GTZ-AMES
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Action

TRAINING MANUAL ON SCOUTING OF SITES FOR PICO AND MICRO HYDRO POWER SCHEMES

AKSM/ PA / GTZ- AMES / DIPREME Manica

ZZ~May 2009

TABLE OF CONTENT

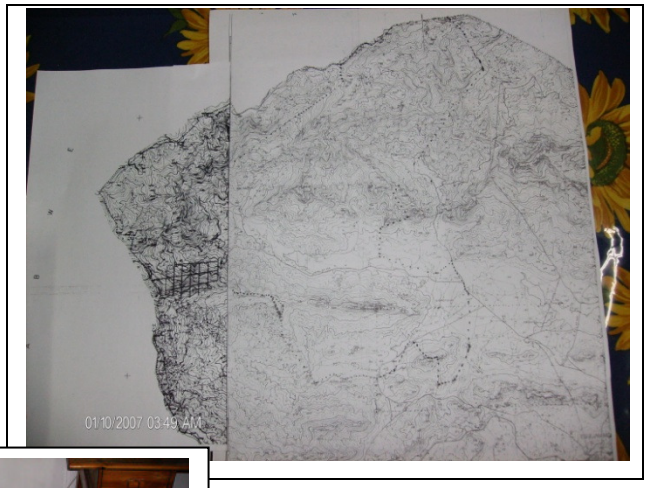
STEP BY STEP TRAINING

1. Site Identification on Maps

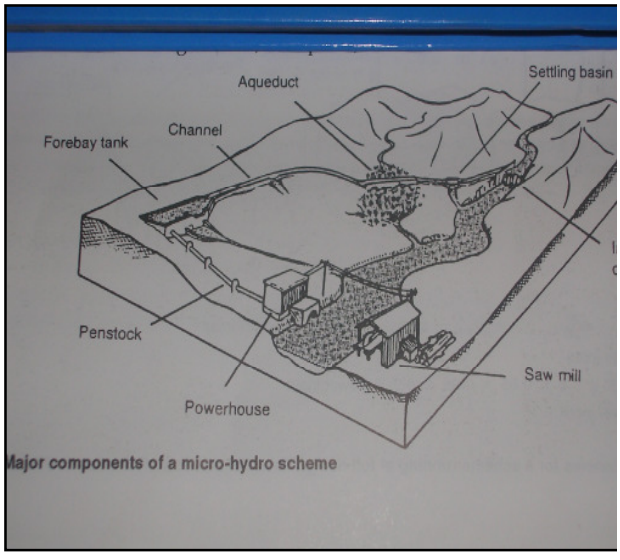
Basic knowledge of map reading is essential in order to interpret the physical features properly.

Based on cartographical maps identify sites that have rivers or streams that flow over steep slopes. Steep slopes are where the contour ridges are very close.

Choose sites that are accessible in order to reduce travel costs. The locations should also save as demonstration sites for marketing purposes to future customers.



2. Layout of Pico / Micro Hydro Schemes and Environmental Considerations



A micro hydro scheme consists of a weir at the intake to divert water from the river into a canal or pipe, canal to transport water from the intake to the forebay tank, settling basin to trap silt, Aqueducts to cross galleys, Forebay tank to collect water into the penstock, Penstock to transport water into the turbine, powerhouse to accommodate the power electromechanical machines and transmission lines to the households or power machines.

For environmental protection the watershed should be covered in vegetation and the canals and penstock protected against soil erosion.

3. Preliminary Site Visit

1. Visit the site of the intake and check on feasibility of constructing a weir.
2. Walk along the canal if it exists or along the site for the canal, assess position of forebay tank and the penstock.
3. If a turbine already exists, assess the components and get the historical background of the system.

4. <u>Village Meeting for Project Introduction</u>

Before carrying out surveys in the village there should be a meeting with the community to clarify intentions and collect relevant information.

- Prepare meeting schedule and agenda together with partners to be involved e.g. from Department of Energy
- Prepare information that is required e.g. project philosophy, implementation strategy, the capacity of the MHP Systems to be considered, credit and payments procedures.
- Choose appropriate day for the meeting where people are not busy in the fields and inform them on time. On the day of the meeting arrive on the venue on time in order not to frustrate the villagers
- During the meeting share topics accordingly. Involve the Department of Energy, the district Infrastructure Department, environmental department.
- Check the local ability to manage the scheme and the willingness of the community to pay for electricity
- During the meeting try to listen to the villagers as much as possible. Be more of a moderator than a preacher. Answer questions clearly and if you do not have an answer note down the question and tell the group you will go and research. After the research give feed back.
- Outline the conclusions of the meeting. Write minutes of the meeting and distribute the minutes to stakeholders.

5. Demand Survey Formats

Determine whether there is a local demand for electricity or mechanical power machines like grinding mills. Use the following format for calculation of demand in electricity.

MICRO HYDRO POWER DIMENSIONS				
Nome de dono:	Nome da zona:	Comunidade	Data:	
Demanda	Numero de casas a beneficiar		Populacao	
	Beneficiarios de sistema de recarga de battrias			
			Total	

Nome da familia	**Agregado familiar**	**GPS Data**			**Tipo de Casa**	**Uso de energia**				
		South	East	Height	**0,1,2,4**	**Ilumin ação**	**Radio**	**TV**	**Banca**	**Outros**
TOTAL										
TOTAL		Watt								
Demanda Total										

6. Measuring Water Flow and Formats

6.1 Electronic Flow meter (propeller)

The flow meter uses a propeller that is dipped into the flowing water.

The instrument measures the velocity of the flowing fluid in m/s that can then be calculated into m^3/s. It can also be programmed to measure the flow in m^3/s. The instrument also measures temperature, pressure

Make sure that the batteries are charged before taking the machine to the field.

6.2 Bucket and Stop Watch Method

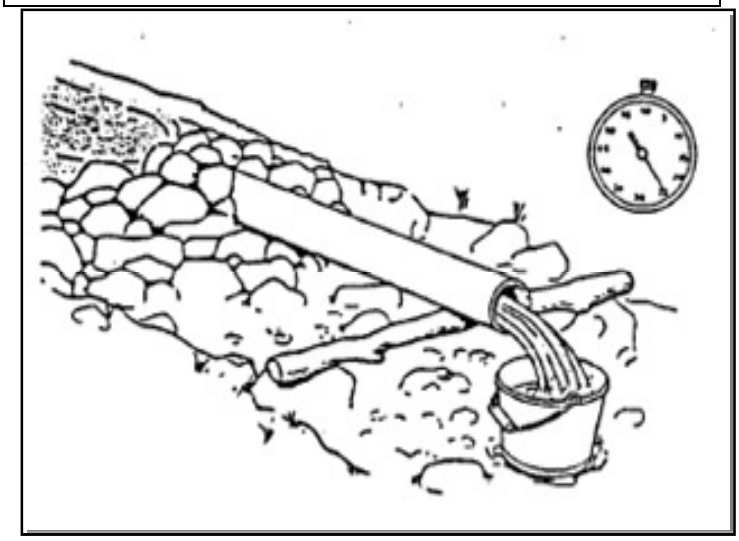
This method is suitable for rivulets only and water in canals.

Required equipment: 20 liter open bucket, short piece of pipe say one meter of 100mm diameter pvc pipe and a stop watch.

Water is dammed to flow through the pipe to discharge into the bucket. Time taken to fill the bucket (t) is measured and recorded in seconds. Ten measurements are taken and the average calculated.

The water flow (Q) is measured in liters per second by dividing 20 liters by the time taken to fill it up.

Q [l/s] = 20 / t



6.3 Float method

This method is suitable for small to medium size rivers where one can walk across. Chose portion of the river where the river is accessible, has fairly parallel sides for at least three meters and the water flows gently. You need at least three people, one to throw the float at start point, the second to capture it and operating a stop watch at end point and the third to record the data. Carry out ten counts and find average. Water flow speed (Q) is measured in cubic meters per second = Cross-sectional area (A) in square meters x length (L) in meters / Time of flow (t) in seconds

$Q = A \times L / t$ in $[m^3/s]$

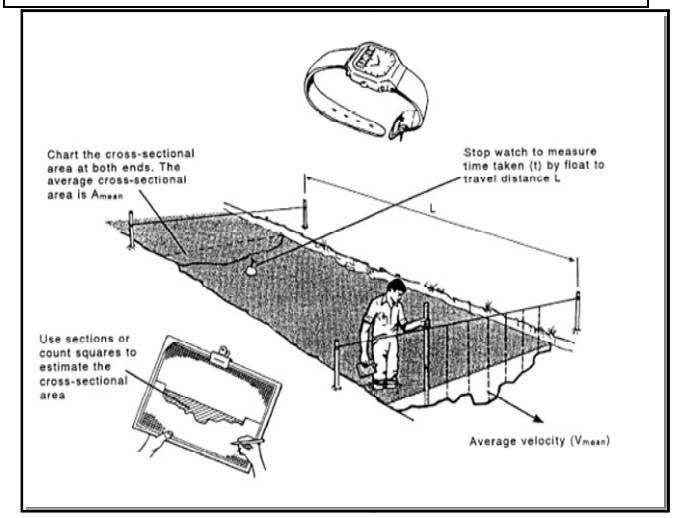


Chart for Recording Water Flow Measurements

WATER FLOW RATE

GPS: | S | E | H

Stream or Canal Dimensions:

	width	depth	
A =			mm
B =			mm
C			

Length	L =		mm
Average	Width		mm
Average	Depth		mm
Volume			ltrs

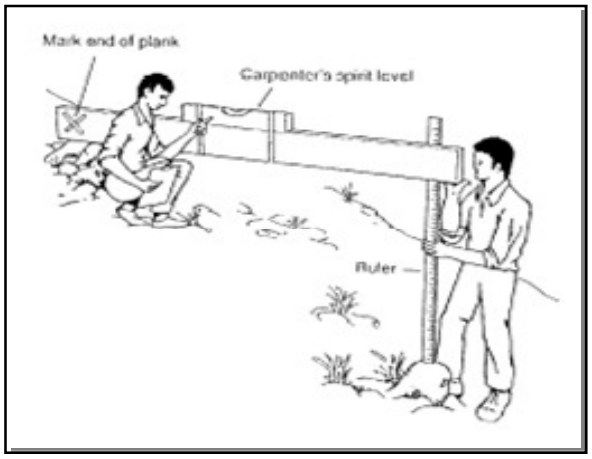
Floating Speed				
1		6		
2		7		
3		8		
4		9		
5		10		
		Total		
		Average		sec

Average Flow rate

per sec	per min	per hour	Unit
			Mtrs
			Liters
			Cu.mtrs.

7. Measuring the Head

7.1 Spirit level / straight edge and line



Using a vertical ranging rod, a timber straight edge with a spirit level (the straight edge is calibrated or supported with a tape measure) progressively measure vertical and horizontal distances from the position of the powerhouse to the position of the forebay tank and also measure the distance on the slope.

Record the measurement on a chart and calculate the head and the length of the penstock.

Data Recording Chart

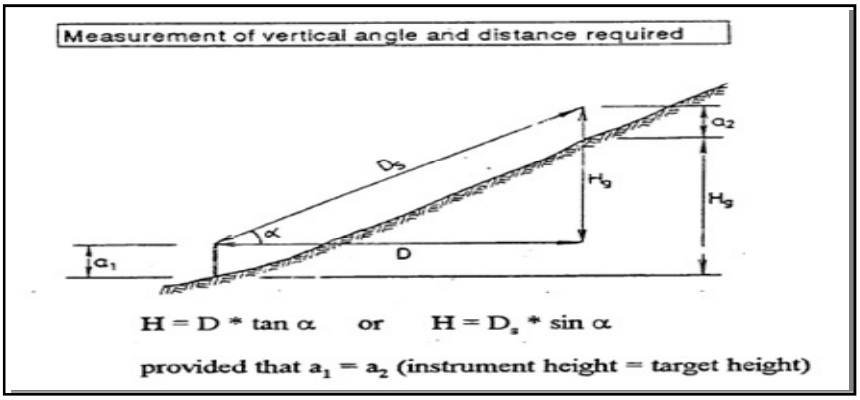
	Horizontal (A)	Vertical (B)	Slope (C)
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
Total			

7.2 Clinometer and Tape Measure

Also known as an Abbey level is a small version of a line level that is used to measure vertical angles. This is used to measure the angle of the slope. Two points are marked using two strong pegs of equal size (1,5m long). With a tape measure of 20 to 50m for measuring the distance between two points, D_s. The vertical angle is measured by placing the Clinometer on top of the first peg placed at the position of the turbine base and sighting the second peg. Record the measured angle. Move the first peg to the third position along the route of the penstock and repeat the measurement.

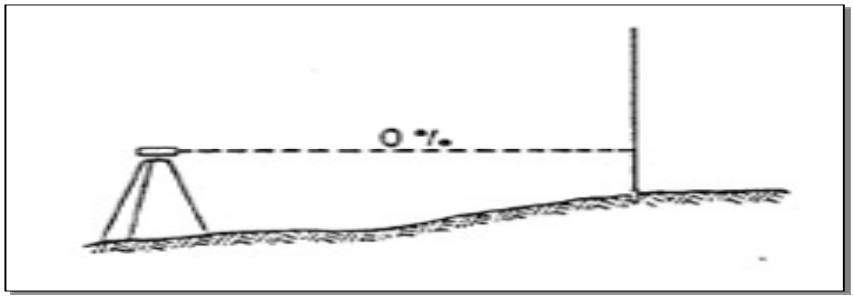
Head (H) is calculated as $H = D_s \times \sin\alpha$

Accuracy level about +/- 5%



7.3 Engineer's Automatic Dumpy Level

The dumpy level is used in areas that are cleared without tree obstructions. The operator (qualified operators only) measures the horizontal line on the staff (3 to 5m) that is held upright by the second person.



7.4 Using Altimeter or GPS with Inbuilt Altimeter

Measuring with altimeter simply means taking the reading at the positions of the powerhouse and the fore-bay tank and calculating the difference. N.B. that the accuracy is affected by atmospheric pressure and temperature.

8. Formula for Calculations of Power

Make preliminary estimation of the power to be generated by calculating using the measured head (H) and water flow (Q) using the following formula:

P = 5xHxQ

P = Power in KW

H = Head in meters

Q = Water Flow in cu.mtrs/sec

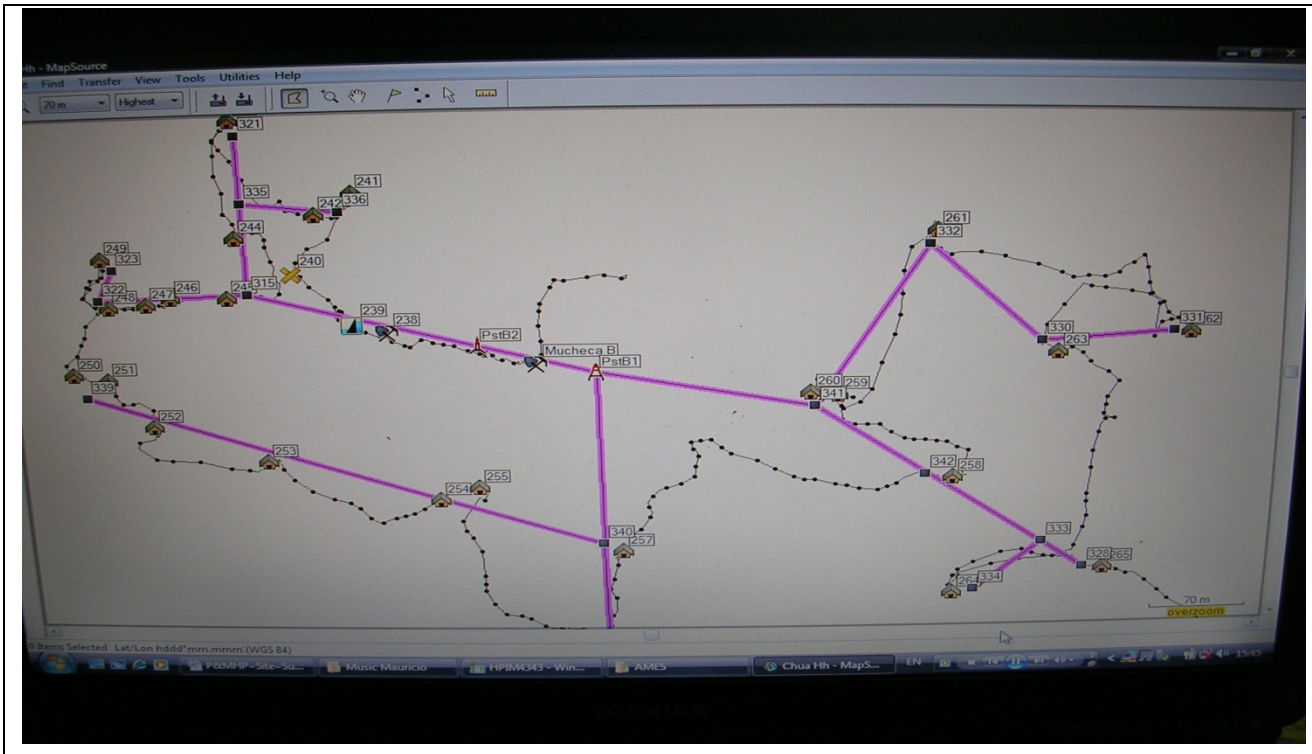
The amount of power will determine whether the scheme is suitable for mechanical poert or for electricity generation or for both.

9. Transmission Power Lines and Electrical Installations

Choose households that are close to each other so that you have short distribution lines that are easier to construct and will keep the costs low. Recommended is a radius of 500m (and 1000m maximum). In the long run small distribution networks are easier to maintain.

Using GPS visit each household and mark on the GPS. Input data on the chart. (see demand chart)

Map of Households and Estimate of Power lines



10. Financial Analysis and Viability Considerations

Calculate the required capital by estimating the bills of materials required for the scheme

Establish the source of key components like turbines, alternators, electrical cables

Call for quotations from reputable suppliers (at least 3 quotations)

Seek quotations from contractors for the electrical installation as well as mechanical installations.

Estimate of Running costs, the Income and Profit for the operator and loan repayment rates.

COST ANALYSIS CALCULATIONS FOR MICRO HYDRO POWER

	ACTIVITY	**Amount**
1	Feasibility and design Study	
2	Civil Works	
3	Intake	
4	Canal	
5	Fore-bay tank	
6	Penstock + supports	-
7	Power house and other civil corks	
8	Turbine improvements	
9	Alternator	
10	Electronic Load Control	
11	Main Electric Power lines incl. instr. box	
12	Household Electric Installations	
	TOTAL	
	Project Considerations Loan for Households Loan for Mill Operator Subsidy offered by Project	
Discounted Annual Payments for Operator ***A=*** *C x j(1 + j)^n / (1 + j)^n-1* Where		
A=	discounted annual repayment	
C =	original capital sum	
n =	loan period in years	
j =	interest rate	
A =	discounted annual Op. loan repayment	
	Op. Loan Repayment per month	
	Number of Households connected	
	Average loan repayment per Household per month	
Considered collections for consumption		
	Mthly charge per h/hold f. Consumption	
	Number of households	
	Monthly revenue collected	
	Annual gross revenue collected	
Maintenance Budget		
	Annual Maintenance budget @ 10%	
Income for Mill operator		
	Annual net revenue collected	

11. Apendix:

11.1 Sites that wre visited during the training

1. Ndirire Village
2. Nhamuquarara Site 1
3. Nhamuquarara Site 2
4. Nhamuquarara Site 3
5. Chimedza Site 1
6. Chimedza Site 2
7. Mudodo
8. Mangunda

11.2 List of Participants

1. **Jemusse David**
2. **Samuel – AKSM**
3. **Luis - AKSM**
4. **Farai - AKSM**
5. **Henure - DIPREME**
6. **Zano – Escola de Artes e Oficio Chimoio**
7. **Eduardo David – Volunteer Mucudo**
8. **– Volunteer Chimedza Village**
9. **Mucheca – Aspiring Operator – Chimedza Village**
10. **Itayi - Aspiring Operator – Mudododo Village**
11. **Aspiring Operator – Nhamuquarara Village**
12. **Aspiring Operator – Ndirire Village**
13. **Z.C.N. Zana – Trainer**
14. **D. Neto - Co-Trainer**

TREINAMENTO EM PESQUISA DE ESQUEMAS DE PICO E MICRO HYDRO

CONTEÚDO E PLANO DE TREINANDO

1. Treinamento teórico (1 dia)

1.1 Identificação de local nas Mapas
1.2 Formatos de Pesquisa de demanda
1.3 Plano de Esquemas de Pico / Micro Hidro e Considerações Ambientais
1.4 Teoria de Medir Fluxo de Água e Formatos
1.5 Teoria de Medir a Desnível (head)
1.6 Formula para Cálculos de Potência
1.7 Rede de transmissão de tenção e Instalações Elétricas
1.8 Análise financeira e Considerações de Viabilidade

2. Campo prático que Treina (4 dias)

2.1 Identificação de local nas sítios
2.2 Reuniões local de Pesquisa de demanda
2.3 Medição de Fluxo de Água
2.4 Plano Esquema
2.5 Aspectos ambientais
2.6 Medição de Desnível
2.7 Cálculos técnicos de Potência
2.8 Rede de transmissão de tenção e Instalações Elétricas

3. Análise financeira e Considerações de Viabilidade (2 dias)

3.1 Estimativa de Capital
3.2 Estimativa de custos de Operação
3.3 Estimativa de Renda

4. Relatórios de pesquisa (2 a 3 dias dependem de número de locais)

4.1 local 1
4.2 local 2
4.3 local 3
4.4 local 4
4.5 etc