An introductory manual for Community Based Organisations, Researchers, Activists and Engineers.

Field Methods in Participatory GIS

R. S. Bhalla and Benjamin Larroquette

January 2004

Foundation for Ecological Research, Advocacy and Learning

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Overview

This manual is comprised of four parts, the first deals with a range of field survey methods. Many of these will be familiar to engineers and hydrologists, but some will not. Part two comprises of applications of these methods in participatory surveys, for which we use the term Geo-PRA. This part will be familiar to the activists and NGO workers, but again, some techniques will be new. The manual is designed to be part of the basic course on GIS. GIS provides the framework for the organisation of the data and storage of the spatial information that is collected during field surveys. Part 3 deals with precisely this and therefore is irrelevant for those using it as an independent text. The final part of the manual is the appendix which contains various examples, exercises and data-sheets. This may be the most important part of the manual. All the data-sheets contained in the manual are provided as soft copies along with the exercises. Most of the exercises that will be run as part of the manual will be done with the examples in the exercise section. All these are in OpenOffice format.

This manual is not a text on participatory methods, often referred to as ``PRA techniques''. Participatory tools and methods are a fast subject on which there is sufficient literature. Here we attempt to add value to some important PRA techniques by integrating them with GIS and geo-referencing the spatial information they contain. Specific advantages of this approach are:

- Techniques for field surveys covered are accurate and to scale.
- Geo-referencing the maps allows them to be related to other maps (neighbouring villages for example).
- The data is stored on a relational database facilitating retrieval.
- Once on a GIS, the data is cumulative in nature allowing you to build up a large database over time.
- GIS and databases allow you to filter data according to your requirements. These “themes” can be used for a range of purposes, from planning to evaluation of com pleted works.

Version information

This is version 1.1 of the Field Methods manual. Subsequent versions of this manual will cover additional techniques, some dealing specifically with bio-assessment and sampling for students of ecology and environment science. We also expect to cover additional participatory techniques and social survey methods in subsequent versions.

Field Survey Methods

Overview

In this section we cover three kinds of survey techniques and instruments used for field surveys.
These are:

Table 0.1.: Survey techniques and their applications.

Survey Technique	Equipment Used	Applications
Elevation surveys	Dumpy or Sight Levels	1. Preparation of plans and estimates. 2. Rapid surveys for two dimensional mapping.
Compass traverse	Compass and metertape.	1. Transect walks and walk-throughsurveys. 2. Social mapping.
GPS assisted mapping	GPS, computer	1. Rapid surveys for two dimensionalmapping. 2. Geo-referencing maps.

Using the Sight Level

The sight level, also known as the Dumpy Level or Automatic Level[1] is among the most commonlyused survey tools. And for a good reason. A good surveyor can create highly accurate maps using a sight level. While laser range finders and total stations can make the process faster and more accurate, knowing how to use a sight level is a fundamental requirement for field surveys.

There are three basic things that you need to know in order to use a sight level.
- Setting up the level
- Taking measurements and
- Conversion field data into x, y and z coordinates

You will need some practise before you feel comfortable with the sight level as a survey instrument. However, once you get the hang of it, you will find it remains one of the cheapest and most accurate survey instruments available.

Note: It is not uncommon for a surveyor completing a few kilometres of survey and ending with an error of a few decimetres.

Parts of a sight level

The various parts of a sight level are shown in figure 01. Here is a brief description of each.

View finder:
This is the most prominent part of the instrument and consists of an eye piece, a prism, and a lens. This is what you see through. You often need to focus the view finder by using the screw next to the eye piece so that the cross wires are clearly visible.

Focus knob:
This is a screw to the right of the view finder which helps you focus the stadia rod. The focus changes as your assistant moves around and you may need to use it fairly often.

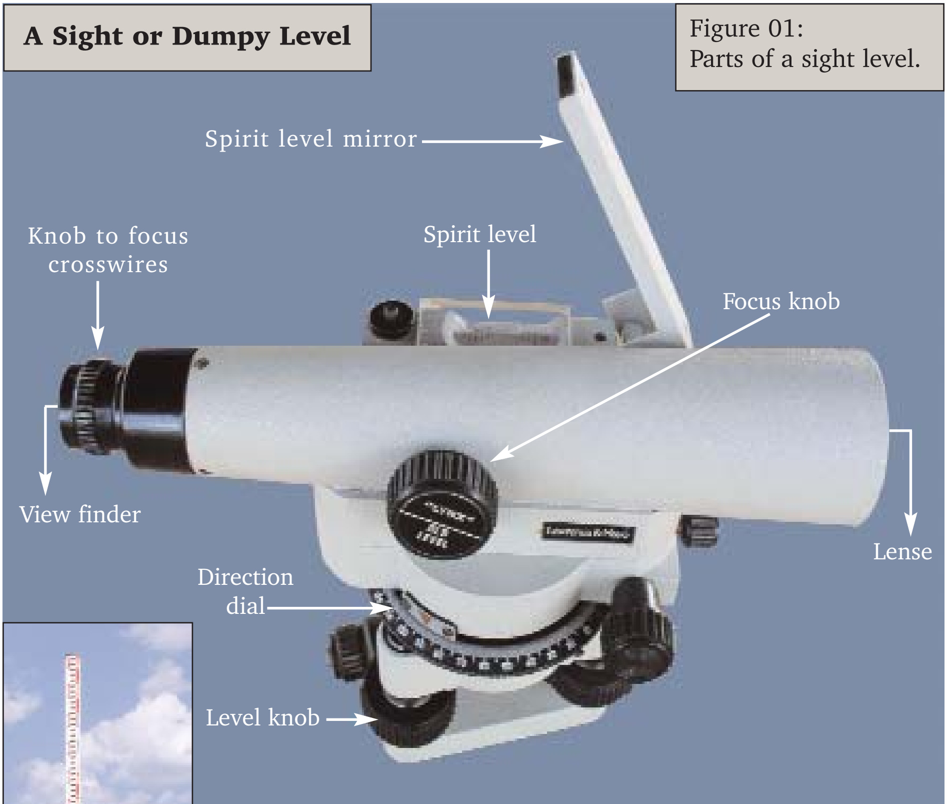
Degree scale:
This is a circular scale, normally at the base of the view finder. It rotates when twisted. You will need to set this each time the setup moves.

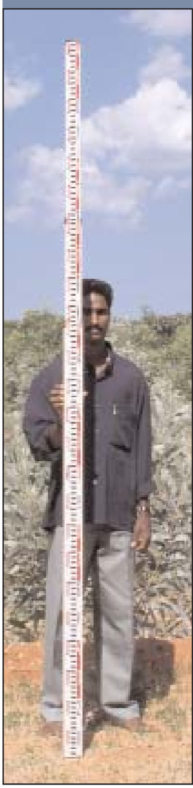
Fixing screw:
This is a small screw that allows you to fix the view finder so that its circular movements are constrained.

1. This is a more “advanced” instrument, capable of re-setting its level automatically.

A Sight or Dumpy Level

Figure 01:
Parts of a sight level.





◂ Stadia rod

Tripod ▸

▴ Compass

Setting up a sight level

The sight level is actually a combination of four instruments. These are

1.The view finder or sighting instrument.
2.The tripod stand on which it is mounted.
3.The staff gauge or stadia rod, from which the readings are taken and finally.
4.A compass.

Many sight levels do not come with in a built in compass and you will probably need

> Note:
> Setting up the sight level is the most crucial part of the survey. Any mistake here will lead to inaccuracies during the survey which could be serious enough to have to re-do the entire exercise.

to use a separate instrument for the purpose of surveying.

To set up a sight level you need to perform the following tasks.

Placing the instrument

Place the tripod firmly and mount the level so it is more or less horizontal to the ground. Ensure the sighting instrument is at a convenient hight, not only for the observer, but from the standpoint of the survey. For example, if you are going to be surveying up hill, the sight level should be high enough for you to take a substantial number of observations. If it is too low, you will only be able to take a few sightings and will have to move the setup repeatedly, making the calculations cumbersome and the results more inaccurate (figure 02).

Setting the spirit level

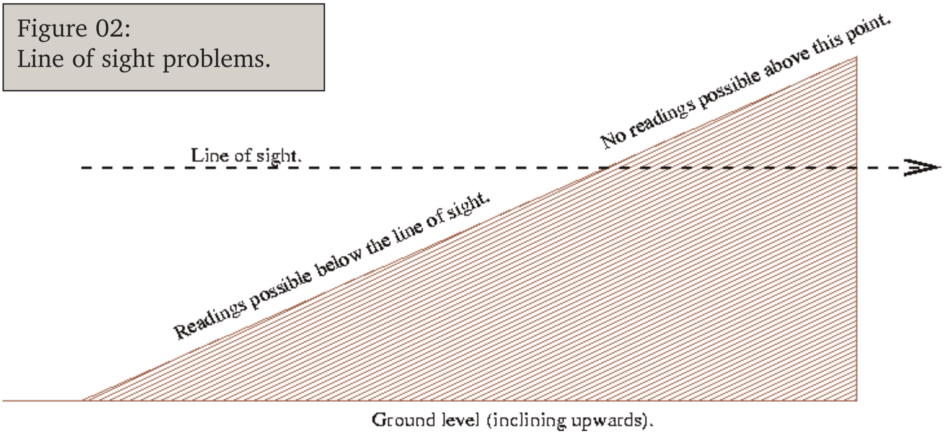
Use the spirit level which is built into the sight level to ensure it is exactly horizontal. This involves a bit of a skill, but is easily acquired. The fundamental trick is:

• First place the sight so it is parallel to two of the level screws, get the air bubble to the centre of the spirit level.
• Rotate the sight 90 degrees and use the level screw under the eye piece to re-adjust the spirit level.

You may have to repeat this exercise a few times to get the desired result.

> Note:
> Test whether the spirit level remains in the centre at all angles by rotating the view finder. If it doesn't your settings are not correct. Fix them before continuing.

Figure 02:
Line of sight problems.



Setting the compass

Set the compass calibration on it so that due North shows up as 0° or 360° . To do so you need to follow these steps.

- Place yourself (with a compass) so that the instrument is between you and the stadia rod.
- Direct (by seeing through the compass) the person with the stadia rod to move about 20 to 30 meters away so that he/she is exactly north of you and the sight level is exactly between you and this person.
- Go to the sight level and rotate it so that it is pointed at the stadia rod.
- Go back again and re-check whether the sight level is exactly between you and the assistant. If there is an error, direct him/her to move accordingly.
- Set the sight level again. Repeat this until you are sure that the stadia rod is exactly north of the sighting instrument.

Once you are satisfied with the position, set the degree scale to zero. Hereafter, each reading you take will be in relation to due North. This is shown in figure 03.

Note:
You can chose any angle you like, simply ensure the compass and the sighting instruments scale are in agreement. Remember you have to re-orient your set up each time it is moved.

Starting the survey

In normal circumstances, it takes between 5 to 10 minutes for the set up to be organised. Once this is done you might want to jump into the action. Wait! Remember the rules for field surveys.

Do you have the following?

- A format for writing down the data (data sheet).
- A pencil (not a pen) for noting down the observations and an eraser to correct mistakes?
- A camera or diary to note down “metadata” about the site.
- Maps of the area. Topographical maps are ideal but cadastral map will do fine.
- A GPS unit for getting the benchmark coordinates or other coordinates (this is optional though desireable).

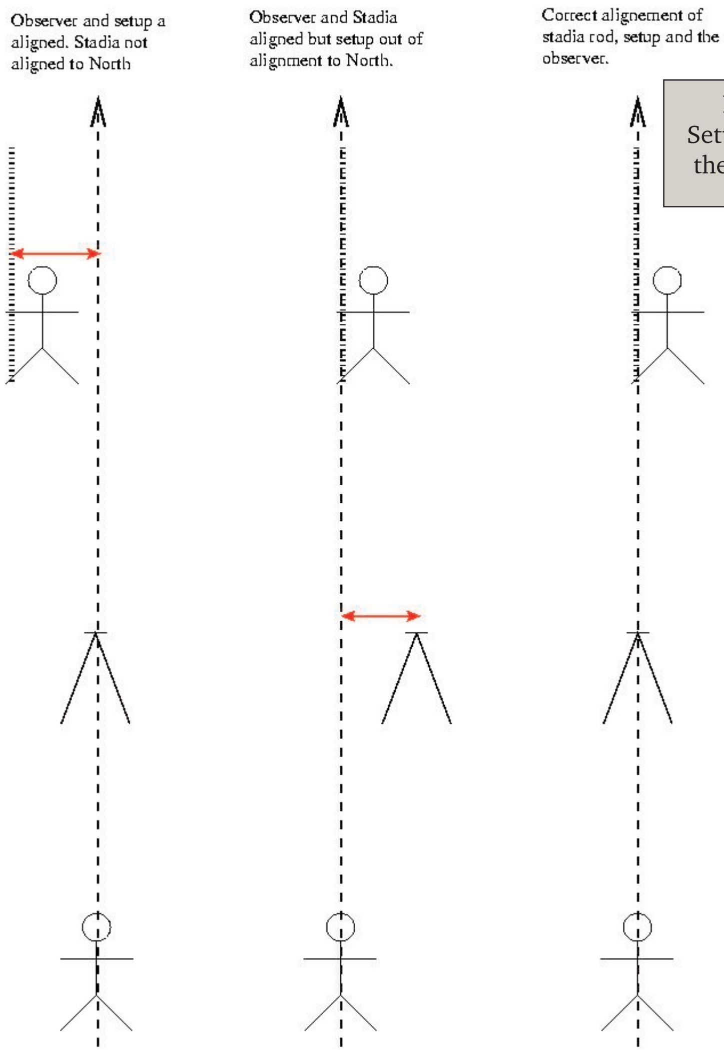


Figure 03: Setting North on the Sight Level.

Data sheets
Appendix 01. has a sample datasheet. You need to devise your own - as per the requirements of your survey. Basically a datasheet contains pre-formatted columns which need to be filled during the survey. Datasheets serve two purposes.

1. Provide the person entering the data a convenient place to write.
2. Ensure that all required information is recorded - good datasheets remind the surveyor of the observations she needs to make.

In addition to the datasheet you should maintain a field diary and mark on the maps your approximate location. Another important thing to remember is to make a free-hand sketch of the area being surveyed. This can be the crucial reference for you to get your bearings while entering data or re-visiting the site.

Benchmarks
Benchmarks are permanent or semi-permanent locations which act as the base reference for your survey. They are a fundamental requirement of any survey and serve the following purposes.

1. They provide the "basic coordinates" off which the rest of your survey is done. This coordinate may be arbitrary or you might use a GPS (later perhaps) to get the exact x, y and/or z value. Normally one sets the benchmark to the x,y and z of 0,0,100.
2. They are needed to calculate "closing errors" which tell you how accurate your survey has been.
3. They can be used by subsequent survey teams who might want to re-do a survey or position themselves on the map you created.
4. They are prominent structures and serve as landmarks.

The very first reading you make when you begin a survey is that of the Benchmark. Later, when you analyse the data, you will re-calculate each reading with reference to the benchmark.

Measurements
There are three coordinates that you measure in a field survey. In some cases you may not be interested in the z coordinate which provides elevations. However, this does not change the data you collect during the survey.

There are four readings you need to record during the field survey:
- Compass bearing
- Top reading
- Middle reading
- Bottom reading

The last three are the readings of the stadia rod at the three cross hairs on the view finder (figure 04).

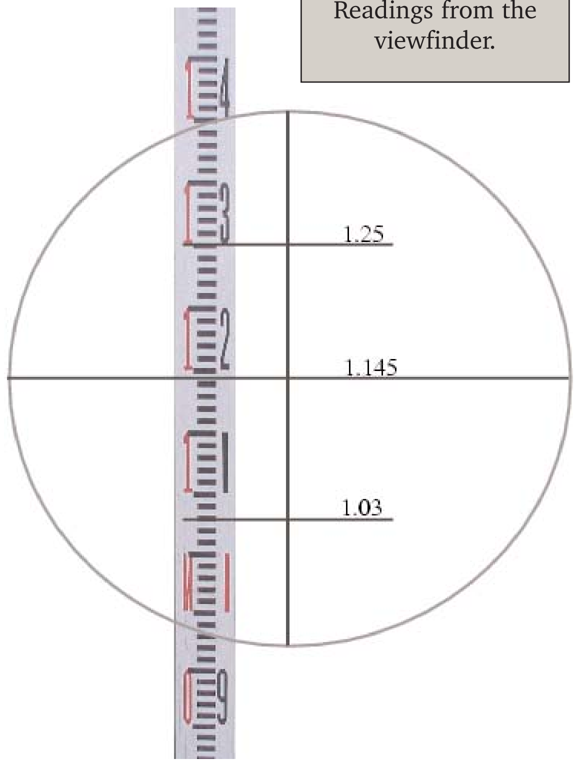


Figure 04:
Readings from the viewfinder.

Figure 05:
Example of a spreadsheet.

	A	B	C	D	E	F	G
1							
2	Station	Back sight			Location of	Instrument	
3		X	Y	Z	X	Y	Z
4							
5	BM1	-13.16	4.79	1.39	13.16	-4.79	1.39
6	1						
7	2						
8	3						
9	4						
10	TP1	9.06	7.87	1.34	-7.05	7.46	1.1
11	5						
12	6						
13	Close						
14							

Stations
There are two kinds of stations (STA) that indicate the kind of reading being taken. The data sheet must indicate a column where the surveyor enters the station being measured. In addition the surveyor needs to note the serial numbers of the different stadia locations.

Turning points (TP)
These are the locations where you move the setup to as you go along the survey. Moving the setup is unavoidable in most circumstances, however you should try to minimise the number of turning points (TP) during the survey which is done simply by choosing each setup carefully. Each turning point involves a fore sight and a back sight - this is crucial because the height of the instrument can only be calculated if both values are present.

Backsight (BS)
This is the reading taken from the station to the previous point surveyed or the Benchmark. This provides you with a reference with which y ou relate the position of the station with that of the benchmark.

Foresight (FS)
This is the reading taken from the station to each point being surveyed using the stadia rod.

Benchmarks (BM)
These are measurements taken to the benchmarks from the instrument.

Coordinates of the instrument (I)
This is simply a serial number for the various foresights taken between one TP and the next.

Analysis and plotting
We use a spreadsheet program for calculating the x,y and z coordinates of the survey. A search on the web will provide you various software which does the same, however, we suggest you figure out how to calculate the coordinates yourself.

Figure 05 is a screen capture of the spreadsheet I used to calculate the coordinates. We have provided an OpenOffice-Calc file called datasheet.sxc (*http://www.feralindia.org/downloads/datasheet.sxc*)which does these calculations automatically. To use the spreadsheet, you simply need to enter the raw data in provided columns and change the cell references for each turning point (TP).
When mapping using a sight level, you need to do three sets of calculations:

- The coordinates from the raw data (x, y and z of each location).
- The calculation of the x and y coordinates with reference to the bench mark.
- The calculation of the z coordinates with reference to the benchmark.

Calculating the coordinates from the raw data

The data collected during the survey consists of the following readings:

- Angle in degrees.
- Readings conforming to the top, middle and bottom on the view finder's cross hair.

We know from before that the distance to a point is calculated by the following formula:

*(bottom-top)X100** = *distance.* But if you look at the data you will also see that : *top-middle = middle-bottom* The difference between the top cross hair and the middle one is the same as that between the middle crosshair and the bottom one.

(top-middle)×2 = top-bottom = (middle-bottom)×2. Multiplying the difference between top and middle by two is the same as the difference between the top and bottom, which is also the same as multiplying the difference between the middle and bottom.

This is really useful for calculating errors in the readings taken and, where required, to substitute missing values.

Formula:

Here is the formula to do this calculation on OpenOffice Calc:= IF((P5-Q5) =(Q5-R5); "OK"; ""ERROR"). The letter P, Q and R are the columns for top, middle and bottom crosshair readings.

So we now have the distances and angles for each point. Let us now assume that the setup or instrument (I) is located at the centre of a graph sheet (the 0,0 coordinates). If we want to calculate the x and y coordinates of a point shown in figure the formule are : x = distance×sin(θ) and y = distancecos(θ). Now this works fine for the first quadrant, but when the readings fall in other quadrants, the signs on the formulae change. To have the computer do so automatically, we convert the degree readings into radians and use the following formulae instead: x = distance×sin(radians(θ)) and y = distance×cos(radians(θ)).

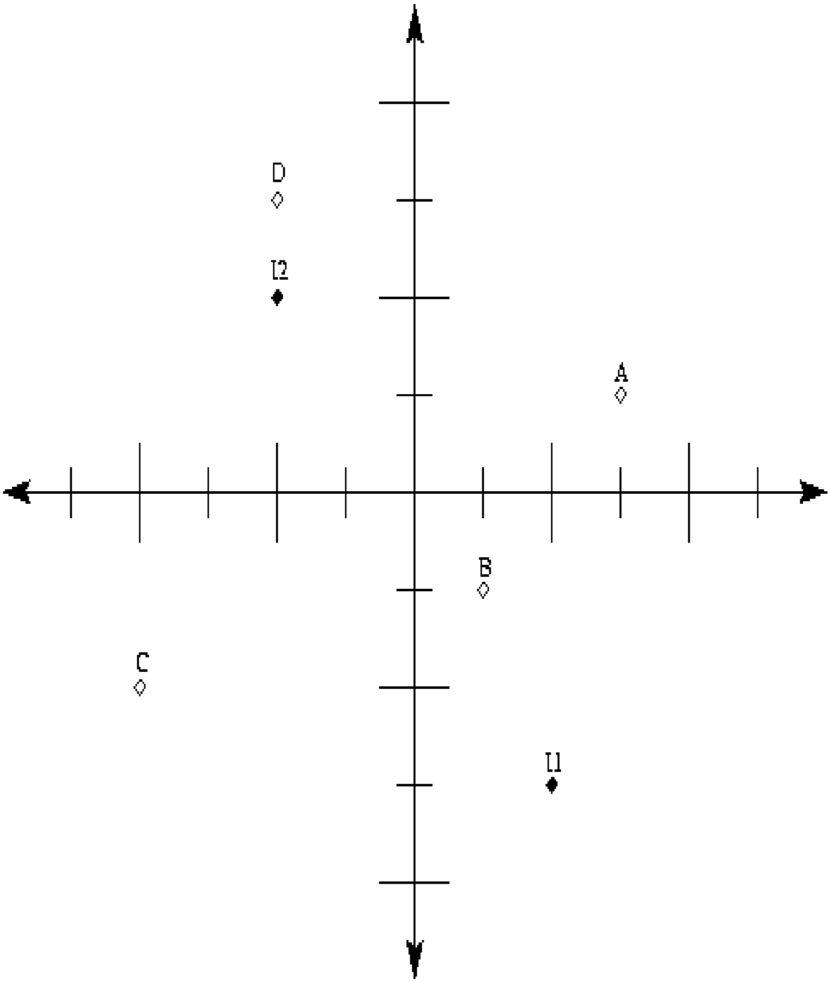
So now we have all the coordinates as x,y and z as seen from the instrument. Now we need to re-organise this data so that it provides us the actual x,y and z coordinates or as seen from the benchmark. To do so, we essentially need to re-reference the data in relation to the coordinates of the various setups (I) as seen from the benchmark. We will deal with the x and y coordinates first and then with the z coordinate or heights.

Calculating the x and y coordinates

Let us take the example of a graph sheet with the centre equivalent to 0,0. The coordinates of the various objects the figure 06. are as follows:

Let us now get the relationships between coordinates for each of these points from various references, i.e. the eyes of the viewer located at the benchmark (actual) and two instruments (I and I2). These have been provided in Table 02.

Figure 06:
Location of the points and instrument



distance = (bottom-top)X100
Generally the dumpy readings are multiplied a factor of 100, but it could vary across different brands. Please check dump specifications before applyiong the above formula

Table 02: Calculating X and Y

Stn.	Actual		From I1		From I2	
	X	Y	X	Y	X	Y
BM	0	0	-2	3	2	-2
A	3	1	1	3	5	-1
B	1	-1	-1	2	3	-3
C	-4	-2	-6	1	-2	-4
D	-2	3	-4	6	0	1
11	2	-3	0	0	3	-5
12	-2	2	-4	5	0	0

Actual Coordinates: The actual coordinates of the various points (A,B etc) in relation to the benchmark: *Foresight +Instruments coordinates.*
Instrument Coordinates: The coordinates of the instrument in relation to the benchmark: *Actual coordinates of point minus Back Sight.*

Calculating the heights
The first thing that needs to be noted about measuring heights is that what you measure in the view finder is the depth of the station. The lower down it is the higher the value on the rod. As long as you remember this the calculations involved are trivial. Let us now figure out the calculations for ourselves and generate the formulae for the spreadsheet.

The example is shown in figure 07 and the data for the same is shown in table 03. Here are the formulae that are utilised for the calculations (note the figures used in the calculations are readings and not actuals):

Actual height The height of the station (A, B etc.) in relation to the benchmark: *Instrument height- Foresight*
Height of instrument The height of the instrument in relation to the benchmark: *Real Z o f Foresight+Backsight*
Error: The maximum acceptable error: $0.007Xp \sqrt{(DistanceSurveyed/100)}$. This should be more than the actual error after closing the survey.

Now that the calculations are complete, you are ready to plot the data. The easiest way of doing so is to use the XY plot feature in your spreadsheet. The output of my data is presented in figure 08. Packages such as MapMaker Pro, and ArcView are able to read data directly off an excel spreadsheet or an XY or text file. The only step remaining then is to save the appropriate columns as XY files.

Figure 07:
Calculation of heights

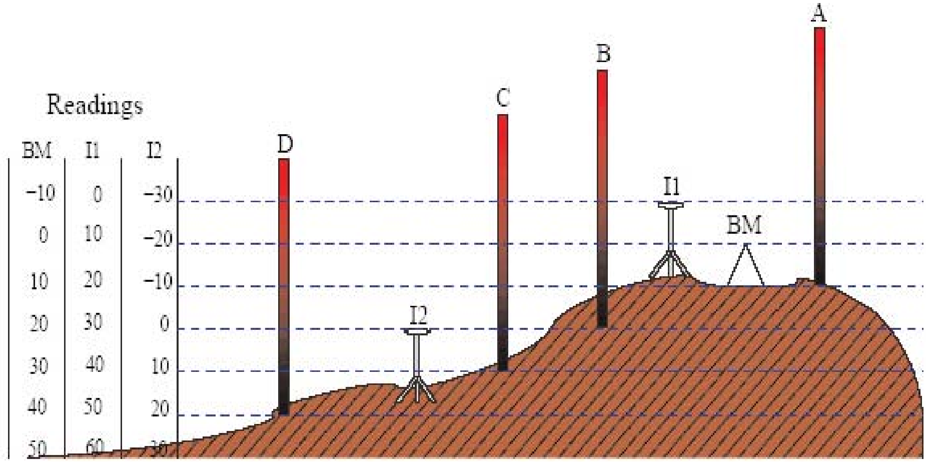
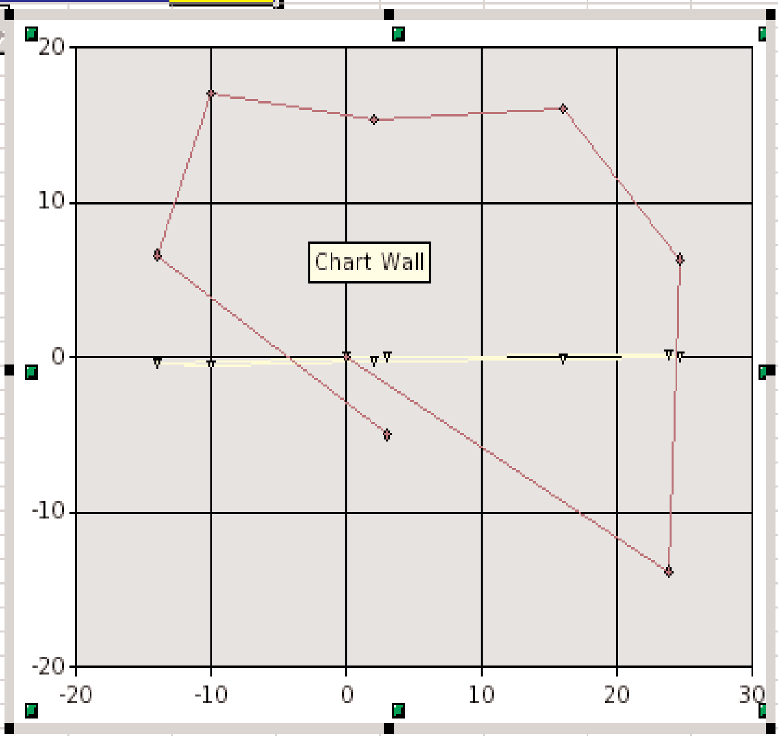


Table 03: Data for height calculations

Stn.	From BM		From I1		From I2	
	Reading	Actual	Reading	Actual	Reading	Actual
BM	0	0	10	-10	-20	20
A	10	-10	20	-20	-10	10
B	20	-20	30	-30	0	0
C	30	-30	40	-40	10	-10
D	40	-40	50	-50	20	-20
11	-10	10	0	0	-30	30
12	20	-20	30	-30	0	0

Figure 08: X Y plot

Actual Coordinates				Data Entry Area				
X	Y	Z	Distance	Angle	Top	Middle	Bottom	Is Error?
0	0	0	14	290	1.46	1.39	1.32	OK
23.88	-13.79	0.14	14	130	1.32	1.25	1.18	OK
24.67	6.33	0.03	16	46	1.44	1.36	1.28	OK
16.08	16.01	-0.14	21	8	1.64	1.53	1.43	Error
2.01	15.33	-0.24	23	331	1.75	1.63	1.52	Error
2.01	15.33	-0.24	12	49	1.4	1.34	1.28	Error
-9.98	17.02	-0.55	10	343	1.7	1.65	1.6	Error
-14	6.6	-0.42	7	263	1.55	1.52	1.48	Error
3.02	-4.98	0.01	16	141	1.19	1.09	1.03	Error



Compass Traverse

This is a very fast and easy to use technique for two dimensional mapping. However, unlike a sight level, a compass traverse is more prone to errors, particularly in undulating terrain. A compass traverse involves the use of a compass to read the direction of movement, and step counts to measure the distances. These distances are later converted to metres for standardisation and mapping.

Methods

A compass traverse involves five basic steps:

1. Take a compass bearing each time you change direction during your walk. If you start your walk in the centre of the village and move along, say a street, you are likely to change direction each time the street turns. Further, once you leave the built up area of the village, you will end up following footpaths, most of which are far from straight. All you need to do during a compass traverse is to try and travel in a straight line (and direction) until you have to turn. On any one turn choose a direction (and straight line) that covers the longest distance before you need to turn again. Remember this is an approximate survey. See figure 09 for an illustration.

Hint:
Take the reading by looking at an object in the desired direction and then walk to wards that object. Choose another object when you turn. This will improve the accuracy of the walk.

2. Count the number of footsteps between each observation or change of direction. Just like the compass reading, you need to keep track of the number of steps you've made between each turn (or compass reading). Remember to walk normally, if you try to be too regular with your steps, the chances are the survey will be more inaccurate. The other precaution that needs to be kept in mind is the way you count your steps. I normally count one each time my left foot moves forward.

3. Average out your step distance with a meter tape at the end of the walk. This is a crucial step. If you are walking in reasonably flat terrain there is no real problem. However if there are any sharp inclines or declines in your route you will need to take separate readings for your stepsize for flat terrain, inclines and declines. To average your step distance, simply walk about thirty steps and then measure the distance you covered using a meter tape.

4. Count the number of footsteps between each observation or change of direction. Just like the compass reading, you need to keep track of the number of steps you've made between each turn (or compass reading). Remember to walk normally, if you try to be too regular with your steps, the chances are the survey will be more inaccurate. The other precaution that needs to be kept in mind is the way you count your steps. I normally count one each time my left foot moves forward.

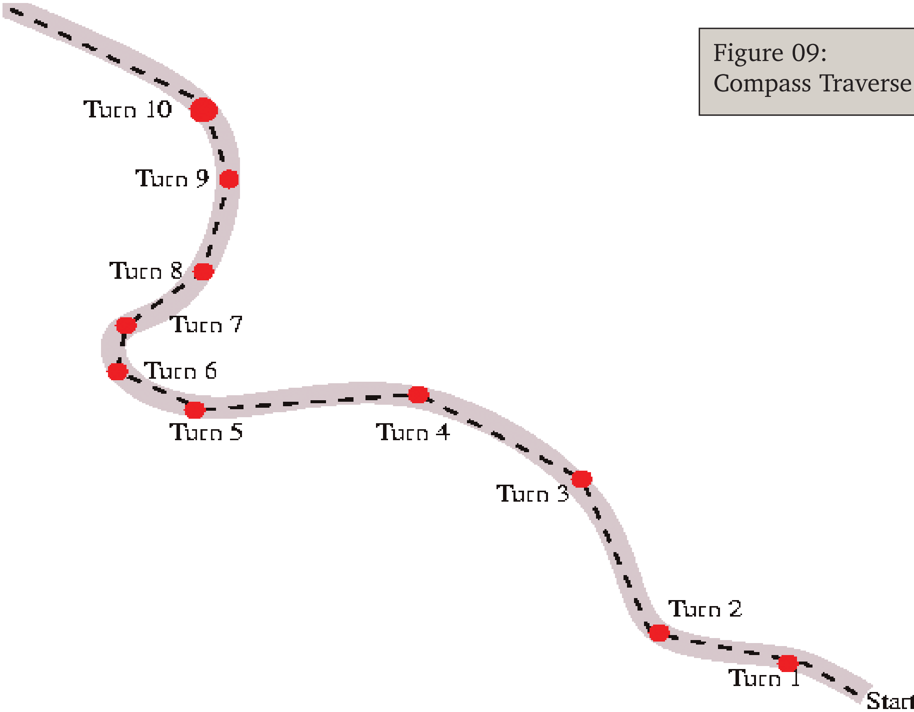


Figure 09:
Compass Traverse

5. Analyse the data or organise it for a GIS package. The final step of course is the analysis of the data. This involves two steps:

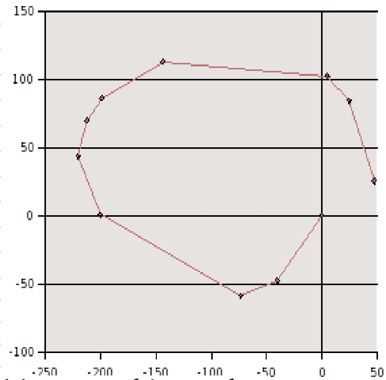
• Convert the step counts into metres. The formula that is used to calculate the distance in meters is as follows (for gnumeric and excel spreadsheets, for open office use a semi colon instead of a comma).
=if(E11=1,D11*J2,if(F11=1,D11*J3,if(G11=1,D11*J4,if(H11=1,D11*J5,0))))
.This formula essentially calculates the distance based on the nature of terrain. The spreadsheet itself has been shown in figure 10.
• Convert the distances and angles into x and y coordinates. This involves a slight

> **Note:**
> It is extremely important that you do the conversion of step counts to meters accurately. Any error in this conversion will mess up your entire survey data.

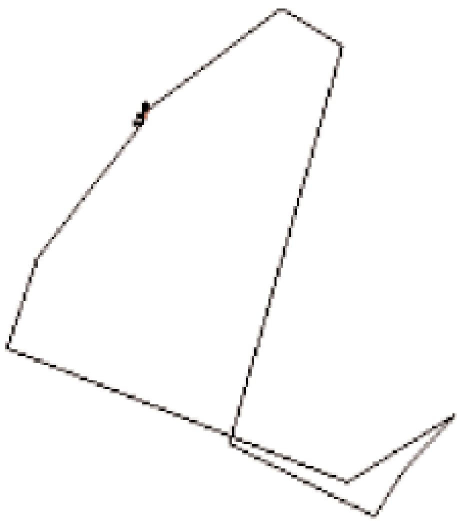
modification of the formula used to calculate the coordinates in the sight level.
The formula for the
X axis is = (sin(radians(AngleReading)) *DistanceReading)+PreviousX Reading.
Similarly the formula for the
Y axis is=(cos(radians(AngleReading))*DistanceReading)+Previous Y Reading.
The difference in the two calculations is that in compass traverses you need to add the value of the previous coordinate to the new one.

Figure 10: Spreadsheet for Compass Traverse Data.

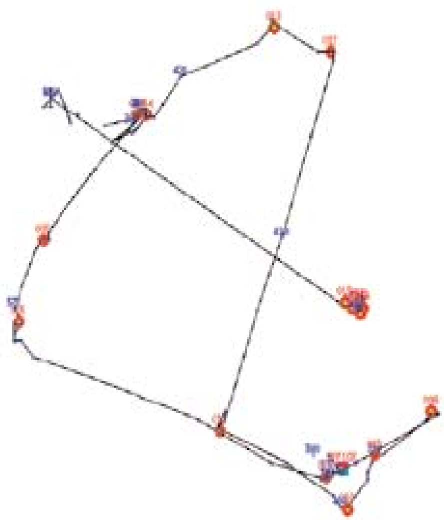
Date:			Name of field site:					Step count conversion:			
								Flat Land	1.5		
Observer:			Time of survey:					Incline	1.23		
								Decline	1.76		
								Slushy	1.05		
Station	Angle	Distance	Steps								
				Flat	Incline	Decline	Slushy	LH Obs	RH Obs		
										Xcoord	Ycoord
BM	0	0	0	1						0	0
1	220	63	42	1						-40.5	-48.26
2	252	34.5	23	1						-73.31	-58.92
3	295	139.5	93	1						-199.74	0.03
4	335	48	32	1						-220.02	43.54
5	377	27	18	1						-212.13	69.36
6	399	21	14	1						-198.91	85.68
7	424	61.5	41	1						-143.64	112.64
8	454	148.5	99	1						4.5	102.28
9	493	27	18	1						24.25	83.86
CLOSE	519	63	42	1						46.82	25.05



(a) Data and its xy plot



(b) Output of a compass traverse.



(c) A GPS based traverse of the same path.

Geo-PRAs

In this part of the manual we try to put together some of the survey techniques discussed earlier and use them as a basis for participatory exercises. Geo-PRAs or Participatory GIS is essentially the application of GIS framework and field survey techniques to PRA exercises.

Please note, we are not going to cover participatory methods per se unless there are specific innovations to be discussed. There is a host of literature on participatory methods available which can be used as a reference.

Transect Walks and Compass Traverse

Introduction

This is a popular participatory survey technique which is used to develop a walk-through map of the village. Transect walks typically are taken in (approximate) straight lines with directions being chosen so as to cover a desired resource or region of the village. Many walks can be taken in a village to build a reasonably good overview. It is both strange and unfortunate that the majority of organisations taking up these exercises have not attempted to improve their accuracies. With the availability of cheap GPS units, doing so is trivial. However, fairly accurate maps can be generated even with a compass. We run exercises with complete “newbies” who end up with errors of under 10 metres after a 1 km walk. This is definitely within most requirements for such surveys. What is more, the data can be then entered on a GIS and used later. More importantly, a compass traverse does away with the need for running the transect as a straight line through the village.

The method of surveys taken for transect walks are called compass traverses. GIS packages such as MapMaker have built in support for compass traverse data. All we need to do is learn to collect it.

> **Note:**
> One can use dumpy levels for the purpose of mapping a village quite effectively as well. The advantage is the ability to determine distances of objects fairly accurately, the disadvantage, of course, is that you need to carry the equipment and one person has to run around with the stadia rod.

However there is one crucial difference. A transect walk assumes you are making continuous observations as you are walking. Ensure these observations are represented in your data sheet. This means you need to organise your walk before hand. A sample datasheet has been enclosed. Note that different “experts” utilise different formats. You probably (and should) have your own format. What we present here is the bare minimum for a datasheet for transect walks and compass traverses (Annexure 02).

Social Mapping

This exercise is normally done to build an initial baseline of the project villages. The exercise consists of three specific phases.

1. A participatory mapping exercise is undertaken during which all the streets are mapped along with various village landmarks.
2. This drawing is then transferred to a notebook and the various streets labelled.
3. Finally, a set of key village resource persons accompany the survey team to each street where a checklist of details about each household is filled.

Figure 11 shows the mapping exercise underway and the coded street map of the village. Social maps are among the most popular tools used during participatory surveys. However, very often social mapping exercises are run to collect information on pre-determined parameters. While this makes the exercise a valuable input for a baseline or evaluation, it reduces the its "participatory" nature.

Linking social mapping to a GIS

How does one link a social mapping exercise to a GIS? The answer really lies in the reason for the social map and the data that is being collected for the baseline. However there are two basic ways of attaching spatial attributes to households (the normal unit of a social map).

1. Assign each house a unique ID and locate it either using a GPS or by mapping (compass traverse).

2. Assign the household values that correspond to other areas in the village which have already been mapped. For example SF number or plot number to assign them land use, resource locations for resource mapping etc.

We believe both are useful, provided you are going to be involved in that village for a substantial period of time (for a 3 or more year project for instance). The compass traverse method, in particular, is very useful when combined with a social map. Some advantages of doing this are:

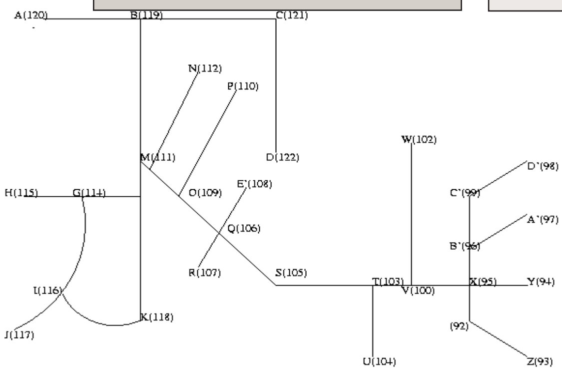
1. Social data can be attached to spatial data through the mapping of all houses.
2. Social divisions of the village can be mapped.
3. The spatial relation of resources and facilities such as drinking water, roads, schools, command areas etc. can be determined.
4. Built up areas in villages are usually not mapped accurately, if at all. This lacuna is easily overcome by combining a compass traverse with a social mapping exercise.

The figures below provides an example of what can be done with social mapping:

(a) Street mapping underway

Figure 11:

(b) Completed street map.



(c) Coded street map.

(d) Data being collected.

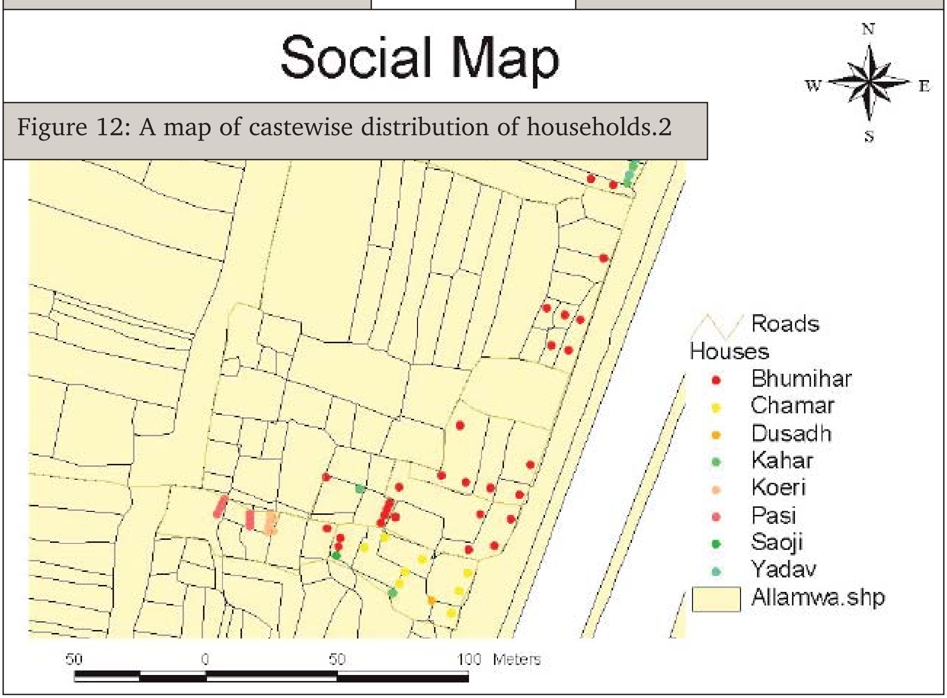


Figure 12: A map of castewise distribution of households.2

Resource Mapping

This exercise provides a good baseline of the natural resources use and pattern of a village or a project area. It is a map of the boundaries of the village and enables the study of land, water, cropping patterns, and other resources of the village.

The process

1. A cadastral or revenue map of the village needs to be scanned and digitised.

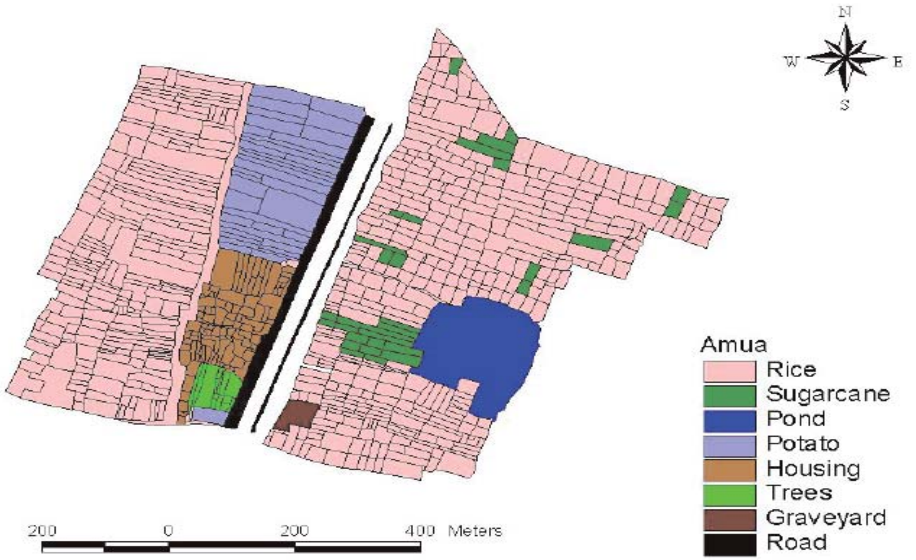
2. Landmarks of the village, such as wells, roads, hand pumps etc. are marked on this map. These points may be collected either via a GPS unit or during transect walks or other surveys.
3. The digitised map is printed on a large paper sheet. The larger the better, but also the more expensive.
4. A PRA like exercise is then organised where the people of the village are requested to draw the map of their village on the floor based on the digitised map brought along.
5. They then carry on drawing a classic Resource Map of their village on the floor.
6. Once the map is completed, it is transferred onto the digitised paper map.
7. The map is then entered in the GIS software for archival and analysis.

The advantages compared to the traditional resource mapping

1. The accuracy of the features on the map are much greater, particularly if you have added landmarks on to the digitised sheet.
2. Hijacking of the PRA process is not possible by influential of the village because the entire map needs to be filled with data.
3. Ability to manoeuvre with the data much better. One can look at certain aspects of the map only through the layering tool of the GIS software. The allows you to focus on relevant data without the noise of other information.
4. Analysis of area, cropping pattern, options for Income Generation Projects and other intervention made possible.
5. Maps can be kept throughout the project life without deterioration from moisture or insects.
6. It is easy to make comparisons between changes in resources over time, further, these comparisons can be accurate.
7. Resource maps made in this manner can be verified through field visits, satellite imagery and other mapping exercises.

The figure 13 shows outputs of a resource mapping exercise.

(a) Cropping patterns in a village command



(b) Soil map of the same village.

Seasonality

This exercise is useful to assess the various time patterns of the village activity. It helps to study seasonal variations for example rainfall, credit, availability of labour, agricultural operations and recurrent sicknesses.

The process

1. This is typically done at the beginning of a traditional PRA exercise. Usually the resource persons chosen for this exercise should be knowl edgeable about the village.
2. The twelve months of the year are represented with stones or any other material.
3. Issues are then identified and described on paper sheet used or the exer cise or on the ground.
4. For example to get rainfall data one will ask the people to put a stick pro portionate to the amount of rainfall for each month. This can yield surprisingly accurate data.
5. The activities of the village can also be represented. For example sowing season, peaks of agricultural works, seasonal sicknesses and unemploy ment times appear clearly.

How is it useful

This exercise allows to capture critical information pertaining to the pattern of activities taking in the village along the year. When are the men busy and when are they free to do other jobs ? What are the good times for asking for contribution either in kind or in cash according to the income and availability of labour ? The rainfall pattern can be very useful when other means of collecting rainfall data is not available.

Links with GIS

Seasonality data is linked to GIS based mapping when it refers to spatial objects. Here are some examples:

- Cropping patterns - different seasons have different crops.
- Resource availability. Resources that are seasonally such as water spreads in village ponds, grazing areas which fluctuate with seasons.

Constructing maps where the variable is temporal can be extremely useful while planning interventions such as timing of planting, release of fingerlings (fisheries) channel lining soil and water conservation works etc.

Resource use/control

Ballot based resource use and control exercises provide useful insights into the manner in which communities partition available resources. While there are a number of different exercises that can be utilised, we settled for a ballot box system which seems to work well with a mixed group irrespective of their litracy levels. The exercise consists of the following steps.

1. Each resource is drawn onto a chart paper by the facilitator. This drawing is put up on the wall or floor and the facilitator gives a short introduction to the exercise. The rules are stated here (and again, as often as required). These are:

a) Each person is given four ballot papers - two containing the faces of women and two with the faces of men.
b) Each person can caste only one vote in each ballot box.
c) This vote can therefore be either a man or a woman, as drawn on the ballot.
d) Thus each voter will have two extra ballot papers at the end of every round of voting.

e) One of the boxes represents control - who controls the given resource, the other represents the user - who uses this resource most?

2. Two ballot boxes or envelopes are placed on the floor or wall.
3. Prior to the voting, each resource and its use is discussed.
4. After each round of voting the ballots are counted.
5. The process is repeated for the resources under discussion.

Linking the exercise to GIS

Using GIS it is possible to convert a resource use and control exercise from a perception based process to on that is based on factual spatial data. To do so, the facilitator is required to have completed the resource mapping and prepared the required map. This provides the respondents two kinds of information:

- Prioritising of the resource is possible on the basis of its extent and potential.
- Stakes are more clearly articulated and any negotiations are based on factual data and not wrong perceptions.

Typically, a resource use/control exercise is preceded by the group having a discussion on a map or, in the absence of one, the creation of a resource map. The group is then able to take up specific resources for the use/control exercise and subsequent discussions are more focused.

Micro Planning

Introduction

Thus far we have covered the basics of field surveys and of thematic mapping. In this chapter we discuss how such data can be used for planning at the micro level. The term micro-planning or micro level planning normally refers to the level of detail where every nitty gritty is factored into the plan.

There are a number of programmes which expect the facilitating agency to organise microplanning exercises. These exercises are normally conducted with primary stake holders. However in large projects which can involve hundreds or thousands of primary stake holders, the level of facilitation is often limited to representatives of these stake holders. Further, in situations where there are multiple stake holders from different socio-economic backgrounds, a microplan can involve a period of negotiation and ratification by a larger village body such as the Panchayat or Gram Sabha.
A typical micro plan comprises of four stages.

Stage one

The outline of the strategy is prepared in the greatest detail possible. This is done

with representatives of each community based organisation which has a stake. Stage one of a micro plan can start off being very vague with a host of possible activities being suggested. One of the major task for the facilitator is to select the most appropriate set of activities for each CBO. Stage one of the micro-plan is completed after the output is presented to the general body of the concerned CBO by its representatives and a resolution passed in its favour.

Stage two

This involves the comparison of the micro-plan of different CBOs from the same village. This is often done in a moderated meeting where representatives of all the organisations operating in the village are invited. This stage is particularly necessary in areas where the facilitation agency is only involved with some of the existing CBOs and where local governance mechanisms such as Panchayats or traditional leaders have not been consulted earlier. The second stage typically involves some negotiation on the extent of activities different groups may take up, their locations and time period. Other outputs of this stage include a listing of agreements to be drafted betwee the CBOs and Panchayats and agreements on fee or payments between the CBOs.

Stage three

This is the meat of the micro-plan. Each CBO discussed in detail the activities that will be taken up and allocates responsibilities to various tasks to its members.

Stage four

Finalisation or ratification of the micro-plan by a larger body is the final stage of the micro-plan. This makes the microplan an “official” document and can involve signing of MoU and lease agreements in some cases. In less formal situations it involves an announcement of the intentions of the microplan to the community.

What users need from a micro-plan

Let us now try to list out the requirements from a micro plan, keeping in mind the problems listed above.

Flexibility: The plan has to allow a high degree of flexibility to be useful for stakeholders.
Standardisation: There has to be some level of standardisation, a framework within which the micro-plan is built.
Accuracy: The micro-plan should be based on accurate data. Some system which allows for triangulation of data needs to be put in place.
Methodology: Any data that is being collected, be it field survey data or information from a discussion, needs to follow standard methods.

What a micro-plan needs

Background information: The first thing needed prior to starting a micro-planning exercise is a clear background of the activity including past attempts and achievements, time frames and expected outputs. This provides the basic framework within which the micro-plan is to be devised.

Maps: Most micro plans require spatial attributes which are best displayed on maps. These maps normally are thematic and show details relevant to the activity. For example a WUA planning lining of a distribution channel would find a map of cropping patterns in the command and existing structures very useful.

Field measurements: A good micro-plan is based on primary survey data, often collected by the participants during transect walks or field surveys.

Data: Data on the activity is a pre-requisite of any micro plan. Data could range from market and feasibility studies to schedule of estimates for propose construction works on a sluice gate.

Expected outputs from a micro-plan

Micro plans are used for various purposes. The most obvious one of course is for planning. However a well designed and documented micro-plan is also useful for monitoring and evaluation. Some organisations utilise the micro-plan as a tool for mobilisation and negotiation. For example, SHGs formed in a project FERAL is associated with, used the micro plans to negotiate for rights over fisheries and contracts for tree planting. The same project[1] regularly uses micro-plans during WUA meetings to help

1 The India Canada Environment Facility funded project on tank management in Tamil Nadu. FERAL provides the planning and monitoring support for this project.

focus discussions. In another project, the micro-plan is used as a contract between communities and the government. The micro-plan (called an integrated tank development plan in this case[2]) includes detailed estimates for rehabilitation works for tanks. Qualified engineers are involved in the preparation of this document which is the basis for fund release and monitoring. The same document is also used to build a consensus in the community and is ratified by the Gram Sabha. A very similar process is followed by projects running under the Integrated Watelands Development Programme.

Protocols for preparing a microplan

A micro plan is essentially a compilation of information into a strategy document. This section is deliberately generic and you will undoubtedly modify each step to your requirements. What is stated here typically is the core of stage 1 and stage 3 described earlier.

State the objectives of the group - what they want to do

The first part of a micro plan comprises of creating a clear vision statement with the participants. This vision statement is then broken down into specific and quantifiable objectives. In situations where objectives are difficult to articulate, the facilitator can first list out problems that prevent the implementation of the vision. For example of the vision statement is “improve nutritional levels at the household”, the facilitator may then ask the representatives to state what the prevents them from doing so. These problems can later be re-phrased as objectives.

List strategies and activities

Each objective is broken down into specific strategies - how it will be achieved. A strategy normally comprises of a number of activities. For example: To improve nutritional levels we can either improve the earning capacity and credit worthiness of each household or provide facilities that allow each household to maintain a kitchen garden. Here are two strategies each comprising of different activities. The first would result in the formation of a micro-credit group and the second in a series of steps that help the group acquire land and take up kitchen garden cultivation.

Sequence the activities and give each item a time line

This is a time consuming phase of the micro-plan involving the organisation of activities first into a sequence, and then by the time taken for each. Various graphical methods can be used for this (see seasonality on page 28).

2. The Karnataka Community Based Tank Management Project.

List the participants/stake holders and clearly define their stakes and roles for each activity

1. What are their stakes in terms of social status, economics or cultural?
2. What are their roles in ensuring their get their stakes?
3. What are the perceived stakes and roles of the stakeholder?
4. What is your mobilisation strategy or project strategy regarding this?

List prerequisites of activities

This involves the social pre-requisites as well as physical ones. In most community based projects, social pre-requisites form the bulk of the capacity building and mobilisation phase. The kinds of pre-requisites could include:

- Certain levels of awareness and capacities among the primary stake holders.
- MoUs and agreements within and between different CBOs or in certain cases, the govt. and the CBOs
- Formation of a CBO or a level of maturity of a CBO, for example an SHG might require to be of a certain age and eligible for certain kinds of finan cial credit and subsidy from the government.
- Acquisition of facilities either through lease or via permission.
- Other activities, as per the time line.

Budget the activities and define sources of finance

Each activity item needs a clear budget, both in terms of cash as well as contribution of labour or materials. Further the sources for each kind of contribution need to be defined. Quite often, raising resources for enabling an intervention require a strategy of their own.

List the expected outputs from each activity

Each activity needs to be evaluated in terms of expected outputs. This is both to ensure that the cost-benefit ratio is favourable, as well as to be able to monitor the results of the activity.

List schedules and means of monitoring the activities

Clear schedules for monitoring the outputs of each activity and the methods or indicators for each output need to be listed. Indicators selected should ideally be easy to collect and fairly accurate.

Microplans and GIS

Transferring data from micro-plans to a GIS can be a challenge. Some of the issues that arise are:

- Standardising data from micro-plans is a non-trivial issue. What are the common denominators in all micro plans and how are these to be measured and used for comparisons are serious questions for the facilitator. Micro plans are activity dependent. Even the same programme run in different groups can lead to very different activities. For example, a programme for income generation projects for SHGs can result in one doing kitchen gardens and the other candle making. Naturally the micro-plan will be different.

- Facilitation at the level of the representative does not imply that the representative will be equally adept at facilitating a micro plan. This is the main reason why many organisations (particularly govt. based) switch back to a form or schedule for the representative or hire external persons to do the surveys and devise the equivalent of a non-participatory micro plan.

- The link between the data providers (facilitator or GIS expert) and the data user is broken. There is a real danger that some information required by the primary stake holder will not be available forcing parts of the micro-plan to be based on speculation or bad data. This needs to be addressed adequately.

- Accuracies and validity of the data collected are difficult to verify. Questions such as "did they really do the walk through survey or were they having tea at the dhaba while making the maps?" are common. While these can be verified it may not be feasible in very large projects.

- Data entry and collation become serious issues in their own right.
    - ⇨Incorrect data/bad data, missing entries or unreadable information results in holes in the overall picture.
    - ⇨Information from one micro-plan to another becomes non-comparable and incon sistent.
    - ⇨Designing databases to store the information becomes more and more difficult.

- The output of a geo-microplan must be useable by the primary stake holders. Presentation of information becomes crucial, particularly if it is to be used for regular monitoring of activities.

However, once accomplished, a GIS based planning system is an extremely powerful monitoring and planning tool that can be used equally effectlively at various levels of aggregation.

Appendices

Appendix 01

Datasheet for sight level readings

Stn.	Back Sight			Fore Sight					Notes
	Top	Middle	Bottom	Angle	Top	Middle	Bottom	Angle	

Appendix 02

Datasheet for a compass traverse and transect walk

Observer:			Name of field site:					Step count conversion	
								Flat Land	1.5
Observer:			Time of survey:					Incline	1.23
								Decline	1.76
								Slushy	1.05
Station	Angle	Distance	Steps						
				Flat	Incline	Decline	Slushy	LH Obs	RH Obs
BM	0	0	0	1					
1	220	63	42	1					
2	252	34.5	23	1					
3	295	139.5	93	1					
4	335	48	32	1					
5	377	27	18	1					
6	399	21	14	1					
7	424	61.5	41	1					
8	454	148.5	99	1					
9	493	27	18	1					
CLOSE	519	63	42	1					

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Appendix 03

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