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**TRANSECT WALKS
TO DO MEASURE
ACTUAL LAND USE**

1. PURPOSE OF THE SURVEY

- 1.1 A rapid assessment system is required to measure crop areas and total cropped area by season in irrigated schemes constructed by the BMIADP, before and after improvements to the irrigation system. There are 42 schemes, and there are not sufficient resources to carry out conventional ground survey of all of these. The transect system will allow the crop area to be estimated quickly and with sufficient accuracy to allow the impact of the BMIADP on area to be estimated.

2. DESCRIPTION OF METHODOLOGY ADOPTED

- 2.1 The system is based on carrying out transects of cropped blocks within a notional grid. This is done by carrying out transects across the blocks at fixed intervals, and taking observations along each transect at fixed intervals. For example transects can be taken every 100 metres, and observations made every 20 metres along the transect.

- 2.2 The system depends on the notional grid being maintained accurately. This means that care is required in measuring angles and the distance between observations and transects. Care is needed to ensure that all the cropped areas in the catchment are identified and surveyed. This may need a local guide.

3. BASIC FIELD TECHNIQUE

3.1 Definitions

- 3.1.1 The command area is the whole of the area where water from a scheme will be used. It may consist of more than one block of land. It is possible for the command area to change, if for example, a new canal is built.

- 3.1.2 The cropped area is the area on which crops are planted at the time of the survey intended for harvesting in the season being measured. Thus crops left over from the previous season and new plantings for the next season are not part of the cropped area. They can be recorded but it must be clear that they do not form part of the cropped area being measured. Perennial crops are part of the cropped area even if no harvest is expected in the season being surveyed.

- 3.1.3 A block is an area of cropped fields that form one unit, and which will be measured with one set of

transects. It may contain fallow fields, and the crop may not be continuous.

3.1.4 A field is an contiguous area of land with a recognised boundary, belonging to one person. A plot is part or all of a field on which the same enterprise is being undertaken.

3.1.5 The transect distance is the distance, in metres, between one transect line and the next. It is also the length of the notional grid on which the transect survey is based.

3.1.6 The observation distance is the distance, in metres, between one observation and the next. For practical reasons this will normally be 20 metres.

3.1.7 The observer is in charge of the survey, takes compass bearings and records observations.

3.1.8 The rope man is responsible for measuring the distance between observations and moving the rope.

3.2 Staff required

3.2.1 The work is possible with two people, but much easier with three, as observing angles whilst holding a moving rope is difficult and slow. The work will take some three days per scheme, and involves walking ten to twenty kilometres.

3.3 Equipment required

3.3.1 Equipment required are:

- a rope marked at 20 meters and 25 meters
- a compass capable of reading bearings to under one degree
- a random number table
- a set of record forms
- a pencil

Extra equipment that may be used:

- 3 surveyor poles
- a 30 metre tape
- a Dumpy level or plane table and tripod

3.3.2 The rope should be easy to handle and not easily stretched. It is best marked by inserting large key rings as required. These can be moved if the rope

changes length in use. The rope should be checked against the tape before each days work.

3.4 Timing of survey

3.4.1 Only what is observable can be recorded. The timing of the survey is, therefore, critical, and for crop areas must be after germination and before the crop is removed from the field. It is possible to measure wheat acreage after harvest, as the stubble is easily identified. Perennial crops can be measured at any time.

3.4.2 A note of the cropping calendar for each survey scheme should be made during the first visit, and the optimum dates for transect surveys estimated. This can best be done by talking to local farmers.

3.5 Identifying the command area

3.5.1 The command area must be identified on the first visit to the scheme, and a sketch map of the boundaries prepared to assist in subsequent surveys. Suitable maps may be available from the design documents of the scheme, and these should be used where possible. Identifying the command area may need the help of a local guide, especially if the cropped areas are scattered.

3.5.2 When identifying the command area ensure that the local authorities and leaders are aware of the survey, and agree to it being carried out. It may be best to hire at least one of the rope men from the area, as he will know the owners of the fields the survey will cross.

3.6 Identify cropped areas

3.6.1 Once the boundaries of the command area are known all the cropped land within it must be located. This may need the help of a local guide.

3.7 Decide transect distance

3.7.1 To get reliable estimates some 500 observations are required on each scheme. If the cropped area is small transects will have to be close together, if it is large they can be further apart. The transect distance for the first survey is given in the table at the end of this manual. In future seasons the transect distance should be based on the area measured the season before, adjusted if it is clear the area has changed. Table 1

gives suggested transect distances for selected cropped areas. As can be seen it is the same number of metres as there are hectares. This is because there are 10,000 m² in a hectare, and the observations are 20 metres apart. If we require 500 observations we divide the total area by 500*20, which is also 10,000.

Table 1 Transect Distances for given cropped areas.

Cropped Area		Transect distance (assuming a 20 metre observation distance)
Hectare	Acre	Metres
10	25	10
50	124	50
100	247	100
150	371	150
200	494	200
250	618	250
500	1236	500
1000	2471	1000

- 3.7.2 The transect distance should always be a multiple of 20 or 25 metres, which are easy to measure with the rope.
- 3.7.3 Areas of less than 25 Ha would be better measured by using a chain and compass or plane table to measure each plot, as this will be quicker than the transect method. There is little point in using a transect distance of less than 50 metres.
- 3.7.4 The transect distance and observation distance must be recorded on the field form. They are the basis of area estimates.
- 3.8 Decide transect direction
- 3.8.1 The transects will be easier to carry out if taken across the block, rather than along it. Transects will be undertaken in parallel lines on each block, and the transect distance will be measured at 90° to the transect direction. As the second transect is undertaken in the opposite direction to the first it will be necessary to use the back bearing, which is 180° from the first bearing. Whilst any set of bearing could be used for the transects it will be easier to stick to the cardinal points. Transects will be either North/South or East/West, depending on the layout of the block. If, for some reason, these are impossible then an alternative direction can be chosen. In this case write down the bearing, the back bearing and the bearing for the transect distance.

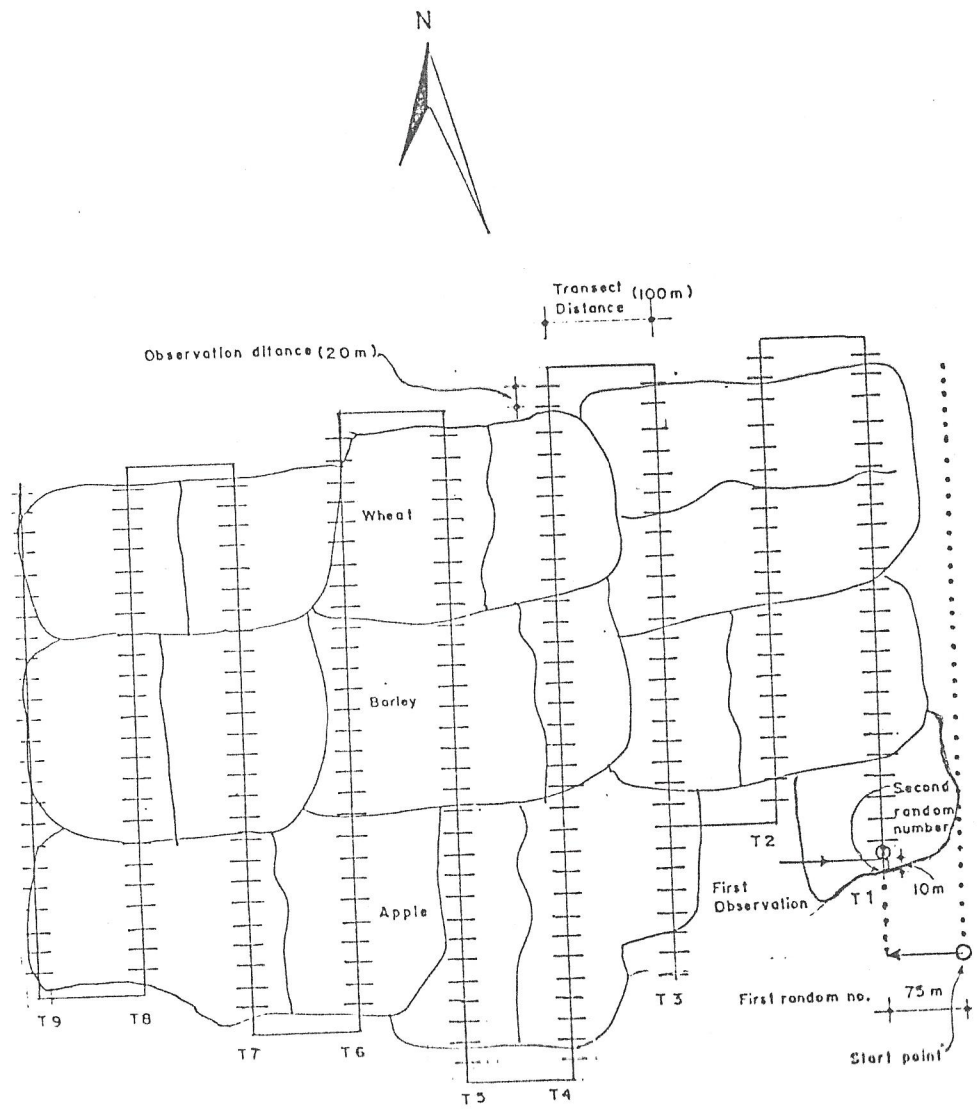
- 3.8.2 If transects are North/South the transects will be taken on bearings 0° and 180° . The transect distance will be measured either due East, 90° or due West, 270° . 0° is the same as 360° .
- 3.9.3 If transects are East/West then the transects will be taken on bearings 90° and 270° . The transect distance will be measured either due North, 0° or due South, 180° .
- 3.9 Establishing the starting point
- 3.9.1 For each block a random starting point must be established. To do this move to one corner of the block, and to a point where you are on the transect bearing from the corner. In other word if you were to start a transect from this point you would not cross any of the block.
- 3.9.2 The starting point for the transects is selected using two random numbers selected from a random number table. The first is between 0 and the transect distance, and the second is between 0 and 20. These must be recorded on the field form.
- 3.9.3 Measure the distance of the first random number in metres from the position at the corner of the block. in the direction if the transect distance. Then move to the boundary of the block along the transect direction and measure the second random number in metres into the block. This is the first observation point. The distances can be measured with the rope, and pacing out if they are small.
- 3.10 Taking observations
- 3.10.1 The observer stands on the random start point, indicates the direction of travel, and the rope man takes end of the rope till it is stretched. The observer than adjusts the position of the rope man till he is exactly on the transect bearing. The features of interest are recorded. The observer moves to the rope mans position and repeats the process until the whole cropped area has been crossed. The work is a little quicker if the position of the observation is marked on the ground, so the second rope man can find it easily. This can be done with a stick, marking the ground and putting a pulled up weed on the spot.
- 3.10.2 Using the compass requires some practice, best done before starting work. The bearings must be taken along the rope, and to half a degree. This is best done by standing in front of the rope man and taking the bearing to the middle of the second rope man. It is

much easier to take bearings from the first observation point, which is fixed, to the second. The second rope man should be asked to move until exactly on the transect bearing. Allow the compass time to settle and stop swinging.

- 3.10.3 On a long transect it is possible for the rope man to select a natural feature, usually a point on the ridge line, as a transit mark, and keep very close to the true bearing, which speeds up the work. The observer can also use a transit mark to help keep a steady bearing. The compass **MUST** be used to check every observation, as the accuracy of the survey depends on this.
- 3.10.4 Observations can be made of any feature of interest, such as crops, bunds, ditches, roads, wells, soil type, slope, aspect, irrigation method, planting system, crop arrangement, crop condition, stage of growth, plant density, soil preparation as flat, ridged or mounded, pests, weeds and in deed any item that can be observed.
- 3.10.5 For the transect survey the ground cover at the point of observation will be recorded. This can be the crop, fallow land, bunds and other structures or uncultivated land. In a close planted crop, like wheat or sorghum, record the cover within a metre of the point of observation. In orchards record the enterprise in the plot, for example "apples and plums with alf alfa".
- 3.10.6 The source of water at each observation point will be recorded. This is to try to separate project impacts from other sources. The source of water can be project supplied canal, other supplied canal, run off, tube well or several sources. If it is not possible to identify the water source by observation record unknown.
- 3.10.7 Always remember that you are on someone's land, and take care not to damage the crop. Remember you will be back again next season. Damage from the rope is small if the rope men keep close to the line of the transect and avoid dragging it across the crop.
- 3.11 Subsequent transects
- 3.11.1 The second transect is started at exactly the transect distance from the first, at exactly 90 degrees to the transect direction. This is also measured with the compass and rope. The second transect is observed in the opposite direction to the first. Transects are continued until all the cropped block has been covered.

- 3.11.2 Observations are NOT recorded along the transect distance, which would normally be outside the block.
- 3.11.3 The number of field boundaries that are crossed between transects must be counted and recorded under Boundary No. on the field form. If no boundaries are crossed between transects record 0. These data are required to estimate the sampling fraction of the survey.
- 3.11.4 Measuring the transect distance will require several measurements with the rope. For a transect of 100 metres then four 25 metre observations are required. It is very easy to forget the number done, so the observer should shout out the number of each. The rope men should check the number of measurements done is correct. If the transect distance is wrong so are the area estimates.

FIGURE 1 Sketch map of a transect survey.



3.12 Recording observations

3.12.1 At each observation point the ground cover should be recorded on the field form as described in 3.10.5. It will be easier to use abbreviations such as WM&O for Water Melon and Onion or W for Wheat. Record these in detail on the field form for each block surveyed, so there can be no confusion during analysis. If preferred you can use the crop codes from the Agro Economic Survey, but make sure you get them right!

3.12.2 The source of water should be recorded at each observation point. If the whole block uses one source you can record this on the form, and leave the individual observations blank.

3.12.3 In orchard crops the number of trees within a 5 m radius of the observation point are counted, to give an estimate of planting density. In addition the size of the trees within a 5 metre radius are recorded. Size is recorded as new planting, single stalk under head height, small tree under 3 metres, large tree over 3 metres, and closed canopy, all estimated by eye. Where there is doubt whether a tree is within 5 metres the rope can be used. If the trunk of the tree is inside the 5 metre circle it is counted.

4. SPECIAL PROBLEMS

4.1 Irregular blocks

4.1.1 If the block is irregular the transects will be of different lengths. This may mean that it is necessary to continue a transect over uncropped land, so as to start the next transect on the edge of the cropped area, or that the second transect may need to be taken in both directions from a start point located partly along it. This can be done by clearly marking the observation point located at the end of the transect distance, taking observations in one direction to the edge of the block, returning to the marked point and taking observations in the opposite direction to the other edge of the block. This is quicker than crossing uncropped land.

4.2 Small cropped blocks

4.2.1 If a block is very small, say under a hectare, it may be difficult to run the transect survey properly. In this case it may be better to measure the crops with a chain and compass or plane table.

4.3 High bunds and dense cover

4.3.1 High bunds can obscure the rope man from the observer, in which case the compass bearing can be taken from the top of the bund back to the start point and forward to the new point. The observer must be exactly on the transect bearing from the first observation point (using the back bearing), and can then locate the second observation point. The same technique can be used in thick orchard, where it is not always possible to see one observation point from another. The work is slower, but can be very accurate. It may be very difficult to conduct a transect in a tall close planted crop, like maize or sugar cane. Try to avoid these by carrying out the survey when they are still small.

4.4 Long transect distances

4.4.1 On a large cropped area, where the transects are several hundred metres apart it may be quicker to measure the transect distance with a dumpy level and stave. This will require an extra two labourers to carry the equipment.

4.4.2 The use of a ground wheel is not likely to be accurate enough for the transect distance.

4.5 Changing direction in curved blocks

4.5.1 Cropped blocks that curve around may mean that the initial direction of the transects becomes inconvenient. The direction of transects can be changed by marking the edge of the notional grid being measured, and starting a new series of transects in the new direction, measuring up to the edge of the previously measured area.

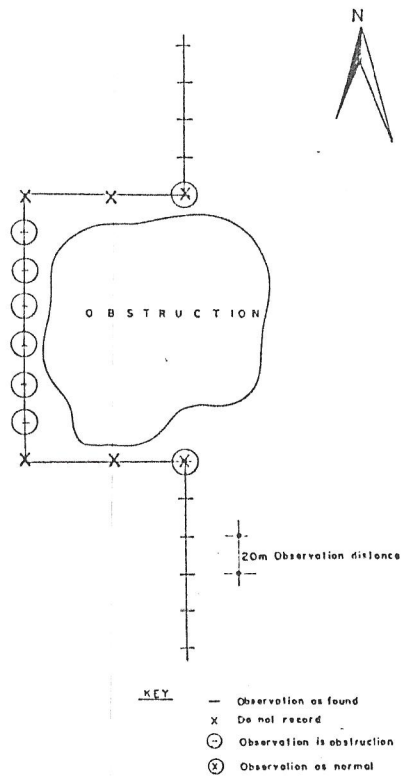
4.5.2 The edge of the notional grid is located parallel to the direction of the transit and at the transect distance less the random start point. Thus if the transects are 100 metres apart, and the random start point was 60 metres, the edge of the notional grid is 40 metres from the current transect line.

4.5.3 The edge of the notional grid can be marked with surveyors rods set at a considerable distance apart, using the compass to align them. If at least three poles are used it is always possible to identify the edge to the area already surveyed, by using the transit of the poles. They should form a straight line.

4.6 Obstructions

4.6.1 Small obstructions can be overcome by stepping the transect around them, moving the transect a fixed distance at 90 degrees to the direction of the transect, and then back again once the obstruction is passed. The observations made are, of course, those that would have fallen in the obstruction if the transect had been continued, NOT the points on the shifted transect.

FIGURE 2. Stepping around obstructions



4.6.2 Large obstructions may require taking observations in two separate blocks.

4.7 Very regular plots

4.7.1 If plots are very regularly laid out there may be a problem with fixing each transect the same distance apart. For example if the cropped area was designed with field bunds at the transect distance and arranged in a north south grid, then should the first observation be on a bund, so, by definition, would all subsequent observations, and a highly biased sample would result.

4.7.2 If the plots are very regular the start point of each transect should be randomised. This is done selecting a random start point for the first transect in the normal way, and recording it. At the end of the transect identify the edge of the first transect grid, which will be the transect distance less the first random number. From this point select a new random number for the start point of the next grid. Repeat this for each transect carried out. Thus the block will still be divided into a notional grid, giving the total area, but the transect lines will be a random sample, not a systematic sample.

4.7.2 If there is any suspicion that the layout of the plots is causing bias with fixed transects the randomised method should be used, as it does not involve a great deal more field work.

4.8 Missing or unidentified crops

4.8.1 It may happen that a survey has to be undertaken when some minor crops have yet to be planted or are already harvested. Vegetables will be a common problem, as some of them have a short growing season. In some cases there may be residues by which the crop can be recognised, like wheat stubble. In other cases the crop may have left no trace. If it is suspected that crops are missing then local advice should be sought on the likely area. If it is a high proportion of the cropped area the survey should be abandoned. If it is small the errors will not be serious. If local labour is hired for the rope men they may be able to recall the crop on the field being observed, and this can be recorded. In other cases the farmer may be in the area, probably to see what you are doing!, and you can ask him. Always try to get the observations as accurately as possible.

IADP schemes selected for crop area transect surveys.
 commended transect distances for the first survey.

12-Jun-91

Scheme	District	Comm Date	Altitude (Feet)	Irrigated Area (Acre)	Total Cropped Area		Transect Distance	
					Khariif (Acre)	Rabi (Acre)	Khariif (Metres)	Rabi (Metres)
BAT	Khuzdar	May-91	4500	373	19	101	*	40
Abdul Raman	Khuzdar	Mar-88	4400	100	5	27	*	*
Chhogi	Zhob	Dec-87	6500	450	70	165	25	60
Ch	Las Bela	Jun-91	518	230	36	44	20	20
Pir	Las Bela	Jun-92	900	1440	145	220	50	75
	Loralai	Sep-90	6750	602	272	520	100	200
SI	Las Bela	Mar-92	220	200	51	17	20	*
Shah Murad	Zhob	Sep-90	6000	70	17	22	*	*
Yazai	Loralai	Dec-92	3100	420	0	240	0	100
Jeji	Kacchi	Jun-92	300	2684	219	370	80	150
Jjak	Sibi	Dec-92	470	2929	435	946	175	375
Mehtarzai	Zhob	Apr-90	7400	446	322	324	125	125
Morgha	Pishin	Dec-89	5200	397	93	235	40	100
Yaza	Zhob	Aug-92	4500	1132	510	756	200	300
IGRI	Loralai	Jun-92	4100	275	33	59	*	25
Yazai Tor Khula	Zhob	Jun-92	4500	1170	64	22	25	*
IL	Loralai	Dec-91	3400	612	13	276	*	100
Bargh	Loralai	Nov-92	5500	1310	125	325	50	125
Sura	Pishin	Nov-90	6500	200	NA	NA	100	100
Khanzai	Zhob	Aug-90	4750	98	NA	NA	50	50
Gori Matwarch	Loralai	Dec-92	4700	1140	148	366	60	150
Mbai Manda Kareze	Pishin	Nov-91	5200	530	107	283	40	100
i Viala	Loralai	Apr-92	3400	1409	259	608	100	250
rik	Zhob	Dec-92	4500	936	35	179	*	75

Where the transect distance is marked *
 either measure the area directly or use a
 transect distance of ten metres.

Where there is no cropped area no survey
 need be undertaken.

Balochistan Minor Irrigation & Agricultural Development Project
 Field form for grid transect survey

Scheme EXAMPLE Block SEE FIG 1. Date 13/6/91
 Transect Distance 100 Random number Transect 75
 Observation distance 20 Observation 10
 Transect direction N/S Page 1 of 1

O b s e r v	Transect No. 5 Boundary No. 1	W a t e r	Tree		O b s e r v	Transect No. 6 Boundary No. 1	W a t e r	Tree	
			N u m e r	S p e c i e s				N u m e r	S p e c i e s
1	NOT CULT	ALL FROM scheme canal			1	NOT CULT	ALL FROM scheme canal		
2	FALL				2	NOT CULT			
3	F				3	NOT CULT			
4	F				4	BUND wheat			
5	F				5				
6	F				6	W			
7	F				7	W			
8	F				8	W			
9	F				9	W			
10	F				10	W			
11	F			11	Barley				
12	F			12	B				
13	F			13	B				
14	BARLEY			14	B				
15	B			15	B				
16	B			16	B				
17	B			17	B				
18	B			18	B				
19	B			19	B				
20	B			20	B				
21	B			21	APPLE		2	CC	
22	B			22	A		2	CC	
23	WHEAT (HARVESTED)			23	A		1	CC	
24	W (H)			24	A		3	CC	
25	W (H)			25	A		2	CC	
26	W (H)			26	A		2	CC	
27	W (H)			27	A		3	CC	
28	W (H)			28	A		1	CC	
29	W (H)			29	A		1	CC	
30	W (H)			30	NOT CULT				
31	W (H)			31					
32	NOT CULT			32					
33				33					
34				34					
35				35					

(CLOSED CANOPY)

F = FALLOW
 B = BARLEY

