_{2.5}$ exposure in a given location to estimate the PAF for total PM$_{2.5}$, and then splitting it proportionally based on the previously estimated ambient:household PM$_{2.5}$ ratio (see appendix, figure 2b). This method assumes that it is unknown which area of the dose–response curve each source is contributing to, and therefore they must be considered equivalently as opposed to being subtracted from a particular slope of risk increase. Our approach is also dependent on an assumption of particle equitoxicity, and there is evidence that bias may be introduced by this method if there are fundamental differences in the chemical composition of particles generated by household and ambient sources of pollution. Upon the availability of adequate data from which to develop more granular risk–response curves that provide source-specific distinctions, this assumption should be revisited.

3.5 PM$_{2.5}$ dose–response

To estimate the relative risk of exposure to ambient and household particulate matter (PM$_{2.5}$) air pollution we leveraged a cause-specific risk curve for acute lower respiratory infection, which had been produced as part of the GBD 2019 study. To generate dose–response curves as a function of PM$_{2.5}$, splines were fit to relative risk and PM$_{2.5}$ exposure estimates from studies of ambient PM$_{2.5}$, household solid fuel use, and secondhand smoking using an open-source Bayesian, regularised, trimmed, meta-regression software (MR-BRT). With the flexibility of splines in MR-BRT and the addition of recent studies from high exposure settings, the approach utilised for GBD 2019 no longer included studies of active smoking data in the risk curves. Specifically, for each of the risk–outcome pairs, various model settings and priors were tested in order to fit splines specified for the relationship as:

$$\log((\text{MRBRT}(X))/\text{MRBRT}(X_{\text{CF}})) \sim \log(\text{Published Effect Size})$$
where $X$ and $X_{CF}$ represent the range of exposure characterised by the effect size. The final models included third-order splines with two interior knots and a constraint on the right-most segment forcing a linear fit. GBD 2019 used an ensemble approach to knot placement, where 100 different models were run with randomly placed knots and then combined by weighting based on a measure of fit that penalises excessive changes in the third derivative of the curve. Knots were free to be placed anywhere within the 5th and 95th percentile of the data, as long as a minimum width of 10% of that domain exists between them. The functions were shaped constrained, such that the curves were monotonically increasing and concave downwards, the most biologically plausible shape for PM$_{2.5}$ risks. On the nonlinear segments, a Gaussian prior was specified on the third derivative of mean 0 and variance 0.01 to prevent over-fitting; on the linear segment, a stronger prior of mean 0 and variance $1e^{-6}$ was used to ensure that the risk curves did not continue to increase beyond the range of the data. Additional information about how this approach was specified is available in the GBD 2019 risk factors summary manuscript.$^{16}$

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4.0 Supplementary figures

Supplementary Figure 1: Data processing flowchart ................................................................. 12
Supplementary Figure 2a/b: Geospatial modelling/Post-estimation flowcharts .......................... 14
Supplementary Figure 3: Map of modelling regions ................................................................. 18
Supplementary Figure 4a-e: Solid fuel use data availability by type and country, 2000-2018 .... 19
Supplementary Figure 5: Geospatial covariates ................................................................. 24
Supplementary Figure 6: Finite elements mesh ................................................................. 26
Supplementary Figure 7: Posterior means and 95% uncertainty intervals for solid fuel use prevalence at the first administrative level, 2018 ................................................................. 27
Supplementary Figure 8: Posterior means and 95% uncertainty intervals for TAP dose at the second administrative level, 2018 ................................................................. 29
Supplementary Figure 9: Posterior means and 95% uncertainty intervals for TAP dose at the first administrative level, 2018 ................................................................. 31
Supplementary Figure 10: Posterior means and 95% uncertainty intervals for HAP share at the second administrative level, 2018 ................................................................. 32
Supplementary Figure 11: Posterior means and 95% uncertainty intervals for HAP share at the first administrative level, 2018 ................................................................. 34
Supplementary Figure 12: Posterior means and 95% uncertainty intervals for LRI mortality counts due to TAP at the second administrative level, 2018 ................................................................. 35
Supplementary Figure 13: Posterior means and 95% uncertainty intervals for LRI mortality counts due to TAP at the first administrative level, 2018 ................................................................. 37
Supplementary Figure 14: Posterior means and 95% uncertainty intervals for LRI mortality rates due to TAP at the second administrative level, 2018 ................................................................. 38
Supplementary Figure 15: Posterior means and 95% uncertainty intervals for LRI mortality rates due to TAP at the first administrative level, 2018 ................................................................. 40
Supplementary Figure 16: HAP annualized rate of change 2000-2018 at the second administrative level ................................................................. 41
Supplementary Figure 17a-u: Population and attributable under-5 LRI mortalities, distributed as a function of PM2.5 by region ................................................................. Error! Bookmark not defined.
Supplementary Figure 18a-v: Air pollution risk transition (2000–2018) by region ...... Error! Bookmark not defined.
Supplementary Figure 19a-c: SFU in-sample by aggregation level .......... Error! Bookmark not defined.
Supplementary Figure 20a-c: SFU out-of-sample by aggregation level ...... Error! Bookmark not defined.
Supplementary Figure 1: Data processing flowchart

Source identification and inclusion and exclusion criteria are outlined above. This illustrates the data pipeline starting with data intake to finalised data for modelling. Sources that met initial cooking fuel, household sampling, country, and time frame criteria were extracted and standardised. Each survey’s set of clusters were matched to the finest geography possible. Surveys were dropped due to implausible or insufficient cooking fuel and household sampling data. All remaining data were then collapsed by survey, year, country, and geography. The collapse process filters out high-income countries, data before 1998–2000, and the absence of survey weights. Observations and survey clusters were also dropped if there was excessive (>20%) missing data in cooking fuel or survey weights as well as if geography information was not able to be matched. Usable survey reports were manually extracted at the finest aggregated level available and appended onto collapsed data, where all polygon data were then resampled to points. All surveys underwent final vetting reviews with diagnostic plots, where final exclusions took place due to implausible trends. The resulting cleaned data were used as input data ready for modelling.
Supplementary Figure 2a: Geospatial modelling flowchart

The geospatial modelling process consists of three sections. First (in blue), all available survey data are compiled if they could be referenced to coordinates/points or polygon units from survey clusters as well as calculate the use of cooking fuel types at their respective levels. Data matched to polygons are resampled into pseudo points using a k-means clustering algorithm. Covariates are subsequently merged to the points and pseudo points via a spatial join. Second (in green), point data and their associated covariates along with a stacked generalisation ensemble model is used. The children models, boosted regression trees, generalised additive models, and elastic net regression were fit using a 5-fold cross-validation process. The cross-validated predictions from each model then serve as the covariate values for the main/parent model (spatiotemporal GPR) model. The predictions from when the child models were fit on all the data (rather than 4/5ths implied by the cross-validation) are then used to create posterior predictions of solid fuel use prevalence in a 5x5 km grid for the years 2000–2018. Finally (in orange), our estimates are aggregated to the first administrative-level units.
Supplementary Figure 2b: Post-estimation flowchart

We combined the model output with geospatial estimates of ambient PM$_{2.5}$ exposure from GBD 2019$^{23}$ in order to calculate personal exposure to total PM$_{2.5}$ pollution (TAP) as the sum of the AAP and HAP concentration in each 5 x 5-km grid cell $i$ (pixel). Estimates of the expected incremental PM$_{2.5}$ concentration (see Definitions) generated in a household using solid fuels (HPM$_{2.5}$) for a given country ($c$) and year ($t$) from GBD 2019 were used to calculate the HAP concentration for the exposed population.$^{24}$ The per capita annual average ambient PM$_{2.5}$ estimate from GBD 2019 (APM$_{2.5}$) was summed with the HAP concentration to provide the TAP concentration. The fraction of TAP contributed by HAP in each pixel was estimated to provide the HAP share (AAP: HAP ratio). Finally, the per capita TAP concentration in each pixel was used as an input to the GBD 2019 risk (IER$^{23}$) curve for LRI in order to estimate a relative risk (RR) and PAF for every PM$_{2.5}$-associated outcome ($o$) in each pixel. The PAF for LRI was combined with pixel-level estimates$^{25}$ of under-5 LRI mortality counts ($N_{l,c,t,o}$) in order to estimate the count (TAP $N$) and rate of LRI deaths that were attributable to TAP and – using the estimated HAP share – HAP (HAP Deaths $N_{l,c,t,o}$) versus AAP in each district.
Supplementary Figure 3: Map of modelling regions

We stratified our data and analyses into 21 contiguous regions selected. Each color represents a different modelling region, where grey represents countries that we did not include in our analysis. In order of appearance in the legend, the regions are: Andean South America (yellow), Central America and the Caribbean (red), China (lavender), central sub-Saharan Africa (purple), Eritrea, Djibouti and Yemen (burgundy), eastern sub-Saharan Africa (light pink), Middle East (mint green), Mongolia (pastel yellow), north Africa (blue), Oceania (lime green), southeast Asia (turquoise), south Asia (peach), southern sub-Saharan Africa (dark teal), central Asia (brown), Tropical South America (green), western sub-Saharan Africa (orange), and South Africa (navy).
Supplementary Figure 3a-e: Solid fuel use data availability by type and country, 2000–2018

All data shown are by country and year of survey and mapped at its corresponding geopositioned coordinate or cluster area. In the left panel, the total number of points and polygons (areal) for each country are plotted by data source, data type (point coordinate or polygon area) and sample size. The sample size represents the total number of individual microdata records for each survey. In the right panel, the mean solid fuel use for the input coordinate or area is mapped. Figure a) displays solid fuel use data availability in Africa by type and country from 2000 to 2018. Figure b) displays solid fuel use data availability in Latin America and the Caribbean by type and country from 2000 to 2018. Figure c) displays solid fuel use data availability in Middle East and central Asia by type and country from 2000 to 2018. Figure d) displays solid fuel use data availability in southeast Asia by type and country from 2000 to 2018. Figure e) displays solid fuel use data availability in south Asia by type and country from 2000 to 2018.

a)
Solid Fuel Use: Southeast Asia

1998-2002
2003-2007
2008-2012
2013-2018

Data Source:
- ASH_BKIS
- COUNTRY_SPECIFIC
- FUMIF_CENSUS
- MACRO_AIS
- MACRO_BKIS
- NAME_FUZ
- ENRICHMENT
- WS_LIMHS
- WHO_SAGES

Data Type:
- Point
- Polygon

Sample Size:
- Asia: 28,000
- Global: 70,000

N: 178,044,669
Points: 16,816
Polygons: 22,624
Supplementary Figure 5: Geospatial covariates

23 covariate raster layers of possible socioeconomic and environmental correlates of solid fuel use were used as inputs for the stacking modelling process. Time-varying covariates are presented for the year 2018. For the year of production of non-time-varying covariates and additional details, please refer to the individual covariate citation in Supplementary Table 4 for additional details. These maps reflect administrative boundaries, land cover, lakes, and population. Pixels with fewer than ten people per 1x1 km grid cell and classified as “barren” or “sparsely vegetated” are colored in grey. Covariates are labeled as follows: travel time to nearest settlement [access2], aridity [aridity], diurnal temperature range [crutsdtr], frost day frequency [crutsfrs], potential evapotranspiration [crutspet], average daily mean temperature [crutstmp], dependency ratio of dependents to working-age adults [depratio], distance from rivers or lakes ≥ 50 km² [distriverslakes], nighttime lights [dmspntl], elevation [elevation], agricultural land [escroplandarea], enhanced vegetation index [evi], fertility [fertility], urban or rural [ghslurbanicity], nutrient yield [herreronyield], irrigation [irrigation], urban proportion of location [landcover], average land surface temperature [lst_avg_v6], precipitation [mswep], normalised difference vegetation index [nexndvi], tassled cap brightness [tcb_v6], tassled cap wetness [tcw_v6], and population [worldpop].
Supplementary Figure 5: Finite elements mesh

The finite elements mesh used to fit the space-time correlated error for the north Africa (NOAF) region overlaid on the countries in NOAF. Both the fine-scale mesh over land in the modelling region as well as the coarser buffer region mesh are shown. The simplified region polygon used to determine the boundary for the modelling region is shown in blue.

Finite elements mesh over north Africa
Supplementary Figure 6: Posterior means and 95% uncertainty intervals for solid fuel use prevalence at the second administrative level, 2018

95% uncertainty intervals were calculated as the difference between the 97.5\textsuperscript{th} percentile and the 2.5\textsuperscript{th} percentile of 1000 draws from the posterior distribution. This map presents uncertainty at the second administrative level for solid fuel use prevalence. Maps reflect administrative boundaries, land cover, lakes, and population; grey-coloured grid cells were classified as “barren or sparsely vegetated” and had fewer than ten people per 1x1km grid cell, or were not included in these analyses.
Supplementary Figure 7: Posterior means and 95% uncertainty intervals for TAP dose at the second administrative level, 2018

95% uncertainty intervals were calculated as the difference between the 97.5\textsuperscript{th} percentile and the 2.5\textsuperscript{th} percentile of 1000 draws from the posterior distribution. This map presents uncertainty at the second administrative level for TAP dose. Maps reflect administrative boundaries, land cover, lakes, and population; grey-coloured grid cells were classified as “barren or sparsely vegetated” and had fewer than ten people per 1x1km grid cell, or were not included in these analyses.
Supplementary Figure 8: Posterior means and 95% uncertainty intervals for TAP dose at the first administrative level, 2018

95% uncertainty intervals were calculated as the difference between the 97.5th percentile and the 2.5th percentile of 1000 draws from the posterior distribution. This map presents uncertainty at the first administrative level for TAP dose. Maps reflect administrative boundaries, land cover, lakes, and population; grey-coloured grid cells were classified as “barren or sparsely vegetated” and had fewer than ten people per 1x1km grid cell, or were not included in these analyses.
Supplementary Figure 9: Posterior means and 95% uncertainty intervals for HAP share at the second administrative level, 2018

95% uncertainty intervals were calculated as the difference between the 97.5th percentile and the 2.5th percentile of 1000 draws from the posterior distribution. This map presents uncertainty at the second administrative level for HAP ratio. Maps reflect administrative boundaries, land cover, lakes, and population; grey-coloured grid cells were classified as “barren or sparsely vegetated” and had fewer than ten people per 1x1km grid cell, or were not included in these analyses.
Supplementary Figure 10: Posterior means and 95% uncertainty intervals for HAP share at the first administrative level, 2018

95% uncertainty intervals were calculated as the difference between the 97.5th percentile and the 2.5th percentile of 1000 draws from the posterior distribution. This map presents uncertainty at the first administrative level for HAP ratio. Maps reflect administrative boundaries, land cover, lakes, and population; grey-coloured grid cells were classified as “barren or sparsely vegetated” and had fewer than ten people per 1x1km grid cell, or were not included in these analyses.
Supplementary Figure 11: Posterior means and 95% uncertainty intervals for LRI mortality counts due to TAP at the second administrative level, 2018

95% uncertainty intervals were calculated as the difference between the 97.5th percentile and the 2.5th percentile of 1000 draws from the posterior distribution. This map presents uncertainty at the second administrative level for LRI mortality counts due to TAP. Maps reflect administrative boundaries, land cover, lakes, and population; grey-coloured grid cells were classified as “barren or sparsely vegetated” and had fewer than ten people per 1x1km grid cell, or were not included in these analyses.
Supplementary Figure 12: Posterior means and 95% uncertainty intervals for LRI mortality counts due to TAP at the first administrative level, 2018

95% uncertainty intervals were calculated as the difference between the 97.5th percentile and the 2.5th percentile of 1000 draws from the posterior distribution. This map presents uncertainty at the first administrative level for LRI mortality counts due to TAP. Maps reflect administrative boundaries, land cover, lakes, and population; grey-coloured grid cells were classified as “barren or sparsely vegetated” and had fewer than ten people per 1x1km grid cell, or were not included in these analyses.
Supplementary Figure 13: Posterior means and 95% uncertainty intervals for LRI mortality rates due to TAP at the second administrative level, 2018

95% uncertainty intervals were calculated as the difference between the 97.5th percentile and the 2.5th percentile of 1000 draws from the posterior distribution. This map presents uncertainty at the second administrative level for LRI mortality rates due to TAP. Maps reflect administrative boundaries, land cover, lakes, and population; grey-coloured grid cells were classified as “barren or sparsely vegetated” and had fewer than ten people per 1x1km grid cell, or were not included in these analyses.
Supplementary Figure 14: Posterior means and 95% uncertainty intervals for LRI mortality rates due to TAP at the first administrative level, 2018

95% uncertainty intervals were calculated as the difference between the 97.5th percentile and the 2.5th percentile of 1000 draws from the posterior distribution. This map presents uncertainty at the first administrative level for LRI mortality rates due to TAP. Maps reflect administrative boundaries, land cover, lakes, and population; grey-coloured grid cells were classified as “barren or sparsely vegetated” and had fewer than ten people per 1x1km grid cell, or were not included in these analyses.
Supplementary Figure 15: HAP percentage change, 2000–2018, at the second administrative level

Estimated percentage decrease in household air pollution from 2000 to 2018. Maps display the rates aggregated up to the second administrative level using population weighting and reflects administrative boundaries, land cover, lakes, and population; grey-coloured grid cells were classified as “barren or sparsely vegetated” and had fewer than ten people per 1x1km grid cell, or were not included in these analyses.
Supplementary Figure 17a-u: Population and attributable under-5 LRI mortalities, distributed as a function of PM2.5 by region.

Population (a) and under-5 LRI mortality attributable to total PM2.5 (b) for the year 2018, plotted a function of total PM2.5 concentrations. The mirror image reflects the distribution for the year 2000. The distributions are colored by country. Within each distribution, the dark shading represents the portion contributed by household sources, while the lighter shading indicates the portion contributed by ambient sources. The plotted data represent local smoothing of normalized distributions that were computed over 400 logarithmically spaced bins. The dashed vertical line indicates WHO's interim threshold of 35 ug/m3.

a) Southeast Asia
b) Southeast Asia, continued
c) Oceania

Papua New Guinea
d) Central Asia

a

Kyrgyzstan
Mongolia
Tajikistan
Turkmenistan
Uzbekistan

b

35 50 100 300 600

2000 2018
f) Andean Latin America
g) Central Latin America

[Diagram showing a comparison of data for various countries in Central Latin America over the years 2000 and 2018.]
h) Central Latin America, continued
i) Tropical Latin America
j) North Africa and Middle East
k) North Africa and Middle East
l) North Africa and Middle East, continued
m) South Asia

![Graph showing data for South Asia in 2000 and 2018. The graph includes data for Bangladesh, Bhutan, Nepal, and Pakistan.](image)
n) Central Sub-Saharan Africa

a

b
o) Eastern Sub-Saharan Africa
p) Eastern Sub-Saharan Africa, continued
q) Eastern Sub-Saharan Africa, Continued

a

b
r) Southern Sub-Saharan Africa
s) Western Sub-Saharan Africa
t) Western Sub-Saharan Africa, Continued
u) Western Sub-Saharan Africa, Continued
Supplementary Figure 18a-v: Air pollution risk transition (2000–2018) by region.

a. Trends in the percent of LRIs attributed to TAP at the second administrative unit (districts). The x-axis displays the percent of total air pollution exposure that is contributed by ambient air pollution. The blue and red background shading indicate the dominant source of air pollution is household or ambient sources. The y-axis displays the fraction of under-5 LRIs that are attributable to TAP, as estimated by the population attributable fraction (PAF). The y-axis rugs indicate the gradient of background LRI mortality rates for 2000 (left) and 2018 (right), illustrating the correlation between LRI rates and the fraction attributable to TAP. The lines connect a district to its preceding time point across the series.

a) East Asia
b) Southeast Asia
c) Southeast Asia, continued
d) Oceania
e) Central Asia
f) Caribbean
g) Andean Latin America
h) Central Latin America
i) Central Latin America, continued
j) Tropical Latin America
k) North Africa and Middle East
I) North Africa and Middle East
m) North Africa and Middle East, continued
n) South Asia
o) Central Sub-Saharan Africa
p) Eastern Sub-Saharan Africa
q) Eastern Sub-Saharan Africa, continued
r) Eastern Sub-Saharan Africa, Continued
s) Southern Sub-Saharan Africa
t) Western Sub-Saharan Africa
u) Western Sub-Saharan Africa, Continued
v) Western Sub-Saharan Africa, Continued
Supplementary Figure 19a-c: SFU in-sample by aggregation level

a) Admin 0
b) Admin 1

Validation Plot for cooking_fuel_solid by Admin 1
COV: FALSE

Mean Prediction

Data Estimate
c) Admin 2

Validation Plot for cooking_fuel_solid by Admin 2
OCS: FALSE

Weight:
- 500000
- 1000000
- 1500000
- 2000000

Data Estimate vs. Main Prediction for different years.
Supplementary Figure 20a-c: SFU out-of-sample by aggregation level

a) Admin 0
b) Admin 1

Validation Plot for cooking_fuel_solid by Admin 1

COS: TRUE

2005

Mean Prediction

2010

2015

2018

Data Estimate

Weight

3 SE

3 M

3 L

2 SE

2 M

2 L
c) Admin 2

Validation Plot for cooking_fuel_solid by Admin 2
OOS: TRUE

Weight
- 50000
- 100000
- 150000
- 200000

Data Estimate

Mean Prediction
5.0 Supplementary Tables

Supplementary Table 1: Guidelines for Accurate and Transparent Health Estimates Reporting (GATHER) ........................................................................................................................................... 78
Supplementary Table 2: Socio-demographic Index (SDI) of countries included in analysis ........................................ 80
Supplementary Table 3: Socio-demographic Index (SDI) of countries excluded from analysis ........................................ 83
Supplementary Table 4: Cooking Fuel input dataset ........................................................................................................ 84
Supplementary Table 5: Covariates used in mapping ........................................................................................................ 106
Supplementary Table 6a-b: Covariates used in ensemble modelling via stacked generalisation, stratified by modelling region ............................................................................................................................................ 109
Supplementary Table 7: Fitted parameters by region for model of Solid Fuel Use ................................................................ 113
Supplementary Table 8: Predictive metrics for SFU, aggregated to the national level (Admin 0) ........................................ 116
Supplementary Table 9: Predictive metrics for SFU, aggregated to the first administrative level (Admin 1) ......................................................................................................................................................... 117
Supplementary Table 10: Predictive metrics for SFU, aggregated to the second administrative level (Admin 2) .................................................................................................................................................... 117

Supplementary Table 1: Guidelines for Accurate and Transparent Health Estimates Reporting (GATHER)

This table’s ‘Reported on’ column is currently only tentative will be updated when all manuscript and Supplementary Information text are finalized.

| Item # | Checklist item | Reported on |
|--------|----------------|-------------|
| **Objectives and funding** | | |
| 1 | Define the indicator(s), populations (including age, sex, and geographic entities), and time period(s) for which estimates were made. | Manuscript: Methods  
Supplementary Information: Data Section |
| 2 | List the funding sources for the work. | Manuscript: Acknowledgements |
| **Data Inputs** | | |
| For all data inputs from multiple sources that are synthesized as part of the study: | | |
| 3 | Describe how the data were identified and how the data were accessed. | Manuscript: Methods  
Supplementary Information: Data Section |
| 4 | Specify the inclusion and exclusion criteria. Identify all ad-hoc exclusions. | Manuscript: Methods  
Supplementary Information: Data Section; Figure 1 |
| 5 | Provide information on all included data sources and their main characteristics. For each data source used, | Supplementary Information: Data Section |
|   | **Report reference information or contact name/institution, population represented, data collection method, year(s) of data collection, sex and age range, diagnostic criteria or measurement method, and sample size, as relevant.** |   |
|---|---|---|
|6 | Identify and describe any categories of input data that have potentially important biases (e.g., based on characteristics listed in item 5). | **Manuscript: Methods, Limitations** |

*For data inputs that contribute to the analysis but were not synthesized as part of the study:*

|7 | Describe and give sources for any other data inputs. | **Manuscript: Methods**  
**Supplementary Information: Covariates Section** |

*For all data inputs:*

|8 | Provide all data inputs in a file format from which data can be efficiently extracted (e.g., a spreadsheet rather than a PDF), including all relevant meta-data listed in item 5. For any data inputs that cannot be shared because of ethical or legal reasons, such as third-party ownership, provide a contact name or the name of the institution that retains the right to the data. | **GHDx link available upon publication**  
**Supplementary Information: Data Section** |

**Data analysis**

|9 | Provide a conceptual overview of the data analysis method. A diagram may be helpful. | **Manuscript: Methods**  
**Supplementary Information: Figure 1-2** |

|10 | Provide a detailed description of all steps of the analysis, including mathematical formulae. This description should cover, as relevant, data cleaning, data pre-processing, data adjustments and weighting of data sources, and mathematical or statistical model(s). | **Manuscript: Methods**  
**Supplementary Information: Data section, Figure 1-2** |

|11 | Describe how candidate models were evaluated and how the final model(s) were selected. | **Manuscript: Methods** |

|12 | Provide the results of an evaluation of model performance, if done, as well as the results of any relevant sensitivity analysis. | **Manuscript: Methods** |

|13 | Describe methods for calculating uncertainty of the estimates. State which sources of uncertainty were, and were not, accounted for in the uncertainty analysis. | **Manuscript: Methods** |

|14 | State how analytic or statistical source code used to generate estimates can be accessed. | **https://github.com** |

**Results and Discussion**

|15 | Provide published estimates in a file format from which data can be efficiently extracted. | **GHDx link available upon publication** |
Report a quantitative measure of the uncertainty of the estimates (e.g., uncertainty intervals).

Interpret results in light of existing evidence. If updating a previous set of estimates, describe the reasons for changes in estimates.

Discuss limitations of the estimates. Include a discussion of any modelling assumptions or data limitations that affect interpretation of the estimates.

### Supplementary Table 2: Socio-demographic Index (SDI) of countries included in analysis

| Location Name                  | ISO3 | Region                              | SDI Level (2019) | SDI (2019)   |
|--------------------------------|------|-------------------------------------|------------------|--------------|
| Afghanistan                    | AFG  | North Africa and Middle East        | Low SDI          | 0.343232181  |
| Benin                          | BEN  | Western Sub-Saharan Africa          | Low SDI          | 0.352031382  |
| Burkina Faso                   | BFA  | Western Sub-Saharan Africa          | Low SDI          | 0.25738523   |
| Burundi                        | BDI  | Eastern Sub-Saharan Africa          | Low SDI          | 0.2839369    |
| Central African Republic       | CAF  | Central Sub-Saharan Africa          | Low SDI          | 0.273669311  |
| Chad                           | TCD  | Western Sub-Saharan Africa          | Low SDI          | 0.238012087  |
| Comoros                        | COM  | Eastern Sub-Saharan Africa          | Low SDI          | 0.45466725   |
| Cote d'Ivoire                  | CIV  | Western Sub-Saharan Africa          | Low SDI          | 0.408196034  |
| Democratic Republic of the Congo| COD  | Central Sub-Saharan Africa          | Low SDI          | 0.382172191  |
| Eritrea                        | ERI  | Eastern Sub-Saharan Africa          | Low SDI          | 0.39598799   |
| Country          | Code | Region                              | Development Category | SDI       |
|------------------|------|-------------------------------------|----------------------|-----------|
| Ethiopia         | ETH  | Eastern Sub-Saharan Africa          | Low SDI              | 0.342967449 |
| Guinea           | GIN  | Western Sub-Saharan Africa          | Low SDI              | 0.324580469 |
| Guinea-Bissau    | GNB  | Western Sub-Saharan Africa          | Low SDI              | 0.355423473 |
| Haiti            | HTI  | Caribbean                           | Low SDI              | 0.431969896 |
| Liberia          | LBR  | Western Sub-Saharan Africa          | Low SDI              | 0.369615587 |
| Madagascar       | MDG  | Eastern Sub-Saharan Africa          | Low SDI              | 0.396293769 |
| Malawi           | MWI  | Eastern Sub-Saharan Africa          | Low SDI              | 0.383936706 |
| Mali             | MLI  | Western Sub-Saharan Africa          | Low SDI              | 0.263484935 |
| Mozambique       | MOZ  | Eastern Sub-Saharan Africa          | Low SDI              | 0.3073155   |
| Nepal            | NPL  | South Asia                          | Low SDI              | 0.421996036 |
| Niger            | NER  | Western Sub-Saharan Africa          | Low SDI              | 0.161629227 |
| Papua New Guinea | PNG  | Oceania                             | Low SDI              | 0.394095992 |
| Rwanda           | RWA  | Eastern Sub-Saharan Africa          | Low SDI              | 0.429139732 |
| Senegal          | SEN  | Western Sub-Saharan Africa          | Low SDI              | 0.388935561 |
| Sierra Leone     | SLE  | Western Sub-Saharan Africa          | Low SDI              | 0.347333599 |
| Somalia          | SOM  | Eastern Sub-Saharan Africa          | Low SDI              | 0.080983671 |
| South Sudan      | SSD  | Eastern Sub-Saharan Africa          | Low SDI              | 0.363419895 |
| Tanzania         | TZA  | Eastern Sub-Saharan Africa          | Low SDI              | 0.423252126 |
| The Gambia       | GMB  | Western Sub-Saharan Africa          | Low SDI              | 0.398656595 |
| Togo             | TGO  | Western Sub-Saharan Africa          | Low SDI              | 0.417121069 |
| Uganda           | UGA  | Eastern Sub-Saharan Africa          | Low SDI              | 0.404470575 |
| Yemen            | YEM  | North Africa and Middle East        | Low SDI              | 0.412238638 |
| Algeria          | DZA  | North Africa and Middle East        | Middle SDI           | 0.651946134 |
| Botswana         | BWA  | Southern Sub-Saharan Africa         | Middle SDI           | 0.634369974 |
| Brazil           | BRA  | Tropical Latin America              | Middle SDI           | 0.639528523 |
| Colombia         | COL  | Central Latin America               | Middle SDI           | 0.632568305 |
| Costa Rica       | CRI  | Central Latin America               | Middle SDI           | 0.680111655 |
| Ecuador          | ECU  | Andean Latin America                | Middle SDI           | 0.639975089 |
| Country            | Code | Region                        | Income Stage | SDI          |
|--------------------|------|-------------------------------|--------------|--------------|
| Egypt              | EGY  | North Africa and Middle East  | Middle SDI   | 0.657680121  |
| Equatorial Guinea  | GNQ  | Central Sub-Saharan Africa    | Middle SDI   | 0.685124105  |
| Gabon              | GAB  | Central Sub-Saharan Africa    | Middle SDI   | 0.655830167  |
| Guyana             | GUY  | Caribbean                     | Middle SDI   | 0.618266528  |
| Indonesia          | IDN  | Southeast Asia                | Middle SDI   | 0.659878161  |
| Iraq               | IRQ  | North Africa and Middle East  | Middle SDI   | 0.670654     |
| Jamaica            | JAM  | Caribbean                     | Middle SDI   | 0.684352436  |
| Mexico             | MEX  | Central Latin America         | Middle SDI   | 0.64908918   |
| Namibia            | NAM  | Southern Sub-Saharan Africa   | Middle SDI   | 0.612335601  |
| Panama             | PAN  | Central Latin America         | Middle SDI   | 0.685526052  |
| Paraguay           | PRY  | Tropical Latin America        | Middle SDI   | 0.638276934  |
| Peru               | PER  | Andean Latin America          | Middle SDI   | 0.648408781  |
| Philippines        | PHL  | Southeast Asia                | Middle SDI   | 0.622858401  |
| South Africa       | ZAF  | Southern Sub-Saharan Africa   | Middle SDI   | 0.67825053   |
| Suriname           | SUR  | Caribbean                     | Middle SDI   | 0.635912299  |
| Syria              | SYR  | North Africa and Middle East  | Middle SDI   | 0.619444771  |
| Thailand           | THA  | Southeast Asia                | Middle SDI   | 0.686576643  |
| Tunisia            | TUN  | North Africa and Middle East  | Middle SDI   | 0.67176511   |
| Turkmenistan       | TKM  | Central Asia                  | Middle SDI   | 0.670472955  |
| Uzbekistan         | UZB  | Central Asia                  | Middle SDI   | 0.631435113  |
| Vietnam            | VNM  | Southeast Asia                | Middle SDI   | 0.61743942   |
| Angola             | AGO  | Central Sub-Saharan Africa    | Low-middle SDI | 0.469857606 |
| Bangladesh         | BGD  | South Asia                    | Low-middle SDI | 0.482676885 |
| Belize             | BLZ  | Caribbean                     | Low-middle SDI | 0.602517206 |
| Bhutan             | BTN  | South Asia                    | Low-middle SDI | 0.455077121 |
| Bolivia            | BOL  | Andean Latin America          | Low-middle SDI | 0.56641717  |
| Cambodia           | KHM  | Southeast Asia                | Low-middle SDI | 0.468990684 |
| Cameroon           | CMR  | Western Sub-Saharan Africa    | Low-middle SDI | 0.489610885 |
| Djibouti           | DJI  | Eastern Sub-Saharan Africa    | Low-middle SDI | 0.458670351 |
| Dominican Republic  | DOM  | Caribbean                     | Low-middle SDI | 0.591906159 |
| El Salvador        | SLV  | Central Latin America         | Low-middle SDI | 0.572623622 |
| Ghana              | GHA  | Western Sub-Saharan Africa    | Low-middle SDI | 0.556887637 |
| Guatemala          | GTM  | Central Latin America         | Low-middle SDI | 0.526345014 |
| Honduras           | HND  | Central Latin America         | Low-middle SDI | 0.495975306 |
| Country          | Code | Region                  | Development Level   | SDI       |
|------------------|------|-------------------------|---------------------|-----------|
| India            | IND  | South Asia              | Low-middle SDI      | 0.565900043 |
| Kenya            | KEN  | Eastern Sub-Saharan Africa | Low-middle SDI    | 0.50844187 |
| Kyrgyzstan       | KGZ  | Central Asia            | Low-middle SDI      | 0.59566124 |
| Laos             | LAO  | Southeast Asia          | Low-middle SDI      | 0.48997377 |
| Lesotho          | LSO  | Southern Sub-Saharan Africa | Low-middle SDI    | 0.507011919 |
| Mauritania       | MRT  | Western Sub-Saharan Africa | Low-middle SDI    | 0.49569688 |
| Mongolia         | MNG  | Central Asia            | Low-middle SDI      | 0.605566533 |
| Morocco          | MAR  | North Africa and Middle East | Low-middle SDI | 0.548494837 |
| Myanmar          | MMR  | Southeast Asia          | Low-middle SDI      | 0.520765117 |
| Nicaragua        | NIC  | Central Latin America   | Low-middle SDI      | 0.516771682 |
| Nigeria          | NGA  | Western Sub-Saharan Africa | Low-middle SDI    | 0.51525579 |
| Pakistan         | PAK  | South Asia              | Low-middle SDI      | 0.448851517 |
| Palestine        | PSE  | North Africa and Middle East | Low-middle SDI | 0.587868157 |
| Republic of the Congo | COG | Central Sub-Saharan Africa | Low-middle SDI    | 0.568429044 |
| Sao Tome and Principe | STP | Western Sub-Saharan Africa | Low-middle SDI    | 0.502156323 |
| Sudan            | SDN  | North Africa and Middle East | Low-middle SDI | 0.515086174 |
| Swaziland        | SWZ  | Southern Sub-Saharan Africa | Low-middle SDI    | 0.577452676 |
| Tajikistan       | TJK  | Central Asia            | Low-middle SDI      | 0.538654316 |
| Timor-Leste      | TLS  | Southeast Asia          | Low-middle SDI      | 0.51372636 |
| Zambia           | ZMB  | Eastern Sub-Saharan Africa | Low-middle SDI    | 0.505086432 |
| Zimbabwe         | ZWE  | Southern Sub-Saharan Africa | Low-middle SDI | 0.475632182 |
| China            | CHN  | East Asia               | High-middle SDI     | 0.685967969 |
| Iran             | IRN  | North Africa and Middle East | High-middle SDI | 0.670415892 |
| Jordan           | JOR  | North Africa and Middle East | High-middle SDI | 0.731025449 |
| Libya            | LBY  | North Africa and Middle East | High-middle SDI | 0.709294185 |
| Sri Lanka        | LKA  | Southeast Asia          | High-middle SDI     | 0.689520933 |
| Trinidad and Tobago | TTO | Caribbean               | High-middle SDI     | 0.756858482 |

**Supplementary Table 3: Socio-demographic Index (SDI) of countries excluded from analysis**
| Location Name                        | ISO3 | Region          | SDI Level (2019) | SDI (2019)  |
|-------------------------------------|------|-----------------|------------------|------------|
| Solomon Islands                     | SLB  | Oceania         | Low SDI          | 0.406846203 |
| Cuba                                | CUB  | Caribbean       | Middle SDI       | 0.667855786 |
| Fiji                                | FJI  | Oceania         | Middle SDI       | 0.664044301 |
| Grenada                             | GRD  | Caribbean       | Middle SDI       | 0.66915426  |
| Saint Lucia                         | LCA  | Caribbean       | Middle SDI       | 0.670409821 |
| Saint Vincent and the Grenadines    | VCT  | Caribbean       | Middle SDI       | 0.626784725 |
| Samoa                               | WSM  | Oceania         | Middle SDI       | 0.640812792 |
| Tonga                               | TON  | Oceania         | Middle SDI       | 0.635899444 |
| Cape Verde                          | CPV  | Western Sub-Saharan Africa | Low-middle SDI | 0.524957239 |
| Federated States of Micronesia      | FSM  | Oceania         | Low-middle SDI   | 0.579853271 |
| Kiribati                            | KIR  | Oceania         | Low-middle SDI   | 0.526513752 |
| Maldives                            | MDV  | Southeast Asia  | Low-middle SDI   | 0.561816599 |
| Marshall Islands                    | MHL  | Oceania         | Low-middle SDI   | 0.544149104 |
| Vanuatu                             | VUT  | Oceania         | Low-middle SDI   | 0.484678789 |
| Venezuela                           | VEN  | Central Latin America | Low-middle SDI | 0.606514719 |
| American Samoa                      | ASM  | Oceania         | High-middle SDI  | 0.712008609 |
| Dominica                            | DMA  | Caribbean       | High-middle SDI  | 0.72914183  |
| Malaysia                            | MYS  | Southeast Asia  | High-middle SDI  | 0.737370877 |
| Seychelles                          | SYC  | Southeast Asia  | High-middle SDI  | 0.723944512 |

**Supplementary Table 4: Cooking Fuel input dataset**

| NID  | ISO3 | Start Year | End Year | Survey Series                                      | Survey Module |
|------|------|------------|----------|---------------------------------------------------|---------------|
| 20888| TLS  | 2003       | 2003     | ADB_DHS                                           | HH            |
| 18468| AFG  | 2006       | 2006     | AFG/HEALTH_SURVEY_2006                            | HH            |
| 30394| AGO  | 2008       | 2009     | AGO/INTEGRATED_SURVEY_ON_POPULATION_WELFARE       | HHM           |
| 107340| LBY | 2007       | 2007     | ARAB_LEAGUE_PAPFAM                                | HHM           |
| 126909| MAR | 2010       | 2011     | ARAB_LEAGUE_PAPFAM                                | WN            |
| 9999 | PSE  | 2006       | 2007     | ARAB_LEAGUE_PAPFAM                                | HH            |
| 126911| SYR | 2009       | 2009     | ARAB_LEAGUE_PAPFAM                                | HH            |
| 151805| BEN | 2011       | 2012     | BEN/HOUSEHOLD_LIVING_CONDITIONS_SURVEY             | HH            |
| ID     | Country | Year 1 | Year 2 | Survey Description                                      | Code |
|--------|---------|--------|--------|--------------------------------------------------------|------|
| 236156 | BFA     | 2014   | 2014   | BFA/CONTINUOUS_MULTI SECTORAL_SURVEY_EMC               | HHM  |
| 283269 | BGD     | 2015   | 2015   | BGD/INTEGRATED_HOUSEHOLD_SURVEY                        | HHM  |
| 153062 | BGD     | 2011   | 2012   | BGD/INTEGRATED_HOUSEHOLD_SURVEY_MALE                   | HH   |
| 336686 | BOL     | 2016   | 2016   | BOL_HHS                                                | HHM  |
| 317285 | BOL     | 2015   | 2015   | BOL_HHS                                                | HHM  |
| 1245   | BOL     | 2000   | 2000   | BOL/HH_SURVEY                                          | HH   |
| 1259   | BOL     | 2001   | 2001   | BOL/HH_SURVEY                                          | HHM  |
| 1278   | BOL     | 2002   | 2002   | BOL/HH_SURVEY                                          | HH   |
| 32374  | BOL     | 2003   | 2004   | BOL/HH_SURVEY                                          | HHM  |
| 32388  | BOL     | 2005   | 2005   | BOL/HH_SURVEY                                          | HHM  |
| 148343 | BOL     | 2006   | 2006   | BOL/HH_SURVEY                                          | WN   |
| 148344 | BOL     | 2007   | 2007   | BOL/HH_SURVEY                                          | HHM  |
| 164634 | BOL     | 2011   | 2011   | BOL/HH_SURVEY                                          | HHM  |
| 164635 | BOL     | 2013   | 2013   | BOL/HH_SURVEY                                          | HH   |
| 283486 | BOL     | 2014   | 2014   | BOL/HH_SURVEY                                          | HHM  |
| 93522  | BRA     | 2009   | 2009   | BRA/HOUSEHOLD_SAMPLE_SURVEY_PNAD                       | HH   |
| 93487  | BRA     | 2008   | 2008   | BRA/HOUSEHOLD_SAMPLE_SURVEY_PNAD                       | HH   |
| 1489   | BRA     | 2003   | 2003   | BRA/HOUSEHOLD_SAMPLE_SURVEY_PNAD                       | HH   |
| 238441 | BRA     | 2014   | 2014   | BRA/HOUSEHOLD_SAMPLE_SURVEY_PNAD                       | HH   |
| 106724 | BRA     | 2011   | 2011   | BRA/HOUSEHOLD_SAMPLE_SURVEY_PNAD                       | HH   |
| 156581 | BRA     | 2012   | 2012   | BRA/HOUSEHOLD_SAMPLE_SURVEY_PNAD                       | HH   |
| 156583 | BRA     | 2013   | 2013   | BRA/HOUSEHOLD_SAMPLE_SURVEY_PNAD                       | HH   |
| 281548 | BRA     | 2015   | 2015   | BRA/HOUSEHOLD_SAMPLE_SURVEY_PNAD                       | HH   |
| 1488   | BRA     | 2002   | 2002   | BRA/HOUSEHOLD_SAMPLE_SURVEY_PNAD                       | HH   |
| 93490  | BRA     | 2007   | 2007   | BRA/HOUSEHOLD_SAMPLE_SURVEY_PNAD                       | HH   |
| 1490   | BRA     | 2004   | 2004   | BRA/HOUSEHOLD_SAMPLE_SURVEY_PNAD                       | HH   |
| 1477   | BRA     | 2001   | 2001   | BRA/HOUSEHOLD_SAMPLE_SURVEY_PNAD                       | HHM  |
| 80311  | BRA     | 2005   | 2005   | BRA/HOUSEHOLD_SAMPLE_SURVEY_PNAD                       | HHM  |
| 93528  | BRA     | 2006   | 2006   | BRA/HOUSEHOLD_SAMPLE_SURVEY_PNAD                       | HH   |
| 195010 | BRA     | 2013   | 2013   | BRA/NATIONAL_HEALTH_SURVEY_PNS                         | HHM  |
| 32244  | BRA     | 2002   | 2005   | BRA/RISK_FACTOR_MORBIDITY_NCD_SURVEY                    | HH   |
| 1175   | BTN     | 2005   | 2005   | BTN/CENSUS                                             | HHM  |
| 151536 | BWA     | 2009   | 2010   | BWA_CWIS                                              | HHM  |
| 22114  | BWA     | 2004   | 2004   | BWA/AIDS_IMPACT_SURVEY                                  | HHM  |
| 134753 | BWA     | 2013   | 2013   | BWA/AIDS_IMPACT_SURVEY                                  | HHM  |
| Code   | Country | Year1  | Year2  | Study Description                                      | Code |
|--------|---------|--------|--------|--------------------------------------------------------|------|
| 21970  | BWA     | 2006   | 2006   | BWA/DEMOGRAPHIC_SURVEY                                  | HH   |
| 22125  | BWA     | 2007   | 2008   | BWA/FAMILY_HEALTH_SURVEY                                 | HH   |
| 4779   | GTM     | 2008   | 2009   | CDC_RHS                                                | WN   |
| 10370  | PRY     | 2004   | 2004   | CDC_RHS                                                | WN   |
| 27525  | PRY     | 2008   | 2008   | CDC_RHS                                                | WN   |
| 27599  | SLV     | 2002   | 2003   | CDC_RHS                                                | WN   |
| 314646 | BLZ     | 2013   | 2013   | CHILD_ACTIVITY_SURVEY                                    | HH   |
| 283812 | CHN     | 2010   | 2010   | CHINA_FAMILY_PANEL_STUDIES                              | HH   |
| 283815 | CHN     | 2012   | 2012   | CHINA_FAMILY_PANEL_STUDIES                              | HH   |
| 2039   | CMR     | 2001   | 2001   | CMR/HH_SURVEY                                           | HH   |
| 3100   | COL     | 2007   | 2008   | COL/NATIONAL_HEALTH_SURVEY_ENS                          | HH   |
| 68396  | COL     | 2011   | 2011   | COL/NATIONAL_QUALITY_OF_LIFE_SURVEY_ENCV                | HH   |
| 68334  | COL     | 2010   | 2010   | COL/NATIONAL_QUALITY_OF_LIFE_SURVEY_ENCV                | HH   |
| 3209   | CRI     | 2001   | 2001   | CRI/MULTIPURPOSE_HH_SURVEY                              | HHM  |
| 3212   | CRI     | 2002   | 2002   | CRI/MULTIPURPOSE_HH_SURVEY                              | HHM  |
| 3218   | CRI     | 2003   | 2003   | CRI/MULTIPURPOSE_HH_SURVEY                              | HHM  |
| 3215   | CRI     | 2004   | 2004   | CRI/MULTIPURPOSE_HH_SURVEY                              | HHM  |
| 3177   | CRI     | 2005   | 2005   | CRI/MULTIPURPOSE_HH_SURVEY                              | HHM  |
| 3180   | CRI     | 2006   | 2006   | CRI/MULTIPURPOSE_HH_SURVEY                              | HHM  |
| 3183   | CRI     | 2007   | 2007   | CRI/MULTIPURPOSE_HH_SURVEY                              | HHM  |
| 30434  | CRI     | 2008   | 2008   | CRI/MULTIPURPOSE_HH_SURVEY                              | HHM  |
| 30437  | CRI     | 2009   | 2009   | CRI/MULTIPURPOSE_HH_SURVEY                              | HHM  |
| 149360 | CRI     | 2010   | 2010   | CRI/NATIONAL_HOUSEHOLD_SURVEY_ENAHO                     | HHM  |
| 149366 | CRI     | 2011   | 2011   | CRI/NATIONAL_HOUSEHOLD_SURVEY_ENAHO                     | HHM  |
| 149372 | CRI     | 2012   | 2012   | CRI/NATIONAL_HOUSEHOLD_SURVEY_ENAHO                     | HHM  |
| 169717 | CRI     | 2014   | 2014   | CRI/NATIONAL_HOUSEHOLD_SURVEY_ENAHO                     | HHM  |
| 238431 | CRI     | 2015   | 2015   | CRI/NATIONAL_HOUSEHOLD_SURVEY_ENAHO                     | HHM  |
| 282883 | CRI     | 2016   | 2016   | CRI/NATIONAL_HOUSEHOLD_SURVEY_ENAHO                     | HHM  |
| 3455   | DOM     | 2006   | 2006   | DOM/HOUSEHOLD_SURVEY_ENHOGAR                            | HH   |
| 3441   | DOM     | 2007   | 2007   | DOM/HOUSEHOLD_SURVEY_ENHOGAR                            | HH   |
| 35583  | DOM     | 2005   | 2005   | DOM/HOUSEHOLD_SURVEY_ENHOGAR                            | HHM  |
| 95320  | ECU     | 2010   | 2010   | ECU/CENSUS                                             | HH   |
| 46924  | ECU     | 2005   | 2006   | ECU/LIVING_CONDITIONS_SURVEY_ECV                        | HHM  |
| 153674 | ECU     | 2012   | 2012   | ECU/NATIONAL_HEALTH_AND_NUTRITION_SURVEY_ENSA Nut       | HHM  |
| Code     | Country | Year 1 | Year 2 | Survey Description                                      | Source |
|----------|---------|--------|--------|---------------------------------------------------------|--------|
| 323944   | BOL     | 2016   | 2016   | EDSA                                                    | HHM    |
| 34085    | ETH     | 2004   | 2004   | ETH/WELFARE_MONITORING_SURVEY                            | HH     |
| 365281   | ETH     | 2015   | 2016   | ETH/WELFARE_MONITORING_SURVEY                            | HH     |
| 4010     | GHA     | 2001   | 2001   | GHA/CHILD_LABOR_SURVEY                                  | HHM    |
| 5009     | HND     | 2004   | 2004   | HND/SURVEY_OF_LIVING_CONDITIONS                         | HH     |
| 219201   | IDN     | 2012   | 2012   | IDN/FAMILY_LIFE_SURVEY_EAST                             | HH     |
| 43552    | IDN     | 2009   | 2009   | IDN/SOCIOECONOMIC_SURVEY_SUSENAS                        | HH     |
| 150884   | IDN     | 2012   | 2012   | IDN/SOCIOECONOMIC_SURVEY_SUSENAS                        | HH     |
| 151184   | IDN     | 2013   | 2013   | IDN/SOCIOECONOMIC_SURVEY_SUSENAS                        | HH     |
| 85265    | IDN     | 2011   | 2011   | IDN/SOCIOECONOMIC_SURVEY_SUSENAS                        | HH     |
| 65181    | IND     | 2009   | 2010   | IND/COVERAGE_EVALUATION_SURVEY                           | CH     |
| 23219    | IND     | 2002   | 2004   | IND/DISTRICT_LEVEL_HOUSEHOLD_SURVEY                      | HH     |
| 23258    | IND     | 2007   | 2008   | IND/DISTRICT_LEVEL_HOUSEHOLD_SURVEY                      | HH     |
| 165390   | IND     | 2012   | 2014   | IND/DISTRICT_LEVEL_HOUSEHOLD_SURVEY                      | HH     |
| 174154   | IND     | 2010   | 2010   | IND/LONGITUDINAL_AGING_STUDY_IN_INDIA                    | HHM    |
| 225626   | IND     | 2014   | 2014   | IND/NATIONAL_SAMPLE_SURVEY                               | HHM    |
| 5285     | IND     | 2004   | 2004   | IND/NATIONAL_SAMPLE_SURVEY                               | HHM    |
| 129770   | IND     | 2011   | 2012   | IND/NNMB_RURAL_SURVEY                                   | HH     |
| 367347   | BEN     | 2002   | 2002   | IPUMS_CENSUS                                            | HHM    |
| 367419   | BEN     | 2013   | 2013   | IPUMS_CENSUS                                            | HHM    |
| 105403   | BFA     | 2006   | 2006   | IPUMS_CENSUS                                            | HHM    |
| 1362     | BOL     | 2001   | 2001   | IPUMS_CENSUS                                            | HHM    |
| 294205   | BWA     | 2001   | 2001   | IPUMS_CENSUS                                            | HHM    |
| 105800   | CMR     | 2005   | 2005   | IPUMS_CENSUS                                            | HHM    |
| 3029     | COL     | 2005   | 2006   | IPUMS_CENSUS                                            | HHM    |
| 227111   | CRI     | 2011   | 2011   | IPUMS_CENSUS                                            | HHM    |
| 151304   | DOM     | 2010   | 2010   | IPUMS_CENSUS                                            | HHM    |
| 3549     | ECU     | 2001   | 2001   | IPUMS_CENSUS                                            | HHM    |
| 105801   | ECU     | 2010   | 2010   | IPUMS_CENSUS                                            | HHM    |
| 35578    | EGY     | 2006   | 2006   | IPUMS_CENSUS                                            | HHM    |
| 38508    | GHA     | 2000   | 2000   | IPUMS_CENSUS                                            | HHM    |
| 151306   | GHA     | 2010   | 2010   | IPUMS_CENSUS                                            | HHM    |
| 367563   | HND     | 2001   | 2001   | IPUMS_CENSUS                                            | HHM    |
| 106473   | HTI     | 2003   | 2003   | IPUMS_CENSUS                                            | HHM    |
| ID  | Country | Year 1 | Year 2 | Source            | Country Code |
|-----|---------|--------|--------|-------------------|--------------|
| 56573 | IDN     | 2005   | 2005   | IPUMS_CENSUS      | HHM          |
| 39396 | IRN     | 2006   | 2006   | IPUMS_CENSUS      | HHM          |
| 39450 | JAM     | 2001   | 2001   | IPUMS_CENSUS      | HHM          |
| 35329 | KHM     | 2008   | 2008   | IPUMS_CENSUS      | HHM          |
| 151310 | LBR    | 2008   | 2008   | IPUMS_CENSUS      | HHM          |
| 367585 | LSO    | 2006   | 2006   | IPUMS_CENSUS      | HHM          |
| 151311 | MLJ    | 2009   | 2009   | IPUMS_CENSUS      | HHM          |
| 40186 | MWI     | 2008   | 2008   | IPUMS_CENSUS      | HHM          |
| 151312 | NGA    | 2007   | 2007   | IPUMS_CENSUS      | HHM          |
| 151314 | NGA    | 2009   | 2009   | IPUMS_CENSUS      | HHM          |
| 151315 | NGA    | 2010   | 2010   | IPUMS_CENSUS      | HHM          |
| 56520 | NIC     | 2005   | 2005   | IPUMS_CENSUS      | HHM          |
| 40907 | PAN     | 2000   | 2000   | IPUMS_CENSUS      | HHM          |
| 106529 | PAN    | 2010   | 2010   | IPUMS_CENSUS      | HHM          |
| 41267 | PER     | 2007   | 2007   | IPUMS_CENSUS      | HHM          |
| 41296 | PHL     | 2000   | 2000   | IPUMS_CENSUS      | HHM          |
| 367607 | PHL   | 2010   | 2010   | IPUMS_CENSUS      | HHM          |
| 227167 | PRY    | 2002   | 2002   | IPUMS_CENSUS      | HHM          |
| 41088 | PSE     | 2007   | 2007   | IPUMS_CENSUS      | HHM          |
| 42432 | RWA     | 2002   | 2002   | IPUMS_CENSUS      | HHM          |
| 367645 | RWA   | 2012   | 2012   | IPUMS_CENSUS      | HHM          |
| 43167 | SDN     | 2008   | 2008   | IPUMS_CENSUS      | HHM          |
| 11661 | SLE     | 2004   | 2004   | IPUMS_CENSUS      | HHM          |
| 56476 | SLV     | 2007   | 2007   | IPUMS_CENSUS      | HHM          |
| 106548 | SSD   | 2008   | 2008   | IPUMS_CENSUS      | HHM          |
| 43231 | THA     | 2000   | 2000   | IPUMS_CENSUS      | HHM          |
| 294807 | TTO   | 2011   | 2011   | IPUMS_CENSUS      | HHM          |
| 43212 | TZA     | 2002   | 2002   | IPUMS_CENSUS      | HHM          |
| 294725 | TZA   | 2012   | 2012   | IPUMS_CENSUS      | HHM          |
| 43328 | UGA     | 2002   | 2002   | IPUMS_CENSUS      | HHM          |
| 43412 | VEN     | 2001   | 2001   | IPUMS_CENSUS      | HHM          |
| 43726 | VNM     | 2009   | 2009   | IPUMS_CENSUS      | HHM          |
| 43152 | ZAF     | 2001   | 2001   | IPUMS_CENSUS      | HHM          |
| 43158 | ZAF     | 2007   | 2007   | IPUMS_CENSUS      | HHM          |
| 227194 | ZAF   | 2011   | 2011   | IPUMS_CENSUS      | HHM          |
| Code   | Country | Year1 | Year2 | Dataset Description                                           | Source  |
|--------|---------|-------|-------|--------------------------------------------------------------|---------|
| 151325 | ZMB     | 2000  | 2000  | IPUMS_CENSUS                                                | HHM     |
| 151326 | ZMB     | 2010  | 2010  | IPUMS_CENSUS                                                | HHM     |
| 367747 | ZWE     | 2012  | 2012  | IPUMS_CENSUS                                                | HHM     |
| 34524  | IRQ     | 2006  | 2007  | IRQ/HH_SOCIOECONOMIC_SURVEY                                  | HHM     |
| 133219 | KEN     | 2007  | 2007  | KEN/AIDS_INDICATOR_SURVEY                                   | HHM     |
| 133304 | KEN     | 2012  | 2013  | KEN/AIDS_INDICATOR_SURVEY                                   | HHM     |
| 157397 | KEN     | 2010  | 2010  | KEN/CHILD_LABOR_SURVEY                                      | HHM     |
| 157655 | KEN     | 2007  | 2007  | KEN/HH_HEALTH_EXPENDITURE_UTILIZATION_SURVEY                 | HHM     |
| 7375   | KEN     | 2005  | 2006  | KEN/KIHBS                                                   | HHM     |
| 57990  | KEN     | 2007  | 2007  | KEN/MALRIA_INDICATORY_SURVEY                                 | HHM     |
| 164729 | KHM     | 2013  | 2013  | KHM/INTERCENSAL_POPULATION_SURVEY                            | HHM     |
| 30963  | KHM     | 2003  | 2005  | KHM/SOCIO_ECONOMIC_SURVEY                                   | HHM     |
| 165631 | KHM     | 2007  | 2008  | KHM/SOCIO_ECONOMIC_SURVEY                                   | HHM     |
| 31143  | KHM     | 2009  | 2009  | KHM/SOCIO_ECONOMIC_SURVEY                                   | HHM     |
| 327852 | MWI     | 2016  | 2017  | LSMS_ISA                                                    | HHM     |
| 3333   | COG     | 2009  | 2009  | DHS_AIS                                                     | HHM     |
| 4837   | GUY     | 2005  | 2005  | DHS_AIS                                                     | HHM     |
| 8906   | MOZ     | 2009  | 2009  | DHS_AIS                                                     | HHM     |
| 157060 | MOZ     | 2015  | 2015  | DHS_AIS                                                     | HHM     |
| 12630  | TZA     | 2003  | 2004  | DHS_AIS                                                     | HHM     |
| 12644  | TZA     | 2007  | 2008  | DHS_AIS                                                     | HHM     |
| 77395  | TZA     | 2011  | 2012  | DHS_AIS                                                     | HHM     |
| 55973  | UGA     | 2011  | 2011  | DHS_AIS                                                     | HHM     |
| 13544  | VNM     | 2005  | 2005  | DHS_AIS                                                     | HHM     |
| 157018 | AFG     | 2015  | 2016  | DHS_AIS                                                     | HHM     |
| 218555 | AGO     | 2015  | 2016  | DHS_AIS                                                     | HHM     |
| 30431  | BDI     | 2010  | 2011  | DHS_AIS                                                     | HHM     |
| 286766 | BDI     | 2016  | 2017  | DHS_AIS                                                     | HHM     |
| 18950  | BEN     | 2001  | 2001  | DHS_AIS                                                     | HHM     |
| 18959  | BEN     | 2006  | 2006  | DHS_AIS                                                     | HHM     |
| 79839  | BEN     | 2011  | 2012  | DHS_AIS                                                     | HHM     |
| 19088  | BFA     | 2003  | 2003  | DHS_AIS                                                     | HHM     |
| 19133  | BFA     | 2010  | 2011  | DHS_AIS                                                     | HHM     |
| 18902  | BGD     | 2004  | 2004  | DHS_AIS                                                     | HHM     |
| 18913  | BGD     | 2007  | 2007  | DHS_AIS                                                     | HHM     |
| Code  | Country | Year   | Year     | Source   |
|-------|---------|--------|----------|----------|
| 55956 | BGD     | 2011   | 2012     | DHS      |
| 157021| BGD     | 2014   | 2014     | DHS      |
| 19001 | BOL     | 2003   | 2004     | DHS      |
| 19016 | BOL     | 2008   | 2008     | DHS      |
| 18533 | CIV     | 2011   | 2012     | DHS      |
| 19211 | CMR     | 2004   | 2004     | DHS      |
| 19274 | CMR     | 2011   | 2011     | DHS      |
| 19381 | COD     | 2007   | 2007     | DHS      |
| 76878 | COD     | 2013   | 2014     | DHS      |
| 19391 | COG     | 2005   | 2005     | DHS      |
| 56151 | COG     | 2011   | 2012     | DHS      |
| 19359 | COL     | 2000   | 2000     | DHS      |
| 19324 | COL     | 2004   | 2005     | DHS      |
| 21281 | COL     | 2009   | 2010     | DHS      |
| 218566| COL     | 2015   | 2016     | DHS      |
| 76850 | COM     | 2012   | 2013     | DHS      |
| 19444 | DOM     | 2002   | 2002     | DHS      |
| 19456 | DOM     | 2007   | 2007     | DHS      |
| 77819 | DOM     | 2013   | 2013     | DHS      |
| 19511 | EGY     | 2000   | 2000     | DHS      |
| 19529 | EGY     | 2003   | 2003     | DHS_INTERIM |
| 19521 | EGY     | 2005   | 2005     | DHS      |
| 19539 | ERI     | 2002   | 2002     | DHS      |
| 19571 | ETH     | 2000   | 2000     | DHS      |
| 19557 | ETH     | 2005   | 2005     | DHS      |
| 21301 | ETH     | 2010   | 2011     | DHS      |
| 218568| ETH     | 2016   | 2016     | DHS      |
| 19579 | GAB     | 2000   | 2001     | DHS      |
| 76706 | GAB     | 2012   | 2012     | DHS      |
| 19627 | GHA     | 2003   | 2003     | DHS      |
| 21188 | GHA     | 2008   | 2008     | DHS      |
| 157027| GHA     | 2014   | 2014     | DHS      |
| 218572| GHA     | 2017   | 2017     | DHS_SPECIAL |
| 19683 | GIN     | 2005   | 2005     | DHS      |
| 69761 | GIN     | 2012   | 2012     | DHS      |
| Code  | Country | Start Year | End Year | Agency   |
|-------|---------|------------|----------|----------|
| 77384 | GMB     | 2013       | 2013     | DHS      |
| 157031| GTM     | 2014       | 2015     | DHS      |
| 21348 | GUY     | 2009       | 2009     | DHS      |
| 19728 | HND     | 2005       | 2006     | DHS      |
| 95440 | HND     | 2011       | 2012     | DHS      |
| 19708 | HTI     | 2000       | 2000     | DHS      |
| 19720 | HTI     | 2005       | 2006     | DHS      |
| 65118 | HTI     | 2012       | 2012     | DHS      |
| 218574| HTI     | 2016       | 2017     | DHS      |
| 20011 | IDN     | 2002       | 2003     | DHS      |
| 20021 | IDN     | 2007       | 2007     | DHS      |
| 76705 | IDN     | 2012       | 2012     | DHS      |
| 19950 | IND     | 1998       | 2000     | DHS      |
| 19963 | IND     | 2005       | 2006     | DHS      |
| 157050| IND     | 2015       | 2016     | DHS      |
| 20073 | JOR     | 2002       | 2002     | DHS      |
| 20083 | JOR     | 2007       | 2007     | DHS      |
| 21206 | JOR     | 2009       | 2009     | DHS       |
| 77517 | JOR     | 2012       | 2012     | DHS      |
| 20145 | KEN     | 2003       | 2003     | DHS      |
| 21365 | KEN     | 2008       | 2009     | DHS      |
| 157057| KEN     | 2014       | 2014     | DHS      |
| 77518 | KGZ     | 2012       | 2012     | DHS      |
| 19156 | KHM     | 2000       | 2000     | DHS      |
| 19167 | KHM     | 2005       | 2006     | DHS      |
| 30379 | KHM     | 2010       | 2011     | DHS      |
| 157024| KHM     | 2014       | 2014     | DHS      |
| 20191 | LBR     | 2006       | 2007     | DHS      |
| 77385 | LBR     | 2013       | 2013     | DHS      |
| 20167 | LSO     | 2004       | 2005     | DHS      |
| 21382 | LSO     | 2009       | 2010     | DHS      |
| 157058| LSO     | 2014       | 2014     | DHS      |
| 20361 | MAR     | 2003       | 2004     | DHS      |
| 20223 | MDG     | 2003       | 2004     | DHS      |
| 21409 | MDG     | 2008       | 2009     | DHS      |
| Code   | Country | Start Year | End Year | Agency | Type |
|--------|---------|------------|----------|--------|------|
| 20315  | MLI     | 2001       | 2001     | DHS    | HH   |
| 20274  | MLI     | 2006       | 2006     | DHS    | HH   |
| 77388  | MLI     | 2012       | 2013     | DHS    | HH   |
| 157061 | MMR     | 2015       | 2016     | DHS    | HH   |
| 20394  | MOZ     | 2003       | 2004     | DHS    | HH   |
| 55975  | MOZ     | 2011       | 2011     | DHS    | HH   |
| 20322  | MRT     | 2000       | 2001     | DHS    | HH   |
| 20252  | MWI     | 2000       | 2000     | DHS    | HH   |
| 20263  | MWI     | 2004       | 2005     | DHS    | HH   |
| 21393  | MWI     | 2010       | 2010     | DHS    | HH   |
| 218581 | MWI     | 2015       | 2016     | DHS    | HH   |
| 20417  | NAM     | 2000       | 2000     | DHS    | HH   |
| 20428  | NAM     | 2006       | 2007     | DHS    | HH   |
| 150382 | NAM     | 2013       | 2013     | DHS    | HH   |
| 20499  | NER     | 2006       | 2006     | DHS    | HH   |
| 74393  | NER     | 2012       | 2012     | DHS    | HH   |
| 20567  | NGA     | 2003       | 2003     | DHS    | HH   |
| 21433  | NGA     | 2008       | 2008     | DHS    | HH   |
| 77390  | NGA     | 2013       | 2013     | DHS    | HH   |
| 20487  | NIC     | 2001       | 2001     | DHS    | HH   |
| 20450  | NPL     | 2001       | 2001     | DHS    | HH   |
| 20462  | NPL     | 2006       | 2006     | DHS    | HH   |
| 21240  | NPL     | 2011       | 2011     | DHS    | HH   |
| 286782 | NPL     | 2016       | 2017     | DHS    | HHM  |
| 20595  | PAK     | 2006       | 2007     | DHS    | HH   |
| 77521  | PAK     | 2012       | 2013     | DHS    | HH   |
| 20649  | PER     | 2000       | 2000     | DHS    | HH   |
| 275090 | PER     | 2003       | 2008     | DHS    | HH   |
| 270404 | PER     | 2009       | 2009     | DHS    | HH   |
| 270469 | PER     | 2010       | 2010     | DHS    | HH   |
| 270470 | PER     | 2011       | 2011     | DHS    | HH   |
| 270471 | PER     | 2012       | 2012     | DHS    | HH   |
| 210182 | PER     | 2014       | 2014     | DHS    | HHM  |
| 21421  | PHL     | 2008       | 2008     | DHS    | HH   |
| 142943 | PHL     | 2013       | 2013     | DHS    | HH   |
| Code   | Country | Start Year | End Year | Agency   | Survey Type |
|--------|---------|------------|----------|----------|-------------|
| 337877 | PHL     | 2017       | 2017     | DHS      | HH          |
| 44870  | PNG     | 2006       | 2007     | MACRO_DHS| HH          |
| 20722  | RWA     | 2000       | 2000     | DHS      | HH          |
| 20740  | RWA     | 2005       | 2005     | DHS      | HH          |
| 21222  | RWA     | 2007       | 2008     | DHS_INTERIM| HH         |
| 56040  | RWA     | 2010       | 2011     | DHS      | HH          |
| 157063 | RWA     | 2014       | 2015     | DHS      | HH          |
| 26855  | SEN     | 2005       | 2005     | DHS      | HH          |
| 56063  | SEN     | 2010       | 2011     | DHS      | HH          |
| 111432 | SEN     | 2012       | 2013     | DHS      | HH          |
| 191270 | SEN     | 2014       | 2014     | DHS      | HH          |
| 218592 | SEN     | 2015       | 2015     | DHS      | HH          |
| 286772 | SEN     | 2016       | 2016     | DHS      | HH          |
| 353526 | SEN     | 2017       | 2017     | DHS      | HH          |
| 21258  | SLE     | 2008       | 2008     | DHS      | HH          |
| 131467 | SLE     | 2013       | 2013     | DHS      | HH          |
| 26866  | STP     | 2008       | 2009     | DHS      | HH          |
| 20829  | SWZ     | 2006       | 2007     | DHS      | HH          |
| 157025 | TCD     | 2014       | 2015     | DHS      | HH          |
| 77515  | TGO     | 2013       | 2014     | DHS      | WN          |
| 74460  | TJK     | 2012       | 2012     | DHS      | HH          |
| 341838 | TJK     | 2017       | 2017     | DHS      | HH          |
| 21274  | TLS     | 2009       | 2010     | DHS      | HH          |
| 20875  | TZA     | 2004       | 2005     | DHS      | HH          |
| 21331  | TZA     | 2009       | 2010     | DHS      | HH          |
| 218593 | TZA     | 2015       | 2016     | DHS      | HH          |
| 20993  | UGA     | 2000       | 2001     | DHS      | HH          |
| 21014  | UGA     | 2006       | 2006     | DHS      | HH          |
| 56021  | UGA     | 2011       | 2011     | DHS      | HH          |
| 286780 | UGA     | 2016       | 2016     | DHS      | HH          |
| 112500 | YEM     | 2013       | 2013     | DHS      | HH          |
| 21102  | ZMB     | 2001       | 2002     | DHS      | HH          |
| 21117  | ZMB     | 2007       | 2007     | DHS      | HH          |
| 77516  | ZMB     | 2013       | 2014     | DHS      | HH          |
| 21163  | ZWE     | 2005       | 2006     | DHS      | HH          |
| Code  | Country | Year 1  | Year 2  | Agency               | Code  |
|-------|---------|---------|---------|----------------------|-------|
| 55992 | ZWE     | 2010    | 2011    | DHS                  | HH    |
| 157066| ZWE     | 2015    | 2015    | DHS                  | HH    |
| 56099 | AFG     | 2010    | 2010    | DHS_SPECIAL          | HH    |
| 21173 | GHA     | 2007    | 2008    | DHS_SPECIAL          | HH    |
| 21173 | GHA     | 2007    | 2008    | DHS_SPECIAL          | WN    |
| 137351| IDN     | 2012    | 2012    | DHS_SPECIAL          | HH    |
| 20040 | IDN     | 2002    | 2003    | MACRO_DHS_SP        | HHM   |
| 21039 | UZB     | 2002    | 2002    | DHS_SPECIAL          | HH    |
| 672   | AGO     | 2007    | 2007    | DHS_MIS             | HH    |
| 56169 | AGO     | 2011    | 2011    | DHS_MIS             | HH    |
| 108080| BDI     | 2012    | 2013    | DHS_MIS             | HHM   |
| 188785| BFA     | 2014    | 2014    | DHS_MIS             | HH    |
| 286788| GHA     | 2016    | 2016    | DHS_MIS             | HH    |
| 58006 | KEN     | 2010    | 2010    | DHS_MIS             | HH    |
| 34279 | LBR     | 2008    | 2009    | DHS_MIS             | HH    |
| 56828 | LBR     | 2011    | 2011    | DHS_MIS             | HH    |
| 286768| LBR     | 2016    | 2016    | DHS_MIS             | HHM   |
| 69806 | MDG     | 2011    | 2011    | DHS_MIS             | HH    |
| 111438| MDG     | 2013    | 2013    | DHS_MIS             | HH    |
| 218580| MDG     | 2016    | 2016    | DHS_MIS             | HH    |
| 218587| MLI     | 2015    | 2015    | DHS_MIS             | HH    |
| 77387 | MWI     | 2012    | 2012    | DHS_MIS             | HH    |
| 157059| MWI     | 2014    | 2014    | DHS_MIS             | HH    |
| 30991 | NGA     | 2010    | 2010    | DHS_MIS             | HH    |
| 218590| NGA     | 2015    | 2015    | DHS_MIS             | HH    |
| 77391 | RWA     | 2012    | 2013    | DHS_MIS             | HH    |
| 350836| RWA     | 2017    | 2017    | DHS_MIS             | HHM   |
| 11540 | SEN     | 2008    | 2009    | DHS_MIS             | HH    |
| 286773| SLE     | 2016    | 2016    | DHS_MIS             | HH    |
| 359318| TGO     | 2017    | 2017    | DHS_MIS             | HHM   |
| 350798| TZA     | 2017    | 2017    | DHS_MIS             | HH    |
| 13109 | UGA     | 2009    | 2010    | DHS_MIS             | HH    |
| 157065| UGA     | 2014    | 2015    | DHS_MIS             | HH    |
| 150485| MAR     | 2009    | 2010    | MAR/HOUSEHOLD_AND_YOUTH_SURVEY | HHM |
| Code | Country | Start Year | End Year | Survey Title | Variable Type |
|------|---------|------------|----------|--------------|---------------|
| 8684 | MEX | 2002 | 2003 | MEX/NATIONAL_PERFORMANCE_EVALUATION_SURVEY_ENED | HH |
| 23982 | MEX | 2006 | 2006 | MEX/SURVEY_DEMOGRAPHIC_DYNAMICS_ENADID | HH |
| 8618 | MEX | 2005 | 2006 | MEX/SURVEY_HEALTH_AND_NUTRITION_ENSANIT | HH |
| 8618 | MEX | 2005 | 2006 | MEX/SURVEY_HEALTH_AND_NUTRITION_ENSANUT | HH |
| 81748 | MEX | 2011 | 2012 | MEX/SURVEY_HEALTH_AND_NUTRITION_ENSANUT | HH |
| 165610 | MEX | 2012 | 2012 | MEX/SURVEY_INCOME_AND HOUSEHOLD_EXPENDITURE_ENIGH | HH |
| 165610 | MEX | 2012 | 2012 | MEX/SURVEY_INCOME_AND HOUSEHOLD_EXPENDITURE_ENIGH | HH |
| 93321 | MEX | 2010 | 2010 | MEX/SURVEY_INCOME_AND HOUSEHOLD_EXPENDITURE_ENIGH | HH |
| 25358 | MEX | 2008 | 2008 | MEX/SURVEY_INCOME_AND HOUSEHOLD_EXPENDITURE_ENIGH | HH |
| 25335 | MEX | 2006 | 2006 | MEX/SURVEY_INCOME_AND HOUSEHOLD_EXPENDITURE_ENIGH | HH |
| 25317 | MEX | 2005 | 2005 | MEX/SURVEY_INCOME_AND HOUSEHOLD_EXPENDITURE_ENIGH | HH |
| 25293 | MEX | 2004 | 2004 | MEX/SURVEY_INCOME_AND HOUSEHOLD_EXPENDITURE_ENIGH | HH |
| 25273 | MEX | 2002 | 2002 | MEX/SURVEY_INCOME_AND HOUSEHOLD_EXPENDITURE_ENIGH | HH |
| 25254 | MEX | 2000 | 2000 | MEX/SURVEY_INCOME_AND HOUSEHOLD_EXPENDITURE_ENIGH | HH |
| 141910 | MMR | 2003 | 2003 | MMR/MULTIPLE_INDICATOR_CLUSTERSURVEY | HH |
| 134132 | NAM | 2011 | 2011 | NAM/CENSUS | HHM |
| 134371 | NAM | 2009 | 2010 | NAM/NAN/HH_INCOME_AND_EXPENDITURE_SURVEY | HHM |
| 24890 | NGA | 2006 | 2007 | NGA/GENERAL_HOUSEHOLD_SURVEY | HHM |
| 24915 | NGA | 2007 | 2008 | NGA/GENERAL_HOUSEHOLD_SURVEY | HHM |
| 151719 | NGA | 2008 | 2010 | NGA/LIVING_STANDARDS_SURVEY | HHM |
| 126952 | NIC | 2011 | 2012 | NIC/DHS_ENDESA | HH |
| 9951 | PAK | 2004 | 2005 | PAK/SOCIAL_AND_LIVING_MEASUREMENT_SURVEY | HHM |
| 265082 | PAK | 2014 | 2015 | PAK/SOCIAL_AND_LIVING_MEASUREMENT_SURVEY | HHM |
| 303663 | PER | 2015 | 2015 | PER/DEMOGRAPHIC_AND_FAMILY_HEALTH_SURVEY_END | HH |
| 358824 | PER | 2017 | 2017 | PER/DEMOGRAPHIC_AND_FAMILY_HEALTH_SURVEY_END | HH |
| 44275 | PER | 2000 | 2000 | PER/NATIONAL_HH_SURVEY_ENAHO | HH |
| 44315 | PER | 2000 | 2000 | PER/NATIONAL_HH_SURVEY_ENAHO | HH |
| Code  | Country | Year1 | Year2 | Survey Code                          | Region |
|-------|---------|-------|-------|-------------------------------------|--------|
| 44470 | PER     | 2001  | 2001  | PER/NATIONAL_HH_SURVEY_ENAHO        | HH     |
| 44696 | PER     | 2002  | 2002  | PER/NATIONAL_HH_SURVEY_ENAHO        | HH     |
| 44748 | PER     | 2003  | 2004  | PER/NATIONAL_HH_SURVEY_ENAHO        | HH     |
| 49279 | PER     | 2004  | 2004  | PER/NATIONAL_HH_SURVEY_ENAHO        | HH     |
| 49429 | PER     | 2006  | 2006  | PER/NATIONAL_HH_SURVEY_ENAHO        | HH     |
| 33702 | PER     | 2009  | 2009  | PER/NATIONAL_HH_SURVEY_ENAHO        | HH     |
| 33829 | PER     | 2010  | 2010  | PER/NATIONAL_HH_SURVEY_ENAHO        | HH     |
| 265406| PER     | 2014  | 2014  | PER/NATIONAL_HH_SURVEY_ENAHO        | HH     |
| 265409| PER     | 2015  | 2015  | PER/NATIONAL_HH_SURVEY_ENAHO        | HH     |
| 283383| PER     | 2016  | 2016  | PER/NATIONAL_HH_SURVEY_ENAHO        | HH     |
| 126396| PHL     | 2011  | 2011  | PHL/FNRI                            | HH     |
| 243566| PRY     | 2014  | 2014  | PRY/PERMANENT_HH_SURVEY_EPH         | HH     |
| 243564| PRY     | 2013  | 2013  | PRY/PERMANENT_HH_SURVEY_EPH         | HH     |
| 243562| PRY     | 2012  | 2012  | PRY/PERMANENT_HH_SURVEY_EPH         | HH     |
| 336799| PRY     | 2016  | 2016  | PRY/PERMANENT_HH_SURVEY_EPH         | HH     |
| 286233| PRY     | 2015  | 2015  | PRY/PERMANENT_HH_SURVEY_EPH         | HH     |
| 367995| PRY     | 2017  | 2017  | PRY/PERMANENT_HH_SURVEY_EPH         | HH     |
| 243548| PRY     | 2011  | 2011  | PRY/PERMANENT_HH_SURVEY_EPH         | HH     |
| 243537| PRY     | 2010  | 2010  | PRY/PERMANENT_HH_SURVEY_EPH         | HH     |
| 41856 | PRY     | 2009  | 2009  | PRY/PERMANENT_HH_SURVEY_EPH         | HH     |
| 41851 | PRY     | 2008  | 2008  | PRY/PERMANENT_HH_SURVEY_EPH         | HH     |
| 41844 | PRY     | 2007  | 2007  | PRY/PERMANENT_HH_SURVEY_EPH         | HH     |
| 41837 | PRY     | 2006  | 2006  | PRY/PERMANENT_HH_SURVEY_EPH         | HH     |
| 41830 | PRY     | 2005  | 2005  | PRY/PERMANENT_HH_SURVEY_EPH         | HH     |
| 41823 | PRY     | 2004  | 2004  | PRY/PERMANENT_HH_SURVEY_EPH         | HH     |
| 10377 | PRY     | 2003  | 2003  | PRY/PERMANENT_HH_SURVEY_EPH         | HH     |
| 10373 | PRY     | 2002  | 2002  | PRY/PERMANENT_HH_SURVEY_EPH         | HH     |
| 10040 | PSE     | 2007  | 2008  | PSE/CENSUS                          | HHM    |
| 264956| IDN     | 2014  | 2015  | RAND_FLS/IDN                        | HHM    |
| 6464  | IDN     | 2007  | 2007  | RAND_FLS/IDN                        | HHM    |
| 6111  | IDN     | 2000  | 2000  | RAND_FLS/IDN                        | HH     |
| 58185 | RWA     | 2006  | 2006  | RWA/COMPREHENSIVE_FOOD_SECURITY_AND_VULNERABILITY_ASSESSMENT | HH |
| 151436 | RWA | 2012  | 2012  | RWA/COMPREHENSIVE_FOOD_SECURITY_AND_VULNERABILITY_ASSESSMENT | CH |
| 151437 | RWA | 2010  | 2011  | RWA/INTEGRATED_LIVING_CONDITIONS_SURVEY_EICV | HHM |
| Code     | Country | Start Year | End Year | Survey Description                                                                 | Code | Country | Start Year | End Year | Survey Description                                                                 |
|----------|---------|------------|----------|-------------------------------------------------------------------------------------|------|---------|------------|----------|-------------------------------------------------------------------------------------|
| 97       | RWA     | 2008       | 2008     | RWA/VISION_2020 UMURENGE_PROGRAM_BASELINE_SURVEY                                   |      | HHM     |            |          |                                                      |
| 30368    | SSD     | 2009       | 2009     | SDN/NATIONAL_BASELINE_HOUSEHOLD_SURVEY                                              |      | HH      |            |          |                                                      |
| 30349    | SSD     | 2009       | 2009     | SDN/NORTH_NATIONAL_BASELINE_HH_SURVEY                                                |      | HH      |            |          |                                                      |
| 165017   | SLV     | 2013       | 2013     | SLV/MULTIPURPOSE_HH_SURVEY_EHPM                                                      |      | HH      |            |          |                                                      |
| 238389   | SLV     | 2014       | 2014     | SLV/MULTIPURPOSE_HH_SURVEY_EHPM                                                      |      | HHM     |            |          |                                                      |
| 137328   | SLV     | 2012       | 2012     | SLV/MULTIPURPOSE_HH_SURVEY_EHPM                                                      |      | HH      |            |          |                                                      |
| 240604   | MEX     | 2014       | 2014     | SURVEY_DEMOGRAPHIC_DYNAMICS_ENADID                                                   |      | HHM     |            |          |                                                      |
| 31740    | TZA     | 2000       | 2001     | TZA/HH_BUDGET_SURVEY                                                                  |      | HH      |            |          |                                                      |
| 31887    | TZA     | 2007       | 2007     | TZA/HH_BUDGET_SURVEY                                                                  |      | HH      |            |          |                                                      |
| 280228   | TZA     | 2014       | 2014     | TZA/INTEGRATED_LABOR_FORCE_SURVEY_ILFS                                                |      | HH      |            |          |                                                      |
| 23687    | UGA     | 2005       | 2006     | UGA/HOUSEHOLD_SURVEY                                                                 |      | HH      |            |          |                                                      |
| 56830    | AFG     | 2010       | 2011     | UNICEF_MICS                                                                         |      | HH      |            |          |                                                      |
| 1981     | BDI     | 2005       | 2005     | UNICEF_MICS                                                                         |      | HH      |            |          |                                                      |
| 206075   | BEN     | 2014       | 2014     | UNICEF_MICS                                                                         |      | HH      |            |          |                                                      |
| 1927     | BFA     | 2006       | 2006     | UNICEF_MICS                                                                         |      | HH      |            |          |                                                      |
| 951      | BGD     | 2006       | 2006     | UNICEF_MICS                                                                         |      | HH      |            |          |                                                      |
| 151086   | BGD     | 2012       | 2013     | UNICEF_MICS                                                                         |      | HH      |            |          |                                                      |
| 1089     | BLZ     | 2006       | 2006     | UNICEF_MICS                                                                         |      | HH      |            |          |                                                      |
| 76699    | BLZ     | 2011       | 2011     | UNICEF_MICS                                                                         |      | HH      |            |          |                                                      |
| 40028    | BTN     | 2010       | 2010     | UNICEF_MICS                                                                         |      | HH      |            |          |                                                      |
| 2223     | CAF     | 2006       | 2006     | UNICEF_MICS                                                                         |      | HH      |            |          |                                                      |
| 82832    | CAF     | 2010       | 2011     | UNICEF_MICS                                                                         |      | HH      |            |          |                                                      |
| 26433    | CIV     | 2006       | 2006     | UNICEF_MICS                                                                         |      | HH      |            |          |                                                      |
| 218611   | CIV     | 2016       | 2016     | UNICEF_MICS                                                                         |      | HH      |            |          |                                                      |
| 2053     | CMR     | 2000       | 2000     | UNICEF_MICS                                                                         |      | HH      |            |          |                                                      |
| 2063     | CMR     | 2006       | 2006     | UNICEF_MICS                                                                         |      | HH      |            |          |                                                      |
| 244455   | CMR     | 2014       | 2014     | UNICEF_MICS                                                                         |      | HH      |            |          |                                                      |
| 26998    | COD     | 2010       | 2010     | UNICEF_MICS                                                                         |      | HH      |            |          |                                                      |
| 234733   | COG     | 2014       | 2015     | UNICEF_MICS                                                                         |      | HH      |            |          |                                                      |
| 3114     | COM     | 2000       | 2000     | UNICEF_MICS                                                                         |      | HH      |            |          |                                                      |
| 125596   | CRI     | 2011       | 2011     | UNICEF_MICS                                                                         |      | HH      |            |          |                                                      |
| 3404     | DJI     | 2006       | 2006     | UNICEF_MICS                                                                         |      | HH      |            |          |                                                      |
| 200697   | DOM     | 2014       | 2014     | UNICEF_MICS                                                                         |      | HH      |            |          |                                                      |
| 210614   | DZA     | 2012       | 2013     | UNICEF_MICS                                                                         |      | HH      |            |          |                                                      |
| Code  | Country | Year1 | Year2 | Source | CodeType |
|-------|---------|-------|-------|--------|----------|
| 159617| EGY     | 2013  | 2014  | UNICEF_MICS | HH       |
| 4694  | GHA     | 2006  | 2006  | UNICEF_MICS | HH       |
| 160576| GHA     | 2007  | 2008  | UNICEF_MICS | HH       |
| 56241 | GHA     | 2010  | 2011  | UNICEF_MICS | HH       |
| 63993 | GHA     | 2011  | 2011  | UNICEF_MICS | HH       |
| 303458| GIN     | 2016  | 2016  | UNICEF_MICS | HH       |
| 3935  | GMB     | 2005  | 2006  | UNICEF_MICS | HH       |
| 91506 | GMB     | 2010  | 2010  | UNICEF_MICS | HH       |
| 4818  | GNB     | 2006  | 2006  | UNICEF_MICS | HH       |
| 174049| GNB     | 2014  | 2014  | UNICEF_MICS | HH       |
| 27215 | GNB     | 2010  | 2010  | UNICEF_MICS | WN       |
| 4916  | GUY     | 2000  | 2000  | UNICEF_MICS | HH       |
| 4926  | GUY     | 2006  | 2007  | UNICEF_MICS | HH       |
| 200598| GUY     | 2014  | 2014  | UNICEF_MICS | HH       |
| 7028  | IRQ     | 2006  | 2006  | UNICEF_MICS | HH       |
| 76707 | IRQ     | 2011  | 2011  | UNICEF_MICS | HH       |
| 141336| JAM     | 2011  | 2011  | UNICEF_MICS | HH       |
| 7387  | KEN     | 2000  | 2000  | UNICEF_MICS | HH       |
| 155335| KEN     | 2007  | 2007  | UNICEF_MICS | HH       |
| 7401  | KEN     | 2008  | 2008  | UNICEF_MICS | HH       |
| 56420 | KEN     | 2009  | 2009  | UNICEF_MICS | HH       |
| 7540  | KGZ     | 2005  | 2006  | UNICEF_MICS | HH       |
| 162283| KGZ     | 2014  | 2014  | UNICEF_MICS | HH       |
| 7629  | LAO     | 2006  | 2006  | UNICEF_MICS | HH       |
| 103973| LAO     | 2011  | 2012  | UNICEF_MICS | HH       |
| 375362| LAO     | 2017  | 2017  | UNICEF_MICS | HHM      |
| 125594| MDG     | 2012  | 2012  | UNICEF_MICS | HH       |
| 264590| MEX     | 2015  | 2015  | UNICEF_MICS | HH       |
| 270627| MLI     | 2009  | 2010  | UNICEF_MICS | HH       |
| 248224| MLI     | 2015  | 2015  | UNICEF_MICS | HH       |
| 90696 | MMR     | 2009  | 2010  | UNICEF_MICS | HHM      |
| 8788  | MNG     | 2000  | 2000  | UNICEF_MICS | HH       |
| 8777  | MNG     | 2005  | 2005  | UNICEF_MICS | HH       |
| 76704 | MNG     | 2010  | 2010  | UNICEF_MICS | HH       |
| 150866| MNG     | 2013  | 2013  | UNICEF_MICS | HH       |
| Code   | Country | Start Year | End Year | Survey Type | Sector |
|--------|---------|------------|----------|-------------|--------|
| 189048 | MNG     | 2012       | 2012     | UNICEF_MICS | HH     |
| 27031  | MOZ     | 2008       | 2009     | UNICEF_MICS | HH     |
| 8115   | MRT     | 2007       | 2007     | UNICEF_MICS | HH     |
| 152783 | MRT     | 2011       | 2011     | UNICEF_MICS | HH     |
| 7919   | MWI     | 2006       | 2006     | UNICEF_MICS | HH     |
| 161662 | MWI     | 2013       | 2014     | UNICEF_MICS | HH     |
| 9516   | NGA     | 2007       | 2007     | UNICEF_MICS | HH     |
| 76703  | NGA     | 2011       | 2011     | UNICEF_MICS | HH     |
| 218613 | NGA     | 2016       | 2017     | UNICEF_MICS | HH     |
| 39999  | NPL     | 2010       | 2010     | UNICEF_MICS | HH     |
| 162317 | NPL     | 2014       | 2014     | UNICEF_MICS | HH     |
| 32470  | PRY     | 2016       | 2016     | UNICEF_MICS | HH     |
| 125591 | PSE     | 2010       | 2010     | UNICEF_MICS | HH     |
| 161590 | PSE     | 2014       | 2014     | UNICEF_MICS | HH     |
| 12243  | SDN     | 2000       | 2000     | UNICEF_MICS | HH     |
| 153643 | SDN     | 2010       | 2010     | UNICEF_MICS | HH     |
| 200617 | SDN     | 2014       | 2014     | UNICEF_MICS | HH     |
| 27044  | SEN     | 2000       | 2000     | UNICEF_MICS | HH     |
| 287639 | SEN     | 2015       | 2016     | UNICEF_MICS | HH     |
| 11649  | SLE     | 2005       | 2005     | UNICEF_MICS | HH     |
| 76700  | SLE     | 2010       | 2010     | UNICEF_MICS | HH     |
| 218619 | SLE     | 2017       | 2017     | UNICEF_MICS | HH     |
| 200636 | SLV     | 2014       | 2014     | UNICEF_MICS | HH     |
| 11774  | SOM     | 2006       | 2006     | UNICEF_MICS | HH     |
| 91508  | SOM     | 2011       | 2011     | UNICEF_MICS | HH     |
| 91507  | SOM     | 2011       | 2011     | UNICEF_MICS | HH     |
| 12232  | SSD     | 2000       | 2000     | UNICEF_MICS | HH     |
| 32189  | SSD     | 2010       | 2010     | UNICEF_MICS | HH     |
| 27055  | STP     | 2000       | 2000     | UNICEF_MICS | HH     |
| 214640 | STP     | 2014       | 2014     | UNICEF_MICS | HH     |
| 12289  | SUR     | 2006       | 2006     | UNICEF_MICS | HH     |
| 81203  | SUR     | 2010       | 2010     | UNICEF_MICS | HH     |
| 12320  | SWZ     | 2000       | 2000     | UNICEF_MICS | HH     |
| 30325  | SWZ     | 2010       | 2010     | UNICEF_MICS | HH     |
| 200707 | SWZ     | 2014       | 2014     | UNICEF_MICS | HH     |
| Code  | Country | Year1 | Year2 | Survey | Type |
|-------|---------|-------|-------|--------|------|
| 12399 | SYR     | 2006  | 2006  | UNICEF_MICS | HH   |
| 76701 | TCD     | 2010  | 2010  | UNICEF_MICS | HH   |
| 12896 | TGO     | 2006  | 2006  | UNICEF_MICS | HH   |
| 40021 | TGO     | 2010  | 2010  | UNICEF_MICS | HH   |
| 12732 | THA     | 2005  | 2006  | UNICEF_MICS | HH   |
| 148649| THA     | 2012  | 2012  | UNICEF_MICS | HH   |
| 296646| THA     | 2015  | 2016  | UNICEF_MICS | HH   |
| 331377| THA     | 2016  | 2016  | UNICEF_MICS | HH   |
| 12595 | TJK     | 2000  | 2000  | UNICEF_MICS | HH   |
| 12608 | TJK     | 2005  | 2005  | UNICEF_MICS | HH   |
| 13064 | TKM     | 2006  | 2006  | UNICEF_MICS | HH   |
| 264583| TKM     | 2015  | 2016  | UNICEF_MICS | HH   |
| 12950 | TTO     | 2006  | 2006  | UNICEF_MICS | HH   |
| 76709 | TUN     | 2011  | 2012  | UNICEF_MICS | HH   |
| 13445 | UZB     | 2006  | 2006  | UNICEF_MICS | HH   |
| 13719 | VNM     | 2006  | 2006  | UNICEF_MICS | HH   |
| 57999 | VNM     | 2010  | 2011  | UNICEF_MICS | HH   |
| 152735| VNM     | 2013  | 2014  | UNICEF_MICS | HH   |
| 13816 | YEM     | 2006  | 2006  | UNICEF_MICS | HH   |
| 35493 | ZWE     | 2009  | 2009  | UNICEF_MICS | HH   |
| 152720| ZWE     | 2014  | 2014  | UNICEF_MICS | HH   |
| 151568| AGO     | 2011  | 2011  | WB_CWIQ   | HHM  |
| 1855  | BFA     | 2003  | 2003  | WB_CWIQ   | HH   |
| 22950 | BFA     | 2005  | 2005  | WB_CWIQ   | HH   |
| 18499 | BFA     | 2007  | 2007  | WB_CWIQ   | HH   |
| 23017 | GHA     | 2003  | 2003  | WB_CWIQ   | HH   |
| 9522  | NGA     | 2006  | 2006  | WB_CWIQ   | HH   |
| 31797 | TZA     | 2005  | 2005  | WB_CWIQ   | HH   |
| 31831 | TZA     | 2006  | 2007  | WB_CWIQ   | HH   |
| 31786 | TZA     | 2004  | 2004  | WB_CWIQ   | HHM  |
| 4679  | GHA     | 2005  | 2006  | WB_LSMS   | HHM  |
| 165101| GHA     | 2012  | 2013  | WB_LSMS   | HH   |
| 46317 | MWI     | 2004  | 2005  | WB_LSMS   | HH   |
| 9422  | NIC     | 2001  | 2001  | WB_LSMS   | HH   |
| 44645 | NIC     | 2005  | 2005  | WB_LSMS   | HH   |
|   | Country | Year1 | Year2 | Study | Group |
|---|---------|-------|-------|-------|-------|
| 46480 | NPL | 2003 | 2004 | WB_LSMS | HH |
| 94168 | NPL | 2010 | 2011 | WB_LSMS | HHM |
| 10224 | PAN | 2003 | 2003 | WB_LSMS | HH |
| 46517 | PAN | 2008 | 2008 | WB_LSMS | HH |
| 12863 | TLS | 2001 | 2001 | WB_LSMS | HHM |
| 46682 | TLS | 2007 | 2008 | WB_LSMS | HH |
| 235215 | ETH | 2013 | 2014 | WB_LSMS_ISA | HH |
| 286657 | ETH | 2015 | 2016 | WB_LSMS_ISA | HH |
| 260407 | MLI | 2014 | 2015 | WB_LSMS_ISA | HHM |
| 224223 | MWI | 2013 | 2013 | WB_LSMS_ISA | HH |
| 94140 | NER | 2011 | 2012 | WB_LSMS_ISA | HH |
| 27297 | TZA | 2008 | 2009 | WB_LSMS_ISA | HH |
| 81005 | TZA | 2010 | 2011 | WB_LSMS_ISA | HH |
| 224096 | TZA | 2012 | 2013 | WB_LSMS_ISA | HHM |
| 311265 | TZA | 2014 | 2016 | WB_LSMS_ISA | HHM |
| 299064 | LKA | 2012 | 2012 | WB_STEP_HH_SURVEY | HH |
| 299045 | VNM | 2012 | 2012 | WB_STEP_HH_SURVEY | HH |
| 111485 | GHA | 2007 | 2008 | WHO_SAGE | HH |
| 111488 | ZAF | 2007 | 2008 | WHO_SAGE | HH |
| 244480 | YEM | 2014 | 2014 | YEM/COMPREHENSIVE_FOOD_SECURITY_SURVEY_CFSS | HH |
| 22882 | YEM | 2005 | 2006 | YEM/HH_BUDGET_SURVEY | HH |
| 249499 | YEM | 2012 | 2013 | YEM/NATIONAL_SOCIAL_PROTECTION_MONITORING_SURVEY_NSPMS | HHM |
| 12146 | ZAF | 2011 | 2011 | ZAF/CENSUS | HH |
| 280803 | ZAF | 2016 | 2016 | ZAF/COMMUNITY_SURVEY | HHM |
| 25100 | ZAF | 2007 | 2007 | ZAF/COMMUNITY_SURVEY | HHM |
| 115481 | ZAF | 2002 | 2002 | ZAF/HH_SURVEY | HHM |
| 11787 | ZAF | 2003 | 2003 | ZAF/HH_SURVEY | HHM |
| 11788 | ZAF | 2004 | 2004 | ZAF/HH_SURVEY | HHM |
| 11789 | ZAF | 2005 | 2005 | ZAF/HH_SURVEY | HHM |
| 115486 | ZAF | 2006 | 2006 | ZAF/HH_SURVEY | HHM |
| 11790 | ZAF | 2007 | 2007 | ZAF/HH_SURVEY | HHM |
| 115488 | ZAF | 2008 | 2008 | ZAF/HH_SURVEY | HHM |
| 115489 | ZAF | 2009 | 2009 | ZAF/HH_SURVEY | HH |
| 115490 | ZAF | 2010 | 2010 | ZAF/HH_SURVEY | HH |
| Code | Country | Year | Year | Survey Title | Code |
|------|---------|------|------|--------------|------|
| 115491 | ZAF | 2011 | 2011 | ZAF/HH_SURVEY | HH |
| 238485 | ZAF | 2014 | 2014 | ZAF/HH_SURVEY | HH |
| 265084 | ZAF | 2015 | 2015 | ZAF/HH_SURVEY | HH |
| 238483 | ZAF | 2013 | 2013 | ZAF/HH_SURVEY | HH |
| 317089 | ZAF | 2016 | 2016 | ZAF/HH_SURVEY | HH |
| 11848 | ZAF | 2005 | 2006 | ZAF/INCOME_AND_EXPENDITURE_SURVEY | HH |
| 265153 | ZAF | 2014 | 2015 | ZAF/NATIONAL_INCOME_DYNAMICS_STUDY | HH |
| 369644 | ZAF | 2017 | 2017 | ZAF/NATIONAL_INCOME_DYNAMICS_STUDY | HH |
| 14027 | ZMB | 2002 | 2003 | ZMB/LCMS | HHM |
| 14063 | ZMB | 2004 | 2005 | ZMB/LCMS | HH |
| 14105 | ZMB | 2006 | 2006 | ZMB/LCMS | HH |
| 58660 | ZMB | 2010 | 2010 | ZMB/LCMS | HH |
| 286783 | PAK | 2017 | 2018 | DHS | HH |
| 237943 | IDN | 2015 | 2015 | IDN/INTERCENSAL_POPULATION_SURVEY_SUPAS | HH |
| 165186 | IDN | 2014 | 2014 | IDN/SOCIOECONOMIC_SURVEY_SUSENAS | HH |
| 238332 | IDN | 2015 | 2015 | IDN/SOCIOECONOMIC_SURVEY_SUSENAS | HH |
| 282087 | IDN | 2016 | 2016 | IDN/SOCIOECONOMIC_SURVEY_SUSENAS | HH |
| 395694 | IDN | 2017 | 2017 | IDN/SOCIOECONOMIC_SURVEY_SUSENAS | HH |
| 356955 | JOR | 2017 | 2018 | DHS | HH |
| 218565 | BEN | 2017 | 2018 | DHS | HHM |
| 369294 | CHN | 2016 | 2016 | CHINESE_FAMILY_PANEL_STUDIES_CFPS/2016 | HH |
| 286781 | IDN | 2017 | 2017 | DHS | HH |
| 393799 | ZAF | 2016 | 2016 | ZAF/HH_SURVEY | HH |
| 364181 | ECU | 2013 | 2014 | ECU_LIVING_CONDITIONS_SURVEY_ECV | HH |
| 141521 | PAK | 2011 | 2011 | PAK_NATIONAL_NUTRITION | HHM |
| 390338 | LBR | 2016 | 2017 | LBR_HH_INCOME_EXPENDITURE | HHM |
| 385708 | IRQ | 2018 | 2018 | UNICEF_MICS | HH |
| 165290 | BTN | 2012 | 2013 | BTN/NATIONAL_HEALTH_SURVEY | HH |
| 31050 | KHM | 2006 | 2007 | KHM/SOCIO_ECONOMIC_SURVEY | HHM |
| 24143 | SDN | 2006 | 2006 | ARAB_LEAGUE_PAPFAM | HH |
| 24143 | SSD | 2006 | 2006 | ARAB_LEAGUE_PAPFAM | HH |
| 327591 | TZA | 2016 | 2017 | ICAP_PHIA | HH |
| 151566 | AGO | 2005 | 2006 | WB_CWIQ | HHM |
| 287629 | MWI | 2015 | 2016 | MWI_ICAP_PHIA | HH |
| 409558 | TUN | 2018 | 2018 | UNICEF_MICS | HH |
| Code | Country | Start Year | End Year | Agency | Survey Type |
|------|---------|------------|----------|--------|-------------|
| 413556 | BFA | 2017 | 2018 | DHS_MIS | HH |
| 408226 | KGZ | 2018 | 2018 | UNICEF_MICS | HH |
| 415531 | SWZ | 2016 | 2017 | ICAP_PHIA | HH |
| 400526 | PAK | 2017 | 2018 | UNICEF_MICS | HH |
| 413934 | MOZ | 2018 | 2018 | DHS_MIS | HH |
| 12865 | TLS | 2002 | 2002 | UNICEF_MICS | HH |
| 21622 | GHA | 2003 | 2003 | WHO_WHS | HHM |
| 77393 | SLE | 2013 | 2013 | DHS_MIS | HH |
| 27885 | ZAF | 2008 | 2008 | ZAF/NATIONAL_INCOME_DYNAMICS_STUDY | HHM |
| 60405 | CHN | 2007 | 2010 | WHO_SAGE | HHM |
| 339653 | MEX | 2016 | 2016 | MEX/SURVEY_INCOME_AND_HOUSEHOLD_EXPENDITURE_ENIGH | HH |
| 326837 | LKA | 2016 | 2016 | DHS | HHM |
| 18815 | LKA | 2006 | 2007 | DHS | HHM |
| 90707 | LKA | 2000 | 2000 | MACRO_DHS | HH |
| 396957 | GIN | 2018 | 2018 | DHS | HH |
| 398033 | MLI | 2018 | 2018 | DHS | HH |
| 81416 | IRN | 2010 | 2010 | IRN/MULTIPLE_INDICATOR_DEMOGRAPHIC_HEALTH_SURVEY | HH |
| 264910 | BLZ | 2015 | 2016 | UNICEF_MICS | HH |
| 267343 | MRT | 2015 | 2015 | UNICEF_MICS | HH |
| 286769 | MWI | 2017 | 2017 | DHS_MIS | HH |
| 286785 | TLS | 2016 | 2016 | DHS | HH |
| 336042 | MNG | 2016 | 2016 | UNICEF_MICS | HH |
| 335994 | MNG | 2016 | 2016 | UNICEF_MICS | HH |
| 332558 | TTO | 2011 | 2011 | UNICEF_MICS | HH |
| 22108 | BTN | 2007 | 2007 | BTN/LIVING_STANDARDS | HH |
| 404407 | MEX | 2018 | 2018 | MEX/ENADID | HH |
| 400219 | NPL | 2016 | 2016 | NPL_RISK_VULNERABILITY_ASSESSMENT | HHM |
| 403435 | BOL | 2012 | 2012 | BOL/HOUSEHOLD_SURVEY | HH |
| 124467 | COL | 2004 | 2005 | COL/NATIONAL_SURVEY_ON_NUTRITION_SITUATION_ENSI N | HHM |
| 407869 | PER | 2018 | 2018 | PER/DEMOGRAPHIC_AND_FAMILY_HEALTH_SURVEY_END ES | HH |
| 403655 | PRY | 2018 | 2018 | PRY/PERMANENT_HOUSEHOLD_SURVEY_EPH | HH |
| 148346 | BOL | 2009 | 2009 | BOL/HH_SURVEY | HHM |
| Code   | Country | Start Year | End Year | Description                                                                 | Source  |
|--------|---------|------------|----------|------------------------------------------------------------------------------|---------|
| 413667 | PER     | 2007       | 2008     | DHS                                                                          | HH      |
| 413666 | PER     | 2003       | 2006     | DHS                                                                          | HH      |
| 400535 | TZA     | 2014       | 2015     | TZA/MEASURING_LIVING_STANDARDS_WITHIN_CITIES                                 | HHM     |
| 148345 | BOL     | 2008       | 2008     | BOL/HH_SURVEY                                                                | HHM     |
| 424884 | GMB     | 2018       | 2018     | UNICEF_MICS                                                                  | HH      |
| 317305 | THA     | 2015       | 2016     | UNICEF_MICS                                                                  | HH      |
| 317305 | THA     | 2015       | 2016     | UNICEF_MICS                                                                  | HH      |
| 317305 | THA     | 2015       | 2016     | UNICEF_MICS                                                                  | HH      |
| 317305 | THA     | 2015       | 2016     | UNICEF_MICS                                                                  | HH      |
| 317305 | THA     | 2015       | 2016     | UNICEF_MICS                                                                  | HH      |
| 317305 | THA     | 2015       | 2016     | UNICEF_MICS                                                                  | HH      |
| 317305 | THA     | 2015       | 2016     | UNICEF_MICS                                                                  | HH      |
| 317305 | THA     | 2015       | 2016     | UNICEF_MICS                                                                  | HH      |
| 317305 | THA     | 2015       | 2016     | UNICEF_MICS                                                                  | HH      |
| 317305 | THA     | 2015       | 2016     | UNICEF_MICS                                                                  | HH      |
| 317305 | THA     | 2015       | 2016     | UNICEF_MICS                                                                  | HH      |
| 426238 | PNG     | 2016       | 2018     | DHS                                                                          | HH      |
| 399853 | MDG     | 2018       | 2018     | UNICEF_MICS                                                                  | HH      |
| 429742 | MNG     | 2018       | 2018     | UNICEF_MICS                                                                  | HH      |
| 427983 | SUR     | 2018       | 2018     | UNICEF_MICS                                                                  | HH      |
| 431951 | ZWE     | 2019       | 2019     | UNICEF_MICS                                                                  | HH      |
| 284177 | ZMB     | 2015       | 2015     | ZMB/LCMS                                                                     | HHM     |
Supplementary Table 5: Covariates used in mapping

A variety of socioeconomic and environmental variables were used to estimate cooking fuel type use. Where available, the finest spatiotemporal resolution of gridded datasets was used. In addition to the geospatial covariates detailed below, the last three covariates listed are country level covariates: healthcare access and quality index, lag distributed income per capita, and proportion of the population with access to adequate sanitation.

| Covariate                          | Temporal Resolution | Justification                      | Source                                                                 | Reference                                                                 |
|-----------------------------------|---------------------|------------------------------------|------------------------------------------------------------------------|--------------------------------------------------------------------------|
| Distance from rivers or lakes >= 50 sq. km | Static             | Related to availability of biofuels | Natural Earth Data (derived)                                            | Available at: http://www.naturalearthdata.com/downloads/10m-physical-vectors/10m-rivers-lake-centerlines/ AND http://www.worldwildlife.org/pages/global-lakes-and-wetlands-database |
| Night-time lights                  | Annual              | Related to development             | NOAA DMSP satellite program (derived)                                  | Available at: https://www.ngdc.noaa.gov/eog/dmsp/downloadV4composites.html |
| Elevation                          | Static              | Related to availability of biofuels | NOAA GLOBE                                                             | Available at: https://www.ngdc.noaa.gov/mgg/topo/glitiles.html           |
| Agricultural land                  | Static              | Related to availability of biofuels | Earth Stat Project                                                     | Ramankutty, N., Evan, A.T., Monfreda, C., & Foley, J.A. Farming the planet. Part 1: Geographic distribution of global agricultural lands in the year 2000. Global Biogeochemical Cycle 22, GB1003 (2008), doi: 10.1029/2007GB002952. Available at: http://www.earthstat.org/data-download/ |
| Enhanced vegetation index          | Annual              | Related to availability of biofuels | MODIS, pre-processed by Oxford                                        | Weiss, D. J. et al. An effective approach for gapfilling continental scale remotely sensed timeseries. Isprs J. Photogramm. Remote Sens. 98, 106–118 (2014). USGS & NASA. Vegetation indices 16-Day L3 global 500m MOD13A1 dataset. Available at: https://lpdaac.usgs.gov/dataset_discovery/modis/modis_products_table/mcd43b4. (Accessed: 25th July 2017) Huete, A., Justice, C. & van Leeuwen, W. MODIS vegetation index (MOD 13) algorithm theoretical basis document. (1999). |
| Fertility                          | Annual              | Related to development             | WorldPop (derived)                                                     | Lloyd, C. T., Sørichetta, A. & Tatem, A. J. High resolution global gridded data for use in population studies. Sci. Data 4, sdata20171 (2017). Available at: http://www.worldpop.org.uk/data/get_data/. (Accessed: 25th July 2017) |
| Urban or rural                     | Annual              | Related to availability of clean fuels and technologies | European Commission/GHS                                              | Pesaresi, M. et al. Operating procedure for the production of the Global Human Settlement Layer from Landsat data of the epochs 1975, 1990, 2000, and 2014. JRC Technical Report EUR 27741 EN, doi:10.2788/253582 (online) Available at: http://ghsl.jrc.ec.europa.eu/data.php |
| Nutrient yield                     | Static              | Related to availability of biofuels | Herrero et al.                                                        | Herrero, M. et al. Farming and the geography of nutrient production for human use: a transdisciplinary analysis. Lancet Planet. Health 1, e33–e42 (2017). |
| Covariate                        | Temporal Resolution | Justification                        | Source                                      | Reference                                                                 |
|---------------------------------|---------------------|--------------------------------------|---------------------------------------------|---------------------------------------------------------------------------|
| Irrigation                      | Static              | Related to availability of biofuels   | University of Frankfurt and FAO             | Siebert, S., Doll, P., Hoogeveen, J., Faures, J.-M., Frenken, K., & Feick, S. Development and validation of the global map of irrigation areas. Hydrology and Earth System Sciences 9, 535-547 (2005). Goethe-Universität. Generation of a digital global map of irrigation areas. Available at: https://www.unifrankfurt.de/45218039/GLOBAL_Irrigation_Map. (Accessed: 25th July 2017) Also from: http://www.fao.org/nr/water/aquastat/irrigationmap/index10.stm |
| Land cover                      | Annual              | Related to availability of clean fuels and technologies | MODIS                                       | Lobser, S.E. & Cohen, W.B. MODIS tasselled cap: land cover characteristics expressed through transformed MODIS data. International Journal of Remote Sensing 28(22), 5079-5101 (2007). Available at: https://lpdaac.usgs.gov/dataset_discovery/modis/modis_products_table/mcd12q1                                                                 |
| Average land surface temperature| Annual              | Related to availability of biofuels   | MODIS                                       | Weiss, D. J. et al. An effective approach for gapfilling continental scale remotely sensed timeseries. Isprs J. Photogramm. Remote Sens. 98, 106–118 (2014). Available at: https://modis.gsfc.nasa.gov/data/dataprod/mod11.php                                                                 |
| Precipitation                   | Annual              | Related to availability of biofuels   | Beck et al.                                | Beck, H.E., A.I.J.M. van Dijk, V. Levizzani, J. Schellekens, D.G. Miralles, B. Martens, & A. de Roo. MSWEP: 3-hourly 0.25 global gridded precipitation (1979-2015) by merging gauge, satellite, and reanalysis data. Hydrology and Earth System Sciences 21(1), 589-615 (2017). Available at: https://data.princetonclimate.com/opendap                                                                 |
| Tassled cap brightness          | Annual              | Related to availability of biofuels   | MODIS                                       | Lobser, S.E. & Cohen, W.B. MODIS tasselled cap: land cover characteristics expressed through transformed MODIS data. International Journal of Remote Sensing 28(22), 5079-5101 (2007). Available at: https://modis.gsfc.nasa.gov/data/dataprod/mod43.php                                                                 |
| Tassled cap wetness             | Annual              | Related to availability of biofuels   | MODIS                                       | Lobser, S.E. & Cohen, W.B. MODIS tasselled cap: land cover characteristics expressed through transformed MODIS data. International Journal of Remote Sensing 28(22), 5079-5101 (2007). Available at: https://modis.gsfc.nasa.gov/data/dataprod/mod43.php                                                                 |
|                        |        | Related to                |                                      |
|------------------------|--------|---------------------------|-------------------------------------|
| **Population**         | Annual | development               | WorldPop                            |
|                        |        |                           | Lloyd, C. T., Sorichetta, A. & Tatem, A. J. High resolution global gridded data for use in population studies. Sci. Data 4, sdata20171 (2017). World Pop. Get data. Available at: http://www.worldpop.org.uk/data/get_data/. (Accessed: 25th July 2017) |
| **Healthcare access and quality index** | Annual | development               | Barber et al.                       |
|                        |        |                           | Barber, R. M. et al. Healthcare Access and Quality Index based on mortality from causes amenable to personal health care in 195 countries and territories, 1990-2015: a novel analysis from the Global Burden of Disease Study 2015. Lancet 390, 231-266 (2017). |
| **Lag distributed income per capita** | Annual | development               | Global Burden of Disease Study      |
|                        |        |                           | Institute for Health Metrics and Evaluation (IHME). Findings from the Global Burden of Disease Study 2017. Seattle, WA: IHME, 2018. |
| **Concentration of Particulate Matter 2.5** | Annual | target indicator          | van Donkelaar et al (derived)       |
|                        |        |                           | van Donkelaar, A., Martin, R.V., Brauer, M., & Boys, B.L. Use of Satellite Observations for Long-Term Exposure Assessment of Global Concentrations of Fine Particulate Matter. *Environmental Health Perspectives* **123**(2), 135-143 (2015). Available at: https://ehp.niehs.nih.gov/1408646/#tab1 |
| **Deforestation**      | Annual | availability of biofuels  | University of Maryland's Global Forest Change project, based on Landsat data archive |
|                        |        |                           | Hansen, M. C. *et al*. High-Resolution Global Maps of 21st-Century Forest Cover Change. *Science*. **342**, 850-853 (2013). |
| **Landcover classes**  | Annual | development               | ESA-CCI project                     |
|                        |        |                           | Available at: [https://cds.climate.copernicus.eu/](https://cds.climate.copernicus.eu)cdsapp#!/dataset/satellite-land-cover?tab=overview}
Supplementary Table 6a-b: Covariates used in ensemble modelling via stacked generalisation, stratified by modelling region

Each ‘TRUE’ indicates that a specific covariate was used in the model for a specific modelling region. Table a) presents the first 10 modelling regions. Table b) presents the remaining 11 modelling regions.
| Covariate                                           | Andean South America | Central America and the Caribbean | China | Central Sub-Saharan Africa | Eritrea, Djibouti, Yemen | Eastern Sub-Saharan Africa | Middle East | Mongolia | Nigeria |
|-----------------------------------------------------|----------------------|-----------------------------------|-------|-----------------------------|--------------------------|---------------------------|-------------|----------|---------|
| Travel time to nearest settlement                   | TRUE                 | TRUE                              | TRUE  | TRUE                        | TRUE                     | TRUE                      | TRUE        | TRUE     | TRUE    |
| aridity                                             | TRUE                 | FALSE                             | TRUE  | TRUE                        | FALSE                    | TRUE                      | TRUE        | FALSE    | FALSE   |
| Diurnal temperature range                           | TRUE                 | FALSE                             | TRUE  | TRUE                        | TRUE                     | TRUE                      | TRUE        | TRUE     | TRUE    |
| Frost day frequency                                 | TRUE                 | TRUE                              | FALSE | TRUE                        | TRUE                     | TRUE                      | TRUE        | FALSE    | FALSE   |
| Potential Evapotranspiration                        | TRUE                 | TRUE                              | TRUE  | FALSE                       | TRUE                     | TRUE                      | FALSE       | TRUE     | TRUE    |
| Average daily mean temperature                      | FALSE                | FALSE                             | FALSE | TRUE                        | FALSE                    | FALSE                    | FALSE       | TRUE     | TRUE    |
| deforestation                                       | TRUE                 | TRUE                              | TRUE  | TRUE                        | FALSE                    | TRUE                      | FALSE       | TRUE     | TRUE    |
| Dependency ratio of dependents to working age adults| FALSE                | FALSE                             | TRUE  | TRUE                        | TRUE                     | TRUE                      | TRUE        | TRUE     | TRUE    |
| Distance from rivers or lakes >= 50 sq km           | TRUE                 | TRUE                              | TRUE  | TRUE                        | FALSE                    | TRUE                      | TRUE        | TRUE     | TRUE    |
| Nighttime lights                                     | FALSE                | TRUE                              | TRUE  | FALSE                       | TRUE                     | FALSE                    | TRUE        | FALSE    | TRUE    |
| elevation                                           | FALSE                | TRUE                              | TRUE  | FALSE                       | FALSE                    | FALSE                    | TRUE        | TRUE     | TRUE    |
| Landcover classes                                   | TRUE                 | TRUE                              | TRUE  | TRUE                        | TRUE                     | TRUE                      | TRUE        | TRUE     | TRUE    |
| escroplandarea                                      | TRUE                 | TRUE                              | TRUE  | TRUE                        | TRUE                     | TRUE                      | TRUE        | TRUE     | TRUE    |
| evi_v6                                               | TRUE                 | TRUE                              | TRUE  | TRUE                        | TRUE                     | TRUE                      | TRUE        | TRUE     | FALSE   |
| fertility                                            | TRUE                 | TRUE                              | FALSE | TRUE                        | TRUE                     | TRUE                      | TRUE        | TRUE     | TRUE    |
| Urbanicity                                           | TRUE                 | TRUE                              | TRUE  | TRUE                        | TRUE                     | TRUE                      | TRUE        | TRUE     | TRUE    |
| haqi                                                | FALSE                | FALSE                             | TRUE  | FALSE                       | FALSE                    | FALSE                    | TRUE        | TRUE     | TRUE    |
| nutrient yield                                       | TRUE                 | TRUE                              | TRUE  | TRUE                        | TRUE                     | TRUE                      | TRUE        | TRUE     | TRUE    |
| irrigation                                           | TRUE                 | TRUE                              | TRUE  | TRUE                        | TRUE                     | TRUE                      | TRUE        | TRUE     | TRUE    |
| Covariate                                      | North Africa | Oceania | Southeast Asia | South Asia | Southern Sub-Saharan Africa | Central Asia | Tropical South America | Western Sub-Saharan Africa | South Africa |
|------------------------------------------------|--------------|---------|----------------|------------|----------------------------|--------------|------------------------|-----------------------------|--------------|
| Travel time to nearest settlement             | TRUE         | TRUE    | TRUE           | TRUE       | TRUE                       | TRUE         | TRUE                   | TRUE                         | TRUE         |
| aridity                                        | FALSE        | TRUE    | TRUE           | FALSE      | FALSE                      | TRUE         | FALSE                  | FALSE                        | FALSE        |
| Diurnal temperature range                     | TRUE         | FALSE   | TRUE           | TRUE       | TRUE                       | TRUE         | FALSE                  | FALSE                        | FALSE        |
| Frost day frequency                           | TRUE         | TRUE    | TRUE           | TRUE       | FALSE                      | TRUE         | FALSE                  | TRUE                         | TRUE         |
| Potential Evapotranspiration                  | TRUE         | TRUE    | TRUE           | TRUE       | FALSE                      | TRUE         | FALSE                  | FALSE                        | FALSE        |
| Average daily mean temperature                | FALSE        | TRUE    | FALSE          | FALSE      | FALSE                      | FALSE        | TRUE                   | TRUE                         | FALSE        |
| deforestation                                 | FALSE        | TRUE    | TRUE           | TRUE       | FALSE                      | TRUE         | TRUE                   | TRUE                         | TRUE         |
| Dependency ratio of dependents to working age adults | FALSE       | FALSE   | TRUE           | TRUE       | FALSE                      | TRUE         | FALSE                  | TRUE                         | TRUE         |
| Distance from rivers or lakes >= 50 sq km     | TRUE         | TRUE    | TRUE           | TRUE       | TRUE                       | TRUE         | TRUE                   | TRUE                         | TRUE         |
| Nighttime lights                               | TRUE         | FALSE   | TRUE           | TRUE       | FALSE                      | TRUE         | FALSE                  | TRUE                         | TRUE         |
Supplementary Table 7: Fitted parameters by region for model of Solid Fuel Use

Lower, median, and upper quantiles (0.025%, 0.50%, 0.975%) are displayed for the main parameters by region. The first four columns provide information on the fixed effects: the intercept (int) and the covariates (gam, gbm, and enet) corresponding to the predicted ensemble rasters. Fitted values for the spatio-temporal field hyperparameters and the precisions (inverse variance) for our random effects are shown in the next four columns.
| Quantiles | int     | gam    | gbm    | xgboost | Nominal Range | Nominal Variance | Ar1 ρ | precis | Country Random Effect Precision |
|-----------|---------|--------|--------|---------|---------------|------------------|-------|--------|--------------------------------|
| 0.025     | -1.58485| -0.00068| 0.08620| 0.83292 | 0.84010       | 0.87280          | 0.59480| 2.20950| 0.35370                        |
| 0.975     | -1.47353| 0.04972 | 0.14615| 0.88561 | 1.13830       | 0.97870          | 0.60830| 5.19730| 4.70690                        |
| 0.025     | -0.63052| 0.04751 | 0.10272| 0.69755 | 1.12050       | 0.93050          | 0.43840| 2.75290| 0.63980                        |
| 0.975     | -0.11154| 0.09848 | 0.16087| 0.74063 | 1.31580       | 0.98090          | 0.44920| 4.14210| 1.76390                        |
| 0.025     | 0.39920  | 0.14940 | 0.21901| 0.78367 | 1.47420       | 1.04530          | 0.46810| 6.89890| 4.82600                        |
| 0.975     | 0.09519  | 0.07690 | -0.14714| 1.36121 | 12.50670      | 0.57670          | 9.17030| 7.36900| 220.36210                      |
| 0.025     | 1.38080  | -0.03779| -0.31687| 1.08055 | 2.85840       | 1.17350          | 0.71050| 1.37830| 0.32300                        |
| 0.975     | 2.12847  | 0.02503 | -0.20675| 1.18151 | 3.72010       | 1.44100          | 0.76220| 3.03750| 1.75460                        |
| 0.025     | 2.87562  | 0.08836 | -0.09688| 1.28240 | 4.97860       | 1.81470          | 0.79540| 6.77940| 8.64240                        |
| 0.975     | -1.92666 | -0.03216| -0.51720| 0.78475 | 2.56670       | 1.23210          | 0.14830| 1.18240| 1163.70890                     |
| 0.025     | -1.05112 | 0.17834 | -0.25479| 1.07615 | 4.09890       | 1.62410          | 0.15490| 10.72630| 16039.60500                    |
| 0.975     | -0.17760 | 0.38971 | 0.00724 | 1.36722 | 6.72600       | 2.21540          | 0.16470| 46.47140| 76312.09290                    |
| 0.025     | 1.65691  | 0.03735 | 0.17986 | 0.67583 | 1.12480       | 0.76090          | 0.44880| 0.89430| 1.33090                        |
| 0.975     | 1.97228  | 0.06752 | 0.21961 | 0.71273 | 1.19110       | 0.78280          | 0.45640| 1.14240| 5.66250                        |
| 0.025     | 2.28739  | 0.09800 | 0.25933 | 0.74953 | 1.28730       | 0.81840          | 0.46060| 1.37570| 26.12950                      |
| 0.975     | -3.74763 | -0.07895| 0.53827 | 0.24256 | 1.84990       | 2.17190          | 0.77020| 0.03510| 1139.92650                    |
| 0.025     | -3.51122 | -0.03559| 0.66598 | 0.36715 | 2.25990       | 2.53560          | 0.84960| 0.09680| 14124.22670                   |
| 0.975     | -1.27655 | 0.01337 | 0.79359 | 0.49137 | 2.59610       | 2.82120          | 0.90710| 0.19890| 70417.66600                    |
| 0.025     | 0.43626  | 0.01661 | -0.93653| 1.53200 | 1.97440       | 0.71600          | 0.67810| 3.03670| NA                             |
| 0.975     | 0.80808  | 0.11109 | -0.78340| 1.67242 | 3.11170       | 0.91340          | 0.80250| 9.94220| NA                             |
| 0.025     | 1.17972  | 0.20572 | -0.63059| 1.81264 | 4.65920       | 1.17310          | 0.87440| 21.42290| NA                             |
| 0.975     | 0.94962  | 0.12214 | -0.87223| 1.36671 | 1.02520       | 0.73130          | 0.47810| 1.58970| NA                             |
| 0.025     | 1.31404  | 0.21557 | -0.71940| 1.50385 | 1.23430       | 0.81860          | 0.49150| 3.17030| NA                             |
| Quantiles | int    | gam    | gbm    | xgboost | Nominal Range | Nominal Variance | Ar1 ρ      | precis | Country Random Effect Precision |
|-----------|--------|--------|--------|---------|---------------|------------------|------------|--------|---------------------------------|
| 0.025     | 0.260989 | 0.02938 | 0.32645 | 0.55286 | 3.44670 | 1.44620 | 1.07860 | 0.00860 | 1279.38900 |
| 0.5       | -1.39878 | 0.04992 | 0.36344 | 0.58641 | 4.22000 | 1.70570 | 1.13920 | 0.06330 | 12656.89930 |
| 0.975     | -0.18897 | 0.07114 | 0.40023 | 0.61993 | 5.50710 | 2.09670 | 1.17960 | 0.18020 | 65596.20270 |
| 0.025     | 0.20310 | -0.01904 | -0.00413 | 0.94406 | 1.07990 | 0.89370 | 0.50410 | 0.50370 | 1295.97220 |
| 0.5       | 0.62047 | 0.00664 | 0.02642 | 0.97293 | 1.17200 | 0.92120 | 0.50890 | 0.95770 | 12718.42720 |
| 0.975     | 1.03753 | 0.02035 | 0.05693 | 1.00178 | 1.24950 | 0.95900 | 0.51610 | 3.03050 | 69850.65680 |
| 0.025     | 0.26101 | 0.17272 | -0.04960 | 0.68451 | 1.32550 | 0.82130 | 0.50130 | 0.08010 | 1269.42210 |
| 0.5       | 0.78153 | 0.24449 | 0.01628 | 0.74068 | 1.57150 | 0.89440 | 0.51790 | 0.36290 | 13665.42090 |
| 0.975     | 1.30165 | 0.31134 | 0.08317 | 0.79732 | 1.78310 | 0.96770 | 0.54250 | 0.76430 | 69249.11850 |
| 0.025     | 0.93389 | -0.01766 | -1.44295 | 2.26529 | 0.83740 | 0.97750 | 0.30960 | 0.41740 | 2039.97530 |
| 0.5       | 1.38598 | 0.04739 | -1.37639 | 2.32899 | 0.95310 | 0.99930 | 0.31370 | 0.57560 | 14399.55650 |
| 0.975     | 1.83772 | 0.11239 | -1.30989 | 2.39264 | 1.02760 | 1.03390 | 0.31700 | 0.82640 | 62740.85950 |
| 0.025     | 0.07039 | 0.44656 | -0.73129 | 0.91923 | 0.45910 | 0.93520 | 0.32540 | 0.75520 | 1212.84440 |
| 0.5       | 0.41526 | 0.55710 | -0.60577 | 1.04872 | 0.62710 | 0.99640 | 0.33630 | 1.47970 | 12216.45070 |
| 0.975     | 0.75985 | 0.66760 | -0.48039 | 1.17807 | 0.77600 | 1.04740 | 0.34450 | 2.52000 | 66768.69320 |
| 0.025     | -0.93006 | -0.08087 | -0.38585 | 1.22377 | 10.86020 | 1.16420 | 0.17930 | 0.75020 | 652.34450 |
| 0.5       | -0.27388 | 0.00292 | -0.30124 | 1.29824 | 12.00080 | 1.28420 | 0.19010 | 0.87470 | 7236.75560 |
| 0.975     | 0.38177 | 0.08674 | -0.21671 | 1.37265 | 14.93530 | 14187.26620 | 195.34510 | 1.19530 | 91991.31560 |
| 0.025     | -0.31025 | 0.14782 | 0.17325 | 0.62631 | 2.49180 | 0.75620 | 17.62900 | 5.89530 | 0.23750 |
| 0.5       | 0.51561 | 0.16671 | 0.19252 | 0.64076 | 2.70010 | 0.80770 | 18.21250 | 8.87290 | 1.01690 |
| 0.975     | 1.34085 | 0.18559 | 0.21178 | 0.65520 | 2.97310 | 0.87270 | 19.09090 | 14.03920 | 3.05940 |
| 0.025     | 1.08673 | -0.00911 | 0.26714 | 0.58305 | 1.93070 | 0.77510 | 0.52940 | 0.81450 | 1329.71270 |
| 0.5       | 1.34195 | 0.03971 | 0.32913 | 0.63044 | 2.36570 | 0.83900 | 0.53940 | 1.08000 | 13907.71210 |
| 0.975     | 1.59697 | 0.09127 | 0.39009 | 0.67779 | 2.70350 | 0.90480 | 0.54600 | 1.42260 | 72484.39230 |
| 0.025     | -0.55307 | -0.04261 | 0.42272 | 0.54545 | 0.84230 | 0.46760 | 3.30410 | 14.98960 | NA |
| 0.5       | -0.42193 | -0.01947 | 0.45087 | 0.56860 | 1.03310 | 0.51830 | 3.36150 | 19.83510 | NA |
Supplementary Table 8: Predictive metrics for SFU, aggregated to the national level (Admin 0)

| YEAR | OOS  | Median SS  | Mean err. | RMSE | Corr. | 95% Cov. |
|------|------|------------|-----------|------|-------|----------|
| 2000 | FALSE | 74,345.660 | -0.029    | 0.077| 0.928 | 0.944    |
| 2005 | FALSE | 84,999.073 | 0.000     | 0.052| 0.986 | 0.957    |
| 2010 | FALSE | 110,729.798| -0.038    | 0.043| 0.998 | 0.853    |
| 2015 | FALSE | 84,022.000 | -0.071    | 0.099| 0.971 | 0.736    |
| 2018 | FALSE | 96,822.000 | -0.014    | 0.080| 0.976 | 0.936    |
| 2000 | TRUE  | 74,345.660 | -0.025    | 0.076| 0.928 | 0.944    |
| 2005 | TRUE  | 84,926.073 | -0.011    | 0.056| 0.985 | 0.932    |
| 2010 | TRUE  | 110,729.798| -0.039    | 0.044| 0.998 | 0.803    |
| 2015 | TRUE  | 84,022.000 | -0.101    | 0.118| 0.975 | 0.745    |
| 2018 | TRUE  | 96,822.000 | -0.029    | 0.073| 0.983 | 0.946    |
### Supplementary Table 9: Predictive metrics for SFU, aggregated to the first administrative level (Admin 1)

| YEAR | OOS  | Median SS  | Mean err. | RMSE  | Corr. | 95% Cov. |
|------|------|------------|-----------|-------|-------|----------|
| 2000 | FALSE | 10,066.000 | -0.029    | 0.100 | 0.950 | 0.944    |
| 2005 | FALSE | 5,592.593  | 0.000     | 0.075 | 0.975 | 0.957    |
| 2010 | FALSE | 5,180.552  | -0.038    | 0.055 | 0.993 | 0.853    |
| 2015 | FALSE | 5,192.436  | -0.071    | 0.134 | 0.921 | 0.736    |
| 2018 | FALSE | 9,477.775  | -0.014    | 0.092 | 0.974 | 0.936    |
| 2000 | TRUE  | 9,937.514  | -0.026    | 0.097 | 0.949 | 0.944    |
| 2005 | TRUE  | 5,592.593  | -0.011    | 0.082 | 0.971 | 0.932    |
| 2010 | TRUE  | 5,180.552  | -0.039    | 0.067 | 0.987 | 0.803    |
| 2015 | TRUE  | 5,094.664  | -0.101    | 0.140 | 0.944 | 0.745    |
| 2018 | TRUE  | 9,477.775  | -0.029    | 0.126 | 0.951 | 0.946    |

### Supplementary Table 10: Predictive metrics for SFU, aggregated to the second administrative level (Admin 2)

| YEAR | OOS  | Median SS  | Mean err. | RMSE  | Corr. | 95% Cov. |
|------|------|------------|-----------|-------|-------|----------|
| 2000 | FALSE | 1,423.868  | -0.029    | 0.124 | 0.933 | 0.944    |
| 2005 | FALSE | 764.000    | 0.000     | 0.117 | 0.947 | 0.957    |
| 2010 | FALSE | 333.046    | -0.038    | 0.092 | 0.972 | 0.853    |
| 2015 | FALSE | 710.463    | -0.071    | 0.175 | 0.870 | 0.736    |
| 2018 | FALSE | 159.633    | -0.014    | 0.131 | 0.946 | 0.936    |
| 2000 | TRUE  | 1,405.583  | -0.026    | 0.127 | 0.924 | 0.944    |
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