

Frequently Asked Questions on Hi-Tech Survey (Induction Training Materials)

Question: What is meant by survey and settlement of land? Why re-survey was being considered necessary?

Ans: Survey means measurement of land and preparation of map of a patch of land deriving its area. Settlement means to determine the rent. Re-survey of any area was being considered necessary on interval of every 25-30 years as changes occur in the ground due to efflux of time.

Question: How survey and settlement work were being done earlier?

Ans: As per the traditional procedure, survey work were being made manually using Gunter's Chain and the survey informations were being transferred to a map by the help of plain table method

Question: What were the limitations of earlier method of survey and settlement?

- Ans:**
- a. Time consuming and costly
 - b. Error up to 5% was permissible under law.
 - c. Other Human errors are there
 - d. Low level of accuracy.
 - e. Reference points of land measurement were subject to displacement
 - f. Areas above 10 degree slopes could not be surveyed
 - g. Maps were made in paper form whose updation was difficult and was subject to decay and damage.

Question: What was the necessity of Hi-tech survey?

Ans: Hi-tech survey operations take care of the shortcomings of the traditional procedure. The final outcome being in digital form there is no need of repeating survey operation every 25-30 years. Co-ordinate (latitude & longitude) based land measurement through modern technologies is employed in Hi-tech survey operations which is more scientific, uniform and more accurate. Besides the hi-tech survey operations are less time consuming, cost effective and human errors are minimized /eliminated.

Question: How accuracy and minimization of human errors are ensured in Hi-tech survey operations?

Ans: Earlier maps were prepared manually and hence carry the errors due to human factors, both intentional and unintentional. Keeping that in mind, permissible error up to 5% in total village area was allowed. Besides, previous method required huge manpower mobilization adding to man made errors. Through modern technology, maps are prepared from digital ortho-images (taken either from satellite imagery or aerial photography) that depicts the ground condition accurately without any human intervention. Field measurement is resorted to by use of DGPS and ETS where image portions are hazy and not clear.

Question: How photo (Image of village) is taken?

Ans:- Photo (Image of village) is taken by cameras fitted to satellites (in case of hi-resolution satellite imagery) or to low flying aircrafts (in case of Aerial Photography). Besides the GPS are also installed in the concerned satellite or the aircraft and therefore the images produced by the cameras attached to them are geo-referenced and hence depicts the co-ordinates of each point on it.

Question: What is High-resolution Satellite image and Aerial Photography?

Ans: -High-Resolution Satellite Images are the images of the earth surface taken from the sensors/cameras fitted in the Satellites revolving around the earth at a height of approximately 900km from the surface of earth, where the minimum area of the earth surface that can be imaged by the Satellite is 1 Sq. meter or lower than 1 Sq. meter. Presently for the four districts of Odisha i.e., Keonjhar, Cuttack, Khordha and Ganjam High Resolution Satellite Images of World View-II having area 0.5m x 0.5m are being used under the High- Tech Survey.

Aerial Photography is the science of taking photograph from an aircraft flying at low height to take the photograph of the earth surface. The five Western Districts of Odisha i.e. Sunadargarh, Deogarh, Sambalpur, Bolangir and Sonepur are selected under Cadastral Resurvey Project, where Aerial Photography methodology is being used for the Cadastral Resurvey. Here the minimum area that was photographed is 10 cm x 10 cm.

Question: Please explain in brief DGPS and ETS.

Ans: Differential Global Positioning System (DGPS) is an enhancement to Global Positioning System (GPS) that provides improved location accuracy, from the 5 to 10 meter nominal 'GPS accuracy to about 1mm to 10 mm in case of the best implementations. DGPS system works in pair of two or more GPSs, where one GPS is named as Base and others are known as Rovers.

DGPS uses a network of fixed, ground-based reference stations to broadcast the difference between the positions indicated by the GPS Satellite constellations systems and the known fixed positions. These stations broadcast the difference between the measured satellite pseudo ranges and actual (internally computed) pseudo ranges, and receiver stations may correct their pseudo-ranges by the same amount. The digital correction signal is typically broadcast locally over ground-based transmitters of shorter range.

Electronic Total Station (ETS) is an electronic instrument used in modern survey. It integrates an Electronic Theodolite with an Electronic Distance Meter (EDM). It is also integrated with microprocessor, electronic data collector and storage system. The instrument can be used to measure horizontal and vertical angles as well as sloping distance of object to the instrument. Microprocessor unit processes the data collected to compute:

1. average of multiple angles measured
2. average of multiple distance measured
3. horizontal distance
4. distance between any two points
5. elevation of objects and
6. all the three coordinates of the observed points.

Data collected and processed may be down-loaded to computers for further processing. It works using two known coordinates (Fore and Back Point) and calculates the co-ordinate of the unknown point as long as line of sight from ETS to Prism is clear.

Question: What are the basic differences between DGPS and ETS with regard to their uses?

Ans: The basic differences between DGPS and ETS are as follows.

- I. DGPS works with the Satellite Constellation to calculate the longitude, latitude and altitude of a point location where as ETS does not need any satellite constellation system.
- II. DGPS needs one known Ground Control Point to set up its Base and it calculates differential errors in longitude, latitude and altitude (x, y & z) at the known point and

transmits the error factors to the rover/rovers to further calculate the correct longitude, latitude and altitude up to millimeter accuracy. ETS uses two known points (Ground Control Points) known as Fore point and Back Point to calculate the distance and angle between two known points and using the same the unknown co-ordinates are calculated by ETS. Thus ETS works as long as line of sight between ETS and Prism is clear.

- III. DGPS will not work in forest and town/city areas as the signal would be hindered through the foliage and multipath reflection due to high rising buildings. ETS will work in the Forest and Town/city areas.
- IV. DGPS works for a long distance but ETS works for short distances i.e. the line of sight areas.
- V. DGPS work across the obstacles and barriers like mountains/hills and rivers but the ETS will not work across the barriers/obstacles as the line of sight would not be visible.

Question: What are ground control points? How they play an important role during hi-tech survey operations? Explain with respect to Primary, Secondary and Auxiliary control Points.

Ans: The Ground Control Points (GCP) are defined as points on the surface of the earth whose co-ordinates i.e. longitude, latitude and altitude are calculated using DGPS observations.

These points play major role to geo-reference the high resolution satellite image/aerial photographs as well as to generate ortho image/photo for the areas. These points also act as reference points during DGPS/ETS survey of obscure areas and gharabari areas (House Site).

The Ground Control Points under Cadastral Resurvey Project are classified as Primary Control Point (PCP), Secondary Control Point (SCP), Tertiary Control Point (TCP) and Auxiliary Control Point (ACP). The PCPs, SCPs and TCPs have been established at a grid of 16 km x 16 km, 4 km x 4 km and 1km x 1km respectively. The PCP and SCP points are monumented in the Govt. office premises using pre-cast RCC pillars (15cmx15cmx75cm) engraved with pillar codes at its center. The Tertiary Control Point (TCP) and Auxiliary Control Points are not being monumented and are being established temporarily as per requirement during the survey operations.

Question: What is ortho image/photo?

Ans: An orthophoto, orthophotograph or orthoimage is an aerial photograph geometrically corrected (Horthorectified) such that the scale is uniform: the photo has the same lack of distortion as a map. Unlike an uncorrected aerial photograph, an ortho photograph / image can be used to measure true distances, because it is an accurate representation of the Earth's surface, having been adjusted for topographic relief, lens distortion, and camera tilt.

Question: If Hi-resolution Satellite imagery or Aerial Photography is enough?

Ans:- No. They are not enough always. Where the ground is covered due to tree growth the images taken will not depict clearly the field bunds often used to prepare cadastral maps. Dense clouds during the time of taking photographs create similar situations. The areas where field bunds are not clearly interpretable from the image are called obscure areas. Ground truthing or field measurement of those obscure areas need to be done using ETS & DGPS to complete the map preparation.

Question: What methods are followed by State Government?

Ans: Government of Odisha has decided to employ the hybrid method of using High Resolution Satellite Imagery followed by ground truthing by ETS & DGPS in the districts of Ganjam, Khordha, Cuttack and Keonjhar. Similarly decisions have been taken to employ the hybrid method of using Aerial Photography followed by ground truthing by ETS & DGPS in the districts of Sundargarh, Sambalpur, Deogarh, Bolangir and Subarnapur.

Question: Please indicate the steps undertaken in preparing the draft map?

- Ans:**
- A. The locations of Ground Control Points (Both primary and secondary) are finalized and those are monumented as per the standard procedure. The GNS reading of those GCPs are taken referring the readings (latitude, longitude and altitude) of known points. Finally a virtual grid of Ground Control Point Network is prepared based on the GNS readings. The above procedure must precede the image acquisition so that those GCPs will be clearly visible on the image so acquired. The co-ordinate readings of those GCPs so taken must match with that shown on the image.
 - B. Hi-resolution satellite images/ Aerial photos are acquired. The raw images need to be converted to ortho-images.
 - C. The images taken from satellites or through aerial photography obviously don't depict the village boundaries. For the purpose of delineating village boundaries on the ortho image, we need to refer the cadastral maps available with us. The cadastral maps being in physical form are converted to digital form and all the sheets of a village are mosaiced in the process.
 - D. For the purpose of delineating the village boundary on the ortho-image, the vector cadastral maps of a village shall be mosaiced and geo-referenced with the ortho-image by matching features such as roads, drainage lines, water-bodies, etc. After Geo-referencing of vector village map, the village boundary as in the digitized cadastral map is transported to the ortho-image and the village boundary is delineated on the ortho-image in GIS environment using AutoCAD software. The village boundary so delineated may require to be adjusted at the boundary of edge plots to ensure that it runs on the physical demarcation. Thereafter, the vendor will merge all the land parcels to generate boundary polygon of the village.
 - E. Village boundaries of all such villages are delineated and during such delineation it is kept in mind that there is no gap or overlapping between boundaries of adjoining villages. If the village boundary will not be interpretable in the ortho-image, field verification will be required to confirm the village boundary.
 - F. Thereafter, total village area as derived from ortho-image is compared with the derived area from RoR available. The village boundary as delineated on the ortho-image is confirmed if the variation in area is within +/- 2%. Where there is variation beyond 2% limit, the village boundary is required to be confirmed by the Tahasildar after field verification.
 - G. After delineation of village boundary, the visible plot boundaries on the ortho-image are then digitized following mirror principle using AutoCAD software. But only exception to the mirror principle is that all the Govt. plots are drawn as per the sabik map. The same is undertaken to protect the interest of Government and to avoid recording of

Government land encroachment.

- H. During the internal plot vectorization, the vendor identifies the obscured areas. The plot wise list of such obscured areas are then verified by ORSAC and finally transmitted to the district Collectors through DLR&S, Odisha, which ultimately passed on to the Tahasildars. Those obscured areas will be put to field survey using DGPS/ETS in presents of revenue field functionaries.
- I. For the purpose of validation of image derived plot vectors 5% of such plots are randomly selected. Their dimensions are field measured through ETS and are compared with image derived dimensions. In case of measurement variation found to be beyond 20 cm, fresh look at the digitization of all plots is to be made. After fresh 5% plot will be taken for validation in the above manner. The process is to be repeated till desired level of accuracy is achieved.
- J. All plots under obscured area, habitation areas, plots falling by the inter-state boundaries will be surveyed using DGPS/ETS by the agency in presence of local RI/ARI/Amin. The details of plots put to field survey need to be authenticated by the concerned Tahasildar.
- K. Local officials of other land owning departments should help the survey agencies in identification of boundaries of land parcels owned by those departments.
- L. All survey should be done with reference to nearby GCP. Auxiliary points if necessary can be taken, the co-ordinates of which should be provided to DLR&S/ ORSAC. Gharabari areas must be surveyed section wise and in each section survey should start and end in one control point.
- M. The agency/vendor then incorporates the field measurement data taken by ETS/DGPS in the ortho-image and prepares the draft village map. Plot numbers from the existing map shall be transferred to the new map adopting GIS process. When more than one plots is found in the new map compared to the one plot of previous map, those shall be assigned bata number consistent with the mutation record or otherwise.
- N. The said draft village map is then submitted to the concerned tahasildar for verification. Apart from the draft map the vendor shall also provide the new plot area for each land parcel in a statement compared with the plot areas of previous map.

Question: How planning is important before undertaking field survey activities?

Ans: Planning is essential for successful field survey activities. For the purpose of planning the total volume of work and the resources available to perform the work within a given period of time must be taken into account.

It is needless to say that all Gharabari (Habitation) areas, obscured areas, inter-state boundaries, village boundaries difficult to interpret from ortho-image and 5% randomly selected image derived plot shall be put to DGPS/ETS survey. Hence plot wise details of those areas must be readily available in advance with the revenue field functionaries at grass root level.

Vendor must submit its manpower and equipment resources for to District Administration for appropriate planning. The district administration must also take into

consideration the available manpower resources available with it.

Detail Tahasil wise survey schedule in Form No. 1 (T) with approval of Collector for publication at District/ Tahasil and village level. Village wise survey schedule in Form No. 2 (T) must be notified in the concerned village at least 10 days before commencement of survey.

It is highly important to have involvement of local people and local officials of land owning departments during field survey activities to gain the confidence of people and to avoid future litigation.

Arrangement of Palli Sabhas is an integral part of the planning and publicity process. Those will be organised under the chairmanship of Concerned Tahasildars. All efforts should be made to maximize the presence of local people at the Pallisabha. The Tahasildar, representative / Local Officers of the land owning departments such as forest, water resources, etc shall be invited to the meeting along with the local Sarapanch. The entire action plan (including the day-wise survey schedule) should be discussed in the meeting before commencing the survey work to facilitate further cooperation for the survey exercise. The representative of the Vendor will show the detail plan of survey as well as the DGPS & ETS in the pallisabha for awareness of the Project. The Tahasildar shall maintain the record of the meetings held in different villages/ cluster villages of their areas.

Question: What is the role of Private agency in Hi-tech survey operations?

Ans.: As per provisions of Section 7(1) of Special Survey and Settlement Act-2012, an agency may be appointed by Director, Land Records, Surveys & Consolidation, Odisha who will assist in preparation of Map and Record of Rights (RORs) using modern technologies. But their works are limited to facilitate the preparation of cadastral maps and RoRs only and all responsibilities of correctness of such prepared maps and RoRs lies with the Government functionaries.

While all possible steps are taken by ORSAC scientists to check the quality of the vendor/ agency at laboratory level, it is the responsibility of revenue field functionaries to guide and check the activities of the agency/ vendor during field survey operations. The personnel of the agency will be with the Tahasildars concerned during preparation of preliminary/ draft/ final RoRs and will assist in the dispute resolution processes requiring field measurements.

Question: What will be the nature of the draft map prepared by the vendor agency that should be appreciated by the Tahasildar?

Ans: The draft map so prepared by the vendor agency will be the replica of field level plot boundaries. It will contain plots both visible to be drawn on ortho-image as well as the plots of obscure areas, gharabari areas. Hence, the number of plots will be less than that of current RoRs, because all plots in the RoR may not corresponding field boundaries. Apart from the draft map the vendor agency will also supply the statement of areas of each plot so prepared by it vis-a-vis their areas in the current RoR.

The Tahasildar must analyse the map and plot-wise area vis-à-vis its area with reference to corresponding plot area in current RoR and map. In course of examination of map he will find that some plots have been divided and some new temporary plots have been carved out, which have been given temporary numbers. For example, plot no 305, may have been divided and converted to three parcels those will be reflected in the draft map as 305/1, 305/2 and 305/3 and likewise.

In some cases plot numbers may have been shown in a string, for example, as 5+7+8+10. This indicates that plots numbering 5,7,8 and 10 have been merged to form a single plot physically. Similarly, parts of some plots might have been merged in the field and in that case, the concerned plot will be shown numbered as 7(P) + 8(P) + 9(P). In this case portions of three plots i.e. 7, 8, 9 have been merged to form a new plot in the field.

Question: How preliminary RoR is prepared?

Ans:

- > The preliminary RoR shall be prepared by a team of persons to be constituted by Sub-Collector concerned. The team must be headed by a Revenue Supervisor and essentially include an Amin. The team of persons must work under the direct supervision and control of the Tahasildar / Additional Tahasildar.
- > Proper appreciation and analysis of the draft map as submitted by the vendor agency and planning thereafter will be pre-requisite for successful preparation of preliminary RoR. Hence date wise work calendar must be finalized and such work calendar should get adequate publicity to ensure participation of local people and officials of other land owning departments during the process.
- Before initiation of actual process, the team of persons must analyze the abstract of present RoR and the plot register prepared in Form-5 and Form-6 respectively.
- > Further the self-declarations received by the concerned Tahasildars shall be put to verification for the genuineness of the claims. While many of those claims may be related to succession after demise of the recorded land owner, there will be many relating to acquiring of landed properties by way of purchase, gift or otherwise including decree/order of competent courts. There shall be many cases where land might have been settled/ leased out by the Tahasildar himself while acting under different provisions of other revenue laws. All those self- declarations must be thoroughly verified based on available records and submitted evidences.
- The responsibility of the team of persons entrusted with the job of preparation of preliminary RoR is two-fold. Firstly, it will verify all the plots of the new map with respect to the ground reality and secondly update the record with respect to change in ownership due to transfer/ partition/ hereditary devolution/ exchange and the like,
- Claims and objections shall be disposed of in a summary manner by the tahasildar by passing a reasoned order within the maximum period of 30 working days of filing of such claims and objections. The Tahasildar concerned shall be assisted by the survey team of the agency wherever demarcation of land is required for disposal of claims/ objections.
- After Hal map and records are finally approved by the Tahasildar, the plots will be assigned fresh unique numbers in a sequentially manner beginning from the northwest corner of the village.

Question: How draft RoR is prepared?

Ans:

- > The draft RoR is prepared in Form-12 (in Odisha Special Survey & Settlement Act, 2012) by

Study Material – Revenue Officers' Training Institute, Gothapatana, Bhubaneswar

the Tahasildar stating the orders passed with respect to the claims and objections received against the entries of preliminary RoR.

- > After compliance of the orders of the Tahasildar the survey team shall furnish complete village map with integration of textual data plot schedule with area and corresponding sabik reference in Form No. 6 (T) with the Tahasildar.
- > The draft RoR is published for a period of 30 days on the notice board of Tahasil office concerned, at a conspicuous public place in a revenue village concerned and on the notice board of Gram Panchyat/ ULB of the revenue village concerned.
- > The not final copy of the map shall be made available to the desirous land owners and persons having interest on the land on payment of such fee as may be fixed by the DLR&S, Odisha.
- > After publication of draft RoR, claims and objections are invited with respect to the entries of the draft RoR.
- > Claims and objections shall be heard and evidences if any shall be recorded. If necessary field verification/ measurement may require to be made. All claims and objections shall be disposed of in a summary manner by an officer not below the rank of Additional Sub-Collector within a maximum period of 60 days from the date of filing of such claims and objections.

Question: What are the activities undertaken during the recess?

Ans:

- > Orders passed with respect to the claims and objections against the draft publication of the RoR shall be complied by making necessary additions or alternations from the draft record of rights including the map.
- > The detail comparison of village boundaries with the boundaries shown in the last Revenue village map and orders passed at different earlier stages shall be made and care shall be taken that area of plots shown in the draft record of rights matches with the area shown in the map concerned.
- > The area of each plot and total area of revenue village including boundaries of the revenue village in last survey map and area of the plots and the total area of plots and the total area of revenue village and boundaries as prepared after draft publication of the record of rights shall be Sub-divisions, boundary dimensions. Variations in dimensions shall be enquired and shall then be recorded and the draft map shall be map corrected with red ink, if necessary.
- The current land use, irrigation status and other land attribute data shall be collected by the team.
- It is highly important to make adequate publicity in the local area to ensure involvement of local people and local officers of other land owning Departments during the above process. The Tahasildar concerned should make a date-wise plan and numbers of plots to be verified on any given day. The plan should be publicized with appeal to the land owners to remain present on the site on the specified date and show demarcation of their land.
- While enquiring ownership the team shall verify such documents as submitted by the concerned land owners for their authenticity which shall also be verified by Tehsildar /Addl. Tahasildar on day to day basis. For recording of ownership status of private lands and government lands, the

provisions of "Sarakari Jami Record Kariba Pranali" & "Rayati Jami Record Kariba Pranali" are to be followed scrupulously.

- Where preparing the RoR, caste of the owner is to be enquired and recorded. Caste recorded in previous RoR need not be changed unless during enquiry it comes to notice that the same is erroneous.
- Where the Government land has been settled by Revenue Officer, the Tehsildar, shall be cross-checked on the basis of which land settlement has been claimed. After being satisfied, the land shall be recorded in favour of the beneficiary.
- After the verification, the team shall prepare land owner wise preliminary RoR in Form No. 7 (in Special Survey & Settlement Rules, 2012) in the light of available revenue records, verification certificates of self-declarations as well as actual field verification.
- Those plots corrected during the physical verification shall be verified cent percent by the local Amin and Revenue Inspector, Revenue Supervisor, Tehsildar and Sub-Collector shall randomly check 25%, 10%, 2% and 1% of the plots respectively.
- The village boundary if need to be changed during field verification should be authenticated by the Tahasildar.
- After preparation of preliminary RoR in Form-7 the same is reflected in a land parcel map (LPM) by the vendor and the same shall be served on the land owners including officers concerned for the Government lands. Simultaneously copies of such preliminary RoRs with LPM shall be displayed in a convenient place as the Tehsildar may determine for public inspection for a period of 15 days.
 - Claims and objections against the entries in the preliminary RoR may be filed in Form-8 by the land owners including the representatives of the concerned office of the Government, Central Government and other public body within a period of 15 days. Those claims and objections be thoroughly compared, checked and verified and on being satisfied, the Tehsildar shall pass the new area as prepared after draft publication.
 - After passing of the area by the Tehsildar an abstract of new record of right in **form No 18** and new plot register in **form no 19** shall be prepared by the Amins.
 - The RoRs before its final publication shall be arranged according to the names of land owners alphabetically in Odia language.
 - On the basis of the abstract of new RoRs and plot register, copies of the RoRs shall be prepared in Form 20 for its final publication in 'quadruplicate after proper checking and comparison. Those four copies are for the concerned land owner, Tehsildar, Collector and the DLR&S, Odisha.

Question: How the final RoR is published?

Ans:

- The copies of the RoR and map finally prepared in Form-20 shall be finally published under the hand and seal of the collector and the same shall be placed for public inspection from the date of such final publication for a period of 30 days by displaying it on the notice board of Tehasil Office concerned, at a conspicuous public place of the village/ ULB concerned and on the Notice Board of concerned Gram Panchayat/ ULB.
- Hard and soft copies of the final RoR including the map shall be prepared by the agency concerned and will be handed over to the Tahasildar for distribution as mentioned below.

- I. Hard copy of RoR for Individual Land Owners.
 - II. Softcopy and hardcopy of RoR and hardcopy of map to concerned RI.
 - III. Softcopy and hardcopy of both RoR and map to concerned Tahsildar.
 - IV. Softcopy and hardcopy of both RoR and map to concerned Collector.
 - V. Softcopy and hardcopy of both RoR and map in duplicate to Joint Director, Survey and Map Publication, Odisha.
- Joint Director, Survey and Map Publication, Odisha shall facilitate Web-hosting with the help of NIC.
 - Joint Director, Survey and Map Publication, Odisha shall also preserve the hard copy and softcopy of the Final RoR and Map in safe custody for future reference and -utilization
 - Any land owner or any person having interest in land may file claims and objections against the entries on finally published RoR including the map within three months before the Additional District Magistrate.
 - Claims and objections so received shall be disposed of in a summary manner by the Additional District Magistrate within a maximum period of three months from the receipt of the same.
 - Orders of the Appellate Authority shall be communicated to the concerned Appellant/ Tahasildar. Tahasildar shall effect necessary changes in the RoR both in hardcopy and softcopy and communicate the same to the concerned RI, Collector and DD, S&MP in **Form No. 8 (T)** for effecting necessary changes in the RoR at their level. The RI shall receive **Form No.**

8(T) in duplicate and effect necessary changes in the Hardcopy of the RoR available with him within 7 days of the receipt of the same and the second copy of the **Form No 8 (T)** shall be returned to the concerned Tahasildar so as to reach him within 10th day of the receipt of the same in token of the changes effected at his level.

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