

## CHAPTER XII

### *Survey*

**239. Settlement work based on accurate field survey.** - In order to carry out either of the two branches of his work, the framing of a record of rights or the making of a fair assessment, the Settlement Officer must have an accurate map of each village showing the position and boundaries of every field. Such a map is known as the *shajra kishtwar*. He also requires a record of the area of each field, which is easily, calculated when its shape and linear dimensions are known, and for assessment purpose it is expedient to note at the time of measurement the class or classes of land which each field contains<sup>1</sup>. If no field map exists, the Settlement Officer must make one; if the existing map is defective, he must consider whether it can be corrected without an entirely new survey.

**240. Separate field map for each village.**- There is a separate assessment and a separate record of rights for each estate of *mahal*. But the unit for purpose of survey is not the estate, but the village or *mauza*. These terms have already been explained. The distinction between them introduces no complication into settlement work, for as a matter of fact the things which they denote are in the Punjab almost invariably one and the same. Occasionally a block of land or some scattered fields belonging to one village are enclosed within the boundaries of another village. Such fields should be measured along with the village in which they are included, but given an independent series of numbers.

**241. Survey marks.**- In order to indicate clearly the limits of each estate masonry platforms (*sihaddas*) are built at every point where the boundaries of more than two estates meet (Land Revenue Rule 33). At every angle on the boundary line between two trijunction platforms, mud pillars (*burjis*) are erected (Land Revenue Rule 32). Before the measurement of any estate is undertaken the village headmen should be required to put every platform in a proper state of repair and to replace any pillar that may have been destroyed. Chapter VIII of the Land Revenue Act gives the Settlement Officer power to enforce the erection and maintenance of these and any other survey marks that may be required. The cost of special survey marks set up to facilitate

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<sup>1</sup> See Chapter XIII.

measurements. e.g. at regular intervals on a base line or to mark the corners or corners of square (paragraph 250) is a Government charge.

**242. Field and Kilabandi;-** A field is a parcel of land to which a separate number is assigned in the map. The fixing of the limits of fields for survey purpose is a question to be decided on grounds of convenience, the chief matter for consideration being the use to be made to the maps in the half-yearly crop inspections. Usually any parcel of land lying in one spot in the occupation of one person or of several persons jointly, and held under one title, should be treated as a single field. Occasionally where land is rich and let in small plots the survey numbers under this rules will be very numerous. This cannot be helped for no clear record of tenancies and rents can be kept up if parcels of land tilled by different tenants are not treated as separate fields. But where the rule works in an opposite direction and, if strictly followed, would result in the areas included is single survey numbers being very large, it is subject to important exceptions. Several plots of land owned by a single proprietor, which are always recognized as separate fields having limits indicated by more or less permanent ridges or hedge and being known perhaps by distinct names may at the time of measurement be included in a single tenancy. There is no object in treating these as one field. Or again the area occupied under one title may be so large that the record of crops, harvest by harvest, will be rendered easier if it is broken up into several survey numbers. This is especially true in the case of fields irrigated by a perennial canal. If they are large and irregular in share, the assessment of water-rates by officers of irrigation department becomes much more difficult. Accordingly on new canals in the west of the Punjab each survey square in Crown lands has been divided into 25 small squares, known as *kilas*, each occupying a fraction over an acre. Each Kila forms a field or survey numbers<sup>2</sup>. *Kilabandi* has been introduced to a large extent even in privately owned estate on the Lower Chenab and Lower Jehlum Canals. On the newest canals the squares have been replaced by rectangles containing exactly 25 acres, so that the *kila* is the equivalent of an acre. On old canals it is difficult to induce landowner to accept *Kilabandi*, which involves the breaking up of old field boundaries. But the main advantages of *kilabandi* can be secured if in mapping canal-irrigated estates care is taken to make the fields of moderate size, and, as far as possible, of regular shape. As a rule a canal-irrigated filed much larger than an acre is inconvenient. In the case of extensive blocks of

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<sup>2</sup> See Appendix XIV.

common wasteland each survey square is usually treated as a separate field. It is not essential that a survey number should be wholly cultivated or wholly uncultivated, or that it should consist entirely of one soil or class of land. But if the uncultivated land is of any extent it is convenient to treat it as a separate number and if the line of division between two soils or two classes of cultivated land is clearly marked and of a fairly permanent character, it is better to put land on either side of the line in different fields, even though it is in the cultivating occupancy of a single person. On the other hand, care should be taken not to multiply survey numbers merely on account of the presence on the ground of ridges thrown up for convenience of cultivation or irrigation. Where this is done record work is needlessly increased. Section 101 of the Land Revenue Act empowers any revenue officer engaged in the framing of a record of rights to define the limits of any field as to which a dispute has arisen.

**243. Measure of length and areas.** - The simplest way of measuring land is by pacing. When a man in walking steps out first with his left foot, the pace or *kadam* is the distance between the heel of the right foot in its original position and the heel of the same foot after it has been advanced in from of the left foot to make the second step. A *kadam* is the usual unit of measures of length and a square *kadam* the unit of measures of area. In the east of the Punjab, where the *bigha* is the local measure, the square *kadam* is known as the *biswani*; in the west, where the *ghumao* is employed, it is known as the *sarsahi*. Twenty *biswanis* make a *biswa*, and twenty *biswas* a *bigha*. Nine *sarsahis* make a *Marla*, Twenty *merlas* a *kanal*, and eight *kanals* a *ghumao*. The *bigha* of the Western Punjab is one half of a *ghumao*. As the average height of a man, in different localities varies greatly, it is not surprising that the local measures in use were found to be far from uniform. The variations have been reduced, but not abolished, in our settlement surveys. The *bigha* employed in some settlements in the east of the Punjab is  $\frac{5}{24}$ th of an acre<sup>3</sup>. It is usually known as the *kachcha bigha*, to distinguish it from the old *Mughal* measures known as the *Shahjahani* or *pakka bigah* which is exactly three times as large. Where the *shahjahani bigha* is the unit of area the linear measure is not the *kadam*; but the *gatha* of 99 inches. The *kadams* in use vary from 54 to 66 inches, the latter being the most usual length. It is also the most convenient for, where it is employed, the *ghumao* is exactly equal to an acre. Full details of

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<sup>3</sup>Selections from the Records of the Financial Commissioner's Office, New Series No. 24.

the land measures officially recognized in different districts will be found in Financial Commissioner's Standing Order No. 16.

**244. Calculation of field areas.-** The calculation of field areas depends on the simple fact that the numbers of *kadams* on two sides of a rectangular figure, one of which is perpendicular to the other, multiplied together will give the number of square *kadams*. Area of any triangle can be found by multiplying the number of *kadams* in its base by the number contained in a perpendicular dropped on to the base from the opposite angle and having the result. However irregular the shape of the field may be, so long as its sides are straight or only slightly curved, there is no difficulty in finding its areas, for any figure on this sort can be divided into triangles.

**245. Topographical and cadastral surveys. -** There are two surveys with which a Settlement Officer has to concern himself, the topographical survey made by the Imperial Survey Department and the cadastral or field survey made by the *patwaris*. The second is indispensable for his work, the first is chiefly useful to him as a means to testing the accuracy of the second. The methods used in both cases are scientific. The processes followed in the second are, of course, much simpler than those employed in the former but experience has proved, that properly applied, they are sufficient to secure a degree of accuracy sufficient for all the purposes for which revenue officials employ village maps. The Imperial Survey deals with village as a whole, mapping their boundaries and showing the main topographical features, such as the homestead or *abadi*, roads, canals and large sheets of water. The limits of the cultivated culturable, and barren land have also sometimes been indicated. The cadastral survey marks on the village map the boundaries of every field, and by means of it the areas shown in the *jamabandi* are calculated.

**246. Field survey in Punjab not supervised by officers of Survey Department.-** Some parts of India the topographical and the field survey are both under the charge of the Imperial Survey Department. It has more than once been proposed to extend this system to the Punjab, but the opinion of experienced revenue officers has always been against any change of this sort<sup>4</sup>. The existing system is so simple that, with the exercise of ordinary care, it gives such satisfactory results, that there is small likelihood of its being given up. In fact in some cases the latest

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<sup>4</sup> See Punjab Revenue Proceedings No. 4 of September, 1873 and No. 1 of September, 1883.

topographical maps of the Punjab districts have been made up by the Imperial Survey Department by piecing together reduced copies of the field maps after their accuracy had been tested by making a traverse connecting certain fixed points marked in some permanent way on the ground<sup>5</sup>. It is very desirable but not essential that such a traverse should be made by the Survey Department before the Settlement Officer begins his field measurements. If he is furnished with tables showing the distances between a large number of fixed points, the accuracy of which has been gauged by rigid scientific process, he possesses a very valuable means of judging of the correctness of his own work. The methods of testing the cadastral survey by the help of the topographical survey are noticed in Appendix VII. An absolute agreement between the results of the two surveys is not to be expected. Where a discrepancy between them, large enough to deserve notice, is discovered, it is not safe to conclude that the field measurements are at fault. But it is a reason for testing them rigorously and coming to a definite conclusion on the subject. A description of the methods employed by the Survey Department and the maps prepared will be found in Section No. 30 (New Series) from the records of the office of the Financial Commissioners, Punjab.

**247. Employment of a *amins*.** - Men acquainted with the simple methods used in measurements and known as *amins* have sometimes been employed in settlement on the ground that *patwari* lacked the skill which would enable them to do the work impidly and accurately. The plan is a thoroughly bad one, for it deprives the *patwaris* of the opportunity of learning an essential part of their work, and at the same time increases danger that the survey may be made a means of extortion. The *patwari* has local knowledge which saves him from many mistakes, and he has a far greater interest in making his work accurate than any temporary hand can have, who is only troubled by errors which happen to be found out. The plan of employing *amins* was early condemned in the Punjab. It was revived on a large scale in some later settlements. It is now considered essential that every *patwari* should measure with his own hands the greater part of his circle. When additional surveyors are employed they should, as far as possible be accepted candidates for the post of *patwari*.

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<sup>5</sup> See joint memorandum by the Surveyor General and Colonel Wace, Commissioner of Settlements in Selections from the Records of the Financial Commissioner's Office, New Series No. 26, also paragraph 51 of the report of the Indian Survey Committee, 1904-05, Volume I.

**248. Early field surveys.-** In the first regular settlement the survey of a village consisted of two distinct stages, the preparation of a boundary map (*nakhsa takbast*) after all disputes as to the limits of the village land had been settled, and the making of a field map or *shajra kishtwar* and a *khasra*. The latter was a register, showing in respect of each field, its number in the map, the names of its owner and of the person who cultivated it, its linear dimensions and area, the soil or class of land which it contained and the crops growing in it at the time of measurement. The *shajra* is described in Mr. Thomson's Directions as "rough plan of the village," and in paragraph 17 of Mr. Barne's Report dated 13th December, 1852, on a new system of field measurement in the Punjab<sup>6</sup> as nothing but a rough eye sketch laid down without rule, scale or compass. It might or might not present an approximation to the actual contour and dimensions of the village area, but the only security for such results were the practiced habits and correct eye of the *amin*."

**249. "Plane-table" system of survey. -** No field survey can be worth much, which is not based on a skeleton traverse of fixed points of the surface of the ground whose direction one from the other have been accurately determined. This requirement was met with some measure of success in the plan devised by Mr. Blyth about 1852, and first put into practice in the settlement of the central districts of the Punjab<sup>7</sup>. Mr. Blyth applied his practical experience of the methods of the Survey Department to the working out of a scheme resting on a scientific basis, and yet simple enough for *patwaris* to follow. By the use of plane-table, compass, and sighting rod, maps drawn to scale in which the fields were plotted with a considerable amount of accuracy were produced. The new plan, known as "the Punjab" or "the plane-table" system was speedily adopted in the United Provinces and gradually improved in both provinces till it became a very effective instrument for the making of the field maps. It is only possible here to refer very briefly to the main features of the plane-table system of survey. For details Chapter V of Mr. Vincent Smith's Settlement Officers Manual for the United Provinces and Chapter X and Appendix 1 of the Punjab Manual of Land Measurement - Edition of 1917 - may be consulted<sup>8</sup>. The area of a village was cut up into triangles, and the frame work on which the field survey was

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<sup>6</sup> Selections from the Records of the Punjab Administration Old Series No. IX and Financial Commissioner's Circular No. 86 of 1855, See also Financial Commissioner's Standing Order No. 16, paragraphs 18 and 19.

<sup>7</sup> Selections from the Records of the Punjab Administration, Old Series No. and XI.

<sup>8</sup> For older instructions on the subject see the second chapter of the Vernacular *Dastur-ul-aml Patwarian* published in 1876.

build up consisted of the straight line forming their sides. The triangulation was effected by taking up convenient points all round the boundary, but not necessarily on it and connecting these with one another and with other fixed points in the interior of village. The distance between the various points was carefully chained, and their relative bearings were fixed by the sighting rod, and true north and south having first been determined by means of the compass. Starting from some station on or near the boundary the surveyor worked all round the latter, laying down his triangles as he proceeded. It was possible to apply efficacious tests to the work as it proceeded, but the final test of it was the way in which the circuit closed, in other words, its correctness was proved if the last triangle of the series fitted properly into its place, its dimensions as scaled on the map corresponding with the actual dimensions on the ground as determined by chain measurement. The boundary line was laid down by means of offsets from the bases of the nearest triangles, and on the map the point where the boundary of any field intersected the side of any triangle. A common fault of maps prepared on this system is that the boundaries of adjoining estates do not interlock.

**250. Square system of measurement.** - The plan has been superseded in plains districts by the square system of measurement introduced by Colonel Wace in 1883, an excellent account of which will be found in Mr. Francis's "Manual of Land Measurement for Patwaris." The area of village is now divided into squares of equal size, the skeleton traverse being built up on a square usually of 200 *kadams* laid down with great care somewhere near the centre of the village. In making this square the first thing to do is to measure with the utmost accuracy in open ground a base line of 200 *kadams*, represented by a 5-inch line on the map, the scale commonly adopted being one inch to 40 *Kadam*. The ends of this line are marked by small masonry pillars, which should be well built and carefully preserved by stone or concrete blocks. This system is better suited to *patwaris* than the triangulation plan, for it offers less temptation to fudging. If the first square is accurately laid down, it is not difficult to ensure the correctness of the whole traverse and as a matter of fact, *patwaris* with proper oversight perform this part of their work admirably. The boundary is laid down by means of offsets from the nearest square, and the sides and diagonals of squares are utilized in connections with the plotting of fields in the same way as the side of triangles in the plane table system.

**251. Common base line for a large number of estates.** - In the case of estates near a river the plan introduced by Mr. Francis of having a common base line may be usefully adopted. Where possible there should be a corresponding base line paralleled to the first on the opposite bank<sup>9</sup>. By this device the difficulty of relaying boundaries which are liable to be obliterated is diminished. The full benefits of the plan are secured where the boundaries of the estates which face each other on either side of the stream are fixed. In the last settlement of Peshawar the plan of having common base running due east-west and north and south for the whole district was adopted<sup>10</sup>. Any help which officers of the Imperial Survey Department can give in laying down or checking base lines should be welcomed. It is beyond the capacity of a revenue staff to lay down a base line for any great distance which will not show considerable divergence from the true direction. If for any special reason a long line is required, it is better to lay it down in separate short sections say, of about two miles each, so that the errors in one section may not be continued in the next. In recent settlement surveys of several riverain tracts much valuable assistance has been obtained from plotted sheets supplied by the Survey Department. They show in correct relative position certain convenient points (*chandās*) or corners of squares which have been fixed by skeleton traverse survey run along or over the tract bordering both banks of the rivers concerned. Identical orientation of squares on either side of it can thus be secured. The system is one which should be utilized wherever possible.

**252. Survey work in Hissar and hill tracts.** - In the settlement of the Hissar district carried out between 1887 and 1892, the field measurements were based on a somewhat elaborate traverse made by the Survey Department but this plan has not been followed in other plain districts, except in the case of riverain tracts as noticed in the last paragraph, as it is found that the squares laid down by the *patwaris* furnish an accurate framework for cadastral surveys. But in hilly tracts the square system is impossible. Recourse has therefore, to be had to a modification of the plane-table system, and no great accuracy can perhaps be looked for unless the *patwari* is supplied with mapping sheets on which the positioning of several conspicuous points been marked by the Survey Department<sup>11</sup>. In the tracts under reference, and possibly in others, an increasing amount of assistance of this kind will, it is anticipated, be required as time

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<sup>9</sup> See Casson Walker's Settlement Report of Lahore, paragraph 23.

<sup>10</sup> See Dane's Settlement Report of Peshawar, paragraphs 37-38.

<sup>11</sup> For hill measurement see Appendix 1 to the Punjab Manual of Land Measurement, Edition of 1917.

goes on, from the Survey Department. Plotted sheets showing survey marks fixed and traversed by the Department were supplied in the Kangra District for the purpose the facilitating settlement measurement and mapping. In all settlements for which such plotted sheets are supplied, three traverse points in each estate should be marked with stone pillars under the orders of the Settlement Officer. It may be possible to utilize tri-junctions as traverse points and thus to reduce the expense of laying pillars.

**253. Re-measurement avoided where possible.** - It is the policy of Government to get rid as soon as possible of the necessity of re-measuring villages at settlement, and one of the first tasks which a Settlement Officer must take in hand is to decide to what extent re-measurement is required. The field maps should be not only accurate enough for revenue purpose, but also capable of being utilized after reduction for topographical purpose by the Survey Department<sup>12</sup>. Unless the old maps were really accurate when made it is a mistake to attempt to retain and correct them. When really good maps have once been provided no re-survey should hereafter be necessary in tracts unaffected by the action of streams the spread of ravines, unless great extensions of cultivation and changes in field boundaries have taken place by the introduction of canal irrigation.

**35. Testing of old maps.** - It will be well to note some of the tests which can be applied to the old plane table survey maps. One of the best is to see whether the *patwari* with the map in his hand can or cannot register the crops with ease and accuracy. If he finds it impossible or very difficult to make it the foundation of *girdawari* work, it is better without more ado to prepare a new map on the square system. Even though the old one is drawn pretty accurately to scale, its correction would under such circumstance take a long time and it is better to have a really good map as the basis of future operations than a patchwork of old and new measurements. If the old map was incorrect from the first to any serious mind on this point a Settlement Officer can apply several tests. The maps of adjacent villages should be compared to see if the boundaries dovetail,

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<sup>12</sup> In Peshawar Mr. L.W. Dane reduced his own field maps, which were on a scale of 24 inches to the mile to the scale of 4 inches to the mile. One copy of the reduced map of each estate was filed as an index to the *shajra*, another was put in the village notebook. The reduced village maps were combined into assessment circle maps. Copies of these circle maps containing all the topographical details required by the rules were sent to the Survey Department to be utilized in preparing a new survey map of the district (Dane's Settlement Report of Peshawar, paragraph 38). Compare paragraph 2 of the Government of India. Revenue and Agricultural Department No. 352-365-2, dated 11<sup>th</sup> February, 1899, in Punjab Revenue Proceeding No. 84 of February, 1899.

and test lines can be drawn across the map connecting well marked points, such as tri-junction platforms, and the results of chaining along these lines noted. If the total length as chained and as read off scale from the old map, and also the distance between the field intersection compared in the same way, agree very closely, and the result of carrying the chain right to left along sides of some of the fields traversed by the test line is satisfactory, the map is probably a good one. Or squares may be laid down on the ground and marked on the map, and tests noted by Mr. Francis in Appendix III of his Manual applied<sup>13</sup>.

**255. Boundary disputes.** - Section 101 of the Land Revenue act gives a Settlement officers power to define village boundaries. Fortunately boundary disputes are now rare except in the case of estates subject to river action. The subject of boundaries and of riverain custom is dealt with fully in the Administration Manual<sup>14</sup>. A Settlement Officer must remember that in the case of a boundary dispute between a British Village and an estate lying in the territory of an Indian chief, he can only investigate and report his opinion to the commissioner of the division. Recent orders of Government require that -

"Where a regular settlement is in progress along the boundary line of an Indian State due intimation of the fact will be given to the State by the Commissioner of the division in which the operations are being carried on. This intimation will be to the effect that survey operations along the boundary will be presently undertaken, and that the Settlement Officer will give due notice of the date when the measurement work in each estate will actually approach the boundary, and it will contain a request that the necessary orders may be issued to the proper State officials to be present both when measurements are being made, and when it is desired to attest the boundary resulting from these measurements. It will also request that the names of these officials may be at once intimated so that the Settlement Officer may correspond direct with them in all unimportant matters connected with the subject in question. During the first stage of operations above mentioned it will usually be sufficient for the State *patwari* or *kanungo* or other subordinate revenue officer to be present. If during the progress of this accepted boundary line, the Settlement officer must first intimate the necessity to the State and obtain its assent, unless the work is done with the assent and in the presence of the revenue officials to be present. If during

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<sup>13</sup> See also Appendix XXI.

<sup>14</sup> Land Administration Manual, Chapter XII.

the progress of this accepted boundary line, the settlement officer must first intimate the necessity to the State and obtain its assent, unless the work is done with the assent and in the presence of the revenue officials of the state. On the occasion of the actual attestation of the boundary, an officer corresponding the rank of Tahsildar or Extra Assistant Commissioner should be deputed by the state, and in any special case in which the Settlement Officer himself may think it desirable to be present an official of suitable rank should be sent to meet him. The procedure to be followed thereafter will be the same as that laid down in paragraphs 2 and 3."

The procedure referred to is as follows :-

"If an agreement be arrived at it will be carefully recorded by the revenue officials of the British district in the necessary papers which should always include a map showing the accepted line. The finding and the map should be attested by the officials on both sides. In cases in which no agreement can be arrived at, the proceedings will be submitted to the Commissioner. The Commissioner will make any enquiries which he may deem necessary from the British authorities and from the Indian State, and if the dispute is between a village or villages in his division and in an Indian State under his political control, will pass orders in the case. If otherwise, forwarding a copy of his report to the Deputy Commissioner and to the proper officer of the Indian State concerned. It will be open to the Darbar to make any representation which it may choose to prefer to the Punjab Government on the subject of this report, if it should consider it necessary to do so. But such representation should be made within sixty days of receiving the report and the Deputy Commissioner will during the same period, if he thinks it necessary to do so, make any representation which he may consider necessary through the Commissioner. If neither an Indian State nor the Deputy Commissioner take action as above indicated within sixty days on which the Commissioner's report is received, it will be taken that the boundary proposed by the Commissioner is accepted and the matter will be held to have been finally settled."<sup>15</sup>

**256. Procedure in case of complete re-measurement.-** The existing instructions as to the procedure to be followed by *patwaris* when complete re-measurement of a village takes place will be found in Appendix VII. The directions given there as to soil classification should be compared with the remarks on the subject in the next chapter.

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<sup>15</sup> Punjab Government Circular No. 25, paragraphs 3 and 4.