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Population and Housing Census of Bhutan - 2005

## Census Mapping Manual



*Let's Get Counted!*

Royal Government of Bhutan  
Office of the Census Commissioner  
Thimphu: Bhutan

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# 1 Background

## 1.1 Population and Housing Census of Bhutan, 2005

As per the Executive Order of the Royal Government, the Office of the Census Commissioner has been authorized and mandated to carry out the Population and Housing Census of Bhutan in May 2005. This census would be the first ever census conducted in the country as per the United Nation's recommended methods and shall meet the international standards. To ensure complete coverage, it is imperative to adopt the best available technology and resources for preparing cartographic maps, as it would be important for achieving complete census enumeration and avoid over lapping.

## 1.2 About the Manual

Census mapping is an important component of the Population & Housing Census. To facilitate the completion of census mapping on time and to maintain standards, it is imperative that the surveyors be familiarized on what census mapping would entail. Therefore, a comprehensive manual on census mapping has been developed with an objective to guide and assist the surveyors in taking decision on mapping, while in field.

## 1.3 Objectives of Census Maps

- Mapping for census enumeration primarily involves dividing the entire country into smaller census administrative units called enumeration areas (EA).
- To divide the geogs into smaller enumeration areas for census mapping, which would ensure complete coverage in terms of area and population of Bhutan.
- To assist the census enumerators in locating his/ her assigned areas, the EAs.
- To assist in determining boundaries and geographical coverage of EAs.
- To facilitate the census enumerators in identifying and up-dating newly constructed and dismantled structures after the last house listing operation.

Despite of having a comprehensive manual the surveyors may encounter problems in the field and in such circumstances they should notify their supervisor for further guidance and instructions.

## 2. Concepts and Definitions

### 2.1 Population Census

A **population census** can be described as the “total process of collecting, compiling, evaluating, analyzing, publishing or otherwise disseminating data on demographic, economic and social characteristics of the population in a country or a well defined part of it at a specified time”.

### 2.2 Enumeration Area

An **Enumeration Area** may be defined as "A well delineated territorial unit containing the prescribed household numbers and within which enumeration is to be carried out by a single enumerator during the specified period of enumeration".

### 2.3 Village

A **village** may consist of two or collections of houses or clustered houses. Generally, rural villages consist of evenly scattered houses with prominent physical features defining the boundaries.

### 2.4 Geog

A **geog** is an administrative block comprising of villages with a defined boundaries within Dzongkhag.

In order to have complete and updated census maps, it is necessary to update the existing maps by updating relevant geo-referenced information of villages, *geogs* and *Dzongkhags*. The EAs will be formed on the basis of households and other criterion set by the Census Office.

## 2.5 Structure

A Structure is any independently standing structure having its own independent foundation, comprising of one or more rooms/ spaces that may be enclosed by external walls extending from the foundation to the roof.

Structures will include temporary shed, tent for housing labourers at the road side, a *bago* (thatched shed), a *drupkhang*, a *tshamkhang*, a cave for meditation, a cow herder's shed, temporary sheds in mining, logging and quarrying sites etc.

A structure could be used or intended to be used for residential, commercial, industrial or agricultural/ animal husbandry purposes or for the provision of services e.g. offices, institutions, hospitals, prisons, etc. It could be detached census houses, a shop, a warehouse, a factory, a workshop, a school, a *Lhakhang (Temple)* etc.

## 2.6 Map

A **map** is the representation of the whole or a part of the earth surface in reduced form (drawn to scale) showing physical or/ and man-made features existing on it.

**Geographical Information System (GIS)** is a Computer based systems that are used to store and manipulate geographic information (Aronoff, 1991). This technology is designed for the collection, storage, and analysis of objects and phenomena where geographic location is an important characteristic or critical to the analysis. The GIS is capable of handling and analyzing data that are referenced to a geographic location.

## 2.7 GPS

A **Global Positioning System (GPS)** is Satellite based tracking system to get the position on the surface of the earth. In general there are 24 GPS satellites inclined at 60 degrees in its orbit and continuously moving around the earth.

The handheld GPS receiver sets will be able to record the values of spherical/grid co-ordinates of fairly accurate precision within a short time. Due to the removal of Selective Availability (SA) from the GPS satellite signals, good handheld GPS receivers can now provide accuracy in the range of 10-15 meters. The GPS can be effectively used for locating villages and settlements as well as other ground features on 1:50000 scale maps.

### 3. Pre-Census Mapping

Pre-Census Mapping is one of the basic requirements of the Population & Housing Census Operation. Accurate census maps not only helps in planning the census operation but also ensures complete coverage of areas including structures and census houses that will form the basis of a successful and complete census enumeration.

#### 3.1 Manpower Requirements

The Office of the Census Commissioner has to recruit surveyors from the Department of Survey & Land Records (DSLRL), Department of Urban Development and Engineering Services (DUDES), Department of Geology & Mines (DGM) and City Corporation for census mapping.

#### 3.2 Equipments/Materials

The equipment required for census mapping for surveyors are given below.

S.No.	Item	Quantity
1	GPS Receiver sets	1 No.
2	Scale -30 cm	1 No.
3	Lists of Villages	1 set.
4	Topographic maps, urban layout maps	1 set
5	Cello tape	3 Nos.
6	Stapler	1 No.
7	Stapler pins	1 pkt.
8	File covers with fastener	1 No.
9	Paper punch	1 No.
10	Pencil	2 pkts.
11	Pencil erasers	5 Nos.

S.No.	Item	Quantity
12	Printing paper A4 size	3 Reams
13	Note book	1 No.
15	Ball Point Pens- Red & Blue	2 No. each
16	Colour pencils	1 set
17	Clip board A4 size	1 No.
18	Alkaline battery	20 pairs/ geog

The field staff should check the equipment periodically to ensure its proper maintenance.

The officials concerned shall be held responsible for any damage or loss of the equipment caused due to negligence or unauthorized use.

### 3.3 Pre-Census Base Maps

Surveyors shall be provided with copies 1:50,000 topographic maps and would be held responsible for safe keeping and proper utilization. All the EAs should be formed on the base maps provided and should be able to relate it during the production of the EA maps.

- **Basic elements of maps and its usage**

It is essential to understand elements of base map by the surveyors since there maps for various purposes drawn to appropriate scales.

The scale determines the extent of the territorial coverage of a map, its size and the amount of information that can be legibly presented.

Maps highlight the spatial relationships among the mapped features in terms of direction, distance and area coverage.

Use of appropriate graphic symbols and annotations enhances the readability and usefulness of a map.

- **How to read the maps**

Read the map provided to recognize the features, places with the help of legend. Understand the shapes and dimensions of features and their spatial relationships in terms of distances and directions through the map scale and the systems of coordinates shown on the map. Also identify the physical and man made features on the map in relation to the ground realities and boundaries of administrative divisions (dzongkhags, geogs) on a map

Following should be understood in order to correctly interpret and use the maps provided for field mapping:

- (i) Map reference
- (ii) Map Scales
- (iii) Distance and area measurements
- (iv) Map orientations
- (v) Elevation and relief (Physical features)
- (vi) Map symbols or legend
- (vii) Coordinates/ grids

### **Map reference**

Map reference usually means the different reference system that individual country is adopting depending upon their position on the globe. For a country like Bhutan, we have Everest coordinate system as our reference system.

### **Map scales**

A map scale can be defined as the relationship of the distance between any two points on the map corresponding to horizontal distance between the same points on the surface of the earth. Without an expression of scale on a map it is difficult to determine distances between the places. On the map, Scales are generally shown in 2 ways, namely: (i) Representative Fraction (RF) or ratio and (ii) Graphic scale.

The most preferred representation of scale is RF or Ratio scale. Graphic scale representations are mainly used for small-scale maps.

- (i) It is independent of measuring units, and
- (ii) It makes easier to establish linear relationships between two or more maps of different scales.

### **Measuring Distances on the Maps**

During the course of fieldwork it is often required to know the actual distances of features/places by measuring these on the maps and then converting to ground distances using map scale. Generally scale expressed on a map is R.F. form. The measurements can be made simply by a ruler, once the scale ratio is understood. For instance, on 1:50,000 scale maps, 1 centimeter on the map represents 0.5 kilometer or 500 meters on the ground. Using this ratio or relationship between units of centimeter on map and equivalent units of kilometer on ground, you can easily convert the ground distances to map distances and vice-versa.

### **Direction**

Direction is another basic element that needs to be understood in order to orient the map in the field and plot places and objects at their relatively correct positions. The directions on a map can be determined with reference to north, which is usually indicated by north arrow or can be inferred from the system of map grid coordinates or by magnetic compass.

Once the north direction is known, other directions can be determined with reference to its cardinal points, i.e.; east on the right, west on the left and south down below.

### **Map Orientation**

While using a map, it is important to know how to line up a map with the ground to locate certain ground features that are shown on the map. The act of lining up a map is called "orientation". Before you can start updating your map in the field it is important that you align your map on the ground in such a way that the map's directions correspond with direction of relevant features on the ground. There are 2 possible ways to orient a map:

- 1. By a road or lane:** If there is a road that is shown on the map, you should turn the map until the road on it aligns with the road on ground. Be careful that positions of other features on the sides of road also match with respective symbols on the map.

**2. By distant point:** Identify a distant feature on the ground and its location on the map. If your position is known on the map, you can pin the map down there and rotate it to align the feature on the map with its actual location on the ground. Usually the use of magnetic compass is preferred, however if not available the above method may be used.

While orienting your map, you must ascertain your own position on the map by looking at the surrounding features or by resection from any two visible distant points.

### **Physical features**

Broadly speaking, the topography of Bhutan is primarily characterized with two distinct features, namely; (i) mountains/ ridges, and (ii) valleys. On topographic maps, these features can easily be identified with contours, imaginary lines, drawn at regular intervals are passing through the places of same height/altitude. The values of contours are expressed in terms of meters which represent the height from the mean sea level. The spot heights and control points also provides the information on heights.

### **The Symbol Legend**

All base maps have legend. The legend explains various conventional signs and other symbols used on that particular map to depict various geographic features. These symbols usually includes boundaries (international, Dzongkhag and Geogs) in the forms of lines of various widths and styles, roads by types in the form of firm lines of variable width, structures, physical features like lakes, rivers etc. by relevant conventional symbols. It is important to understand these symbols and get used to them for quick reading and updating of maps.

### **Coordinates**

Conventional method of describing the locations of any geographic feature on the surface of earth is to use geographical coordinates. These are X, Y and Z coordinates just like the ones used on mathematical graphs. Since the earth is a sphere, coordinates used on maps are measured in spherical coordinate system

known as **latitudes** and **longitudes**. These are measured in degrees, minutes and seconds (angular measurements).

The latitudes comprise a set of lines running parallel to equator in east-west direction forming concentric circles. There are 180° of latitudes from pole to pole the numbering of which start from 0° at equator to 90° at each pole. The latitudes are always designated as north or south according to their position from the equator. These are also known as parallels.

The longitudes form a set of meridians running in north-south direction. There are 360° of longitudes. The Prime Meridian numbered as 0° is the longitude passing through Greenwich near London (United Kingdom) and exactly opposite to the meridian of 180°. The other meridians are numbered from 0° to 180° on either side of prime meridian and designated as east or west.

The most commonly used coordinate system on topographical map is spherical coordinate system. The values of spherical coordinate system are measured in degree, minute and seconds. These coordinates are called as **latitudes** and **longitudes**.

### COMMON MAP SCALES AND THEIR DISTANCE EQUIVALENTS

SCALE	ONE CENTIMETER REPRESENTS	ONE KILOMETER IS REPRESENTED BY
1:2500	25 meters	40 centimeter
1:5,000	50 meters	20 centimeter
1:10,000	100 meters	10 centimeter
1:20,000	200 meters	5 centimeter
1:25,000	250 meters	4 centimeter
1:50,000	500 meters	2 centimeters
1:100,000	1 kilometers	1 centimeter
1:250,000	2.5 kilometers	4 Millimeters

Other maps that would be needed for planning, organization and monitoring the process of census enumeration at different levels are:

#### ONE KILOMETER IS REPRESENTED BY

- (i) Map of the **entire country** showing boundaries of individual Dzongkhags and *Geogs*, locations of urban centers and main villages, transport network, prominent topographic features, etc.
- (ii) Dzongkhag Maps showing boundaries of *geogs*, their names, locations of towns and main villages, transport network, prominent topographic features, etc.
- (iii) Geog Maps showing locations of villages, road network, main topographic features, etc.

All the above maps will be generated from the base maps of 1:50,000.

### 3.4 Organization and Responsibilities

#### 3.4.1 Cartographic Division

The responsibilities of Cartography Division of the OCC would be as follows:

- (i) Assisting in procurement, processing and production of rural base map needed for the field work.
- (ii) Training the census mapping staff and their deployment to field.
- (iii) Organizing the supply of maps and materials to field teams.
- (iv) Carrying out periodic field inspections.
- (v) Collecting, verifying and documenting completed field outputs/ data.
- (vi) Collecting, updating and processing of information on digital maps.
- (vii) Production of Enumeration Area (EA) maps for census enumeration.

- **Digital Cartographic Activities**

Once the pre-census mapping field operation is complete, all the topographical maps in 1:50,000 will have to be digitized in the computer environment. Thereafter, all the required Enumeration Area maps corresponding to the respective *Geogs* and *Dzongkhags* will be printed for actual enumeration operations. For this the following equipments are required:

1. Computers (21" monitor) 10 Nos.
2. Scanner (A0 size) 1 No.
3. Color Plotter (A0 size) 1. No.
4. Color Printer (A3 size) 2 No.

- **Software Required**

The Geographical Information System (GIS) softwares, ArcInfo and Arcview, will be used for generating the Population and Housing Census database in GIS platform. ArcInfo and Arcview are the widely used GIS softwares in GIS applications.

The manpower for this digital work will have to be mobilized from GIS sections of various Ministries and Govt. organizations. Since the digital work has to commence

soon after the pre-census mapping operation, it is imperative to complete digital work one month ahead of real census operation.

### 3.4.2 Mappers

The mapper should in consultation with the house lister (coordinator) carry out the following activities:

- Receiving necessary maps, equipment, materials, supplies from the office and ensure its proper usage and maintenance.
- Make a work plan and accordingly make appointments with the local administration (both at the Dzongkhag and *Geog* level).
- Prepare neat EA maps with legible boundary descriptions.
- Carryout stipulated field activities described in subsequent sections.

The implementation strategies and main procedural steps involved in the implementation of these activities are outlined as follows.

#### **A Verification of village locations and demarcation of outer limits**

- Obtaining current list of the villages from the office of *gup*.
- Check the location of villages, contained in the list, on the base map and enquire about the locations of villages not found on the map, if any, and plot them by obtaining coordinates with handheld GPS. *Please refer to section 4.6 on how to calibrate GPS.*
- Similarly enquire about status of villages shown on the map but not included in the list, if any. These may be small villages, which now might have been merged with other adjoining villages to create bigger units.
- Determine the outer limits of individual villages with the help of *gup*, *chupon* or *Tsogpa* to mark on the base map. Generally, natural features like river, stream, and ridges, etc. form village limits.

- In case of doubt about identification of boundary-forming feature on the map, GPS coordinates should be used to ascertain its location.
- Mountainous and forested areas where there are no human inhabitants during the time of mapping operation and that may not be included in any village may be demarcated separately on the map as EAs with zero population.

## **B Delineation of Enumeration Areas**

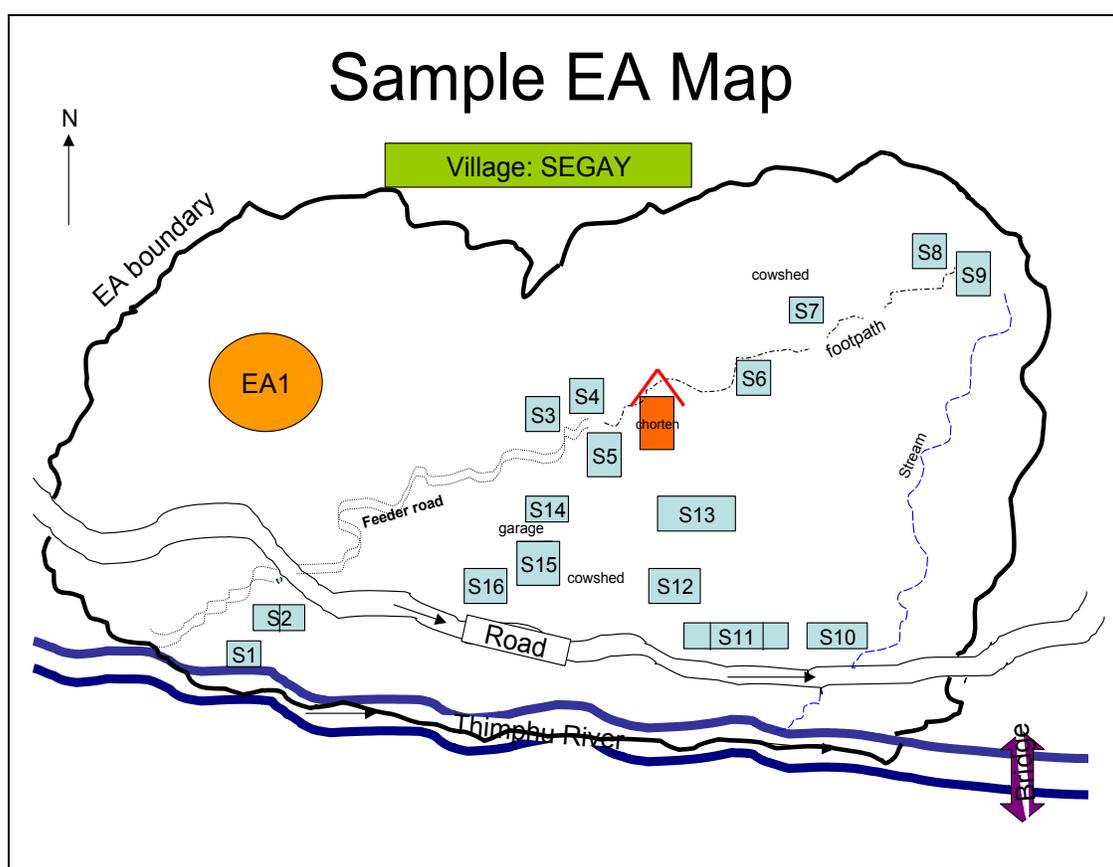
### **1. For Rural Areas**

Criteria for delineating Enumeration Areas are as follows:

The EA should be demarcated on the basis of its terrain, walking distance, spatial distribution of houses and area (should be able to cover the area in one-two days)

- Each EA should contain a maximum household of 20  $\pm$  5.
- EAs delineated within *geogs* should cover its entire space in an exclusive manner. That is, every parcel of land area (settlements as well as empty spaces) should be allocated to one or the other EA and no gaps or overlaps must occur.
- EA boundary of one Geog should not overlap with that of other *geogs*
- As far as possible, boundaries of EAs, particularly when demarcated within a village, should be made identifiable by delineating these along some permanent (preferably physical) features such as streams/ roads/ tracks, etc. Where such features are non-existent, imaginary boundary lines may be drawn and identified with reference to prominent structures (identified by the name of the owner) or other benchmark features by GPS observed coordinates.
- In sparsely populated areas, an EA should be defined in terms of territorial coverage such that it is easily covered by an enumerator and by walking during the prescribed enumeration time. Thus, distance between two farthest population points within an EA in such areas should not exceed 4 kilometers.

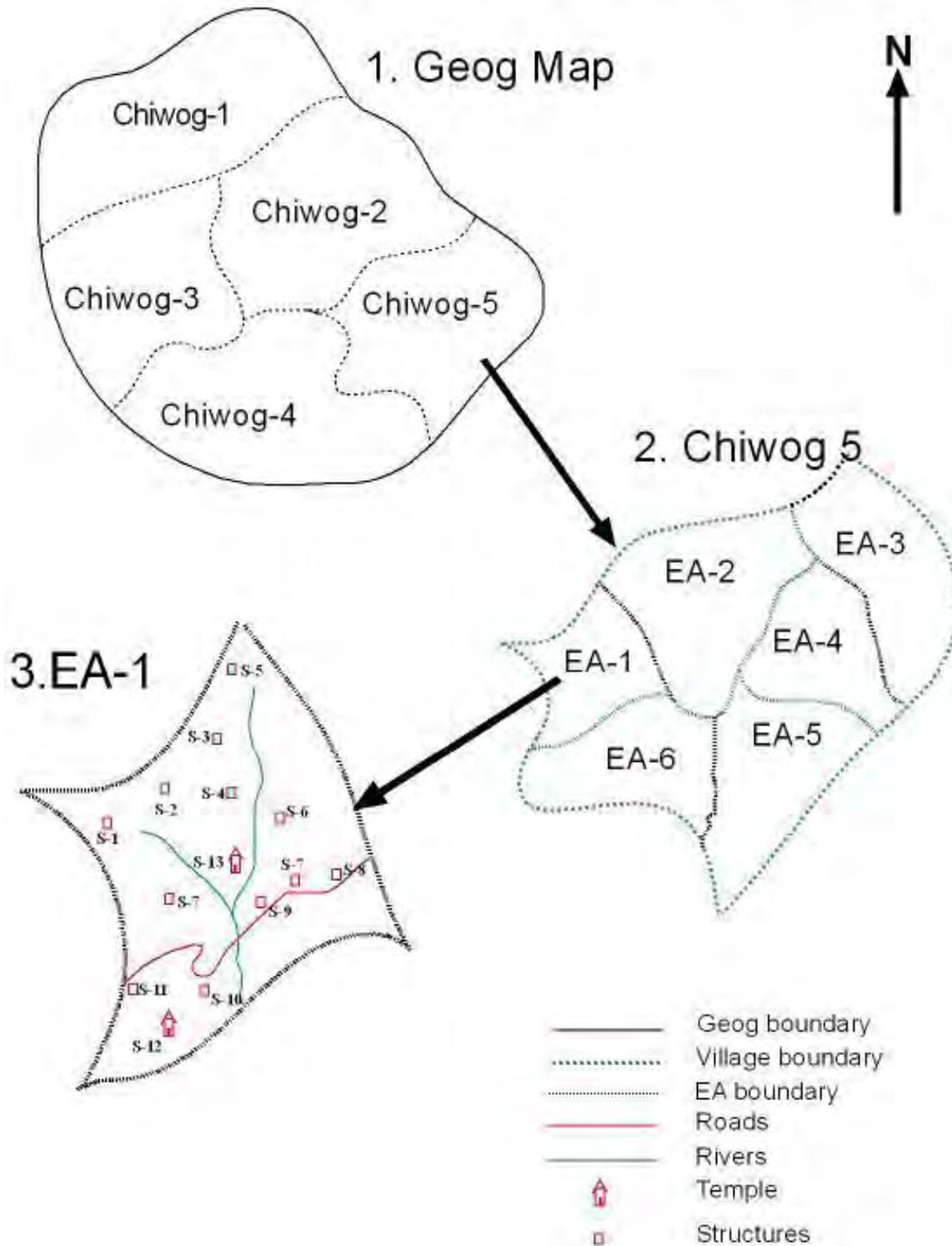
- An enumerator during the enumeration should be able to cover the entire EA assigned to him/her within the census period (ie.2- 3 days for rural areas), therefore it is important to delineate the boundaries according to the terrain. Utmost care must be taken to form EA with difficult terrain like deep gorges, big rivers, mountains and deep valleys.
- The GPS readings for individual structure should be taken details of which have been given in the subsequent paragraphs.
- Prepare a sketch map of EA on A4 size paper to be used for the formation of EAs. A sample of the EA map is shown below.



- A detailed example on how to number the structure, census house and household is shown in the annexure. The red dots marked along the EA boundary lines are just an example and the exact location of observation should be decided by surveyors.-

- Empty houses in the villages temporarily abandoned due to security or any other reasons should be demarcated and recorded in the EAs as these houses may be occupied during the census enumeration period.
  
- There are some cases wherein the villagers of some villages will claim that they fall in another Geog (a) or Dzongkhag (a) although they are geographically in Geog (b) or Dzongkhag(b). In such situation, the EA delineation should be exclusively where they are located topographically and administratively. E.g. Chamgang villagers claim that they fall under genyi geog of Thimphu Dzongkhag although geographically they are located in Chang Geog. In such case, it should be included in Chang geog only.

### MAP REQUIRED TO BE SKETCHED



- Uninhabited areas should also be delineated as zero population EAs. Boundaries of these uninhabited EAs (0 population) should as far as possible follow identifiable physical features. However, the EA should be divided into manageable of manageable size taking into consideration the time duration of census and terrain of the area.

In addition to information shown on the map, some other information need to be verified and updated during field mapping .

- **Names of rivers/stream** - Verify river names with the help of *gup* and correct those found incorrectly written on the map. Also write the names of streams that form village limits if these are not already indicated on the map.
- **Roads/tracks**- All metal roads and most of other gravel roads/tracks have already been shown on the base map provided. Although roads may not have its name, but road name could be given, like *Shumar-kherigoenpa* road.

As indicated above, plotting new features on the map would involve use of GPS receiver sets.

### **Dealing with institutions**

Institutions of classified nature like police camps, army barracks, prisons, *Dratsangs*, *Gomdays*, Hospitals, Royal Compound, Training Institutions, etc. where civilian enumerators may not be allowed to enter and enumerate, should be constituted into separate EAs. Locations of such institutions must be marked on the corresponding base maps.

An outline of procedural steps and other relevant considerations for dealing with the institutions in the process of demarcation are as follows:

- (I) Contact the head of institution and get the information on its name, type and number of inhabitants living there.
- (II) Most of the institutions of civilian type will be demarcated as part of separate EA.

- (III) Under no circumstances any institutions should be divided and attached to two or more different EAs.
- (IV) Locations of these institutions should be clearly indicated on the corresponding EA map.

## **2. For Urban Areas**

Delineation of EAs in urban areas will be carried out on large scale (1:5000/ 1:10000) topographic maps obtained from the DUDES and concerned City Corporations. Details shown on these maps are more up to date as these are based on recently undertaken ground survey or low altitude aerial photography flown during late nineties.

In the urban areas an EA may contain up to maximum of **35 households**. This size may vary depending on how scattered the houses are and on the walking distances.

### **Demarcation Procedures for Urban areas**

- Demarcation of sub-divisions (such as zones, wards, etc.) within the urban area limit, if there is any.
- Demarcation of segments/ blocks within the sub-divisions, if this exists, otherwise within the outer limits of the town based on layout of roads/ streets and other relevant ground features.
- Verification of houses shown on the map within each segment/ block and plotting new houses found on the ground but not shown.
- Counting of structures within each block.
- Demarcation of EAs containing prescribed population size by suitably grouping these blocks.

### **Coding of EAs**

All EAs in a *geog* or block in urban should be assigned EA codes in conformity with the Coding system adopted. For uniform coding of EA, refer

*Instruction manual for House Listing Operations.* The following are the criteria for EA formation in the urban areas

- All the EAs within individual *geog*, wards/ townships should be coded separately and in sequential manner.
  
- Since EAs form basic units of data collection, these need to be identified by types of areas (rural/ urban) for the purpose of organization of census enumeration and subsequently tabulation of census results.
  
- The codes should be assigned in a manner that facilitates quick location of an EA on the map. To achieve this in the best way, the numbers may be assigned in the order of geographical contiguity so that the consecutive codes fall next to each other in an approachable direction.

Similarly while coding EAs in urban areas, the boundaries of lower subdivisions, if any, should be taken into consideration so that all the EAs within each such subdivision are assigned with codes of continuing sequence.

## **4 Management and field conduct**

### **4.1 Time table and work targets**

The census enumeration is scheduled for May 2005. Production of all the maps needed for the planning and conducting of census, therefore, must be completed at least three months before the commencement of census enumeration in order to have adequate time for packaging of the relevant maps with other census materials for dispatch to field offices.

The team coordinator of pre-census operation should prepare program sheets indicating the areas to be visited, time and number of *geogs* to be covered. Attempts should be made to cover up delays occurred in one *Geog* by working extra hours in other *geogs*.

### **4.2 Co-operation and support of local administration**

The OCC will arrange to inform the concerned local authorities about the purpose and expected dates of visit of field teams to their areas. On arrival to a *Dzongkhag*, the team should pay a courtesy call to *Dasho Dzongdags* and apprise him about the purpose, objectives, program and time schedule of your assignments and assistance solicited from the *Dzongkhag*. A meeting may be conducted in the *Dzongkhag* involving various stakeholders including *Geog* officials.

The Team should visit the local municipal office/ representatives and collect latest maps and other useful information related to your assignment.

### **4.3 Discipline and co-operation**

To successfully complete the assignment with a reasonable standards it is necessary to have a congenial working environment at all times in the field, this can be achieved only by developing, maintaining and cultivating good work ethics and relations amongst the team members.

The Team coordinator is entrusted with the responsibilities of planning, coordinating and organizing the work in the field. He is required to foster unity and induce discipline amongst the team.

Any tendencies of idleness, in-punctuality and misbehavior and in-subordination would only affect the progress of the work.

Any issues must be discussed frankly and resolved amicably in the field itself. Although a team member may advise his leader, it is for the leader to make the final decision in the interest of the team.

#### **4.4 Public Relation**

The nature of your work entails constant personal contacts with the general public. You must at all time act as a professional while in the field as you would be representing the Census Commissioner. As a professional you are expected to conduct properly and not bring disrepute to the office. This may, in turn, adversely affect the success of the mapping work and the way you present will influence the public's attitude to the census. Each member of the team will have full responsibility for the work. You are, therefore, advised to be courteous and polite during work and even thereafter.

Some of the people you meet or work with, like *geog* authorities or their representatives, may not understand and become fully convinced about the objective of your work. It is necessary for the team to convene a meeting with the village/*geog* representatives to explain the objectives, its usefulness and solicit their participation to make the house listing and mapping operation successful.

Assure the public that you are conducting mapping exercise legally under the provision of the Executive Order on census promulgated in May 2004. The Executive Order and other related regulations stipulate that whatsoever information you collect during the course of your work is strictly confidential and used for statistical purposes only. It cannot be used as an evidence for deciding any other legal or administrative case.

In case of any unresolved problem, report to the Census Office for further course of action.

#### **4.5 Your conduct**

As a representative of the Census Office, the team must conduct themselves in a manner befitting government representative.

- \* Be polite and friendly
- \* Remain calm and reasonable even if the person you are dealing with is nasty or abusive.
- \* Refrain from discussing any government and local issues besides your assigned responsibilities
- \* Respect the privacy of people
- \* Always be in formal dress
- \* Do not take any body with you who is not connected with work
- \* Thank the respondents/local officials for their cooperation at the end of your assignment.

#### **4.6 Your security**

The field team should be careful about their personal security at all times.

- \* Be alert at all times
- \* Beware of dogs
- \* Avoid working and traveling at late hours in security problem areas.
- \* Carry your ID card at all times

## 4.7 GPS Operation and Guidelines

### a. GPS reading format

Dzongkhag: ..... Geog:.....

Village/ Chiwog .....

Enumeration Area (EA) number:.....

Srl. No	Names of the heads of the household	Easting	Northing	Remarks (Nature of the house) whether permanent temporary or materials used	Structure Number	Purpose of the house/ structure

### b. Setting GPS right

The Handheld GPS receiver called GARMIN VISTA (*Etrex*) is used for this PHC 2005.

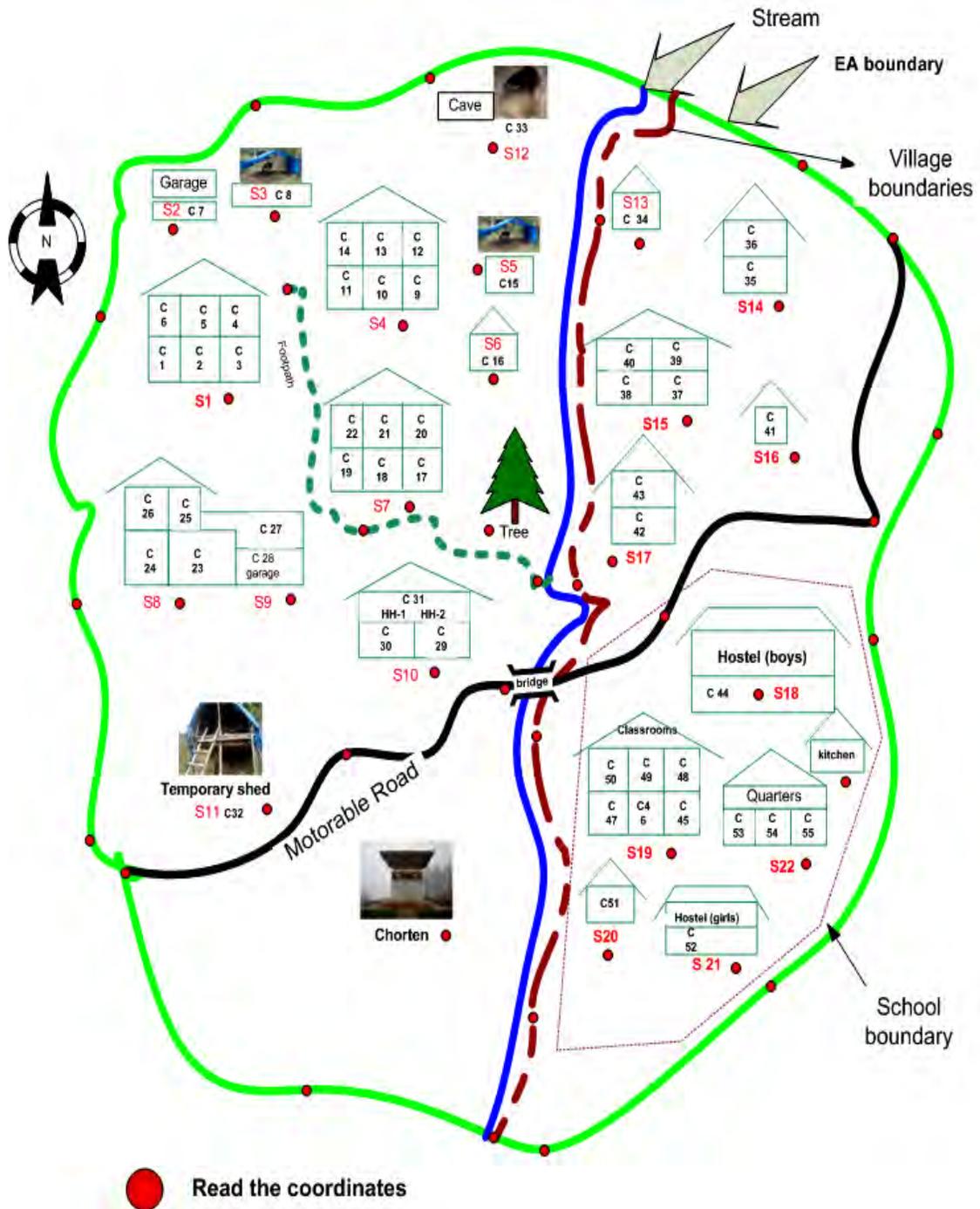
- 1) Insert a pair of pencil batteries (Sony type preferred) in the GPS receiver
- 2) Switch on the GPC receiver by pressing the power button for 2-3 seconds
- 3) Press the page button to get the list of function icons
- 4) Click on the set-up icon to get the list of sub-function icons
- 5) Click on the Unit Icon to get the calibration menu
- 6) On the Unit Menu, choose India Zone IIB in the position format
- 7) Choose India Bangladesh as map datum

- 8) Enter metric under distance/speed option
- 9) Choose meters for Elevation and m/sec for vertical speed
- 10) Choose metric for Depth and Millibars for Pressure
- 11) Press enter and Save
- 12) This completes the calibration procedures
- 13) Press the power button for 2-3 seconds to switch off the GPS receiver

**c. GPS Operation Guidelines**

1. Before taking the GPS readings, make sure that you are not under a roof, trees and in deep valleys.
2. Switch on the GPC receiver by pressing the power button for 2-3 seconds.
3. Wait for 3-5 minutes to track a minimum of 4-5 satellites. It will then show the coordinates and positional accuracy.
4. The accuracy should be within 10-15 meters or 35 feet.
5. Then start to note the coordinates.
6. Recheck the coordinates to ensure that you have taken the correct readings.
7. Although, the GPS can store the readings it has got limited memory. Therefore, you are instructed to record the readings in the provided field register.
8. Time and again plot the coordinates observed to already existing important features (*Ihakangs, chortens*, road crossings, etc) on the map to ensure that you are getting correct coordinates.
9. Keep observing the coordinate changes from house to house for any anomalies.

A SAMPLE MAP OF AN EA ILLUSTRATING THE NUMBERING OF STRUCTURES AND CENSUS HOUSES. IT ALSO SHOWS THAT THE COORDINATES OF LANDMARKS, PHYSICAL FEATURES AND OTHER MANMADE FEATURES.



## POPULATION &amp; HOUSING CENSUS MAPPING 2005

Dzongkhag: Wangdue  
Geog: Phobji

EA-42

Chewog: Gongphel  
Village: Gongphel

Sl.No	Names of Head of Household	Easting	Northing	Remarks	Structure No.
1.	Chethey	2762995	1071423	Wooden Cowshed	S1
2.	Phuntsho Wangdi	2762909	1071397	Wooden Cowshed	S2
3	Thinley Bidha	2762792	1071327	Wooden Cow/manure shed	S3
4	"	2762773	1071321	Water tank (Concrete)	-
5	Penjor	2762760	1071302	2 storied, mud/wood walled house (manure shed attached)	S4+S5
6	Tshering Dorji	2762744	1071112	Firewood shed	S6
7	"	2762755	1071286	Wooden Cowshed	S7
8	Pema Zam	2762902	1071217	Timber shed	S8
9	Penjor / Pema Tshering	2762943	1071201	Wooden Cowshed	S9
10	Nim Penjor	2762933	1071290	Timber shed	S10
11	Thinley Budha	2762940	1071290	"	S11
12	-	2763021	1071389	Water tap (Concrete)	-
13	-	2762997	1071396	Wooden Toilet on Nala	-
14	Chethey	276300	1071383	2 storied, mudwalled house under construction	S12
15	Gem Dorji	2763018	1071369	Power Tiller Garage	S13
16	Chethey	2763008	1071357	Firewood/manure shed	S14
17	-	2763031	1071395	Feeder road Pt.	-
18	-	2763019	1071287	" " (Join E sl. 17 to draw road)	-
19	Kumbu Dem	2763023	1071285	Wooden Cowshed	S15
20	Tshering Dorji	2763036	1071283	Wooden Potatoshed	S16
21	"	2763048	1071253	Wooden Timber shed	S17
22	"	2763038	1071258	Mudwalled, woodroofed house	S18
23	Penjor/Kumbu Dem	2763027	1071257	Wooden Potatoshed	S19
24	Nangay Zam/Kumbo Dem	2763003	1071271	3 storied, mud/wood walled woodroofed house	S20
25	Dorji Dem/Phub Gem	2762999	1071257	2 storied, mudwalled woodroofed house	(S21)
26	Gyem Dorji	2762999	1071241	- do -	S22
27	Nim Dorji	2762993	1071235	3 storied mudwalled woodroofed house	S23
28	Thinley Bidha/Kinley Tshering	2762989	1071222	2 storied, mudwalled, woodroofed house	S24
29	Tshechu Om	2762988	1071213	- do -	S25
30	Gem Dorji	2762969	1071204	Timber shed	S26
31	-	2762997	1071206	Stone/mudwalled Guest house	S27
	Shankar Sharma			Date: 10/11/04	

D. S. E

Toposheet No. 78 1/3

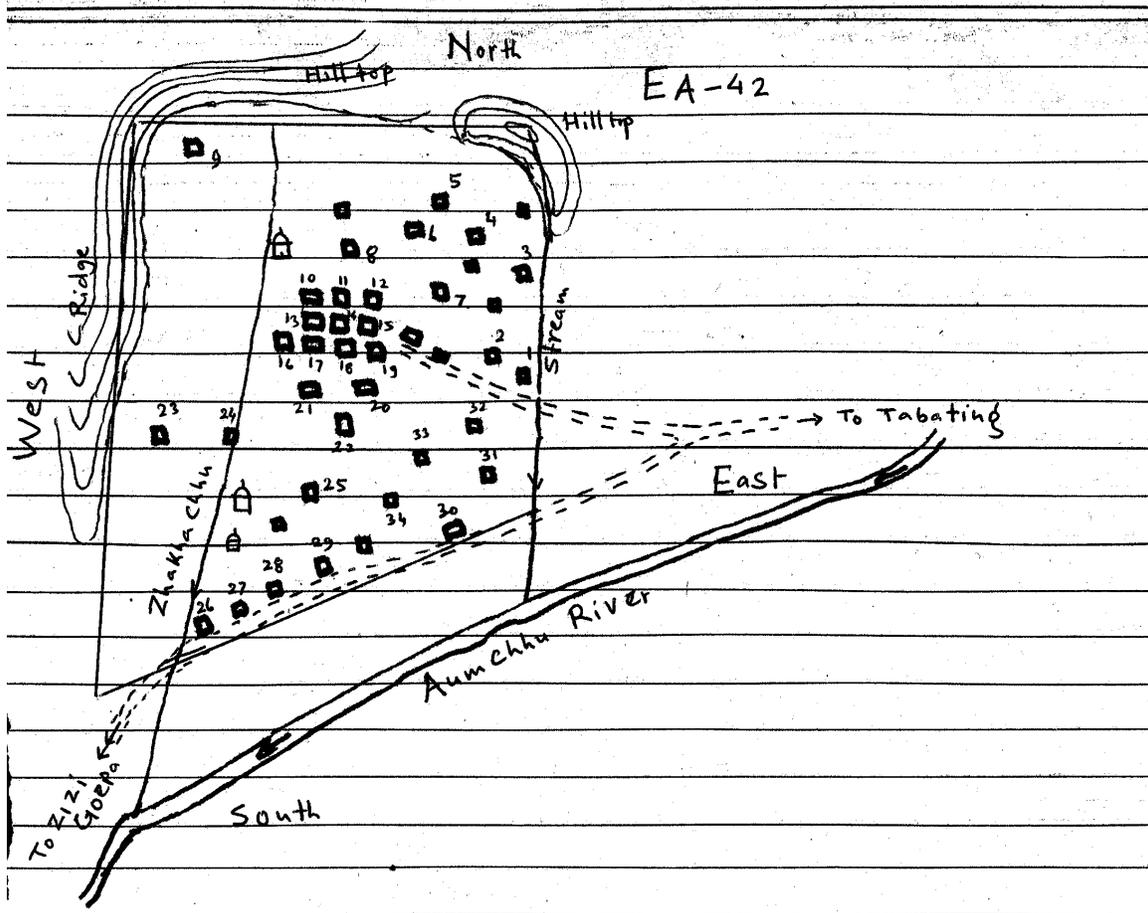
POPULATION & HOUSING CENSUS MAPPING 2005  
 Dzongkhag: Wangdue  
 Gzong: Phobji

Chewog: Gongphel  
 Village: Gongphel

EA-42

Sl. No	Names of Head of Household	Easting	Northing	Remarks	Structure No.
32	Tshechu om	2763002	1071204	firewood shed	S28
33	Passang Tshering	2762997	1071141	floor mill	S29
34	-	2762978	1071177	Chhorten (Mani Dungkhor)	-
35	Passang Tshery	2763000	1071195	Wooden Toilet	-
36	-do-	2763005	1071203	Concrete water tap	-
37	-do-	2763004	1071209	2 storied, mudwalled, wood roofed house (Manure shed attached)	S30+ S31
38	Pema Zam	2763005	1071221	2 storied, wood/stone walled wood roofed house	S32
39	Rinchen Dem	2763012	1071233	2 storied, mudwalled, wood roofed house	S33
40	Dorji Penjor	2763031	1071251	-do- (Potato shed attached)	S34+S35
41	Tshering Penjor	2763031	1071226	-do-	S36
42	-do-	2763032	1071232	Wooden Cowshed	S37
43	Chhoden	2763028	1071218	2 storied, mudwalled, wood roofed house	S38
44	Pemba Tshering	2763029	1071206	-do-	S39
45	-do-	2763026	1071202	Timber shed	S40
46	-do-	2763023	1071193	Wooden Toilet	-
47	Dorji Penjor	2763097	1071113	Wooden Bago (Cowshed/manure)	S41
48	-	2763140	1071093	stonewalled Chhorten	-
49	-	2763150	1071072	Small stonewalled Chhorten	-
50	Chethey	2763209	1071152	Wooden Potato shed	S42
51	Gem Dorji	2763207	1071161	2 storied, mud/wood walled, wood roofed house (Potato shed attached)	S43 & S44
52	Thinley Bidha	2763194	1071279	Wooden Potato shed (on the road side)	S45
53	Passang/Pemba Tshering	2763193	1071288	"	S46
54	Chhader Dem	2763184	1071337	"	S47
55	Wangchuk	2763143	1071425	"	S48
EA-42 Description:					
This EA falls in Gongphel Chewog and Gongphel Village. It is on the west of Zhakha Chhu stream and ridge. On the south is feeder road (Gongphel-Tabating). On the east is Anmchhu river, <sup>stream</sup> towards the south of the EA in the confluence of Anmchhu & Zhakha Chhu. On the north of the EA is hilltop.					
89 Shankar Sherna D. S. E				Date: 10/11/04 Toposheet No. 78 I/3	

Sketch Map



Note: Please make legible sketch to assist work for final EA map preparation.