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Technical Brief

Estimation of affected population figures

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Content

1 Introduction

1.1 Why estimate population size and characteristics in emergencies?

Most crises disrupt communities and many displace people. The size and demographic characteristics of the affected population may change because of displacement, migration or destruction of infrastructure. Timely, accurate and reliable information on the numbers and locations of people affected by a crisis is crucial for an effective and efficient humanitarian response (WFP 2007).

Therefore, the quantitative expression of the size and characteristics of the population affected by a crisis is a central part of the assessment process (ECLAC 2006). Quantitative information is only part of the picture and should be complemented by qualitative information providing details on how and why people are affected as well as the severity of the situation for the affected population. However, without a reasonably accurate estimate of numbers, the scale of the emergency will remain imprecise and the delivery of assistance to beneficiaries, particularly in the early stages of an emergency, is likely to be impaired.

Global numbers and an ethnic, gender and age breakdown are clearly important for a range of humanitarian assistance activities including programme planning, protection, fund-raising, and advocacy. Without statistics and demographics, effective assistance and protection would ultimately become impossible. Furthermore, the affected population has the right to be counted as accurately as possible, since this is a pre-condition for assistance or protection (RNN 1997).

1.2 Estimating population size in emergencies

Estimations of affected population numbers are needed throughout the various phases of a disaster. A government census or recent survey provides the number and characteristics of people in the affected area before the disaster, from which the number of people in need of assistance can be derived. Unfortunately, even with the most recent and disaggregated census data, estimating affected population numbers presents several challenges:

- Crises seldom occur within an entire administrative boundary, so area based population figures may provide an incomplete picture;
- Crises sometimes affect a specific population group or “hard-to-reach population” such as nomads or pastoralist, for which reliable or current population data is sometimes difficult to access;
- In many disaster-prone countries population data is not available, out-dated or inaccurate;
- Geographic information systems and population databases may not be available or known by the teams sent for the assessment;
- Crises often involve population movements, that can be temporary, permanent or back-and-forth, consequently pre-existing demographic data does not represent the current situation;
- The disaster-affected regions may be inaccessible or insecure thereby limiting or preventing contact with local authorities and other informants who could provide local (and possibly more recent) information on population size; and,
- The reported population size may be influenced by politics (WFP 2006).

Choosing a suitable method for assessing population size depends on myriad factors. Each type of crisis affects the impacted area and the population living in that area differently. An earthquake or flood may cause significant destruction and many deaths, but may not result in large or long-term population movements. In contrast, complex emergencies and slow-onset disasters such as food security crises or drought generally produce large and long-term population displacement. Choosing a suitable method also depends on the time and resources available, the availability of pre-disaster information and the accessibility to the affected area.

1.3 About this Technical Brief

This Technical Brief is for assessment experts, information management officers and information analysts planning or implementing assessments in emergency contexts. It provides guidance on how to select and use suitable methods when conducting a population estimation exercise.

This technical brief builds upon the desk review *Rapid estimation of affected population figures*[1], which has identified and detailed a broad range of different population estimation methods. These methods are categorised by sampling methods, site estimation methods, counting methods, remote estimation methods and the usage of existing demographic data. **It is recommended to use the above mentioned review as a reference for more in-depth information about the different techniques described in the present document.** The present technical brief should be considered as a companion to the review.

Investigating these methods led to a comparative table, which provides a short description of each approach, and compares the methods by level of detail, required expertise, available resources, area and population characteristics for which the method is most suitable, the disaster phase and its accuracy. This comparative table is accessible *here*[2].

Solution trees are provided in each section to support the choice of an appropriate method, providing practitioners a first overview in choosing a suitable option depending on different operational parameters.

2 Getting prepared…

2.1 Recommended preparedness measures

Most disasters are predictable, and humanitarian response can be significantly enhanced by good data preparedness, namely the maintenance of up-to-date demographic data as part of disaster preparedness measures. It is important to have figures and other details available on the population that is likely to be affected, including their location, main characteristics and livelihoods. Ideally, (humanitarian) organisations and governments would engage in data preparedness, and agree on the basic national and international sources of demographic information.

[1] http://www.acaps.org/resourcescats/downloader/rapid_estimation_of_affected_population_figures/111
[2] https://docs.google.com/spreadsheet/ccc?key=0Ak1QayWX2ZxddHZRUHczMTVlUkIyVHFJbjAya3QxLVE

The pre-disaster phase allows for time to create baselines (e.g. number of people for a given area or human settlements susceptible to a shock) and to obtain credible and reliable information on specific subgroups of the population. Recommendations include:

- In countries where regular censuses are not conducted, coordination between international agencies, national partners, and the government is required to gather and regularly update relevant data and information on the population. To collect (identify, prioritise and compile), collate (reconcile and order), store and maintain demographic data in advance can all facilitate response planning for disasters or crises.

- Conducting rapid affected population estimations requires time and resources that are often scarce immediately following a disaster. Preparedness measures should ensure that expertise in several population estimations methods is available and dedicated to this task, and that arrangements for other resources (e.g. maps, satellite imagery, human resources for data collection and analysis) are in place. For example, to enable the **tracking of population movements with mobile phone network data**, it is recommended that relationships and agreements with mobile phone providers are established prior to any disaster. Similarly, pre identified and agreed lists of P-codes can facilitate geo-tagging of population data during emergencies.

- In countries with efficient community disaster preparedness measures, **initial reports / D-forms**[3] including affected population figures can be submitted by affected community leaders within hours after occurrence of a disaster and be regularly updated in the following days. Preparedness entails ensuring that the forms are up-to-date, available at the community level, and that the community leaders are sufficiently trained. When correctly implemented (e.g. Cambodia, Philippines), this mechanism has proven to be very effective and cost efficient for estimating affected population figures immediately after disasters.

- Data on specific population groups should be ready prior to the disaster. For example, in countries with nomadic peoples, specialists with in-depth knowledge of the people and their culture can identify their pattern of movements, which will support a potential population estimation exercise the moment a disaster occurs.

- Access to reliable and most up to date information should be maintained on a specialized platform such as the Common and Fundamental Operational Dataset registry[4] of OCHA and/or relevant in country websites (e.g. disaster management agency, ministry of statistics).

[3] The “D-Form” appellation comes from the name given to this very initial report in Bangladesh
[4] http://cod.humanitarianresponse.info/country-region

2.2 Compiling baseline population figures

In practice, most humanitarian organisations have little experience or competencies in the field of population data collection and must rely on data from existing national and international sources. Recommended sources for the collection of disaggregated baseline data include:

When a recent (<2 years) and reliable census is available

Census data provide a detailed disaggregation of the population according to specific categories and by administrative area/locality. For example, census data can show the average number of children per woman, or the average household size in a specific administrative area. Censuses are generally performed every 10 years. These data can be used to estimate populations in affected areas when only an estimate of the number of families or households is available. Moreover it provides valuable baseline data for the sampling process in household surveys and for the design and planning of registration activities. A good source to start with is the national bureau of statistics of the concerning country, which often provides a broad range of population data online. For a list of national statistical agencies: http://www.census.gov/aboutus/stat_int.html. However, available data should be treated carefully, as population statistics can be manipulated for political reasons or for the exclusive benefit of one particular group.

When recent census data is lacking

When census data is not capable of providing an accurate and timely snapshot (for instance when the census is out-dated), **administrative records** could provide data on the number of households in a given region. In combination with other estimates of household size, this information can be used to generate total population estimates for sub-national areas. For instance land parcel data used for taxation and land tenure purposes or utility data collected for billing purposes. Also community health, water and food consumption, education, electricity andphone statistics can all be indicative of the overall size of the population to be assisted. While none alone will be sufficient to provide an overall picture of the size of the population, when combined they can help in testing assumptions. Further, administrative data can provide vital information for the appraisal of trends for early warning and to monitor specific developments in various parts of the country.

Household surveys can also produce baseline population data, based on a sampling frame. Such surveys are even relevant in countries where regular censuses are carried out, since a census is normally conducted once per decade and therefore often outdated. Many survey datasets are accessible online:

- Demographic and Health Surveys (DHS): http://www.measuredhs.com
- Multiple Indicator Cluster Surveys (MICS): http://www.childinfo.org/mics_available.html
- The International Household Survey Network: http://www.ihsn.org/home/index.php?
- The Living Standards Measurement Surveys: http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTRESEARCH/EXTLSMS/0,,contentMDK:21610833~pagePK:64168427~piPK:64168435~theSitePK:3358997,00.html
- Assessments and surveys conducted after an emergency (i.e. Emergency Food Security Assessment at http://www.wfp.org/food-security/assessments)

The International Household Survey Network maintains a central survey catalogue and provides links to national or international databanks when existing: http://www.ihsn.org/home/index.php?q=activities/catalog.

Polio or measles vaccination campaign data, if available and recent, may also provide valuable information on population data at micro level.

Another solution is to consult authoritative sources **of population projections** that already exist, some of which can be accessed on-line. They provide detailed data by year of projection, disaggregated by age and by sex:

- The official United Nations demographic estimates and projections can be found at the United Nations Population Division: http://www.un.org/esa/population/unpop.htm. The webpage on "population prospects" is of particular interest when looking for projections and estimates.
- A central repository of country profiles of statistical systems can be found at the United Nations Statistics Division: http://unstats.un.org/unsd/databases.htm
- The international Data Base of the United States Census Bureau offers a variety of demographic indicators and projections for countries and areas of the world: http://www.census.gov/population/international/data/idb/informationGateway.php
- The United States Census Bureau also offers a list of most international statistical agencies in the world: http://www.census.gov/aboutus/stat_int.html
- The World Gazetteer offers a set of population data and related statistics for different administrative divisions, areas, cities, towns and places: http://www.world-gazetteer.com/

When more "site" or "area specific" estimations are needed, **global spatial databases** can be used to identify population numbers. These datasets are accessible online:

- Gridded Population of the World, version 3 (GPWv3) and the Global Rural-Urban Mapping Project, version 1 (GRUMPv1): http://sedac.ciesin.columbia.edu/gpw/index.jsp
- The Population Estimation Service: http://sedac.ciesin.columbia.edu/gpw/wps.jsp
- The Fewsnet Population Explorer: http://www.populationexplorer.com/
- LandScan: http://www.ornl.gov/sci/landscan/
- The Night time Lights dataset: www.ngdc.noaa.gov/dmsp/global_composites_v2.html
- The AfriPop project: http://www.afripop.org/
- The AsiaPop project: http://www.clas.ufl.edu/users/atatem/index_files/AsiaPop.htm
- The Common Operational Datasets (CODs)**:** http://cod.humanitarianresponse.info/country-region

Even if a recent census is not available, many population data will not change that quickly (e.g. the number of children per woman, distribution of population per geographical area, etc.). Referring to the last census can always be useful for developing assumptions about population figures.

2.3 Estimation of affected population figures – Recommended process

2.3.1 Step 1: Always conduct a desk review

During the initial days or weeks of a crisis, a rough but operational figure of the affected population is needed to support decision making. It will always be useful to conduct a full **desk review** of existing data and to identify who is collecting population figures in order to gather information that is already available, and to identify gaps in available population data. A review of existing affected population figures (reports from the government, United Nations, Civil Protection, etc.) will most probably provide first estimates.

A **desk review** aims to consolidate existing data regarding the population of concern as there may already be information and datasets concerning affected population figures that could be collected and used. To calculate or estimate an affected population number, you will also need to compile baseline demographics, if not already available. As mentioned earlier, **census data, administrative records, household surveys, global spatial databases and population projections** can all be consulted to obtain (a first estimation of) baseline population figures. For any given geographical area:

Total affected pop = Total pop – Total non-affected pop

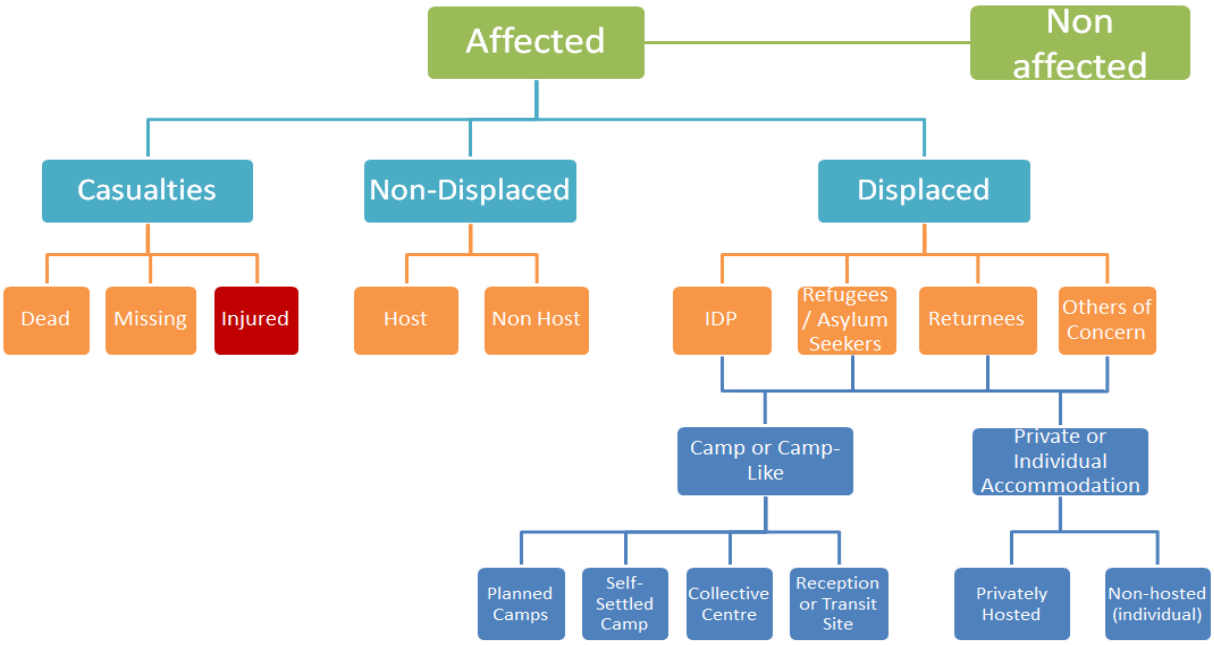
In case the compiled data was not issued by an authoritative institution, **triangulate** the various data to weight the quality and relevance to the population estimation. Firstly, it is important to critically assess the methods of data collection and criteria used to come up with the final data. Secondly, the quality of data regarding the local context of the data sources should be assessed. Thirdly, the reliability of the data should be assessed since it could have been edited. The output of the **desk review** constitutes a “working estimate” and provides the baseline data for further detailed population estimations, assessments and updates. Make sure to be transparent in the assumptions you make, the calculation methods and the sources used to determine the final estimates. At this stage, a range of the estimated population figure is often acceptable.

2.3.2 Step 2: Define the humanitarian profile

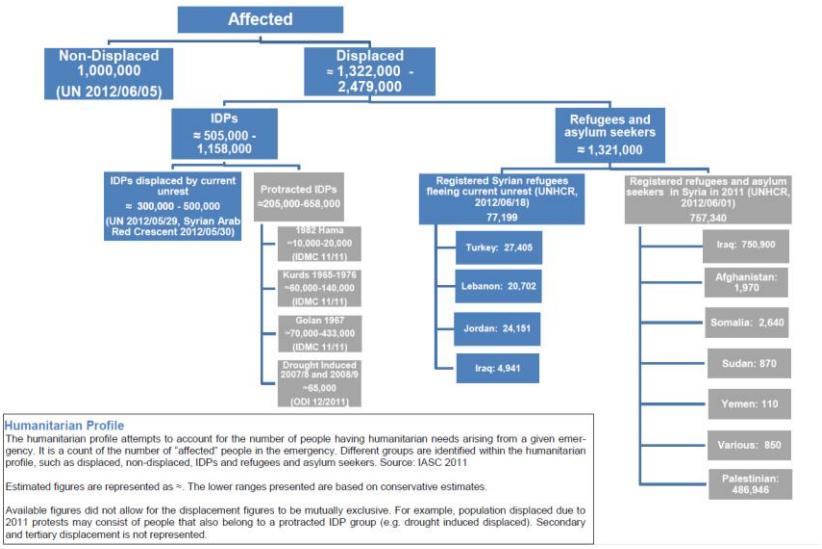
The desk review also allows the identification of different affected groups. Classification of groups of interest is important when working on estimation of affected population figures, for two main reasons:

- Very quickly after a disaster occurs, decision makers will need more disaggregated data. They will not be satisfied with a total number of the affected population, but will ask for a breakdown per province, district, cities, dates, etc. The most important and frequent request will be about disaggregated data per affected group: the number of IDPs (Internally Displaced Persons) in camps, the number of IDPs hosted by the local population, the number of affected residents, etc. Collecting figures for each of those categories has an operational purpose (e.g. the number of children is required for calculating the number of vaccination doses).

- From an information management perspective, the structure, population and maintenance of this classification – which is called the **Humanitarian Profile** – will be of crucial importance[5]. One affected person should not be counted twice, and therefore cannot fall into several of the identified categories (e.g. an affected resident can also be hosting displaced persons). To overcome this overlapping issue, it is necessary to create levels of hierarchy where all categories on a same level sum up to their "parent" in the next higher level in the structure and where each category in a same level is mutually exclusive of another. This way, the sum of categories in a same level equals the total number of people affected, as represented in the following graph:



In this model, only the category "injured people" should be considered as an exception as it may overlap with any of the other categories under "affected".



Note that the category names and structure of the Humanitarian Profile will need to be adapted to each crisis context, such as in this example from the Syria conflict, 2012. Here, the analysts made a distinction between the former Humanitarian Profile (old displaced or refugees from past crises) in grey colour and the recent affected categories of population in blue colour.

[5] Adapted from the IASC Guidelines on the humanitarian profile common operational dataset, 2011

A last critical element to provide for a complete Humanitarian Profile is a **clear definition** for each of the identified groups, so they can be identified without ambiguity and other organization can use the same categorization for their calculation. A standard definition for each group is available in annex A for reference.

2.3.3 Step 3: Provide metadata

In addition to mapping the affected groups and providing a clear description of each, the *2011 IASC Guideline on the Humanitarian Profile* does recommend the following metadata for each figure to be collected or estimated:

- Date of the collected data: Date for which the reported value are considered valid.
- Current location of the population being reported (use official place names such as P codes if available).
- Sex and age category: The age categories will vary depending on what data is available, but the standard categories are <1, 1-4, 5-9, 10-14, …, 60-69, 70+.
- Place of origin: This attribute only applies to displaced persons and its subclasses. It should include p-coded location from which the population being reported moved as a result of the emergency.
- Nationality: This item generally only applies to populations displaced across international borders and contains the nationality of the population being reported.
- Number of person: The number of people in the population group being reported.
- Method: The method by which the Number of Persons was derived, including assumptions.
- Source: The organization(s) providing the information.

2.3.4 Step 4: Choose appropriate methods to further refine estimates

Once the review has been completed and the data stored in a database, decisions can be taken on where, when and how to conduct a more comprehensive population estimation, focusing mainly on information gap areas. This will narrow the scope of further data collection and save time, financial and human resources. New or more specific data collection exercises are generally conducted to have access either to data not already existing or to more detailed, accurate or updated figures.

Several methods and techniques are available to estimate or calculate affected population figures. Choosing the most appropriate is more an art than a science as one unique method cannot be a priori favoured against some others. Depending on the context, the available resources and the characteristics of the population group you are trying to numerically estimate, combining several techniques could produce more reliable results, Expertise and experience will often be required to select and validate the appropriate mix of methods. A recommended combination of techniques that can be applied to most scenarios is as follows:

Step 1: Conduct a desk review to consolidate the baseline data regarding the population of concern.

Step 2: Conduct a desk review of existing affected population figures.

Step 3: Conduct interviews by phone (or face-to-face, internet, radio, SMS, etc.) with available **key informants.** Estimates from district or village authorities and community leaders in the area, service providers, RC/RC movement, NGOs, religious leaders, education or health staff can be important sources of information on population figures, family composition, household size, settlement patterns, and arrival and departure rates. Any other credible first-hand information (e.g. aerial view or any sort of observation) may be used.

Step 4: Reconciliate the estimates from secondary data and the estimates from the field key informants. In many cases there will be little data available, or time will be limited. Statistical methods may be inappropriate (too costly, time-consuming, require considerable expertise, results are difficult to interpret). Besides, often different perspectives, terminologies, frames of reference and working approaches exist, which may hinder effective comparison. In that scenario, a **Delphi exercise** may be considered. The Delphi method brings a group of experts together to reach a consensual opinion about a situation, like the numbers and locations of people affected by a disaster. A prerequisite is that an appropriate number of experts is available to discuss their population data to finally agree upon a total population number. The discussion focuses on agreeing on the small figures at each location or site, after which they can be added up to the total.

Step 5: Identify information gaps and next level of details required as well as appropriate methods, techniques and resources to make the information available.

All contexts are different and different parameters will influence the choice of the suitable method, especially the timeframe available for delivering the estimates (few hours, days, or weeks available), the location size (site or large area) and the characteristics of the population (in movement or stable) to draw estimates from. In the next part of this technical brief, decision trees are proposed based on those parameters. Definitions and characteristics used to develop those decision trees are available in the following tables.

Parameter 1: Timeframe available for providing estimates

"With few hours available"	"With few days available"	"With few weeks available"
• Lack of skills • Important time constraints • Lack of overall pictures • First estimates urgently needed	• More resources and time available • Partial understanding of the scope and scale of the crisis • Completing the Humanitarian Profile	• Resources and funding available • Time to design or use more complex methods • Clear understanding of the crisis • Monitoring and updating the Humanitarian Profile

Parameter 2: Location size

- A "**site**" is a clearly delimitated area that can be visually demarcated by eye from an elevated place (e.g. a helicopter or the top of a hill), and can be a camp, a village, a city neighbourhood, area or block, etc.

- A "**large area**" is an important surface which cannot be visually demarcated from an elevated place, like a district, a province, etc.

Parameter 3: Population movement

- Population "**in movement**" refers to an affected population in continuous transit who have not yet reached their final destination, e.g. IDPs or refugees fleeing violence.

- A "**stable**" population is an affected population which has relocated and can be spatially and temporally anchored.

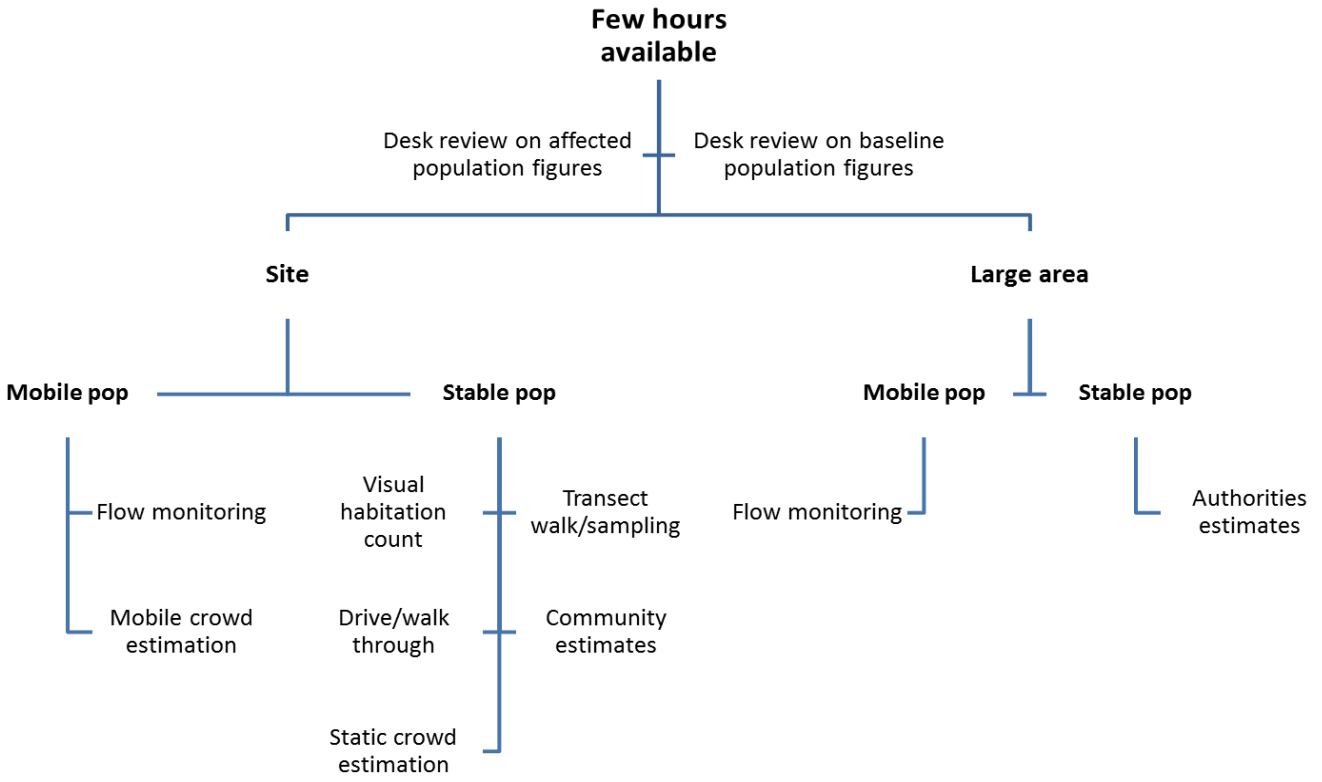
The population estimation methods[6] described in the sections 4 and 5 of this document are recommended for two different scenarios:

- Techniques and methods requiring field and/or affected population access
- Techniques and methods not requiring field access.

3 Methods and techniques requiring field and/or affected population access

[6] Remember, a detailed explanation of each method is given in the ***Rapid estimation of affected population figures*** which can be found on the ACAPS website at http://www.acaps.org/resourcescats/downloader/rapid_estimation_of_affected_population_figures/111

3.1 Field access and few hours available



For sites with available resources

When experienced enumerators are available and can be placed at all significant entry and exit points as quickly as possible, **flow monitoring** should be considered to quantify populations moving into or away from a specific site or a larger area (use of clickers). This method is most suitable when the population is moving across national borders or through major transportation routes. Ideally, the population movement direction should be clear, unique and moving through a few routes or areas.

Mobile crowd estimations may be used to establish first estimations of the number of people moving from or within a given small area or camp (landslide, localized floods, etc.).

For sites with limited resources

A very approximate estimation of a population can be achieved rapidly with the **visual habitation count method**, by visiting and measuring an area considered representative of the population density of the settlement in question, and then observing the total settlement from a high vantage point (hill, building, tower, aircraft or helicopter).

In the case of a large static crowd (a protest in a city, a distribution point, a market or an evacuation point) in a regular, clearly delineated and visible area, the **static crowd estimation method** may apply by multiplying the area by the average density.

Also a **drive through / walk through**, **transect walk and transect sampling** (extrapolation of your sample estimates of non-overlapping transect to the total area of interest) offers the opportunity for a first population estimation, and perspectives on

both central and peripheral areas. It provides closer insights into the conditions of daily life for (hard to reach) disaster-affected populations.

In the absence of other data, **community estimates** (people and community leaders from the area, village elders, service providers, local authorities) can be important sources of information on population figures, family composition, households size and settlement patterns. Make sure to be crystal clear on the population groups or geographical areas you are requesting figures or estimates for.

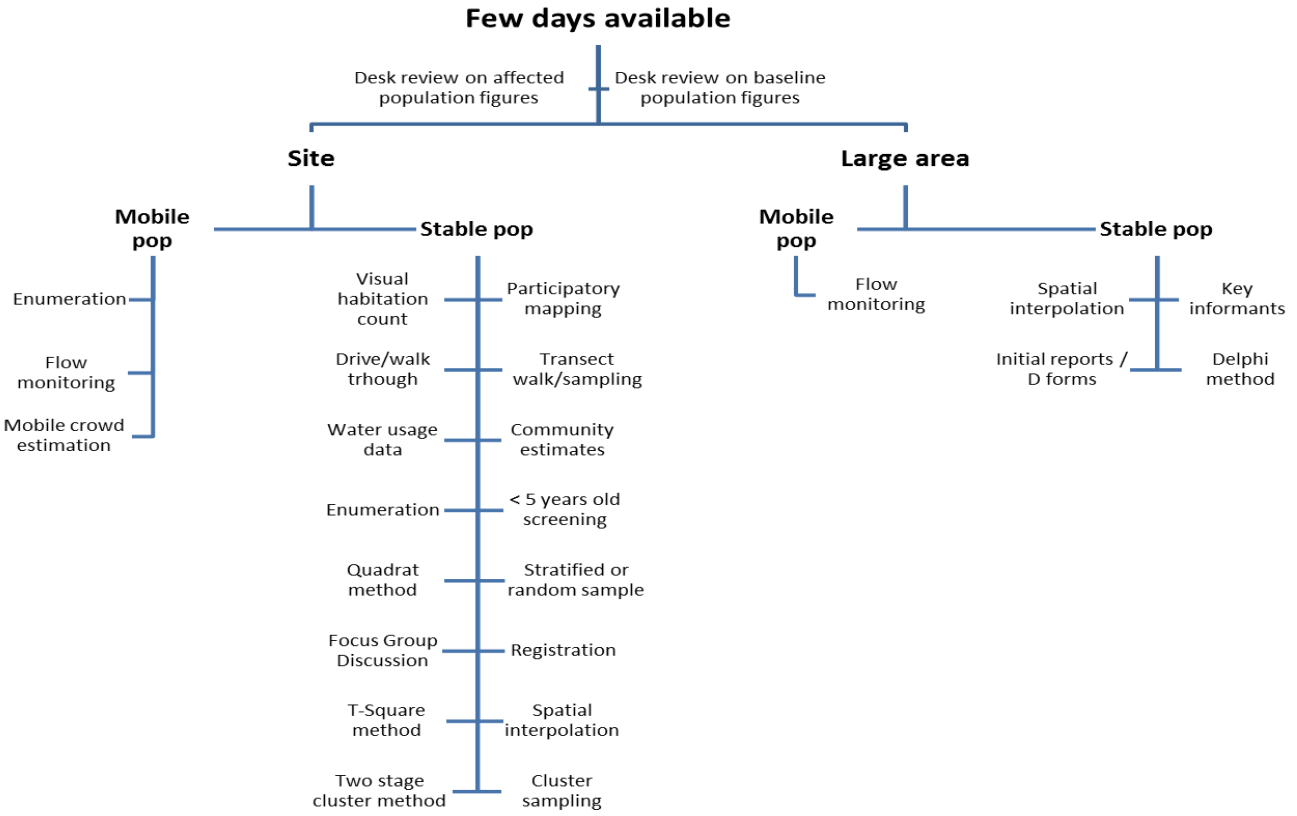
For large areas with available resources

When the population is moving across national borders or through major transportation roads, and experienced enumerators are available who can be placed at all significant entry and exit points as quickly as possible, **flow monitoring** should be considered.

For large areas with limited resources

In the case of a large affected area (floods, earthquake, etc.), provincial or district **authorities estimates** will be the most important sources of affected population figures. However, in case of a large scale disaster (Haiti, Pakistan in 2010) and without adequate data collection preparedness measures, it is very unlikely that the data can be aggregated in a few hours.

3.2 Field access and few days available



For sites with available resources

Flow monitoring, mobile crowd estimations and enumeration may all be used to establish or monitor figures of people moving within a specific zone or camp.

In small areas with a stable population, sampling methods should be considered. Note that for these methods, well-trained survey teams are essential, and that maps and a sampling frame are often required. When a list of households and their location is available, a representative sample, such as a **stratified or random sample, or a cluster sampling** are suitable methods. These methods apply to small and orderly sites.

When a list of households is lacking, but the location and relative population size of the site is known, a **two-stage cluster method** can be used to identify smaller areas to sample and to select households to survey within that smaller area.

Consider the **quadrat method** when disaster-affected populations are in a reasonably well-defined area but the numbers and area are too large to do head counts or habitation counts. An important condition is that houses are one or two storeys tall, uniformly distributed, the topography is flat and undisturbed by streams, rivers or gullies and distances between houses are small (e.g. towns, villages, suburbs, refugee camps).

When a sampling frame is unavailable, unreliable or out-dated, and it is difficult, expensive or laborious to construct one, the **T-square method** can be used to estimate human population size and demographics by measuring the distance between a random point and an occupied house and counting the number of occupants in the house. Also the **spatial interpolation method** can be used to multiply density by the total area to obtain a population estimate.

When resources and expertise are available, a **focus group discussion** can be organised. This entails organising and conducting a group discussion while ensuring that the group is 'representative' of all segments of the community (e.g. women, men, community elders, adolescents, IDPs or community leaders). This method is useful in obtaining additional data and should be triangulated with other sources (e.g. baseline data or a quantitative source). The discussions can be a good way of obtaining situations, reasons for displacement, needs and vulnerabilities, but can also give a more aggregate picture of what whole communities or villages experienced, and can provide data elements as estimates on people killed and wounded and those who fled. They may not achieve great accuracy but can save time and help direct further estimation.

The number of under-fives can be counted or estimated, to estimate the total population. It assumes that the number of children under five within a population represents a given percentage of the total. This method only applies for a situation where the ratio of under-fives does not change. Note that some people may not know their age, in which case you may need to use height measure.

For camp settings with available resources

The **habitation count method** can be used to obtain the number of houses and extrapolate the total number of people in the camp, when triangulated with the average number of people per household and average number of households per house.

The **quadrat method** may be used when populations have settled in a refugee camp, by estimating the population size and characteristics of a small representative area, and extrapolating this information to a larger area. The population number in a camp can also be estimated by the average **amount of water used** by each individual.

A **registration exercise** is often required to initiate as camp services are set up. Registration involves recording information about individuals or families for identification and programming purposes. If registration is not possible, consider a simple **enumeration**.

For sites with limited resources

In the absence of other data and available resources, population figures can be consolidated and/or cross-checked by **community estimates** (people and community leaders from the area, village elders, service providers, local authorities).

Participatory mapping may help define the boundaries of the affected population, and identify the most vulnerable households.

Drive through / walk through, **transect walk and transect sampling** offers the opportunity for population estimations and closer insights into the conditions of daily life for (hard to reach) disaster-affected populations.

Further, the **visual habitation count method** offers a way to achieve very approximate and rapid population number estimation when resources are limited.

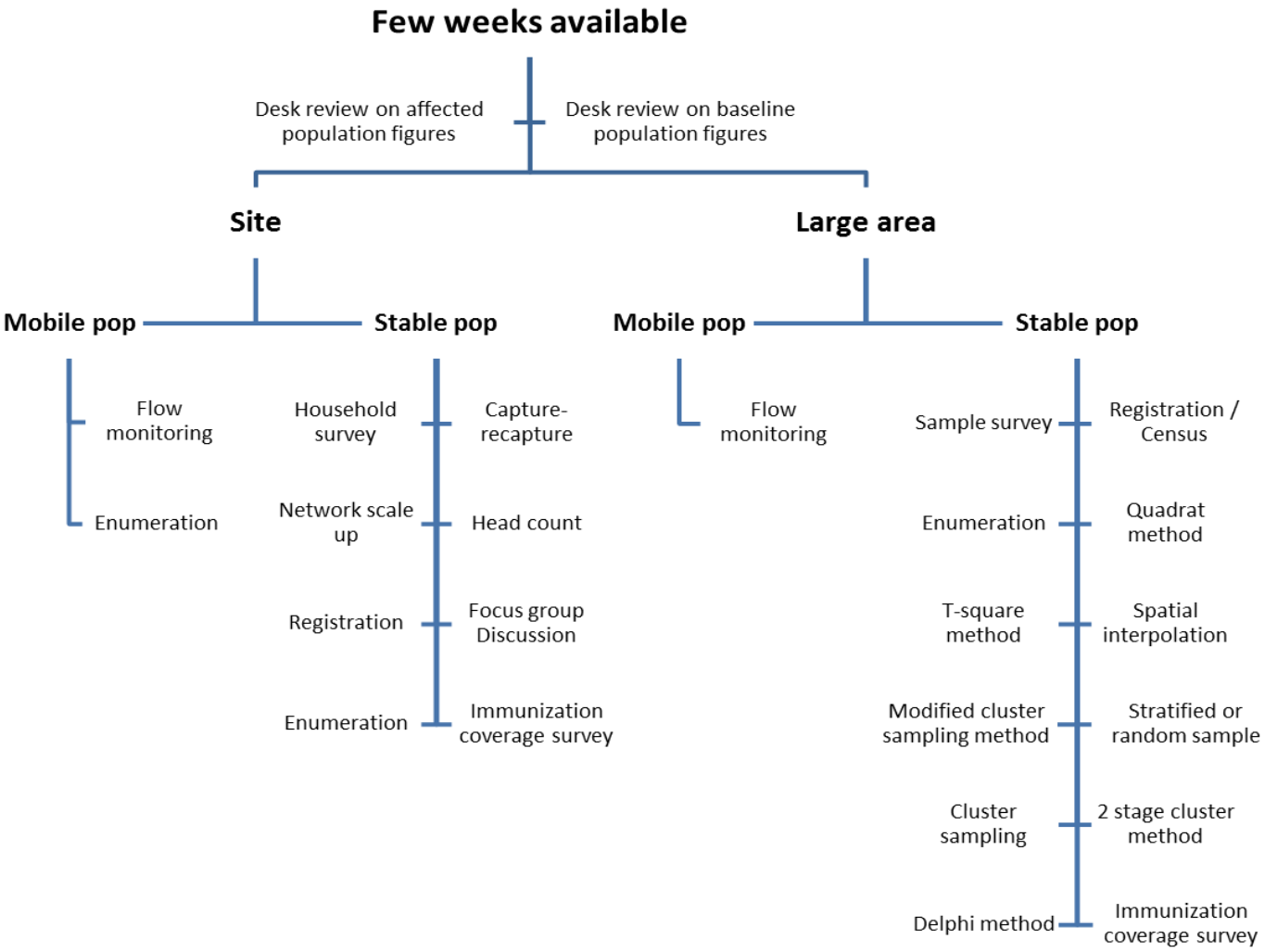
For large areas with available resources

Flow monitoring is still a relevant method to estimate figures of a mobile population from or within a large area.

Interviews with **key informants** and collection of **initial reports/D-forms** from authorities (if available) will also provide good estimates of affected population figures.

In case of contradicting data, calling a meeting and using the **Delphi method** can help reaching consensus on final figures.

3.3 Field access and few weeks available



For sites with available resources

Flow monitoring and enumeration may both be used to establish and monitor figures of people moving within/from a specific site.

For a more stable population in a small area, **enumeration** is also relevant. However, **registration** will provide more accurate information about individuals or families.

When no specific expertise is available, **head counts** can be conducted. Enumerators count each individual physically present in an area at a particular time.

Capture-recapture and a **network scale-up** are highly suitable for defined populations such as nomads and internally displaced people. Also, information collected in general population **household surveys** can be used to estimate the size of “hidden” or “hard to reach” populations.

If available, the **results of an immunization coverage survey** or the number of vaccines administered (for a specific age group) during a mass immunization campaign, can be used as a basis for your estimations. By using the known reference age group distribution, the total population can be deduced.

Focus group discussions are still relevant to gain insight on population characteristics.

For large areas with available resources

Flow monitoring is still relevant to estimate figures of a mobile population from or within a large area.

Sampling methods such as **stratified or random sample** or a **(modified) cluster sampling** are suitable techniques when the extent of damage is widespread, such as after a hurricane, tsunami, flood, or in the case of a famine or drought.

The **two stage cluster method** and the **quadrat method** can also be used, as well as the **T-square method** and the **spatial interpolation method**.

Sample surveys allow generalisations about a whole population by interviewing or observing a part. While not designed to produce estimates of population size per se, they are useful in validating or adjusting estimates. A more detailed **household survey** (with probability sampling design and adequate sample size) can provide more precise estimates of basic demographic information as household size, age and sex composition, births, deaths and in-and-out migration.

A **census** covers the entire population of a country, and collects besides of individual data a set of relevant socio-economic information for every household. This is the most elaborated of population figures calculation techniques. However, a census takes a long time and requires a lot of human resources, which is often lacking in emergencies.

As a more realistic alternative to censuses, **registration** or **enumeration** might prove easier depending on circumstances and resources.

For large areas with limited resources

Using the results of an **immunization coverage survey or a vaccination campaign** is also suitable to estimate population of large areas.

As mentioned before, the **Delphi method** can help reaching an agreement between different stakeholders in case of contradicting figures emerging from different stakeholders or the use of different techniques.

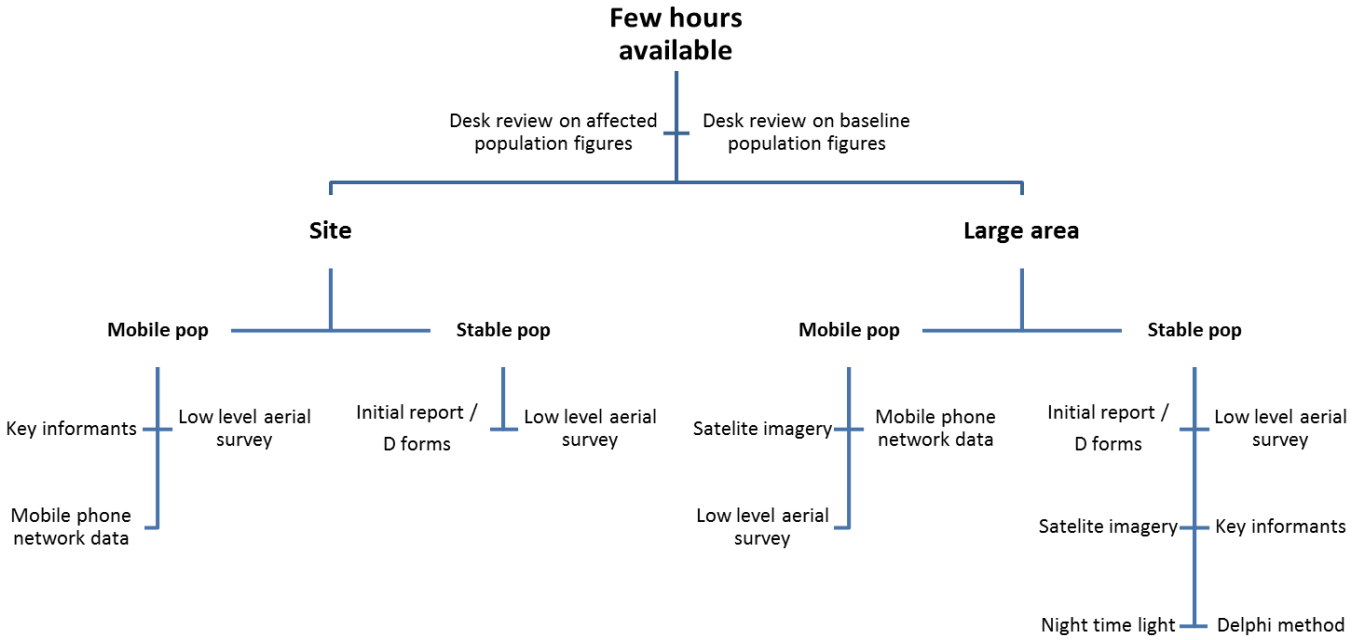
4 Methods and techniques not requiring field and/or affected population access

In certain circumstances, no field access will be granted or possible. Methods that do require field visits, direct observation, counting or sampling will not be feasible and alternative data collection techniques must be found.

Remote sensing is the acquisition of information about an object or phenomenon, without making physical contact with the object. It makes it possible to collect data on dangerous or inaccessible areas and also replaces costly and slow data collection on the ground, ensuring that areas or objects are not disturbed.

When possible, remote sensing techniques should be used in combination with one or several of the field methods discussed in section 4: it allows for triangulation of the information and to not only rely on remote technologies.

4.1 No field access and few hours available



For sites with available resources

Low-level aerial photography and survey may be considered to conduct initial population estimations both for a mobile and stable population. A condition is that there is timely access to these materials and the time and costs related to processing the imagery. GIS and geo-localization expertise is often required in these situations.

Accurate data on population movements can also be acquired within hours if access to **mobile phone network data** is available. A high ratio of people with mobile subscription and access to mobile phone network data are needed. Relationships and agreements with mobile phone providers should be in place prior to the emergency for quick activation.

For sites with limited resources

If phone lines or other communication means are operational (internet, radio, SMS, etc.), **key informants** can be contacted and interviewed to compile information on mobile population. Any other credible first-hand information (e.g. **aerial survey**) may be used to corroborate those figures.

In the case of a stable population and if a data collection system is in place, **Initial reports / D-forms** may be collected from community leaders and aggregated at central level within 12-48 hours after a disaster to provide a first estimate.

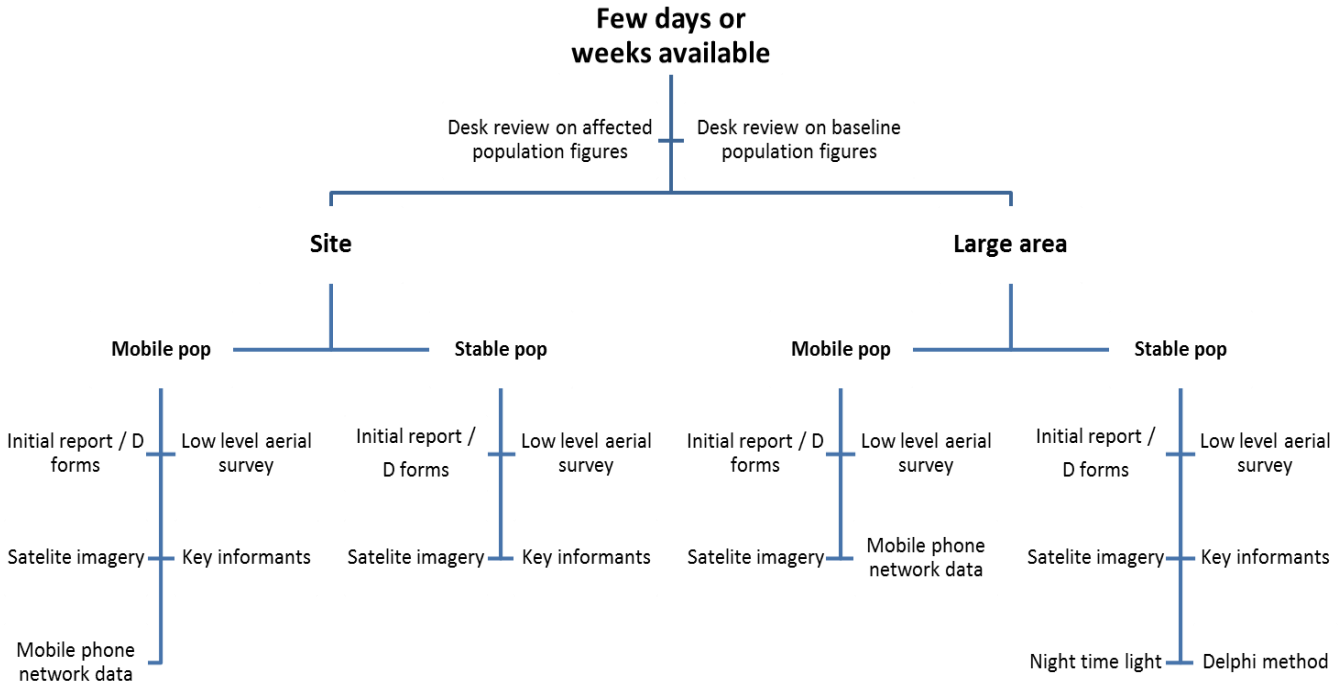
For large areas with available resources

Satellite imagery, **low-level aerial survey and mobile phone network data** can be used to track mobile populations within or from a large area. Additionally, for a stable population **night-time lights** may be used if access to the appropriate technology and skills is granted.

For large area with limited resources

Initial reports / D forms compiled from affected communities and **key informant** interviews (e.g. by phone) can be used in case of limited resources. If figures are inconsistent when reconciling the estimates from secondary data and the estimates from the field key informants, a **Delphi exercise** may be considered.

4.2 No field access and few days available



For sites with available resources

When technical, human and/or financial resources are available, **low-level aerial surveys** may be considered to conduct initial population estimations both for mobile and stable populations. A condition is that there is timely access to the required material and available time to processing the imagery. GIS and geo-localization expertise is often required in these situations.

Accurate data on population movements can also be acquired within hours if access to **mobile phone network data** is available. A high ratio of people with mobile subscription and access to mobile phone network data are needed, and relationships and agreements with mobile phone providers should already be in place.

Finally, detailed high resolution **satellite imagery** of small sites (e.g. camp, border point, etc.) can support effective population estimations.

For sites with limited resources

When the communication network is not interrupted, **key informants** can be contacted and interviewed to compile information on mobile populations. Estimates from province, districts or village authorities and community leaders, RC/RC, existing and/or resuming monitoring and surveillance systems will be important sources of information for population figures, family composition, household size, settlement patterns, and arrival and departure rates.
Any other credible first-hand information (e.g. **aerial survey**) may be used to corroborate those figures.

The compilation of **Initial reports / D-forms** (if available) at central level may also provide an accurate picture of the situation in terms of affected population numbers.

For large areas with available resources

Satellite imagery, **low-level aerial photography and mobile phone network data** can be used to track mobile populations within or from a large area.

For stable populations, s**atellite imagery, night-time lights, or low-level aerial survey** may be used if access to the appropriate technology and skills is available.

Any other credible first-hand information (e.g. **aerial survey, initial reports / D forms, satellite imagery**) may be used if care has been taken to harmonize the forms. At this stage, it is important that the definition and the methods when counting affected populations in different areas have been clearly communicated to assessors in order to ensure reliability and validity of the results as well as easy aggregation at central level.

For large areas with limited resources

Initial reports / D forms compiled from affected communities can be used in case of limited resources for both mobile and stable populations in large geographical areas, and can be supported by data collected through key informant interviews. If figures are inconsistent when reconciling the estimates from secondary data and the estimates from the field key informants, a **Delphi exercise** may be considered.

4.3 No field access and few weeks available

At this stage, a unique reporting channel for affected population figures and the required update mechanisms need to be functional.

In addition, the necessary procedures for aggregation and consolidation of the data need to be in place. Unit of measurement should be individuals and data should be disaggregated by sex and age.

If different estimates or counting methods exist, then the **Delphi method** should be used to support consensus around definitions, figures and methodologies applicable. Guidelines should be made available to relevant authorities and stakeholders.

During the longer-term assessment phases, monitoring of affected population figures and updating of data sets takes place. All remote methods and techniques mentioned in section 5.2 apply here.

5 Annex A - Standard definition of affected groups

Casualties - The sum of dead, missing, and injured:

- **Dead** - Persons confirmed as dead and persons missing and presumed dead[7].
- **Missing** - Persons whose status during or after an emergency is not known.
- **Injured** - Persons suffering from physical injuries, trauma or an illness requiring medical treatment[8].

Affected - The sum of displaced and non-displaced persons.

1) Non-Displaced - The sum of host and non-host persons.

- **Host** - Persons who are part of a host community or family receiving affected people. Due to the stress placed on the host families and communities, they are considered part of the humanitarian caseload.

- **Non-Host** - People requiring immediate assistance during a period of emergency, who have not moved from their homes or places of habitual residence.

2) Displaced - The sum of internally displaced persons, refugees and Asylum seekers, and others of concern.

- **Internally Displaced Persons** – "Persons or groups of persons who have been forced or obliged to flee or to leave their homes or places of habitual residence, in particular as a result of or in order to avoid the effects of armed conflict, situations of generalized violence, violations of human rights or natural or human-made disasters, and who have not crossed an internationally recognized State border"[9].

- **Refugees and Asylum Seekers** - A refugee is someone who "owing to a well-founded fear of being persecuted for reasons of race, religion, nationality, membership of a particular social group or political opinion, is outside the country of his nationality, and is unable to, or owing to such fear, is unwilling to avail himself of the protection of that country"[10]. "An Asylum Seeker is someone who says he or she is a refugee, but whose claim has not yet been definitively evaluated[11].

- **Others of Concern** - Persons who have been displaced by the emergency and form part of the humanitarian caseload, but do not fall into either of the above categories (e.g. third country nationals, migrants).

Each of the above three sub-classes of displaced has the following potential sub-categories. Note that these lower-level classes may not be as universal as the higher level classes described above. The classes and their definitions may need to be adjusted to match operational realities.

[7] EMDAT criteria, http://www.emdat.be/criteria-and-definition
[8] Ibid
[9] UN Guiding Principles on Internal Displacement UN doc E/CN.4/1998/53/Add.2
[10] Article 1, 1951 Convention relating to the status of refugees
[11] UNHCR, http://www.unhcr.org/pages/49c3646c137.html

- **Camp or Camp-like** - The sum of planned camp or settlement, self-settled camp, collective centre, and reception or transit site.

    - **Planned Camps** - Planned camps are places where displaced populations find accommodation on purpose-built sites, and a full services infrastructure is provided, including water supply, food distribution, non-food item distribution, education, and health care, usually exclusively for the population of the site.

    - **Self-settled Camps** - A displaced community or displaced groups may settle in camps, independent of assistance from local government or the aid community. Self-settled camps are often sited on state-owned, private or communal land, usually after limited negotiations with the local population or private owners over use and access.

    - **Collective Centres** - This type of settlement is where displaced persons find accommodation in pre-existing public buildings and community facilities, for example, in schools, barracks, community centres, town halls, gymnasiums, hotels, warehouses, disused factories, and unfinished buildings. They are often used when displacement occurs inside a city itself, or when there are significant flows of displaced people into a city or town. Often, mass shelter is intended as temporary or transit accommodation.

    - **Reception and Transit Camps** - Oftentimes, it is necessary to provide temporary accommodation for displaced persons. These camps might be necessary at the beginning of an emergency as a temporary accommodation pending transfer to a suitable, safe, longer term holding camp, or at the end of an operation as a staging point of return. Reception and transit camps are therefore usually either intermediate or short-term installations.

- **Private or Individual Accommodation –** The sum of privately hosted and non-hosted.

    - **Hosted -** Living in someone's else home with them, sharing resources and a hearth with another household group.

    - **Non-hosted -** Living in one’s own home.

6 Annex B - Methods: time/effort vs accuracy

Methods with only a few hours available	Accuracy		
	Low	Moderate	High
Methods requiring access to the field			
Communities estimates	X		
Authorities estimates		X	
Visual habitation count	X		
Static crowd estimation			X
Drive through/walk trough	X		
Transect walk/sampling	X		
Flow monitoring		X	
Mobile crowd estimation		X	
Methods not requiring access to the field			
Low level aerial survey		X	
Key informant interviews (phone etc.)		X	
Initial report / D forms		X	
Mobile phone network data			X
Satellite imagery		X	
Night time light	X		
Delphi method		X	

Methods with few days available	Accuracy		
	Low	Moderate	High
Methods requiring access to the field			
Quadrat method			X
T-square method			X
Spatial interpolation method		X	
Stratified or random sample			X
Modified cluster sampling method			X
2 stage cluster method			X
Cluster sampling			X
Enumeration			X
Flow monitoring		X	
Mobile crowd estimation		X	
Habitation count			X
Visual habitation count	X		
Participatory mapping	X		
Drive through/walk trough	X		
Transect walk/sampling	X		
Water usage data	X		
Community estimates	X		
< 5 years old screening	X		
Focus group discussion	X		
Registration			X
Initial reports / D forms		X	
Key informant interviews		X	
Delphi method		X	
Methods not requiring access to the field			
Low level aerial survey		X	
Key informant interviews (phone, etc.)		X	
Initial report / D forms		X	
Mobile phone network data			X
Satellite imagery		X	
Night time light	X		
Delphi method		X	

Methods with weeks available	Accuracy		
	Low	Moderate	High
Methods requiring access to the field			
Enumeration			X
Flow monitoring		X	
Household sample survey	X		
Immunization coverage survey or campaign	X		
Sample survey		X	
Quadrat method			X
T-square method			X
Spatial interpolation method		X	
Stratified or random sample			X
Modified cluster sampling method			X
2 stage cluster method			X
Cluster sampling			X
Focus group discussions	X		
Network sale-up	X		
Capture-recapture	X		
Head count			X
Census			X
Registration			X
Delphi method		X	
Methods not requiring access to the field			
Low level aerial survey		X	
Key informant interviews (phone, etc.)		X	
Initial report / D forms		X	
Mobile phone network data			X
Satellite imagery		X	
Night time light	X		
Delphi method		X	

7 Annex C - References and further reading

Bengtsson, L. X. Lu, A. Thorson, R. Garfield, J. von Schreeb (2011) Improved Response to Disasters and Outbreaks by Tracking Population Movements with Mobile Phone Network Data: A Post-Earthquake Geospatial Study in Haiti. *PLoS Medicine* 8 (8): 1-9. Available on: http://www.plosmedicine.org/article/info%3Adoi%2F10.1371%2Fjournal.pmed.1001083

Bjorgo, E. (2000) Using very high spatial resolution multispectral satellite sensor imagery to monitor refugee camps. *International Journal of Remote Sensing* 21(3): 79-88. Available on: http://www.geocarto.com.hk/cgi-bin/pages1/june00/refugee.pdf

Bostoen, K., Z. Chalabi, and R.F. Grais (2007) Optimisation of the T-square sampling method to estimate population sizes. *Emerging Themes in Epidemiology* 4(7)

Bredin, J. (2011) *COD consultancy report*. UNHCR, 2011-09-09

Brown, V., D. Coulombier, F. Belanger, J. Jacquier, S. Balandine, D. Legros (2001). Rapid assessment of population size by area sampling in disaster situations. *Disasters* 25 (2): 164-171

CIEDRS (2003) *Demographic Methods In Emergency Assessment - A Guide For Practitioners*. Johns Hopkins University Bloomberg School of Public Health Baltimore, Maryland. Available on: http://parkdatabase.org/files/documents/2003_Demographic-Methods-In-Emergency-Assessment_A-Guide-for-Practitioners_CIEDRS_Johns-Hopkins-Univ.pdf

Doocy, S., A. Rofi, G. Burnham, C. Robinson. *Tsunami mortality in Aceh province, Indonesia*. Johns Hopkins Bloomberg School of Public Health. Available on: http://parkdatabase.org/files/documents/2005_Tsunami-Mortality-in-Aceh-Province-Indonesia_Johns-Hopkins-Univ_S-Doocy-et-al.pdf

ECLAC (2003) *Handbook for Estimating the Socio-economic and Environmental Effects of Disasters*. Available on: http://parkdatabase.org/files/documents/2003_Handbok-for-Estimating-the-Socio-economic-and-Environmental-Effects-of-Disasters_ECLAC.pdf

Garb, J.L., R.G. Cromley and R.B. Wait (2007) Estimating Populations at Risk for Disaster Preparedness and Response. *Journal of Homeland Security and Emergency Management* 4 (1). Available on: http://parkdatabase.org/files/documents/2007_Estimating-Populations-at-Risk-for-Disaster-Preparedness-and-Response_Journal-of-Homeland-Security-and-Emergency-Mangement_JL-Garb-et-al.pdf

Gorokhovich, Y. and S. Doocy (2008) *Estimating population risk for coastal disasters using spatial models with global data*. Solutions to Coastal Disasters Congress 2008. Available on: http://parkdatabase.org/files/documents/2007_Estimating-Population-Risk-for-Coastal-Disasters-Using-Spatial-Models-with-Global-Data-_Y-Gorokhovich_S-Doocy.pdf

Grais, R.F., D. Coulombier, J. Ampuero, M.E.S. Lucas, A. T. Barretto, G. Jacquier, F. Diaz, S. Balandine, C. Mahoudeau and V. Brown (2006) Are rapid population estimates accurate? A field trial of two different assessment methods. *Disasters* 30 (3): 364-376. Available on:

http://parkdatabase.org/files/documents/2005_Are-Rapid-Population-Estimates-Accurate_A-Field-Trial-of-Two-Different-Assessment-Methods_ODI_RF-Grais-et-al.pdf

Higgs, G. and M. Langford (2009) GIScience, environmental justice, & estimating populations at risk: The case of landfills in Wales. *Applied Geography* 29: 63–76. Available on: http://www.dpi.inpe.br/sil/cst310/Aula13_M%C3%A9todoDasimetrico/Langford_Pop_Wales.pdf

HPN (2007) *Public health in crisis affected populations. A practical guide for decision-makers*.

Available on: http://www.odihpn.org/documents/networkpaper061.pdf

IASC (2011) *IASC Guidelines on the Humanitarian Profile Common Operational Dataset*. IASC IM Task Force 20-Jun-2011

IASC (2010) *IASC Guidelines Common Operational Datasets (CODs) in Disaster Preparedness and Response*. As requested by the 77th IASC Working Group meeting. IASC Endorsed November 1 2010. Available on: http://parkdatabase.org/files/documents/2010_Guidelines-on-Common-Operational-Datasets-in-Disaster-Preparedness-and-Response-June_IASC.doc

IDMC and OCHA (2008) *Guidance on profiling internally displaced persons*. April 2008 edition. Available on: http://parkdatabase.org/files/documents/2008_Guidance-on-Profiling-Internally-Displaced-Persons_NRC-IDMC_OCHA.pdf

IFRC (2007) *The Johns Hopkins and IFRC Public Health Guide for Emergencies.* Available on: http://parkdatabase.org/files/documents/2007_Disaster-Epidemiology_Public-Health-Guide-for-Emergencies_Johns-Hopkins-Univ_IFRC.pdf

Luan R., G. Zeng, D. Zhang, L. Luo, P. Yuan, B. Liang (2005) A study on methods of estimating the population size of men who have sex with men in Southwest China. *European journal of epidemiology* 20(7): 581-585. Available on: https://www.globalhivmeinfo.org/Gamet/pdf/598_Size%20Estimation%20MSM%20in%20China.pdf

MSF (2006) *Rapid health assessment of refugee or displaced populations*. Third edition. Available on: http://www.refbooks.msf.org/MSF_Docs/En/Rapid_health/RAPID_HEALTH_en.pdf

MSF (1997) *Refugee Health - An approach to emergency situations*. Available on: http://www.refbooks.msf.org/MSF_Docs/En/Refugee_Health/RH.pdf

Nepali, A. (2010) *County level population estimation using knowledge-based image classification and regression models*. Master thesis university of North Texas August 2010. Available on: http://digital.library.unt.edu/ark:/67531/metadc30498/m2/1/high_res_d/thesis.pdf

Noji, E.K. (2005) Estimating population size in emergencies. *Bulletin of the World Health Organization* 83 (3). Available on: http://parkdatabase.org/files/documents/2005_Estimating-Population-Size-in-Emergencies_EK-Noji_WHO.pdf

NRC (2002) *Demographic Assessment Techniques in Complex Humanitarian Emergencies-Summary of a workshop*. National Academy Press, Washington DC

NRC (2007) *Tools and Methods for Estimating Populations at Risk from Natural Disasters and Complex Humanitarian Crises*. The National Academies Press, Washington DC

NRC (2007) *Successful Response Starts with a Map: Improving Geospatial Support for Disaster Management*. The National Academies Press, Washington DC. Available on: http://parkdatabase.org/files/documents/2007_Successful-Response-Starts-with-a-Map_Improving-Geospatial-Support-for-Disaster-Management_CPC_National-Academies.pdf

RNN (1997) *Counting and identification of beneficiary populations in emergency operations: registration and its alternatives*. Available on: http://parkdatabase.org/files/documents/1997_Counting-and-Identification-of-Beneficiary-Populations-in-Emergency-Operations_Registration-and-Its-Alternatives_RRN-ODI_J-Telford.pdf

Stone, G., A. Lekht, N. Burris and C. Williams (2007) Data Collection and Communications in the Public Health Response to a Disaster: Rapid Population Estimate Surveys and the Daily Dashboard in Post-Katrina New Orleans. *Journal of Public Health Management Practice* 13 (5): 453–460. Available on: http://www.lphi.org/LPHIadmin/uploads/Stone_2007_Data%20collection%20and%20communications-14436.pdf

Treacy-Wong, V. (2011) *Population Estimation Methods used in Complex Emergency Settings*. Master thesis London school of hygiene & tropical medicine

UNFPA (2010) *Guidelines on Data Issues in Humanitarian Crisis Situations*. June 2010. Available on: http://parkdatabase.org/files/documents/2010_Guidelines-on-Data-Issues-in-Humanitarian-Crisis-Situations_UNFPA.pdf

UNHCR (1994) *Registration: A Practical Guide for Field Staff*. Geneva: May 1994.

UNHCR (2007) *Handbook for Emergencies* - Second edition. Available on: http://parkdatabase.org/files/documents/2010_-UNHCR-Handbook-for-Emergencies-2001_ProCap.pdf

UNHCR/WFP (2004) *Joint Assessment Guidelines.* Available on: http://documents.wfp.org/stellent/groups/public/documents/ena/wfp038210.pdf

UNICEF (2010) Rapid *Assessment Sampling in Emergency Situations*. Available on: http://parkdatabase.org/files/documents/2010_Rapid-assessment-sampling-in-emergencies_UNICEF.pdf

Watson, R. and P. Yip (2011) How many were there when it mattered? Estimating the sizes of crowds. *Significance* September 2011. Available on: http://onlinelibrary.wiley.com/doi/10.1111/j.1740-9713.2011.00502.x/abstract

WFP (2006) *Desk Review: Estimating Population Size in Emergencies.*

WFP (2007) *Area method to estimate population size and demographics in emergency food security assessments*. Technical guidance sheet 7.
WFP (2009) *Using the Delphi method to estimate population size and demographics in emergency food security assessments*. Technical guidance sheet 10.

WFP (2009) *Using the T-square sampling method to estimate population size, demographics and other characteristics in emergency food security assessments*. Technical guidance sheet 11.

WFP (2010) *Pakistan flood impact assessment*. September 2010. Available on: http://parkdatabase.org/files/documents/2010_Pakistan_Pakistan-Floods-Impact-Assessment_WFP.pdf

WHO (1996) A modified cluster-sampling method for post-disaster rapid assessment of needs. *Bulletin of the World Health Organization* 74 (4): 399-405. Available on: http://parkdatabase.org/files/documents/1996_A-Modified-Cluster-sampling-Method-for-Post-disaster-Rapid-Assessment-of-Needs_WHO-Bulletin.pdf

WHO (2010) *Guidelines on Estimating the Size of Populations Most at Risk to HIV*. Available online: http://parkdatabase.org/files/documents/2010_Guidelines-on-Estimating-the-Size-of-Populations-Most-at-Risk-to-HIV_UNAIDS_WHO.pdf