CHAPTER THREE: APPROACH AND METHODOLOGY

3.1 Consultants' General Understanding of Assignment

To achieve the overall objectives of the consultancy services in an effective and efficient manner, the consultants will review the existing institutional setting to implement the various tasks identified under Scope of Consultancy Services and arranged in a sequential manner. The technical consideration to achieve the project objectives will not only be the recorded and printed form of data and information base rather location specific demand and diverse planning approach of line agencies blending with professional outcomes from investigations and surveys will be the prime basis of formulating strategy and plan. It is obvious that the standard norm and practice will be adopted in preparing all sorts of planning framework with due consideration of technical, social, economic and environmental aspects following people's participatory approach by involving all stakeholders, diverse beneficiaries, communities, public representatives, project affected persons, line agencies, NGOs, etc.

The Team will approach towards the Planning of Shibpur, Raipura and Ishwarganj upazila with the objective of telling less what to do, rather generating a process to find out what need to be done and then how to generate alternatives to achieve the objectives and goals. Based on above understanding of the assignment and taking the ToR into account. The consultant team conceives the activities to be carried out sequentially. The approach and methodology for preparation of Development Plan of Three (03) *Upazilas* comprises the following activities:

1. Collection of existing data and information from secondary sources and surveys
2. Sectoral surveys and studies, investigation and identification of problems and potentials through PRA sessions
3. Preparation of development planning package using findings of sectoral analysis and PRA session in compliance with development objectives.

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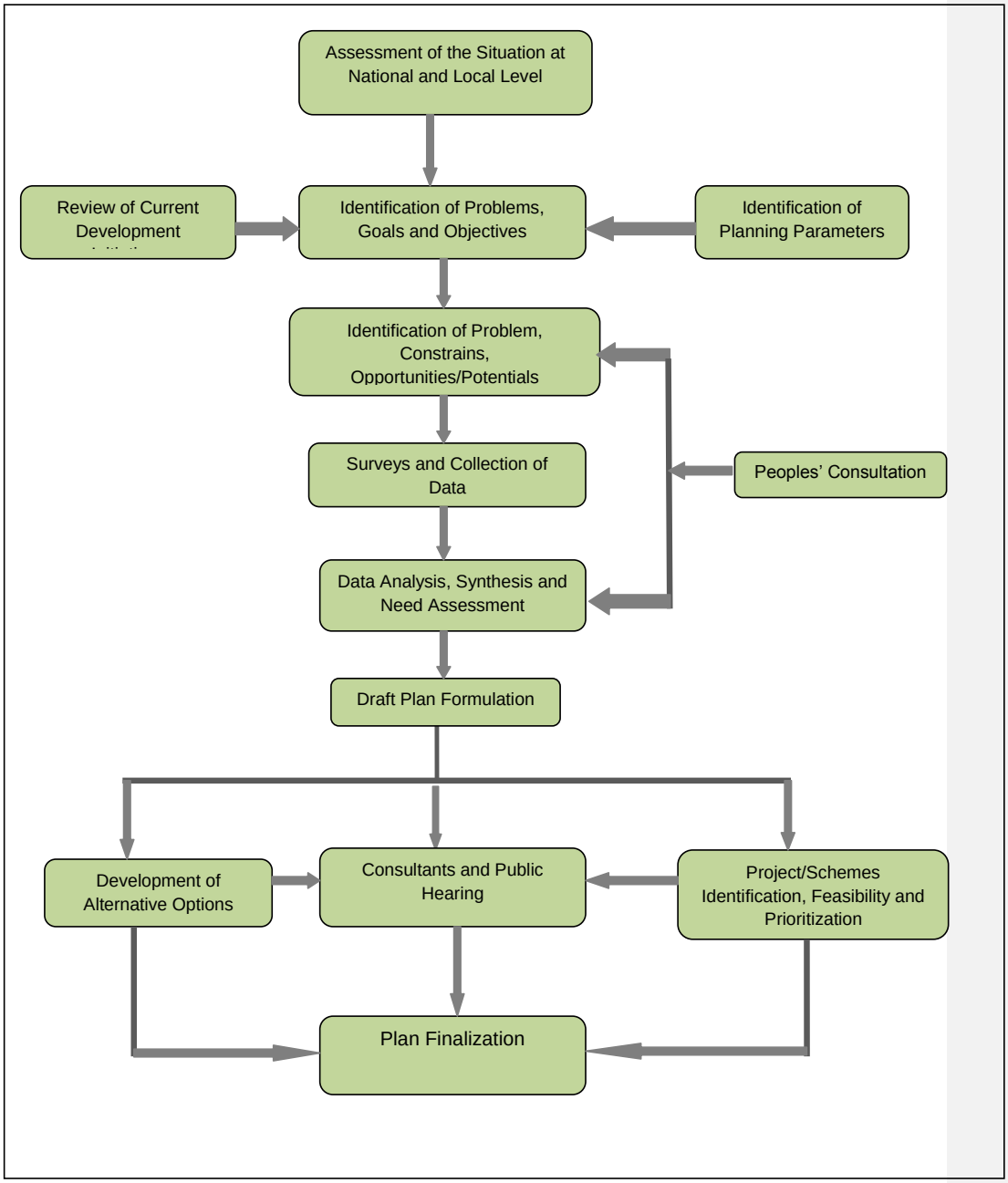


Figure 3.1: General Approach in Plan Making Process

3.2 Review/Assessment of the Situation at National and Local Level

i. *Identification and Assessment of Planning Parameters*

From the national level documents and observations at local levels are assessment would be made to formulate goals and objectives of the tasks. However ToR has already been identified goals and objectives. The consultants will evaluate those and finally make and objective assessment for sharpening the goals.

For plan preparation, basic data will be needed on population and migration, employment, social, economic and physical conditions in the study area, land-use, infrastructure, community and social facilities, environmental conditions etc. Most of this information will be collected from existing studies, plans and programmes, government publications, public authorities, statistical digests, documentation of external agencies as well as the records of UDD, Shibpur, Raipura and Ishwarganj upazila and other development agencies working in the area. Reference will be made to relevant national reports, plans etc. Major data gaps will be identified and will be collected through sector studies/surveys.

ii. *Goals and Objectives of the Plan*

The consultants will review current urban and sectoral policies and programmes, design standards, the institutional arrangements to carryout development in the study area, regulatory and other control tools available and their effectiveness and new initiatives concerning land development and management. Current shortfalls in planning and building legislations; the absence of planning standards; the absence of sub-division regulation; the absence of guidance on detailed area layouts and the absence of methods of funding urban developments, will all be focused by the consultants.
The consultants will also review the inadequate administrative and organizational structures for effective planning and management at *Upazilas* and concerned agencies. The existing mechanism for co-ordination and liaison among the agencies operating in the area will also be reviewed in search of finding a better sustainable coordination mechanism among them. The need for changes in institutional structures over the long run will also be examined.

iii. *Problem Identification*

The consultants will carry out a rapid survey of problems affecting different groups and having different impacts such as existing land use including production process is in the urban and rural areas, health and environment condition, lack of social, utility and services, amenities etc. at different scales through PRA session in each ward and union of every upazila. This will be done through discussions with different interest groups and stakeholders at a preliminary stage. After initial identification of the problem, a further attempt will be made to know the exact nature and quantification of the problems by collecting required data from secondary sources as well as from the inputs of the supporting studies to be carried out under this project or already carried out by other agencies.

Comment [A2]: Edited

A critical task for the team will be to sort out and analyze the identified problems. Problems will also be classified to identify complementarities and existing or potential responsibility at local or national government level.

Important parameters for immediate action will be environmentally poor areas with the potential for upgrading. Examples of criteria for selection of such area will be:

- Environmental and physical conditions,
- Population distribution and densities

- Service deficiencies,
- Health conditions,
- Location and landuses,
- Existing production practices,
- Income level and poverty situation,
- Shelter condition and land tenure, and
- Community attitudes and organizations.

3.3 Review of Current Development Projects

Sectoral projects planned or under taken in the study area by different organizations, which will have impact on the form and character of urban growth, will be identified. As required in the ToR, projects will be mapped using thematic overlays to help identify complementary and incompatible outputs of different projects, urban expansion implications and other spatial economic or social impacts. Information will be obtained as necessary from public agencies as well as from private formal and informal sources.

The consultants will review current urban and sectoral policies and programmes, design standards, the institutional arrangements to carryout development in the study area, regulatory and other control tools available and their effectiveness and new initiatives concerning land development and management Current shortfalls in planning and building legislations; the absence of planning standards; the absence of sub-division regulation; the absence of guidance on detailed area layouts and the absence of methods of funding urban developments, will all be focused by the consultants.

3.4 Constraints and Opportunities

Assessment of the extent of urban expansion/constraints and opportunities will be carried out using SWOT analysis and people's interview in this respect and incorporate the key spatial impacts of projects identified from the review process of current projects. This task will be assisted, where possible, by the use of information regularly collected by government agencies, field inspection, and verification with the local residents. Key outputs of this task will include identification of critical areas opportunities and constrains in respective areas where, for example, infrastructure costs per capita, distance from main services, dependence on major new transport linkage etc.

3.5 Preliminary Consultation Process

3.5.1 Local Level Participation

The process of planning approach will be carried out through the various stages of consultations involving the concerned agencies and community representatives including potential beneficiaries, project affected people as per requirement of the respective consultation processes. The community level participation in the planning process is the latest demand of the Planners of the Government and Donors to make the development plan rational with respect to accommodation of programs of the line agencies and as well as well distribution of local resources and long term sustainability. The People's Participatory Planning approach will be applied in the formulating Action Area Plan, Bankable Projects and Schemes.

Comment [A3]: Edited

The potential participants of the stakeholders for the consultation process would include the following:

i. The Local Government/Public Agencies

The consultants will first identify the location specific public agencies likely to be involved in the development process and select the level of the representatives for the consultation process. The potential agencies relevant to the planning of the study area would include, among others, the following: UDD, DPHE, BWDB, LGED, RHD, BTCL, IWTA, PWD, BRTA, REB, Board of Investment, DLRS, and Local Administrations etc. The agencies will be interviewed by the consultants' team members to have the information and status of the existing development activities and future development plans of the respective agencies with objectives and nature of development with targets with respect to benefits and investment, views on impact of the program/plans on social, economic and environmental aspects. After preparation of basic inventory and basic analysis of the database of development plan and programs of reach line/concerned agencies a consolidated summary sheets will be prepared including area of discussion in the consultation process. Based on which the authorized representative of the respective agencies will be invited to participate in the consultation process following approved schedule at agreed venue.

ii. Local Communities

The consultants will identify and assess the potential participation of the local communities in the planning process. The potential local communities with respect to involvement in the consultation process would include, among others, Elected Public Representatives of the respective areas including Members of the Parliament of the respective areas, Zila and concerned Upazila Parishads, Paurashavas, Union Parishad Chairmen, and Ward Commissioners, Community representative, KSS (agricultural cooperative), fishery cooperative, Transport Owners association, Chamber of Commerce and Industries, etc. The community representatives will be discussed in very careful manner so that they become aware of the background and objective of development plan and take part in the planning process through fruitful contribution in the consultation process. Before the consultation, the consultants will interview the identified community representatives separately with the developed format and manuals based on which the consultation outline will be prepared with the aim at making the consultation process appropriate and effective with respect to consensus building.

iii. Private Sectors at Local Level

The Private sectors include the licensed entrepreneurs engaged in the development activities and services providing in the study area. These are transport owners, real estate business, contractors, trader, commerce/industry owners, etc. The agreement already made and license already provided to the various private sectors need to be reviewed and assessed the probable conflict/impact on the Plan Process. The opinions of the private sector need to be carefully examined to avoid the conflict that might hinder the formulation and implementation of the plan. In addition, the present practice of entrepreneurs with respect to land-use, and economic activities following the condition of the agreement and license will be reviewed through physical verification and interview with the entrepreneurs.

iv. NGOs at Local Level

The consultants will identified the active NGOs in the social infrastructure and community development in the Study Area along with status of their development activities and future plan of actions in different social and urban development activities. The potential NGOs will be discussed and their opinion in the planning process will be explored in the planning process, especially for the social development, social infrastructure development, environmental planning, motivation of the communities, etc.

3.5.2 National Level Participation

i. Professional Groups

The relevant professional groups at the national level from where valuable professional advice and guidance can be sought to enrich the plan and policies. The consultants will discuss the identified issues of this programme with Line agencies, private entrepreneurs, and prevailing resources utilization, infrastructure, economic and environmental issues with potential professional groups.

ii. National Level Government Agencies/Stakeholders

In the local context, the national level government agencies/stakeholders' opinion can play a very important role to take different development plan and policies in the project area. Because they have a clear idea about local constrains and opportunities. With the help of local views of the professional groups can easily take further decision for planning and policy level.

3.6 Methodology for Carrying out the Surveys

The consultants will take various steps of activities in the process of preparation of Development Plan for UDD which are described and provided hereunder in a sequential manner under different stage of Reporting and Deliverables. The Consultants present the methodology almost in accordance with the ToR guideline with some adjustment by blending their views based on the experiences gained from recent past completed similar and related projects.

3.6.1 Preparation of Base Maps through Satellite Image Processing by using Photogrammetric Method

3.6.1.1 Collection of Mauza Maps

The CS/RS Mauza maps are the basis of the base map for the project area. The project area will be delineated on Mauza sheets. Mauza maps have been collected from the Assistant Commissioner's Land of Shibpur, Raipura and Ishwarganj upazila and DLRS covering the entire project area. The Mauza sheets having distortion due to rapping or pasting of cloths/tape have been avoided during collection of Mauza maps. Original copies of mauza maps were supposed to be collected. As original mauza sheets were not available, photocopy versions of the same have been collected from DLRS.

3.6.1.2 Collection of Other Materials

Collation of available secondary sources information, data, maps, photographs, satellite images, reports etc. and their review and identification of shortcomings and gaps, and assessment of real data requirement and survey of both primary and secondary sources will be made by the study team

3.6.1.3 Scanning of Mauza Maps

Large line scanning technology, most suitable for map scanning where distortion and deviation is nearly nil, will be used for scanning Mauza maps. During scanning operation, care shall be taken to maintain the geographical north line alignment. Specifications to be used for scanning Mauza maps are tabulated in Table3.1. Necessary processing shall be done to get rid of the noises on the image of unwarranted marks and spots attributed to senile reasons. Also, the technical specifications of the scanner to be used for the purpose are provided in Table 3.2. The scanned image files of each individual mauza shall be saved in JPG format organized and named individually. The tentative nomenclature of image files is provided in Table 3.3. All the image files of scanned mauza maps shall be structurally organized and backed up in sufficient number of CD electronic media and shall be handed over to UDD as end product of this exercise.

Table-3.1: Specifications for Scanned Images

Image type	Grayscale
Image format	JPG
Image Resolution	300 dpi
Bit depth & Level	8 or 16 Bit (256)
Image Scale	100% (1:1)

Table-3.2: Specifications for Scanner to be used for Scanning of Mauza Maps

Brand & Model	HP Design jet 815mfp
Scan Resolution, enhanced	2400x2400 dpi, with variable resolution setting from 50 dpi in increments of 1 dpi
Scan Resolution, hardware	800x800 dpi
Bit depth	24-bit color
Levels of grayscale	256
Maximum scan size	42 x unlimited in

Table-3.3: Nomenclature of Image Files (Example)

File Name	XX_XXX_XX			
	XX			Initial Code used for District & Thana/Upazila (1st digit for District and 2nd digit for Thana/Upazila)
		XXX		JL No. (3 digits string)
			XX	Sheet No. (2 digit string)

Example: *"RS_185_00.jpg" represents the image file in JPG format of Mauza having JL no. 185 & sheet no. 0 of Ishwarganj thana of Mymensingh district. Underscores are used as separators of Initial Code, JL No & Sheet No fields.*

3.6.1.4 Digitization of Mauza Maps

On screen digitization method will be used for digitization of Mauza maps. ArcGIS software will be used for this purpose. All features (Line, Point and Annotation) will be stored in different feature type in shape or geo-database file with separate ID or code number. Proposed manuscripts for digitization of Mauza maps are given in Table 3.5 and 3.6. Polygon features would be built using the line, point and annotation features using ArcGIS software. To keep uniqueness of all features the ID or code numbers of respective features will be finalized as per suggestion and discussion with UDD. Following steps would be followed during the process of digitization of individual Mauza maps:

A. Preparing the Manuscript.
B. Converting Digitized Maps to Shape/Geo-database Format.
C. Edit Plot Check.

A. Preparing the Manuscript

Feature wise, two types of manuscripts shall be developed for digitizing the mauza maps where all the features of mauza sheets shall be stored as shape file with a unique ID or code number for respective features. Details for the two types of manuscripts are described below:

Manuscript-1: Point Features- This manuscript will contain all point features of the Mauza Maps like Plot Number, Bench Mark, Travers Station, GT Station, Iron Pillar, Other Pillars, etc. Every point shall be digitized and stored with a numeric user ID (Code) representing feature type. Details for Manuscript-1 are given in Table 3.4.

Table-3.4: Sample Feature Description for Digitization Manuscript-1

Sl No	Feature Type	Shape Type	Shape Name	Code (ID)
1.	Mauza Name	Point	xx_xxx_xxP	As in mauza sheets
2.	JL No.	Point		As in mauza sheets
3.	Sheet No.	Point		As in mauza sheets
4.	Plot No.	Point		As in mauza sheets
5.	Unidentified Plot Number (not readable)	Point		99999
6.	Boundary Pillar	Point		41
7.	Bench Mark	Point		42
8.	Iron Pillar	Point		43
9.	Travers Station (Old)	Point		44
10.	Travers Station (New)	Point		45
11.	GT Station	Point		46
12.	Other Pillars	Point		47
13.	Pucca Well	Point		51
14.	Tube Well	Point		52
15.	Mosque	Point		53
16.	Temple	Point		54
17.	Adjacent Mauza/Sheet	Point		61
18.	Any other point feature	Point		88
19.	Demarcation Pillar	Point		71
20.	Settlement Pillar	Point		72
21.	Stone	Point		73
22.	Station	Point		74
23.	Pucca Pillar	Point		75
24.	Municipality Pillar	Point		76
25.	CS Iron Pillar	Point		77

Manuscript-2 and 3: Line & Polygon Features- This manuscript will contain all line and/or closed boundary type features such as mauza boundary, sheet Boundary, plot boundary, road, halot, khal, railway, pond & water bodies, structures, etc. All the features shall be digitized and stored as line having unique ID (Code) representing feature type. Details for Manuscript-2 are given in Table 3.5.

Table-3.5: Feature Description for Digitization Manuscript-2 & 3

Sl No	Feature Type	Shape Type	Shape Name	Code (ID)
1.	Mauza Boundary	Line	xx_xxx_xxL	11
2.	Sheet Boundary	Line		12
3.	Mauza/Sheet Match-line	Line		13
4.	Plot Boundary	Line		14
5.	Road	Line		21
6.	Halot	Line		22
7.	Khal (Canal)	Line		23
8.	River	Line		24
9.	Rail Line	Line		25
10.	Slope	Line		26
11.	North Line	Line		27
12.	Unknown Line	Line		99
13.	Permanent Structure *(Dalan)*	Polygon	xx_xxx_xxS	31
14.	Tin Shade Structure	Polygon		32
15.	Other Structure	Polygon		33
16.	Pan Baraz	Polygon		34
17.	Pond/Water-body	Polygon		35

Table-3.6: Attribute Database Format for Digitized Mauza Map

Field Name	Description	Data Example
Mz_ver	Mauza Map Version	CS
Layer	Name of the Feature which the field contains	Mauza Boundary Sheet Boundary Mauza/Sheet Match-line Plot Boundary Road Halot, etc
Layer_Code	ID of different Features	11, 12, 22, 31, etc
M_Code	Mauza Code	RS_185_00 This code represents the example for the Mauza having JL no. 185, Sheet no. 00 of Ishwarganj Thana, Mymensingh District.
Mauza	Name of the Mauza (as in Mauza Map)	Charpubail, Bakripara, etc
JL_No	JL Number (as in Mauza Map)	185, 169, etc
Sheet_No	Sheet Number (as in Mauza Map)	01, 02, 03, etc. (this would be '00' where the Mauza is within a single sheet)
M_Thana	Name of Thana (as in Mauza Map)	Ishwarganj
M_Dist	Name of District (as in Mauza Map)	Mymensingh
Scale	Original Scale of the Mauza Map (as in Mauza Map)	16" = 1 Mile, 64" = 1 Mile, etc
Sv_Period	Survey Period (as in Mauza Map)	1980, 1984-2000, etc
Revenue_No	Revenue Survey Number (as in Mauza Map)	728, 730, etc

B. Converting Digitized Maps into Shape/Geo-database Format

Line, point and annotation features of digitized mauza sheets/maps would be stored in shape/geo-database (ArcGIS) or dwg (Autodesk) format. Later on these lines, point/annotation features would be used to build polygon database of mauza maps using ArcGIS.

C. Edit Plot Check

After digitization of Mauza maps, edit plots of Mauza maps will be produced containing all the features and boundaries with different legend. The digitized Mauza maps will be checked and verified by superimposing on the original Mauza maps using the light table. All possible errors (missing arcs, dislocation arcs, and wrong or missing polygons, labels, ID etc.) will be solved with this edit plot checking and final digital Mauza maps will be prepared. After digitization and necessary edit plot check, both soft and hard copy of all the digital Mauza maps will be supplied to UDD for preservation**.**

D. GCP Survey

Ground control points will be selected by photo identification of existing ground features. Considerable number of GCP will be collected as required for the whole project area. All GCPs will be collected by conducting field survey using DGPS method. After collecting DGPS data of the GCP, post processing will be done day to day in the sites. Accuracy level will be maintained within 10 cm.

Aerial Triangulation is a mathematical process used to determine the position and orientation of each photograph at the moment of exposure.

Input for AT	Output of AT
- IMU data - GPS (on board) - GCP (collected from field) - Image	Geo-referenced Stereo Model

Match AT 5.2 will be used as the software for aerial triangulation.

3.6.1.5 Geo-referencing & Super-imposing of Mauza Maps

After completion of data base preparation, individual maps/ sheets will be geo-referenced with reference to the collected GCP values (Easting and Northing value) in ArcMap using Spatial Adjustment tool. Mouza sheets will be georeferenced with reference to rectified satellite images. After completion of geo-referencing of mouza maps, the total study area can be perceived to Individual plot level.

3.6.1.6. Joining & Edge Matching of Mauza Maps

After geo-referencing, mauza or sheet boundary will be overlapping with each other or there may be gaps among them. So, edge matching is a very important for producing proper landuse plan of any area. To do this operation consultant will create/draw a common mauza or sheet boundary line whether by removing one from two lines in the boundary or by drawing a new line between the gaps. After this operation the whole project area will be a seamless cadastral map.

3.6.1.7. Preparation of Study Area Map

After the edge matching mauza maps layout of study area map will be prepared as per specification suggested by PD, UDD using ArcGIS 10.1 software. All the features of mauza maps including plot, mauza and boundary of the project area will be identified and shown in the base/study area maps in separate color. Later on this study area map will be incorporated in the physical and topographic survey maps. Both soft and hard copy of base/study area map will be supplied to UDD as per specification and scale mentioned in the ToR.

3.6.2 Stereo (3D) Image Collection & Processing Techniques

The field of photogrammetry is a rapid science with new technologies being developed constantly. Within a short period of time, the practice of photogrammetry has been changed from analog to digital. The development of digital aerial cameras/satellite has advanced significantly over the past 4-5 years. The use of digital aerial images would be more advantageous for all map and image production, especially for orthophoto generation.

3.6.2.1 Image Collection

Since the internal precision of extracted DEMs is strictly related to the mean scale of photographs, image quality, pixel dimension and obviously, morphology of the area, Image Collection is a crucial part of the project. Image will be collected from Satellite image provider, Ikonos and GeoEye-1.

3.6.2.2 Satellite Image Acquisition

The GeoEye-1 Satellite image in 0.5-meter panchromatic and 1.0 -meter multi spectral four-band images in stereo pairs will be procured. The 0.5-meter pan and 1.0 meter multi spectral imagery will also be fused to yield 0.5-meter color imagery (pan-sharpened). In appendix X, the work order is attached for image collection.

3.6.2.3 Image Processing

Base map will be prepared combining mauza maps (CS/RS) and using satellite images of the area. Latest possible image will be collected from an authentic source with resolution of 0.5m and 1m depending upon the area concern.

Image processing will be done after collecting raw digital 3D images. The tasks involved in image processing are:

- Epi-polar Correction
- Color Balance
- Contrast Adjustment
- Sharpening
- Pyramid
- Bit Rate Setting

3.6.2.4 GPS/ INS Processing

Raw IMU (GPS/INS) data of image will be processed and adjusted to accomplish Aerial Triangulation. Match AT software will be used in processing the aerial triangulation.

As it is understood that the proposed assignment includes the works as shown in the flow chart in next page, the methodology has been prepared based on these activities and the assignment will be carried out accordingly.

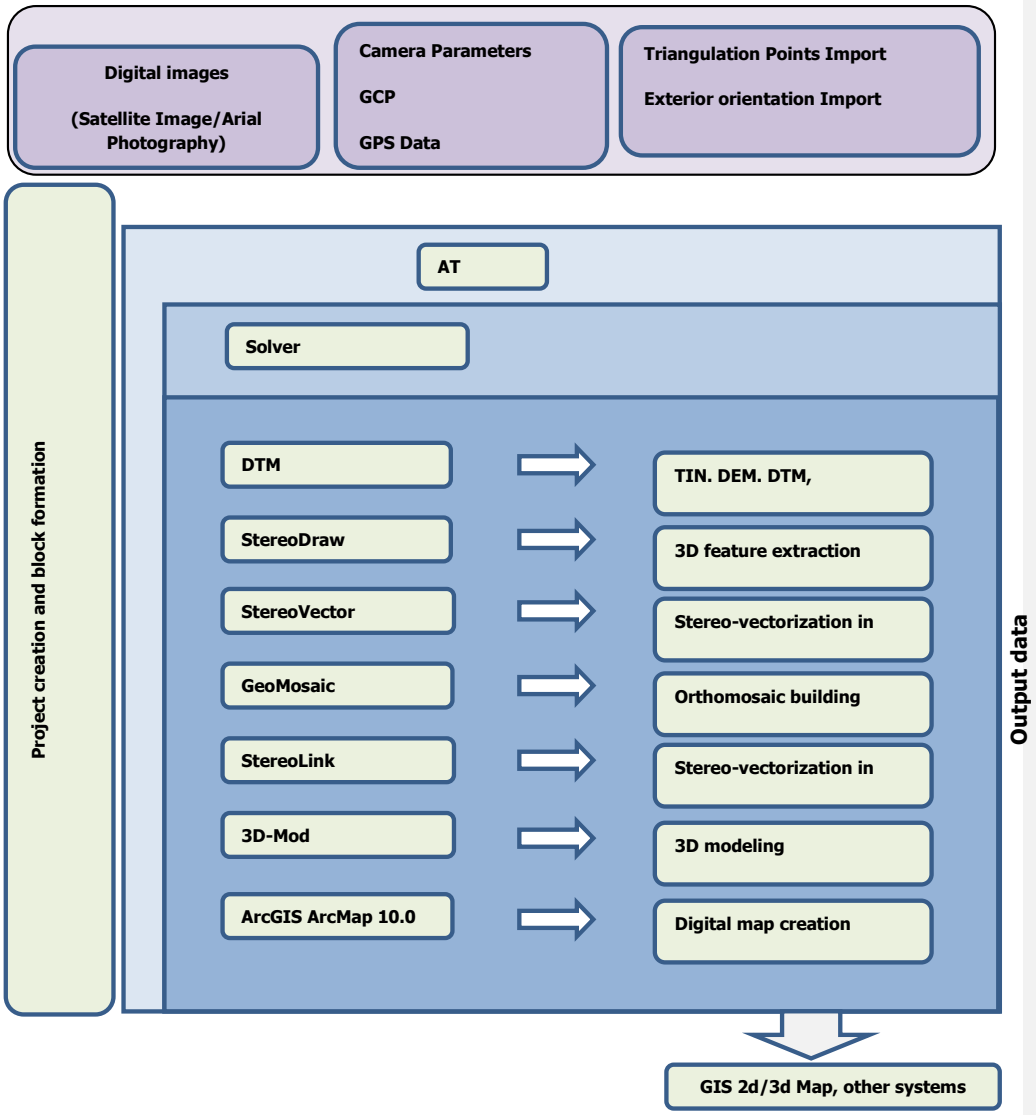


Figure 3.2: Flow Chart of Image Processing Methodology

- AT — aerial triangulation measurements,
- Solver — block adjustment for satellite/Arial images
- DTM — DTM creation
- dDSM — dense DSM generation algorithm
- Stereo Draw — 3D feature extraction in stereo-mode and 3D modeling
- Mosaic — orthomosaicking
- Digital map creation, stereo-editing of digital maps

3.6.2.5 Digital Mapping from Stereo Model

After the orientation of stereo models, digital mapping will be carried out. We propose ArcGIS Geo-database model for storing geo-spatial data. By the photogrammetric technique of feature collection, each vertex of each feature will be registered in three dimension (3D).The proposed Geo-database and its Feature classes will be designed based on the followings:

- Projection Parameters of the Coordinate System
- Name and type of layer (feature classes)
- Structure of Attribute Tables of the Feature classes

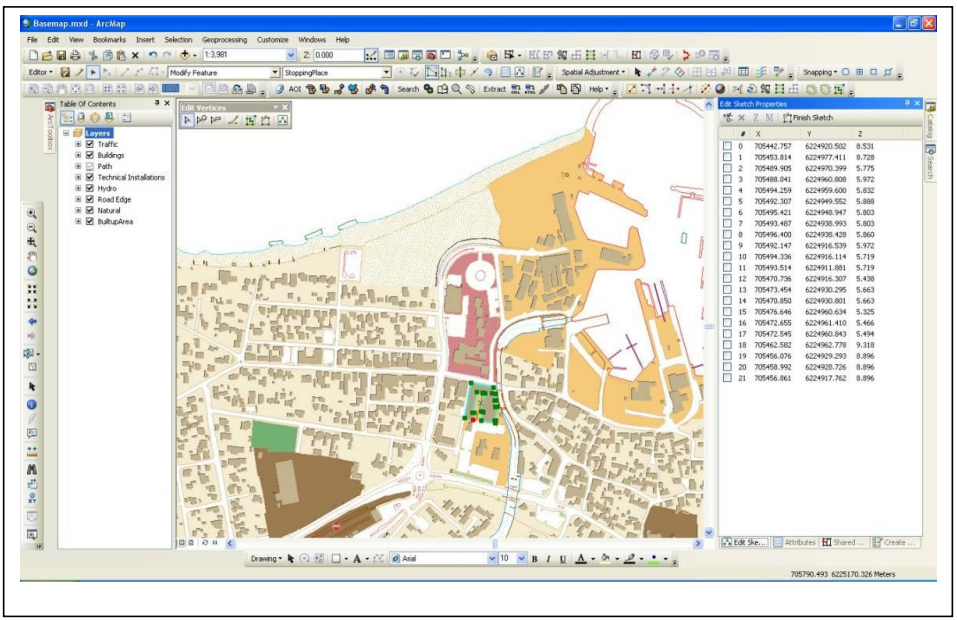


Figure 3.3: 3D Data Structure (Height Value (Z) Enable) and 3D GIS Data Output

3.6.2.6 DTM/DEM/TIN/Contour Generation

DTM Point

Digital photogrammetry is able to acquire 3D points for high spatial resolution DEM generation through semi-automatic procedures, overcoming the problems of process.

In our approach, DTM Points will be generated from Stereo Pair images by the software, and editing of the software generated DTM points will be done by the Photogrammetrist comparing them with stereo model. Creation and editing of Break lines will be done after this stage.

CONTOUR

After creating DTM Points, Contour lines will be produced with 1.0 meter contour interval. The contour lines will be delivered in 1 km x 1 km or 5 km x 5 km blocks for the project area.

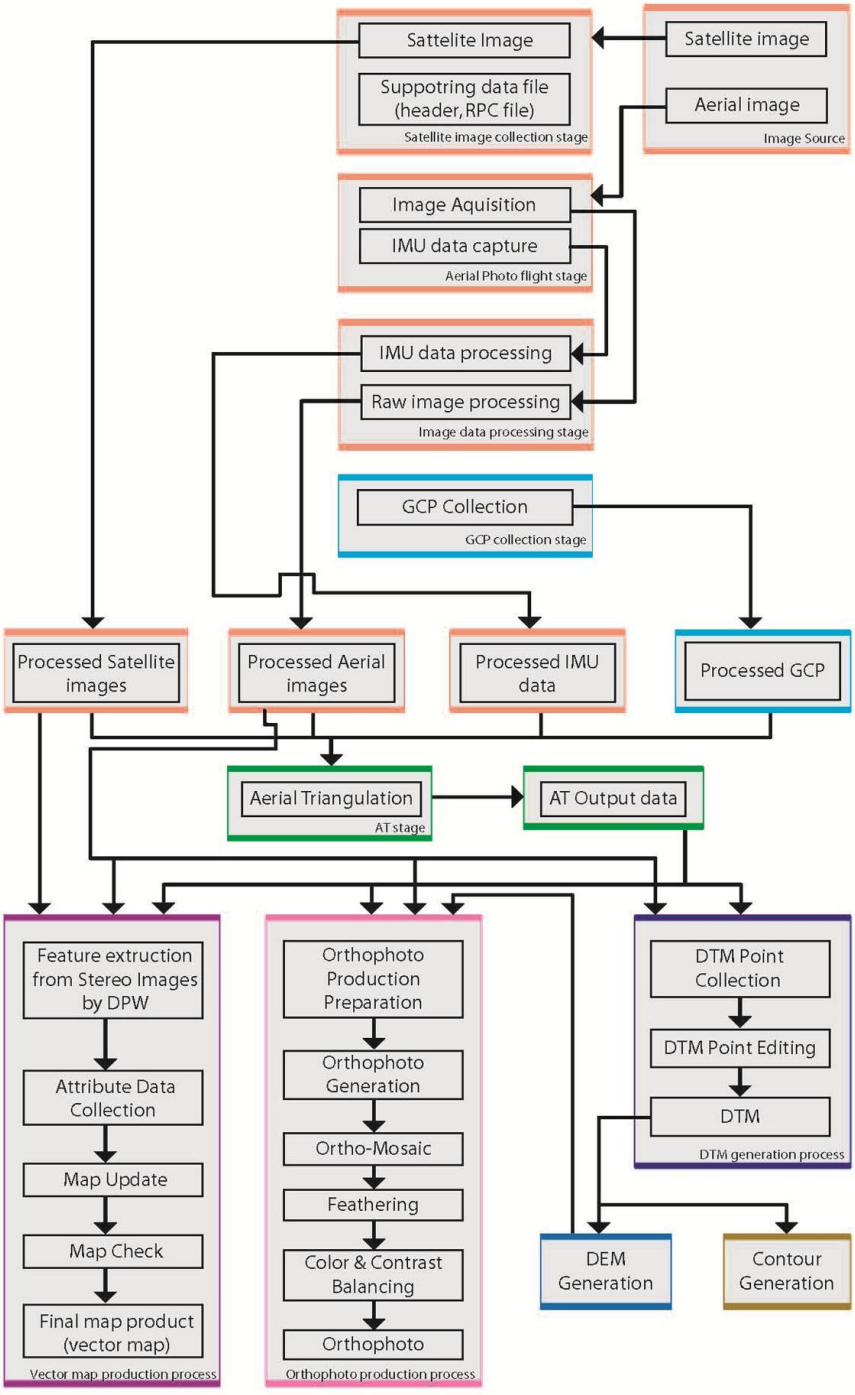


Figure 3.4. Methodology in Flow Chart for DEM and Contour Generation through AT from Satellite Imagery

DEM

Using DTM Points DEM will be generated at a resolution of 10 meters in 1 km x I km or 5 km x 5 km blocks or one single file for the project area.

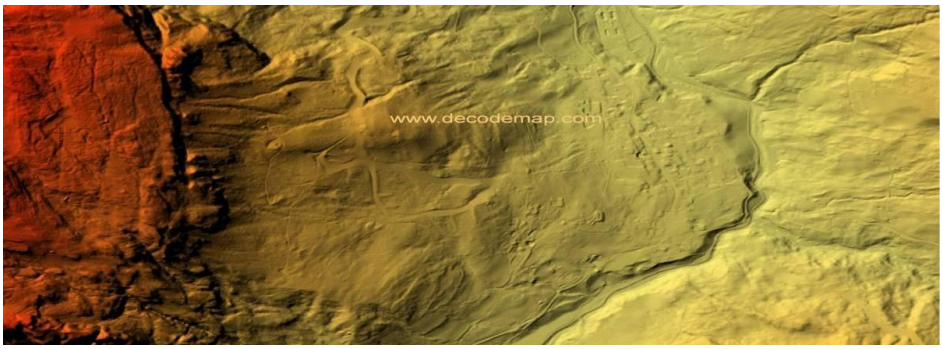


Figure 3.5: Snap Shoot Digital Elevation Model

TIN
Using DTM Points TIN will be generated and delivered in 1 km x 1 km or 5 km x 5 km blocks for the project area.

ORTHOPHOTO

An orthophoto or orthophotograph is a photograph geometrically corrected ("orthorectified") such that the scale is uniform: the photo has the same lack of distortion as a map. Orthophotographs are commonly used in the creation of a Geographic Information System (GIS).

3.6.2.7 Ortho-rectification of Images

Ortho-rectification is a process by which image distortions caused by topography and image orientation are geometrically corrected by the incorporation of a terrain model.
Ortho-rectification of every image will be carried out using digital photogrammetric system based on result of aerial triangulation and the generated DEM. Obliqueness of the images will be adjusted in this stage.

3.6.2.8 Mosaic of Orthophoto

- Individual rectified photograph will be assembled to form seamless mosaic.
- Mosaicing of OrthoPhoto includes the following tasks
  - Seam line Drawing: Drawing the boundary of the image delineating which part of the image will go which image.
  - Balancing of Color and Contrast
  - Feathering

Digital Photogrammetric Workstation (DPW) will be used as the platform for acquiring features from digital stereo images (model).

Figure 3.6: 3D Stereo (Photogrammetry) Mapping (Vector Mapping)

3.7 Survey Activities

3.7.1 Mobilization of Survey Team

Survey Manager along with survey and equipment experts, GPS and Total Station surveyors will be mobilized immediately after approval of the Inception Report by the project authority of UDD.

3.7.2 Methodology of Physical Surveys

GPS and Total Station based advanced survey technique will be used for conducting physical feature, topographic, physical infrastructure and landuse survey. Survey techniques to be used for conducting all types of physical surveys are narrated below.

3.7.2.1 Establishment of Bench Marks (BM)

For GPS and Total Station Survey, establishment of adequate and uniformly distributed Bench Mark is very crucial. Since all the subsequent survey operations are dependent on and related to the Bench Mark, any error simply multiplies and compounds to a huge total deviation. As such accuracy of Bench Mark coordinate values both along horizontal and vertical axes is of utmost importance.

As mentioned in the ToR, covering the project area including approximately 1BM pillar per 5 sq.km. grid in urban area and 1BM pillar per 20 sq.km grid rural area (pillar 10"X10", Base 3' X 3', height 5"). RCC pillars are to be constructed marking unique identification number Coordinate X, Y of these pillars along with Z value is to be marked on base map for future reference. Establishment of BMs comprises the following item of works:

- Construction and Installation of BM pillars.
- Establishment of Co-ordinate of BM Pillars (x, y, z i.e. Northing, Easting & RL in mMSL).

Construction and Installation of BM Pillars

The BM pillars will be constructed and installed before the survey work start. The construction design and specification BM pillars will be obtained from the UDD. The BMs will be established with uniformly distributed grid covering the total project area. However, in selecting the sites for BM Pillars following factors will be taken in to consideration.

- Availability of open sky for good satellite signals.
- Secure place for long term preservation.
- Local resistance to installation of pillars at private lands.

Establishment of Co-ordinates (x,y,z) of BM Pillars

Establishment of co-ordinates {x, y, z i.e. latitude/northing, longitude/easting & Reduce Level (RL) in MSL} of BM Pillars needs extensive GPS survey and data processing work. The total work comprises the following items:

- Selection of reference BM (x, y, z)
- Baseline survey by RTK-GPS Static Method.
- Network Adjustment

Selection of Reference BM

Selection of existing reference BM inside or around the project area is essential for establishment of new BM network for the project area. Reference BM provides geo-reference (x, y) and elevation (z) with respect to a datum i.e. the co-ordinates of the BM pillars. For establishing co-ordinates of the new BMs, the available SoB BMs of the project area has already been collected.

Baseline Survey by RTK-GPS Static Method

The Baseline survey is the simultaneous data collection in static mode at two or more fixed points using two or more duel frequency GPS receivers. The measurement network for RTK-GPS baseline survey will be planned by connecting the BM/Control Points to be established and the selected SoB reference BM points (known Latitude, longitude and ellipsoidal height) available inside and around the project area. A line connecting two measurement points is known as baseline. It is important to emphasis that the configuration of network was based on practical considerations rather than requirements of an ideal network.
The GPS measurements consist of a simultaneous static measurement with dual frequency GPS receivers at the ends of a concerned baseline. Measurement or logging time for a session is usually 15 minutes to one hour. During the measurements the GPS receivers at the two points record the information or data (Latitude, Longitude, Ellipsoidal Height) on the configuration of available satellite at the time, which at the end of day's work will be processed using Spectrum Survey Suite Software v3.5 (L1/L2). If results from the field measurements found unacceptable, measurements will be repeated.

Network Adjustment

The verified results of each baseline will be stored for the subsequent network adjustment. After completing the baseline survey, network adjustment will be done with respect to the known values (Latitude, Longitude, and Ellipsoidal Height) of selected SoB reference BMs available inside and around the project area. After network adjustment the precise co-ordinates (Latitude/Northing, Longitude/Easting, and Ellipsoidal Height) of each BM will be obtained.

3.7.2.2 GPS Survey Technique

The Global Positioning System (GPS) is worldwide all-weather radio-navigation and positioning system formed from a constellation of 24 satellites and their 5 nos. ground control & monitor stations. GPS receivers use these US Navigation Satellites for Timing and Ranging (NAVSTAR) to calculate positions accurate to mater of meters. GPS receives radio waves, modulated for positioning, transmitted by a maximum number of 24 satellites, which enables to work out the distance between satellite and observation points. By receiving radio waves from four satellites simultaneously it is possible to find out the three-dimensional co-ordinates and time (UTC) of the observation point with an accuracy level which cannot be conceived in traditional ground survey. The facility of GPS has been utilized in different kinds of ground surveys including geodetic, topographic and hydrographic survey in the recent times. GPS based survey with its computer based data storage and processing facility on and off the field offers immense flexibility in map production under a GIS environment. To ensure precision and accuracy in survey work and to facilitate geo-reference/digital map production

by GIS software and finally to complete the whole work in a rather shortened time schedule, GPS technology is the best and logical approach to be followed.

Differential Global Positioning System (DGPS) and Real-Time Kinematic Global Positioning System (RTK-GPS) are different versions of GPS technology, each with its own range of applicability and accuracy level. DGPS option gives about ± one meter accuracy data and RTK option deliver ±centimeter position accuracy data.

3.7.2.3 Total Station Survey Technique

Total Station (TS) is combination of electronic theodolite, distance meter and leveling machine with on-board computer having graphic icon menu with LCD display and built-in MS-Dos operating system. It can measure and store the positioning data of a target point in digital form. It consists of a microprocessor with special software for operation, data capture, storage & processing, transmission and receiving to/from a computer. The data can be stored in internal memory or in external memory card. It transmits ledger beam towards the target where a reflector (i.e. prism) is placed and receives the reflected beam by which calculate the distance, bearing and 3-D coordinate of that target point with respect to the reference points whose coordinates are known. Measurements to be done by a Total Station survey technique are as below:

- Distance measurement.
- 3-dimensional co-ordinate measurement (x, y, z).
- Traverse-style co-ordinate measurement.
- Resection.
- Offset measurement.
- Missing line measurement.
- Remote elevation measurement.

3.7.3 Physical Features Survey

Before deployment of the survey team, base map for conducting field level surveys shall be prepared using both high resolution satellite image and Mauza maps of the project area. Base map shall be compiled with major road network of the project area, important infrastructures, permanent & prominent physical features/structures etc. superimposed on Mauza maps having all Mauza features. Physical features shall be surveyed using RTK GPS and Total Station (TS) survey technique. Location of all existing structures and installations along with types in respect of use, construction and number of storey will be surveyed. Names of structures, type of construction, uses and storey etc will also be recorded during physical feature survey. Survey will also cover location of all existing exposed light/electric, telephone posts and towers, water supply structures, roads etc. Data will be recorded with separate ID or code number for each feature (as Line, Point and Polygon). Later on the survey data will be transferred directly to the GIS database where the feature will be kept in separate layer with specified code or ID. Physical feature survey information will be presented on CS/RS Mauza maps. Physical feature survey format attached in Appendix VIII.

3.7.4 Topographic and Drainage Survey

The Topographic database shall be obtained from geo-referenced 3-D (four band) image and further cross-checked and ground trothing by using RTK-GPS and Total Station to obtain and verify 3-D data (X.Y.Z value) on location and alignment of all data obtained from physical feature survey including roads, flood embankments and other drainage divides. Location and alignment of all drainage and irrigation channels/canals showing depth and direction of flow. Closed boundary/outline of homestead, water bodies, swamps, forest etc. junctions, spot heights or land levels at roughly 10 m intervals for the whole project area and close interval as and when required such as dyke, embankment, roads, rail-roads, river bank, rail line etc.

The Total Station survey groups/teams will be responsible for measurement of spot levels (Northing, Easting, Elevation or RL) for contour generation. In general the spot levels on the land will be taken at 10m interval in urban area and 20m interval in rural area . In addition, most of the physical infrastructures will also be survey by the TS team. The exposed utility pole and alignment of exposed utility lines will be surveyed using both TS & DGPS. The secondary BMs established by RTK-GPS will be used by the Total Station Groups as reference (Station and Back Point). 0.3 m interval contour map (Topographic Map) will be prepared at 1"=330' or 1: 3960 scale. DGPS will be used for surveying the location/alignment of all roads, flood embankments and other drainage divides as well as closed boundary/outline of homestead, water bodies, swamps, forest etc.

DGPS group will measure and store the alignment in x and y co-ordinates of roads, embankment and other line features. The point and closed boundary features also surveyed by the DGPS groups. The optical teams will pick-up the crest level of the road at not exceeding 50m intervals. DGPS group is responsible for taking the position and the information of the structures (hydraulic structures, bridges and culverts etc.). At the end of day's survey, the DGPS data will be downloaded, processed and stored into GIS database. Names of settlements, village, rivers, khals, roads, markers, etc. will be also presented on the topographic map. Topographic survey format attached in Appendix XIII.

3.7.5 Land Use Survey

Landuse survey basically records the use of land by its smallest units of area and functional activity such as residential, industrial or commercial etc. Total Station and DGPS based topographic and physical features survey data will be used for landuse map preparation. During Topographic and physical feature survey, each survey feature/structure will be recorded with individual ID or code. Later on landuse features will be extracted/identified and classified using the recorded code and separated in different layers during data processing stage, from where the category wise landuse map will be drawn using the identification layers of each landuse feature. Later on the landuse map will be updated through field checking and verification. The landuse map will be prepared indicating the broad categories of landuse described in ToR. Broad categories of landuse described in appendix I.

Comment [A4]: Edited

As stated before, utilizing the physical features survey overlay on Mauza map the landuse map will be prepared indicating the categories of land (as mentioned in the format of landuse survey in ToR). The Landuse Map will be prepared on CS Mauza base at 1" = 330' or 1:3960 scale.

3.7.6 GIS Mapping

Geographic information System (GIS) software such as Arc GIS 10.1 will be used for processing of physical survey data. As there is no mention in the ToR regarding the legend, layout and other specification of physical survey maps (layout, size etc.) will be finalized in consultation with the project authority of UDD during map preparation process, The well known Triangulated Irregular Network (TIN) method will be applied to draw contour lines. AS per ToR the consultants will prepare the survey maps incorporating the features of CS/RS Mauza maps and other features as mentioned in the Survey Formats (Physical Feature, Land use, Topographic and Physical Infrastructure Survey Format). Both soft and hard format will be supplied according to format of Base Map, Physical Feature, Land use and others maps as provided in the ToR. Technical Specification of GIS data attached in Appendix XII.

3.7.7 Quality Control of Survey and Mapping Works

After preparation of physical survey maps, one set of colored maps (topographic and physical infrastructure, physical feature and land use) will be plotted in 1:3960 scale for field level verification. For the quality of survey and mapping the field level checking will be supervised and monitored by the joint team of UDD and consultants.

3.8 Sector Studies and Surveys

To fulfill the requirement of the Draft Plan consultant need to address the following issues:

3.8.1 Population and Migration Survey/Study (Census Based)

The consultants are required to generate and analyze demographic and household level data to trace on the past growth rates and current trends of migration for the district and the study area. These analyses are required to consider likely growth factors affecting *upazila* level in particular, and estimate broad population within the district over the next 20 years. The methodology to be followed to carry out these tasks is discussed below.

Data from both the secondary and primary sources will be generated and utilized to accomplish the above specified objectives of the study. The 2011, 2001 and 1991 census publications (the volumes on District and community series) can provide valuable information on demographic structure, migration and other data related to this study. In addition, purposive survey may be conducted to fill in the gaps if necessary with the help of a pre coded questionnaire (with socio-economic survey) to facilitate easy processing by computer.

For these purposes the study area can be divided as established urban, newly urbanized, newly growing area, and rural areas. The localities in the study area will be identified depending on this classification. Depending on the actual number of units, some areas from each of these 4 categories will be selected for the PRA frames. A complete list of households will be prepared for these selected units, which will be our sampling frame.

All relevant data collected through questionnaire survey will be presented in appropriate tabular form. Any change in the trend to that of 2011 or 2001's census report will be analyzed. The survey is also expected to produce evidence on fertility rate in the study area. The population projection will be made both at the aggregate level by time series analysis and at the disaggregate level by cohort survival method. However, monthly national level assumptions regarding survival and fertility rate will be used for disaggregate projections.

There are several methods of projecting population. Normally, population increases either at a arithmetic, geometric or exponential rates. Our experience in Bangladesh shows that the geometric growth of population suits in most of the rural population growth. Exponential growth rate may be applicable for very high rates of growth. On the other hand arithmetic rates are quite slow in adding population. Thus, we prefer to follow geometric growth rate for calculating the growth of population and thus for projection.

The secondary data and those will be collected from primary sources will then be transformed into attribute layers (by assigning data into areal format) for analyzing using GIS tool.

3.8.2 Socio-Economic Survey (Household Based)

Planning is principally directed towards people and their needs such as housing, shopping, employment, education, health and recreation services. Detailed information on population and their characteristics (such as migration behavior, economic activities, etc. is, therefore, will be essential for allocating land requirements for these needs as well as allocating that between various competing uses. The socio-economic consultant must therefore study the existing population in terms of its size, structure, socio-economic characteristics and spatial distribution. He also equip himself to make projections about future population growth in order to assess the probable needs and requirements in terms of number of schools, houses, shops, offices, factories and the like, over forthcoming periods of time. Socio-economic data can be collected from secondary sources and primary source through questionnaire survey and also by using PRA technique.

A socio-economic survey for collection of primary data will be conducted in the proposed project area that can assist in meaningful exercise in planning with proper focus on the household level. It is

clearly understood that the purpose of this socio-economic survey is to obtain the project's objective related socio-economic data on households in the project area. Data on socio-economic condition will be collected from both secondary and primary sources. General information on demography, family size, age, religion, education, employment and occupation pattern, land ownership pattern, land value, land utilization, income level, health and recreation facilities, etc. will be collected from the primary sources through a specially designed socio-economic questionnaire survey.

The sample size will depend on the nature of heterogeneity of population characteristics. In urban areas people are more heterogeneous than the rural areas. Thus the relative strength of the size would be higher in urban areas than the rural areas, as the rural population are more homogeneous. Thus the actual size would be depending on the categories of population. More the number of categories, higher the size of the sample size. The smallest size of the samples is 50, but this size would not help under taking statistical tests. Thus we prefer to choose a sample of 384 from each categories of population (when the population categories are unknown) class which will facilitate all kind of tests with 95 percent confidence level. Detailed would be explained in the study phase.

The following type of data/information will be available for using in the plan preparation: such as on Holding information like area of holding, number and types of housing structure; Household size, age, sex composition, educational, employment and occupational status, income, expenditure, etc; Land tenure structure, nature of land utilization of land, income from land, Holding information like house structure, service provision such as electricity, gas supply, water supply connection, etc; Sanitation information, type of latrine, sewerage, drainage system, etc.; Holding information about urban facilities such as road, telephone, hospital, clinic, community center, etc.; and Information about households attitude towards development works and initiatives.

The socio-economic survey will be conducted at household level, taking households from the study areas. Standard and scientific sampling will be used for selection of the household. Like the population and migration data, the household level information will also be used as GIS attributes for making spatial analysis and decision making. (All attribute data if classified in spatial units can be used as GIS data).

3.8.3 Housing Survey

As per ToR, a separate survey on housing, slums and squatter settlements will be carried out. The main purpose of this study is to prepare an inventory of housing in the study area. For each major housing area, a summary of population, density, housing conditions, provision of services, sanitation, drainage, employment, and tenure and income levels will be determined to facilitate residential planning and addressing housing needs and related issues.

Data from both the primary and secondary sources will be utilized for this study. General conditions regarding housing structure, sanitation and provision of services are available from census data. However, most of the information will have to be collected from the primary source through a specially designed household questionnaire survey. The questionnaire will be designed to capture all the required information in a coded form suitable for fast processing by computer. The questionnaire will focus on housing needs and demands of the households at rural and urban levels so that the problems of housing can be scientifically addressed.

A stratified weighted random sampling method will be used to conduct the household level sample survey. Similar to the population and migration study will be carried out in some representative area which will be selected on discussion with clients. After discussion with PD, UDD a suitable housing typology will be developed for each of the broad types of area. The purpose of these sub-classifications is to ensure that the samples are drawn across the broad classification, and no important type is left out, and also duly represented in the sample size according to their number.

For the slums and squatter settlements survey, first the locations and settlement sizes will be collected from a reconnaissance survey in the study area, supplemented by information collected from

secondary sources such as recent survey by BBS. After their identification on a map, sample survey will be conducted. A stratified weighted random sampling method may be suitable for household level survey of the selected slum and squatter settlements. The questionnaire will be similar to the housing study but will be more elaborate and will include additional information on socio-economic characteristics, demographic characteristics, employment, migration, community organization, attitudes, priorities for development etc. Similar type of analysis as that of housing study will be carried out for the slum and squatter settlements. Most of the results will be presented in tabular form.

A separate report along with land use recommendations and development plans for slum and squatter settlements will be produced.

3.8.4 Traffic and Transportation Survey

Transportation Infrastructure and Facilities: Information on this component is essential for preparation of a transport plan for the whole Upazila. In this regard, an inventory of existing facilities available, in the study area for the transportation of passengers and goods by all the 3 modes of road, rail and river will be prepared. The required information will be collected from the relevant authorities as well as from the field level surveys to be conducted by the consultants. The information will include roadway type, physical condition (ROW, x-sectional elements, pavement type and condition), geometry, truck routes and their loading unloading areas, bus routes and terminals, traffic controlling and management system, parking facilities, etc. for Roadway; existing alignment, physical condition, terminals, yards, stations, etc. for Railway; and location of ghats and terminals, physical condition and facilities, ferry routes, inter-modal transfer facilities, etc. for Waterways/river. In addition to this data gathering exercise from primary and secondary sources, an overview appraisal will be developed for the interaction of modal groups, particularly in relation to the spatial development pattern and proposed or committed strategic infrastructure and future development.

The summarized information collected on completion of this activity will help to classify road network by hierarchy and assess the regional connectivity, accessibility, rural-urban linkage, future urban form, agricultural goods movement/marketing, policies intervention, etc. which will form a part of the report on the proposed traffic and transportation study.

In addition to the physical infrastructure and facilities, information will be obtained on the transportation services and fleets operating within the study area. Most of the information will be collected from various registration authorities for different types of vehicles and from their owners' and operators' associations. However some field surveys and verifications will be required especially related to non-motorized vehicles.

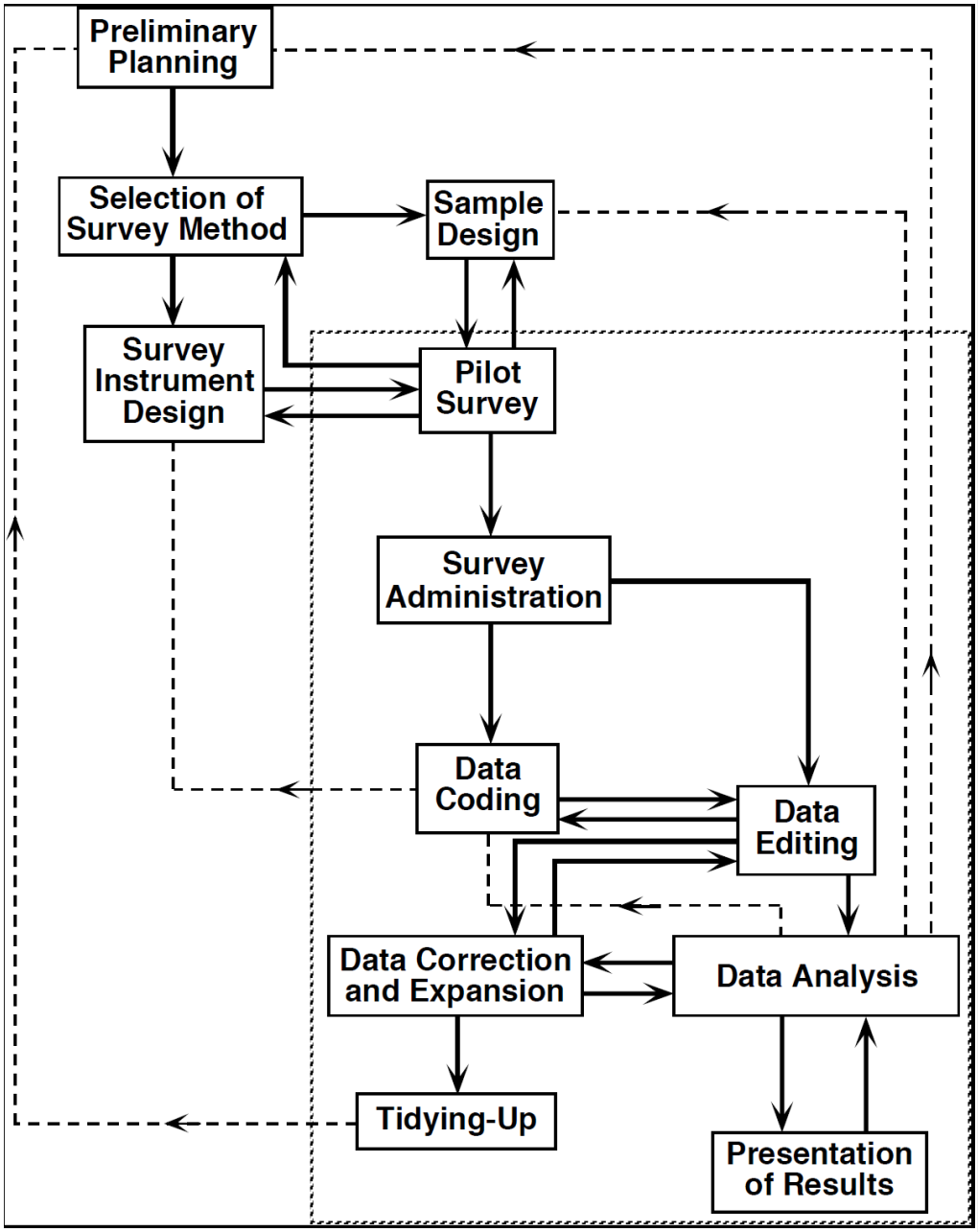
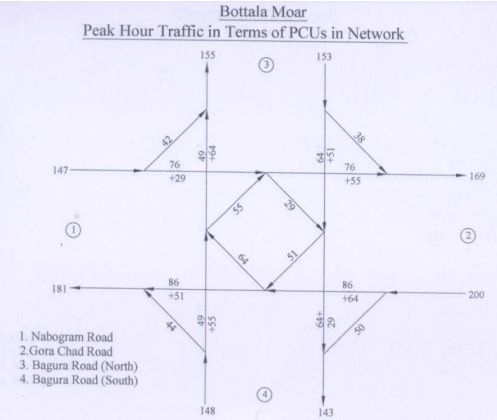


Fig 3.7: The Transportation Survey Process

Volume and Movement Patterns: The volume and movement pattern of people and goods within the study area will be collected through a series of volume and O-D surveys for all the modes - road, rail and river.

Road

Traffic counts will be performed on all major roads and intersections within the study area during both peak and off-peak periods on both week-days and weekend. Existing traffic volume, traffic composition and turning proportions of vehicular movements will be estimated through manual counts during this traffic counts. Traffic counts will be converted to Passenger Car Unit (PCU) by multiplying appropriate Passenger Car Equivalent (PCE). Traffic volume counts will be presented both in tables and figures. A typical representation of traffic volume count is shown in the following figure. Pedestrian counts will also be made at the locations of traffic counts.



In addition to traffic volume study, travel survey will be conducted to know the trip characteristics (i.e., location of the origin and destination of the trip, time at trip started and ended, mode and route of travel, purpose of trip, etc). A comprehensive O-D survey extended to the whole of the study area will be carried out. For this purpose the whole survey area will be divided into a suitable number of Traffic Analysis Zones (TAZs) depending on the homogeneity of activities in the zone. Roadside survey method will be followed for performing the O-D survey. In this method, with the assistance of policemen, vehicles of all types will be stopped and questioned regarding their origin and destination and other journey data. The surveyors will enter all these information in a preceded form. All vehicles that will pass the roadside survey station will be counted, but only a sample of the vehicles will be stopped and interviewed.

The interview sites will be located as near as possible to the TAZs boundaries. Each interview team will consist of at least 5 members (exact number will depend on field condition), two members for each direction and a team leader. In each direction one member for making a classified count of all vehicles and pedestrians passing and the other member conducting the actual interviews. Manual hand-held counters will be used for counting purpose.

Sampling procedure will be used for taking interviews. Sample size and survey hours will be determined from field conditions. Depending on field conditions in most locations, survey hours will be between 12-18 hours.

A total counts will be made for few days at some locations (control stations) to raise the survey data for 24 hours for all other locations. The survey will be conducted on different similar days at different locations. Volume counts may be repeated few times at some major locations.

The consultants would try to accommodate certain important questions regarding people's attitude, preference etc. in the questionnaire for the housing sector study to be carried out under the project.

Trip generation rates of the growth centers will be estimated from the field survey too.

Another important aspect of the road traffic survey will be determining their journey times. On-board observer method will be followed for public transport services. The moving observer and licence plate method will be followed for other types of vehicular traffic. Spot-speed will be measured at strategic locations. A parking survey will also be carried out at major parking locations to determine

accumulation, duration, turnover utilisation, extent of illegal parking and cordon counts to determine net vehicles in core zones.

Rail

Data on rail traffic flows for both passenger and goods traffic will be collected from Bangladesh Railway (BR). To ascertain the flow of passenger traffic, the available data may require to be complemented by direct passenger counts at the terminal. This volume study will be carried out on a typical week-day.

River

Direct counting of arriving and departing passengers in the study area will be made at the Ghats and river terminals. These data will be supplemented by data collected from the service operators (public and private).For goods traffic, a destination survey will be made between traffic in relatively large and small units. In case of large mechanised units, inquires will be made with the shippers, IWTC, jute and other bulk commodity traders. For small units, like country boats, direct and O-D surveys will be made at the Ghats/loading and unloading points. Similar techniques like interview method for road traffic will be applied for the boat or river traffic survey.

Analysis of Volume and Movement Patterns: After completion of the traffic count and transportation surveys as discussed above, sufficient information will have collected and collated to proceed further with the planning activities. The collected information will be collated and analyzed to estimate the past trends in traffic growth with the help of a wide variety of computer software packages, i.e., MS Excel, SPSS. Travel demand model will be developed from O-D survey data and household socio-economic data. The modeling process will consist of four steps: Trip Generation, Trip Distribution, Mode Split and Trip Assignment. Each step of the modeling process will be individual mathematical model. Specific method for each step will be selected later based on the availability and quality of data. The model will be used to predict current and future travel demand within the study area.

The analyses would also reveal which areas within the system are deficient and creating problems. Identification of the problems, their extent and causes would eventually enable consideration of their remedial measures. These are discussed hereunder.

Current Problems and Their causes: As already mentioned, from the analysis of the collected data a detailed assessment of the volume and pattern of traffic movement, the operational performance and the efficiency of use of the existing infrastructure will be made. Traffic volume and performance will be assessed with respect to the following aspects: Traffic projection using past trends in growth, volume of traffic along major arterials/corridors by type, Traffic movement by time of day, Person trips by time and mode, Commodity carried by type of goods vehicles, Congestion point identification, Inadequate capacity locations, Public transport services, capacities, journey times by modes, Modal split for goods and passenger traffic safety conditions, Conditions and facilities for non-motorized transportation including pedestrians, Loading/Unloading of goods, and Parking capacities. Performances of critical roads/intersections will be assessed according to Highway Capacity Manual.

These assessments will provide a clear understanding of the major problems and issues affecting traffic circulation and transport services in the study area. They will also provide an insight to the causes for such problems.

Long Term Policies and Strategies

Future travel demand (both vehicular demand and transit ridership) will be estimated using travel demand model. On the basis of future demand, an overview of traffic and transportation infrastructure and service options will be developed. Special emphasis will be given for the

development/improvement of public transportation system. Strategies and plans will be provided for pedestrian facilities, bicycle track, bus rapid transit, freight transport mode like railway/waterway, etc.

3.8.5 Urban and Rural Economic Study

Comment [A5]: Just title edited as before Soci and Physical Infrastructure survey

An employment and investment survey in the study area is required to be carried out through primary and secondary surveys at the major centres of employment. The ToR requires to project economic activity and workforce by broad employment sectors. The informal sector plays a very significant role in our urban economies, as such; a major proportion of employment is generated in informal sector. The nature, characteristics, growth and other things of this sector is significantly different from those of the formal sector. While most of the required information on the formal sector can be obtained from the secondary sources, information regarding informal sector activities has to be collected from the primary source through sample surveys of the major centres of employment. Accordingly, it is essential that the two sectors be studied separately.

Formal Sector: Information on Formal sector will be collected mostly from the secondary sources. Direct inquiries of large employers, chamber of commerce, trade organizations, owners' associations and labor unions will be conducted. Besides, relevant government agencies (Bureau of Statistics, Ministry of Industry) publish regular reports that contain information on employment, investment, production etc., which will also be a valuable source of such information.

Informal Sector: The objective of this study is to analyze the present economic base of the city and to assess how the significance of its economic base is changing compared to the national economy. This would determine the future growth potential of the city. The Consultants propose to apply standard analytical tools for this purpose such as location quotient and shift and share analysis. The findings of these analyses will depict a clear picture about future employment and investment prospects in the study area.

It would be necessary to identify the nature of informal sector activities in the study area. It is expected that most of these activities will be in the service sector and small manufacturing units. A reconnaissance survey is proposed to identify the nature of activities. While the household surveys will be designed to collect information on employees, type and nature of employment, income level etc. The business unit level survey will be conducted to collect information on investment, production, if locally consumed, or "exported", type of trading, number of employees etc.

All Urban and Rural Economic information will also be used as GIS attributes for making spatial analysis and decision making.

3.8.6 Formal and Informal Industrial Survey

Details of location, present size and capacity, details of labour statistics with the housing conditions and their quality of life, other relevant data and information will be collected through questionnaire and FGD. The consulting firm will be prepared report on the basis of output of the surveyed data showing industrial prosperity and recommendation for Project area. All the collected attribute and spatial industrial data shall be linked with other spatial database.

3.8.7 Agricultural Study

The agricultural land demarcation survey would be based on the levels of land, cropping pattern, cropping type, one coped land, double coped land, land utilization and flood level. Change of agricultural land during the last 10 years should be collected and presented in a report with explanatory notes on the causes for growth or decline covering a possible quality of existing and future agricultural land for the project area. All the collected attribute and spatial transportation data shall be linked with other spatial database by the consulting firm.

One of the important issues is agricultural marketing and storage which will be investigates through PRA method at the study area. All agricultural information will also be used as GIS attributes for making spatial analysis and decision making.

3.8.8 Study on Solid Waste Management

The Consultants will conduct separate study on the scenario of solid waste management in the project area. This issue may not be of same importance for the whole project area but is very important for the built up areas and the areas that are likely to be developed within short time. This study requires identification of formal and informal system of waste type, waste generation rate, solid waste collection, location of dustbins and waste transfer station, formal and informal waste dumping site as well dumping grounds.

3.8.9 Environmental Survey

Environmental pollution is as old as the civilization itself. It has become a major concern in the last few decades. It is the byproduct of the development of civilization and in fact a price for the progress. It is more prone in case of Bangladesh. Air pollution of Bangladesh is mainly caused by the vehicle emission, industrial discharge and burning of fossil fuel. The water resource of Bangladesh becomes a major health hazard due to arsenic contamination, inadequate solid waste and industrial effluent management. Necessary steps are to be taken to protect the environment for our own existence.

The present environmental condition of Bangladesh is not at all equilibrium. Severe air, water and noise pollution are threatening human health, ecosystems and economic growth of Bangladesh. Air pollution caused due to increasing population, burning fossil fuels, industrialization and associated motorization. The water pollution caused due to industrialization. The underground water of Bangladesh has been polluted due to arsenic. The inhabitants of major cities and rural areas of Bangladesh are also exposed to high level of noise pollution. Environmental degradation of Bangladesh is also caused due to poverty, over-population and lack of awareness on the subject. It is manifested by deforestation, destruction of wetlands, soil erosion and natural calamities. Few steps have been taken by the government to improve the environmental degradation and pollution control. These studies identify and analyze the different types of environmental pollution and associated health hazard in these areas. It also discusses the different governmental steps as well as some suggested steps to improve the pollution control.

An environmental examination/survey will be conducted by the Consultant. Environmental safety is of great concern to all. Preparation of Development Plan for the next 20 years for three (03) Upazilas seeks environmental investigation of development activities that will be under taken in next 20 years. The issues/aspects that are to be investigated as per ToR are as follows:-

1) Existing Infrastructures

a) Drainage: exploration of drainage capacity and constraints
   i. Man-made (drainage network, gradient, attachment area, out let) constraints
   ii. Natural (flow direction, hydrology, usability) constraints

b) Water supply (network, coverage) problems and opportunities
c) Sewerage (location/network, condition) and sanitation options
d) Solid waste management-existing system, location of garbage disposal, management aspect

2) Environmental Hazards

a) Identification and risk assessment of hazards.
b) Existing mitigation/coping measures, if any
c) Past Trends
   - Identification of environmental protection laws/regulations
   - Demand of future environmental infrastructure
d) Identification of environmental hot spots

The required information on the above aspects will be collected both from primary questioner surveys and secondary data and will be incorporated with proposals in the Plan.

3) Pollution Study

Environment is the aggregate of conditions affecting the existence or development of life and nature. The overall global environment is declining fast and for Bangladesh it has been doing so more rapidly during the last few decades because of many obvious reasons. In the project areas, apart from fossil fuel combustion, the other sources of air pollution are the brick kilns, fertilizer factories, jute and textile mills, spinning mills, biscuit factories, saw mills and dust from ploughed land. These sources produce an enormous amount of smoke, fumes, gases and dust, which create the condition for the formation of fog and smog. In this way indoor air pollution can be five to ten times that of the dirtiest air outside. This may cause headache and other health problems.

The mostly contributing industries for water pollution are pulp and paper, pharmaceuticals, metal processing, food industry, fertilizer, pesticides, dyeing and painting, textile, tannery etc. Water pollution creates serious health hazard for Bangladesh. The dumping of municipal wastes, hospital wastes and toxic environmental discharges from mostly industries pollute both surface and ground water sources. The most dangerous threat emanating from environmental degradation is the arsenic contamination of ground water. The river water is polluted by food industry, fertilizer, pesticides, and textile industries in the project areas.

In Bangladesh noise pollution (also termed as sound pollution) is a major health hazard. In fact due to noise pollution millions of people in Bangladesh are exposed to a number of health risks -from deafness to heart attack. On city streets noise pollution can be caused by hydraulic horns of vehicles, microphones and cassette players. The hydraulic horns used by buses, trucks and scooters in the crowded city streets are dangerous for human being. This is also how noise pollution is affecting the hearing power of thousands of children every day. The horns especially cause serious damage to children. Experts say, if a child below three years of age hears a horn emitting 100 dB of noise from a close range, he or she might lose his or her hearing power. A child's health may also be adversely affected by loud sounds from the radio, television, cassette players and microphones, the sound of mills and factories and loud noise.

According to a survey of the Department of Environment (DOE), noise causes mental and physical illness among the people. It causes high blood pressure, tachycardia, headache, indigestion, peptic ulcer, and also affects sound sleep. Anyone may become deaf for the time being if 100 dB or more noise pollution occurs for half an hour or more in any place. Working in an atmosphere of loud noise for a long period can cause complete deafness to any person. Any sort of noise pollution seriously affects expecting mothers. It has been observed that pregnant mothers living near big airports give birth to more crippled, deformed and immature children than those living in other places.

One of the directly related consequences of population growth is the increase in waste generation. With the conventional system of collection, transportation and crude dumping of solid waste, areas of Bangladesh are generally faced with rapid deterioration of environmental and sanitation condition. As such, urban solid waste management has become a major concern for the cities and towns of Bangladesh. Municipal services in most cities and towns are already over-burdened, and simply cannot meet the growing demand for municipal services, resulting in unhygienic and filthy living condition in the neighborhoods. Ultimate disposal of urban solid waste is done crudely in open dumps, lowlands or water bodies in an unsanitary manner. As a result, the surrounding environment of the dumpsites is barely hygienic.

3.8.10 Studies on Disaster Management

3.8.10.1 Hydro-Geological Survey

Geographical Investigation

Field geophysical investigation is conducted to achieve the purpose of seismic risk and damage assessment. Seismic site characterization by analyzing seismic wave propagation velocity from acquired shallow seismic wave form data is the main objective. P-S logging, Multi Channel Analysis of Surface Wave (MASW) and Microtremor tools are involved in geophysical investigation.

General purposes of the geophysical survey:

- To estimate shear wave velocity and measure soil/rock properties (i.e. shear modulus, bulk modulus, compressibility, and Poisson's ratio)
- To Seismic site response study
- Characterization of strong motion sites
- Utilize this information for seismic hazard analysis

Geotechnical Investigation

Geotechnical investigations are executed to acquire information regarding the physical characteristics of soil and rocks. The purpose of geotechnical investigations is to design earthworks and foundations for structures, and to execute earthwork repairs necessitated due to changes in the subsurface environment. A geotechnical examination includes surface and subsurface exploration, soil sampling, and laboratory analysis. Geotechnical investigations are also known as foundation analysis, soil analysis, soil testing, soil mechanics, and subsurface investigation. The samples are examined prior to the development of the location. Geotechnical investigations have acquired substantial importance in preventing human and material damage due to the earthquakes, foundation cracks, and other catastrophes. Geotechnical investigations can be as simple as conducting only a visual assessment of the site or as detailed as a computer-aided study of the soil using laboratory tests.

3.8.10.2 Engineering Geological Mapping

Engineering geology refers to the application of geological data, techniques and principles to the study of rock and soil surface materials, and ground water on engineering perspectives. This is important for the proper location, planning, design, construction, operation and maintenance of engineering structures.
An engineering geological map is defined by UNESCO, as a type of geological map, which provides a general representation of all those components of a geological environment of design, construction and maintenance as applied to civil and mining engineering. Engineering geological maps are of different types depending on its scale, purpose and/or content.

The importance of engineering geological mapping is to find out the main obstacles or barriers to construct major structures such as dams, factories, and heavy buildings in a specific area. The consulting firm will prepare report on the basis of output of the obtained data which will help to identify suitable places for further construction of different development projects. The consulting firm collects all necessary data and information from GSB of the study area and prepares geological maps. After that consulting firm submit of all geotechnical and geophysical data as well as report and maps to UDD.

3.8.10.3 Seismic Hazard Assessment

Test detail and Procedure of Down hole Seismic Test (PS Logging)

Field measurement of shear wave velocity profile (Vs profile) will be carried out by seismic down-hole test. Seismic down-hole test is a direct measurement method for obtaining the shear wave velocity profile of soil stratum. The seismic down-hole test aims to measure the travelling time of elastic wave from the ground surface to some arbitrary depths beneath the ground. The seismic wave is generated by striking a wooden plank by a sledge hammer. The plank is placed on the ground

surface at around 3 m in horizontal direction from the top of borehole. The plank is hit separately on both ends to generate shear wave energy in opposite directions and is polarized in the direction parallel to the plank. The shear wave emanated from the plank is detected by a tri-axial geophone. The geophone is lowered to 1 m below ground surface and attached to the borehole wall by inflating an air bladder. Then, the measurement is taken at every 1 m interval until the geophone is lowered to 30 m below ground surface. For each elevation, 6 records are taken and then used to calculate the shear wave velocity. In Downhole Seismic Test (PS logging), this method will be used to calculate shear wave velocity for this project.

Test Detail and Procedure of Shallow Seismic Survey (MASW & SSMM)
Shallow seismic survey utilizes the frequency dependent property of surface wave velocity, or the dispersion property, for Vs profiling. It analyses frequency content in the data recorded from a geophone array deployed over a moderate distance. The principle MASW is to employ and arrange a number of sensors on the ground surface to capture propagating Rayleigh waves, which dominates two-thirds of the total seismic energy generated by impact sources.

Geophysical Test Methods

The list of geophysical work that will be done are giving below table

SL No.	Type of Test/Survey	Reason for Testing
1	Down-hole Seismic Test (PS Logging)	To obtain the shear wave velocity profile of soil stratum.
2	Multi-channel Analysis Surface Wave (MASW)	To determine shear wave velocity of soil layer.
3	Small Scale Miccrotremor Measurement (SSMM)	To determine shear wave velocity of soil layer.
4	Single Microtremor	To Calculate Peak Period and Peak Amplitude.
5	Microtremor Array	To determine shear wave velocity of soil layer.

3.8.10.4 Sub-soil Profile

Subsoil is the layer of soil under the top soil on the surface of the ground. The layer is mixture of small particles such as sand, silt and/or clay, but it lacks the organic matter and humus content of top soil. Sub-soil investigation is a process of site explanation consisting of boring, sampling and testing to obtain geotechnical information for safe practical and economical geotechnical evaluation and design. The main purpose of sub-soil investigation is to determine, within practical limits, the depth, thickness, extent and composition of each subsoil stratum, the depth and type of rock, composition and depth of ground water and strength and compressibility and hydraulic characteristics of soil strata required by geotechnical engineers.

Subsoil profile will provide data on surface and underground condition at the proposed site samples and will facilitate visual inspection to determine physical and index properties depending on sites use. The subsoil profile explores the following:

(a) Determining the nature of the soil at the site and its stratification
(b) Finding out the actual site and ground problems with particular reference to terrain problems, vegetation, swamps and water runoff etc. this may help design of human settlements and physical structures in the planning phase.

Subsoil profile can be done by means of boring, sampling and testing, this can be done by stratigraphy. Investigation consist of boring, i.e. drilling the ground; and sampling by removing the soil from the hole. Testing can facilitate determining the properties from the soil

3.8.10.5 Participatory Vulnerability Analysis (PVA) analytical steps

PVA is a systematic process that involves communities and other stakeholders in an in-depth examination of their vulnerability, and at the same time empowers or motivates them to take appropriate actions. The overall aim of PVA is to link disaster preparedness and response to long-term development. PVA is a qualitative way of analyzing vulnerability, which involves participation of vulnerable people themselves. The analysis helps us to understand vulnerability, its root causes and most vulnerable groups, and agree on actions by, with and to people to reduce their vulnerability.
PVA uses a step-by-step approach to systematically analyze the causes of vulnerability by:

Step 1: Situation analysis of Vulnerability analysis of vulnerability
- — Prevalence/extent of vulnerability
- — How different people are able to cope
- — Analyze present threats/vulnerabilities

Tools
- — Focus group discussions.
- — Historical profile/time line.
- — Vulnerability map.
- — Seasonal calendar to map out when most vulnerability occur during the year.
- — Livelihood analysis.

Step 2: Analysis causes of Vulnerability of vulnerability
- — Identification of causes and root causes
- — Prioritization

Tools
- — Problem tree/objective analysis
- — Concept mapping

Step 3: Analysis of community action
- — Establish the existing strategies, resources and assets used to reduce vulnerability
- — External assistance used to reduce vulnerability

Tools
- — Matrix highlighting communities' ability to cope
- — Venn diagrams
- — Problem tree/objective analysis
- — Concept mapping

Step 4: Drawing actions from analysis

Step 5: Prioritize broad interventions
- — Action plans including dates and responsibilities
- — Scenario planning

Tools
- — Overall vulnerability matrix
- — Community action plan – scenario planning

3.8.10.6 Damage and Risk Assessment

Risk as the probability of harmful consequences casualties, damaged property, lost livelihoods, disrupted economic activity, and damage to the environment — resulting from interactions between natural or human-induced hazards and vulnerable conditions. Risk assessment is a process to determine the nature and extent of such risk, by analyzing hazards and evaluating existing conditions of vulnerability that together could potentially harm exposed people, property, services, livelihoods and the environment on which they depend. A comprehensive risk assessment not only evaluates the magnitude and likelihood of potential losses but also provides full understanding of the causes and

impact of those losses. Risk assessment, therefore, is an integral part of decision and policy-making processes and requires close collaboration among various parts of society.

3.8.10.7 Hydrological Study

Identification of water bodies including pond, ditch, beels, haors elc. (both perennial and seasonal), direction of flow of the river, khal/canals, precipitation analysis, delineation of catchments area, encroachments and blockage in the river, khal/canals, identification of wafer control structures including operational condition and reason for non-operational condition (in case of non-operational water control structures).

Bathymetry survey will carried out of underwater depth of the third dimension of ocean floors. Bathymetric (or hydrographical) charts will be produced to support safety of surface or sub-surface navigation, and usually show seafloor relief or terrain as contour lines (called depth contours or isobaths) and selected depths (soundings), and typically also provide surface navigational information.

All hydrology information will also be used as GIS attributes for making spatial analysis and drainage plan.

3.8.10.8 Drainage Master Plan

A. Calculation of Drainage Run-off

The rational method is a relatively simple, internationally used technique for designing storm drainage system in urban areas, and according has been selected for use in estimating the design discharge for the proposed Primary/Secondary/ Tertiary Drains at UZ level. Accordingly, the peak flows at any given point in a drainage system can be calculated by using the following formula:

Q = CIA/360

Where,

Q = peak flow in m3 / sec, C = run-off coefficient , I = design rainfall intensity in mm/hr, A = Catchment area in hectares

Time of Concentration

The time of concentration, tc, is the time required for water to flow from the most remote point of the catchment to the point of investigation. For urban storm water drains, the time of concentration consists of the time required for runoff to flow over the ground surface to the nearest drain, to and the time of flow in the drainage system to the point being investigated, td, thus

$$tc = to + td$$

The time for overland flow depends on several factors, such as the distance, slope, runoff co-efficient, etc. Several methods have been developed to estimate the time for overland flow all of which give more or less the same results. The time of flow in the drainage system, td is estimated from the hydraulic properties of the drains and the following empirical equation is used compute tc:

Kirpich Equation to compute tc:

tc = 0.01947 L^0.77 S^(-0.385)

Where,

tc = time of concentration (minutes),L = maximum length of travel of water (m) and

S = slope of the catchment = ΔH/L in which ΔH = difference in elevation between the most remote point on the catchment and the outlet

Run – off coefficient

The run-off coefficient C is defined as the ratio of the rate of run–off to the rate of rainfall during the same time period and is dimensionless. Because, some rainfall is retained in depression or ponds and the run–off is prevented from reaching the drain due to obstructions, or infiltrates into the soil, the run – off coefficient is less than one. The following table shows the common run – off coefficient used in the rational method for the individual situations for different type of areas.

A representative range of weighted average for fully developed urban areas for each of the UZ will be considered. Common Run–off coefficients for Different Types of Area

Type of Drainage Area		Run – off Coefficient: C
Business	Downtown areas	0.70 – 0.95
	Neighborhood area	0.50 – 0.70
Residential	Single – family areas	0.30 – 0.50
	Multi – units, detached	0.40 – 0.60
	Multi – units, attached	0.60 – 0.75
	Suburban	0.25 – 0.40
	Apartment dwelling areas	0.50 – 0.70
Industrial	Light areas	0.50 – 0.80
	Heavy areas	0.60 – 0.90
	Parks, cemeteries, playgrounds	0.10 – 0.35
	Rail road yard areas	0.20 – 0.40
	Unimproved areas	0.10 – 0.30
	Streets; Driveways and roofs	0.10 – 0.95
Lawns	Sandy soil, flat, 2%	0.05 – 0.10
	Sandy soil, avg, 2 – 7%	0.10 – 0.15
	Sandy soil, steep, 7%	0.15 – 0.20
	Heavy soil, flat, 2%	0.13 – 0.17
	Heavy soil, avg, 2 – 7%	0.18 – 0.22
	Heavy soil, steep, 7%	0.25 – 0.35

Source: Handbook of Hydrology, by - David R. Maidment

Rainfall Intensity:

The daily rainfall data at the nearest Rainfall Station of each UZ for the last 20-years will be collected from the Surface Water Hydrology of BWDB and will be used for the works in connection with the design of proposed drainage system of each of the UZ.

The maximum daily (24 hour) rainfall records of each of the UZ are available in Surface Water Hydrology of BWDB. However, the short duration rainfall figures i.e. rainfall records for storms lasting less than 24 hours- are available only for Dhaka City, and nowhere else Bangladesh.

Accordingly, the short duration rainfall records for Dhaka have been extrapolated in order to develop an approximation of the short duration rainfall characteristics for the UZs. Based upon comparisons of the mean 24 hour rainfalls of the three UZs with respect to Dhaka over the 20 year period, conversion

factors will be used in the determination of the short duration rainfall data at each UZ. Based on this evaluation, the Gumbel Method for estimating probability of occurrences will be used to develop the frequency analysis for rainfall intensities for each of the UZ for the 2 year, 5 year, 10 year and 25 year recurrence intervals.

Based on this, the following curves are developed

- Rainfall Intensity Curve for short duration rainfall for 1.1 -yr, 2-yr, 5-yr, 10-yr, 25-yr and 50-yr return periods using Gumbel Distribution Method

- For design of drain sizes the following return periods have been used:

  Tertiary and Secondary Drains - 2-year return period;
  Primary Drains - 5-year return period

B. Calculation of Drainage Sizes

The size of the storm drainage channels for each of the UZ is calculated using the conventional Manning's formula, as follows:

Q = aV and

V = 1/n R^0.67 S^0.5

Where,

Q = design flow (m3/sec),a = wetted cross-sectional area (m2), V = velocity of flow (m/sec)

R = hydraulic radius (m) = area (a) in m2 / wetted perimeter (p) in m

S = slope of the drain (m/m), n= Manning's roughness co-efficient

= 0.014 for lined drains (concrete/ plaster)

= 0.025 for earthen drains (good condition)

A summary of the design parameters are shown below in tabular form:

Summary of Design Parameters:

I. For flood estimation

A = the catchment area (in ha), Measured by planimeter from the map

C = runoff co-efficient, Taken from the table for different land use, considering possible ultimate development

to =overland flow time. Depends on distance, slope, soil and vegetation characteristic etc.

td = time of flow in the drain, Estimated on the basis of velocity of flow in the drain and the distance to the point under construction

tc = time of concentration = to + td

Return period, 2 yrs for tertiary & secondary drains and 5 yrs for primary drains.

II. Design of Drain

S = slope of the bottom of the drain, determined from the design invert levels of the drain at u/s and d/s.

a = wetted cross-sectional area (m2), determined from the depth of flow and channel section chosen.

p = wetted perimeter (m), determined from the depth of flow and channel section chosen.

n= Manning's roughness co-efficient, 0.025 for earthen drains and 0.014 for lined drains

Max. Flow velocity1.20 m/sec for earthen drain and 2.50 m/sec for pucca drain

3.8.11 Methods of Conducting PRA Participatory Reflection and Action/Participatory Rural Appraisal (PRA) Session in the study Area

Urban Development Directorate (UDD) under Ministry of Housing and Public Works has taken an initiative to prepare a development plan for 20 years of fourteen Upazilas through participatory method. Participatory methods have gained momentum in recent years as field practices and development experts have sought more effective ways to involve local people in decision-making. It is a way of learning from, and with, community members to investigate, and evaluate constraints and opportunities and make timely decisions regarding development projects. It is a method by which a planning team can quickly and systematically collect information for the general analysis of specific topic, question, or problem, needs assessment, feasibility studies, identifying and prioritizing projects, and finally, the project evaluation. The PRA tools are implemented to achieve increased accuracy at low costs both in terms of time and money. Participatory appraisals methods are useful for accelerated knowledge, not just overall speed, but rapid rounds of field relations that result in the increasingly precise knowledge. Participation means involving local people in the development of plans and activities designed to change their lives. Considering the above, project has taken an initiative to conduct Participatory Reflection and Action/Participatory Rural Appraisal (PRA) Session at each Union in the rural areas and at each ward in the urban areas.

Objective

i. To identify the local problems and potentials in study area
ii. To identify the spatial location of problems and potentials in the study area
iii. To identify all features with productivity in the study area
iv. To identify the time trend of positive or negative change for a long duration in the study area
v. To ensure local people participation in all stage of plan preparation

Expected Result

i. Identified problems and possible solutions from the local peoples at union level in rural areas and ward level in the urban areas of the study area.
ii. Identified spatial locations of problems and potentials on the social map at union and ward level in the study area.
iii. Identified the locations of social infrastructures at union and ward level in the study area and located it on the social map.
iv. Identified the local raw materials or main production as well as its location in the study area.
v. Identified the Disaster prone area and coping mechanism of local people through traditional way in the study area.
vi. Identified the time trend of the problems and potentials in the study area.

3.8.11.1. Approach and Methodology to Achieve the Result

The expected result can fulfil through conducting Participatory Reflection and Action/Participatory Rural Appraisal (PRA) at each Union in the rural areas and at each ward level in the urban areas within the study area. The PRA method of problems Preference Ranking (identification and prioritization) can apply for identifying and prioritizing the problems and potentials. The Social mapping method can apply for spatial location of problems with potentials and location of

infrastructures or other resource areas. The project will be designed for 20 years. In this connection, time trend analysis method can apply for time trend analysis of problems and potentials.

In this regard, total 24-27 participants will be selected from different professions for each union and 15-18 participants will be selected from the different professions for each ward. The number of participant varies because the ward unit is smaller than union and problems of ward are almost kwon to all. At least one third of the target participants will be women. A whole day session may arrange for PRA exercise. PRA Expert will clearly explain about the role of participants in large group and what type of information he is expected from the participant?

At first all participants in a large group will identify the problems and prioritize 5 major problems according to the severity and suggest possible solutions. Then the large group will be divided in to 3 small groups. 3 Facilitators (one for each small group) will clearly explain again about their assignment and how they can perform their assignment. Facilitators will supply the necessary papers, documents and equipment before starting the work of small group.

One small group will work on preparation of social mapping. This group will identify all infrastructures and problems as well as potentials within the union/ward and locate those on the map. One small group will work on root cause and effect analysis. This group will identify all causes as well as effects of major 3-5 problems with diagram.

Another one will work on time trend analyses. The old persons will be helpful for time trend analysis. This group will identify the trend of positive or negative change of major 3-5 problems for future 20 years based on analyzing the past 20 years.

After completion of individual group exercise, all groups will sit together and present their individual group output in to the large group. Other individual group may provide input in case of missing anything or add or delete any logical points which will make PRA output resourceful.
PRA Expert will review the findings of Social map, Root cause & effect analysis as well as time trend analysis carefully. He will analyze and synthesis the collected data which will be helpful for getting direction and selecting options.
Expected result i and v will achieve through exercising the Preference Ranking i.e all problems with prioritization will identify. Expected result # ii-iv will achieve through exercising the Social mapping i,e all infrastructures with potentials will identify and locate those on the map. Expected result # vi will achieve through exercising trend analysis i,e the positive or negative changes of the problems with potentials for past and future will identify.

3.9 Approaches to Plan Preparation

The basic to plan preparing would be pro-people participatory planning implementable by all stakeholders. There are a number of ways to ensure participation of the stakeholders and people in this planning exercise (have been discussed at length in this methodology section). However, in summary, it can be said that four basic steps have been utilized. These are:

- Formulation of goals/objectives
- Critical studies through a participatory approach
- Preparing planning options through synthesizing the findings, and
- Preparation of plan and implementation strategies

3.9.1 Preparation of Planning Options

Preparation of planning options is necessary to choose the best options from among the formulated alternatives. Various alternatives can be discussed at the series of stakeholders meetings at grass root levels and can be identified the better alternatives. However, the alternatives should again be cross examined through our legal and policy regimes. By doing this ultimately we can get a better option which is legally adaptable, compatible with policies and acceptable to the people.

The following points are the basic steps which will be followed throughout this exercise and finally come to conclusions to prepare options. Discussion on the basic steps that would be required in preparing the plan package has been made. In the following section, steps of Detailed Plan preparation process have been presented below:

Step 1	Collection of Maps. Basic Statistics and Information
Step 2	Preparation and Compilation of Base Map and Demarcation of Project Area.
Step 3	Higher Level Frameworks: Concern to Government and Other Agency Level Policies and Decision.
Step 4	Communication Plan and First Consultation: Concern to Local Communities/Beneficiaries and Other Agencies/Interested Quarters (Stakeholders) including all basic surveys
Step 5	Formulate Planning Principles/Standards for the study area
Step 6	Second Consultation: Financial Viability, Social, Economic and Environmental Impact Assessment.
Step 7	Integrated Plans: Concern to Local Communities/Local Leaders/Other Beneficiaries and Investors.
Step 8	Third Consultations
Step 9	Priorities and Phasing: Public Sector Action Program.
Step 10	Development Control, Zoning and Land Management.
Step 11	Legal Supporting Documents.
Step 12	Reporting

3.9.2 Sub-Regional Plan

It would be necessary to prepare a plan at sub regional level. For this study, we translate sub-region as the District. Thus a District level plan would be prepared. Since, the studies will not be carried out at District level, we propose prepare a strategic plan at sub region level. Strategic plan means the direction and various policies to be carried out at sub- regional level, where an upazila functions. This functionality to be enhanced to increase more interactions both economically and socially. Sub-Regional Strategic Plan would be prepared for 20 years using secondary data. National policies, formulated and integrated different sectoral strategies at sub regional level, spatially interpreted sectoral strategies at sub regional level, formulated Conservation Plan at sub regional level and formulated Development Plan, for example.

The physical setting and social settings of an upazila must be linked with a greater context, at a sub-regional level, in order to prepare the contexts of planning. For example, roads, drainage shedings, economic interactions and social needs usually do not found confined within an upazila or a city level. These can be better manage in a larger framework, such as Districts or even Divisions. The ultimate aim of sub regional plan is to make upazila level plans more appropriate, contextual and interrelated.

The process of preparing sub regional plan is simple and straight forward. We can make visit to the District headquarters and can meet the key people to know and understand the strategic links.

Sub-regional plans usually encounters the following issues and problems.

a. Economic growth perspectives of the sub-region (such as agriculture growth, industries. services etc.)
b. Emerging new growth points within the sub-regions.

c. Sites of all kinds of major investment within the sub-region.
d. Population growth, migration, and settlements patterns.
e. Physical constraints and features.

The above issues and problems will be examined from secondary data and primary observations in sub-region to highlight economic profile, population distribution, characteristics and movement, man-made improvement (or damage) of nature, transportation and communication and overall socio-economic organization of this region. The discussion on the above issues and problems will lead to identify whether the region is homogenous in nature, its geographic entity and economic aspects. Thus a region comes into being that differs from other neighboring areas/region.

After identification of the sub-regional problems (through analysis of Location Quotient and Shift Share Method) planning measures will be undertaken. This should be mentioned here that this sub-regional plans under the current exercise will address issues and problems to resolve the major planning problems of the upazila under the sub-region (district) to functionally and ecologically improve the overall planning parameters.

3.9.3 Structure Plan

It develops broad strategies for managing and promoting efficient urban development over the medium to long term and takes into account the integration of economic, physical and environmental planning objectives. A structure plan provides a broad framework for development activities in an area. However, as the division in the jurisdiction and functionality of the Strategic and the Structure Plan are rather blurry and sometimes overlapping, the client and the consultant have agreed to work this through as the project gradually matures and resolve the conflict regarding this issue and merge the two in a single tier of Structure Plan.

However, considering the pressure of population on land and environment in Bangladesh, specially in the study areas, an ideal approach to Structure planning would be an appropriate zoning of all land in the study area into broad categories. Such categories may include agriculture, water bodies, forest resources and human settlements. At the second level, human settlements can be further studied and planed for detailed land use under urban and rural settlements. The aim of such broad zoning is to save agricultural land, along with forest and water bodies for sustainability of economy and environment. National land use policy is now being framed in this direction.

Implementation of policy, plans and programs are totally dependent on the ability of the organization on which the responsibility will be entrusted. Ability includes vision, legal coverage, and resources: human and logistics, and leadership. Therefore, the Structure Plan will include a comprehensive institutional and legislative restructuring section for restructuring of the Organization/Authority who will be the guardian of the plan. Structure Plan will be in a scale of RF 1:10000

3.9.4 Urban Area Plan

Urban Area Plan is prepared for managing and promoting development over medium terms following the broad guidelines set by the longer term Structure Plan. It shows the metropolitan structure of different sub-systems in space over the medium term and identifies broad programmes of direct action especially related to infrastructural development, institutional issues as well as broad financing strategies. The plan may also outline more specific area-wise development policies to guide development over the medium terms. One major objective of preparing Urban Area Plan is the consolidation of development activities by various agencies in areas that have strongest potential for growth in the medium term and can accommodate the anticipated volume of growth. Another purpose of preparing Urban Area Plan is to facilitate the development control function. It shows the broad landuse zones on a more detailed scale of maps as derived from Structure Plan. The plan provides details of landuse zoning and building controls, the development control function becomes easier to

implement with an Urban Area Plan. It also shows land reservations required for essential uses and major infrastructure development. Urban Area Plan will be in a scale of RF 1:3960

3.9.5 Rural Area Plan (RAP)

Rural Area Plan (RAP) provides a long-term strategy for 20 years and covers for the development of rural areas within the project area. Generally, RAP contains an explanatory report, resource maps, conservation and management report, planning rules, rural area plan and a multi-sectoral investment program and so on. The intention has been to concentrate on the physical planning aspects of rural areas in one hand and socio-economic growth and spatial development on the other. The rural area plan aims at primarily zoning rural land use. After synthesizing all maps and data gathered under the present study, rural areas will be categorized under four broad land use categories (or zones). These are land under water bodies and forests. These two categories will be considered as conservation zone. The third category will be agriculture areas. Agriculture areas will be identified and mapped and put forward as a zone of no change of land occupation. Agriculture land will remain as agriculture. The fourth category of land will be human settlements. All development dynamics will rotate within this zone. The zone will be planned in detailed for human habitation, industry development and service sector activity. Urban Area Plan will be in a scale of RF 1:3960

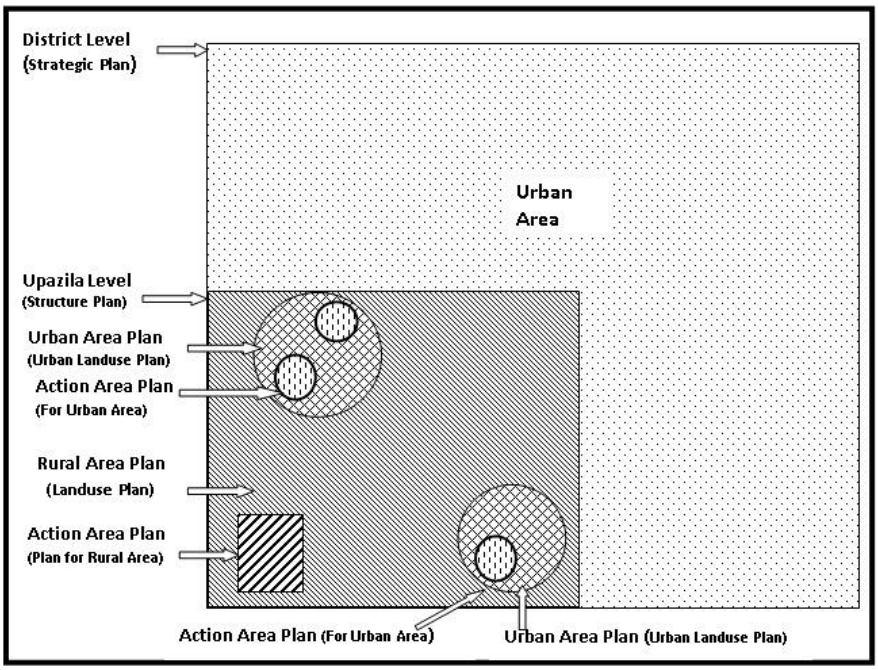


Figure 3.8: Schematic Diagram of Planning Levels

Table 3.7 Goals and Characteristics of Plans at Different Levels

Levels	Type of Plan	Characteristics
District Level	Strategic Plan	Directions and Spatial Policies
Sub District/ Upazila Level	Structure Plan	Spatial Structure of *Upazila* and Sectoral Policies for the *Upazila*
Urban and Rural Area Hierarchical Level	Urban Area Plan/ Rural Area Plans	Generalized landuse plan, infrastructural plan, and inter areas connectivity both physical and economic as well as social / environmental.
Micro Area Level	Action Planning	Detailed implementable action plans for micro areas (ecological units)

3.9.6 Action Area Plan

The Action Plan is a separate document covering the first five-year period of the structure plan. It examines, in the context of the structure plan, those items that might be implemented in this period and thus contains more detail on a more limited range of subjects than the structure plan. It tries to provide the Upazila with guidance in deciding between priorities.

The Action Area Plan (AAP) guides land use and infrastructure within the area potential for immediate intervention based on public demand and necessity. It is prepared on 5 years interval. The preparation of Action Area Plan (AAP) will be formulated through participatory approach involving the local people. It will contains problem analysis using participatory approach, stakeholder analysis, Potential analysis (Basic and derived potentials), identification of possible projects, Priority ranking of projects, Strategy formulation for prioritized projects. Action Area Plan will provide prioritized projects consisting location of project, goal & objectives, activities, tasks, actors, resources, cost and assumptions/constraints.

The action plan consists of three parts, a summary of resources available, project selection and project evaluation. The analysis of available resources looks at the past availability of funds, in so far as this is possible for such a recent institution as an Upazila and attempts to assess funds likely to be available for the Upazila itself for development in the action plan period. Project selection summarizes existing guidelines as they affect five-year plans and lists the criteria used in selection before identifying priorities in each sector and proposing projects to address these priorities. Urban Area Plan will be in a scale of RF 1:3960.

The relationship between Structure Plan (SP), Urban Area Plan (UAP), Detailed Area Plan (DAP) and their major characteristics are depicted in Figure 3.2.

3.9.7 Formulation of Bankable Project & Schemes

Mere plan preparation is not the objective of the project rather it envisages exploring and suggesting implementation strategy for the plan. One of the steps in this regard is selection and identification of Bankable Projects and Schemes. The Bankable Projects and Schemes will identified and priorities

through PRA session. A good number of projects are implemented with external assistance in the form of aid, loan, technical assistance and supplier's credit. The private sector is also being encouraged to invest in the energy and infrastructure development projects. In this situation it is necessary that the projects that will form the major part of the plan implementation process should be developed to an extent, which will help the client to approach the prospective financiers. To develop the inventory of Bankable Projects a list of the projects that are essential to implement the plan will be prepared in the following format.

- Name of the Project,
- Background of the Project,
- Objective of the Project,
- Justification of the Project
- Description of the Project
- Implementing Authority,
- Feasibility Report,
- Project Cost with detail breakup,
- Source of Finance,
- Land Requirement,
- Impact Assessment,
- Implementation Phase,
- Area of Influence of the Project, and
- Projects relation with higher level frame work

Comment [A6]: This point newly added according to comments of UDD

3.9.8 Public Hearing

Public hearing is an important part of the planning process. A public hearing may be a formal meeting for receiving testimony from the public at large on a local issue, or proposed government action. Testimony from both sides of an issue is usually recorded for public record, and a report summarizing the key points is generated. After completion the draft plan an initiative will be taken to display for about a month the plan and reports at upazila level for receiving comments and criticisms (if any) or any complain may be forward to the planning authority to review and corrections.

There are a number of reasons why you may want to hold a public hearing. The main reasons are described below:

- To open discussions about the issue and your advocacy campaign.
- To communicate and clarify needs.
- To communicate a sense of community concern about an issue.
- To increase community awareness about the issue
- To attract media attention
- To bring more of the public over to your way of thinking
- To recruit new members
- To show your side of controversial issues
- To re-open public dialogue on issues that have fallen out of the public mind
- To counter your opponents' arguments against your group or initiative
- To find a solution to a community problem or issue
- To gather information

Comment [A7]: This point newly added according to comments of UDD

3.9.9 Gazette Notification

Implementation of the master plan is an extremely difficult task. There are many elements of the plan implementation process that can not be quantified which restrict determination of an overall status of either individual sector or overall level of implementation of the plan proposals. After finalize the Master Plan it will go for gazette notification to the related ministries and thus the plan will be a legal binding for local level institution to implement the plan.

Comment [A8]: This point newly added according to comments of UDD

3.9.10 Institutional Capacity Building for Implementation

To carry out the project activities and after plan preparation to implement the proposed plans by different authorities there is an ample need for reviewing institutional arrangement and their capacity of the concerned agencies. It will be needed for efficient planning and Implementation of development activities by various public and private organizations. The current approach towards development is overwhelmingly sectoral biased and as such activity is carried out by different sectoral agencies under different controlling ministries. This leaves very little or no room at all for spatial or temporal coordination at local level and creates much of the present confusion, inefficiency and inactivity. The ToR require to review the existing division of responsibilities for guiding and controlling development and make recommendations on any procedural changes and steps needed to bring about such changes to ensure greater coordination of the activities of the various agencies involved.

A variety of activities will be undertaken to accomplish the stated objectives. Key activities to be undertaken in the present task will include:

- Review of existing legal instruments;
- Identify the existing short-comings towards ensuring inter-agency coordination;
- Interview of key persons of all the major development agencies
- Seek the opinion of the key persons of the development agencies regarding an acceptable arrangement for sustainable coordination;
- Examine of the needs for legislative and administrative changes that are required to be carried out to implement the agreed mechanism; and
- Recommendation for all necessary changes in organizational set-up, administrative mechanism, and legal provisions

3.9.11 Training Needs Assessment

With regards to the training requirement of the project, we have to come up with a number of critical parameters for designing a comprehensive training guide line. We have to logically assume some of the complementary and substantive key parameters for the guide line.

SCPL and Arc Bangladesh ltd. standard training methodology will be depicted with the following diagram:

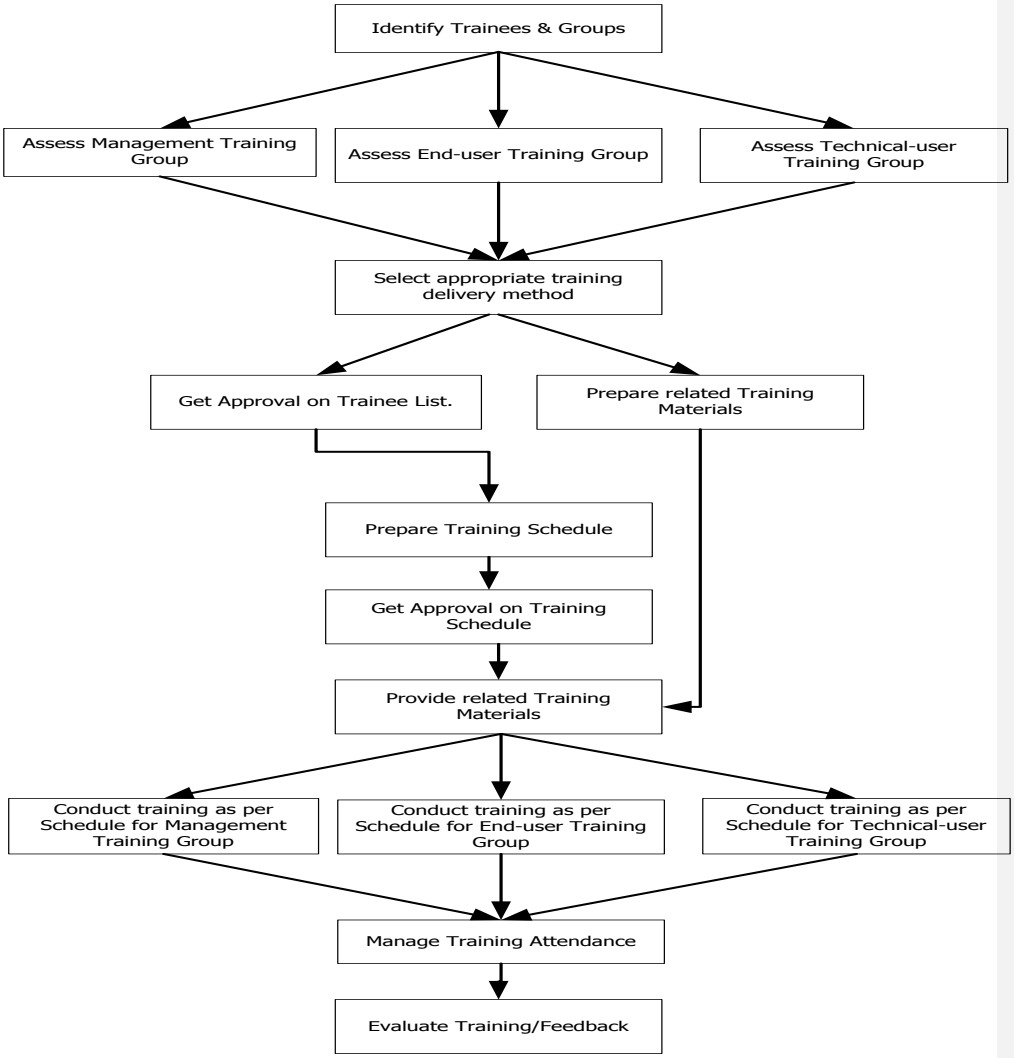


Figure 3.9: Training Methodology

All the activities described in following methodology flow Diagrams

Figure 3.10: Methodology Flow Diagrams