Development of Micro Hydropower Systems in Cameroon

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Problem Statement:

- In the village of Bangang, Cameroon and surrounding areas, only 5% of rural population have access to electricity; 65% of schools have no electricity and cannot enjoy internet access or other forms of modern educational training.
- Bangang, Cameroon only has approximately 500 watts of dependable electricity supported by additional electricity from other hydropower and wind sources.
- Several non operational hydropower generation units exist however they are not as large as the one we are working with. i.e. they are not as important for the village to focus on fixing
- Existing infrastructure must be used as much as possible.

Figure 1. The canal leading water from the source to the penstock.

Figure 2. The location of Cameroon .

Objectives:

- Perform a site analysis of the surrounding watershed
- Design turbines for maximum efficiency with manufacturability in mind
- Implement the design in the community

Current Design

- The African Centre for Renewable Energy and sustainable Technology (ACREST) has initiated renewable energy through small hydropower implementations in the village (Fig. 3).
- We proposed to evaluate and improve the existing systems .
  - Current turbine was made to look like a commercially produced European model.
  - Analysis was completed to find the problem and give insight into the solution (Fig. 4).

Figure.3. An existing turbine in Bangang village

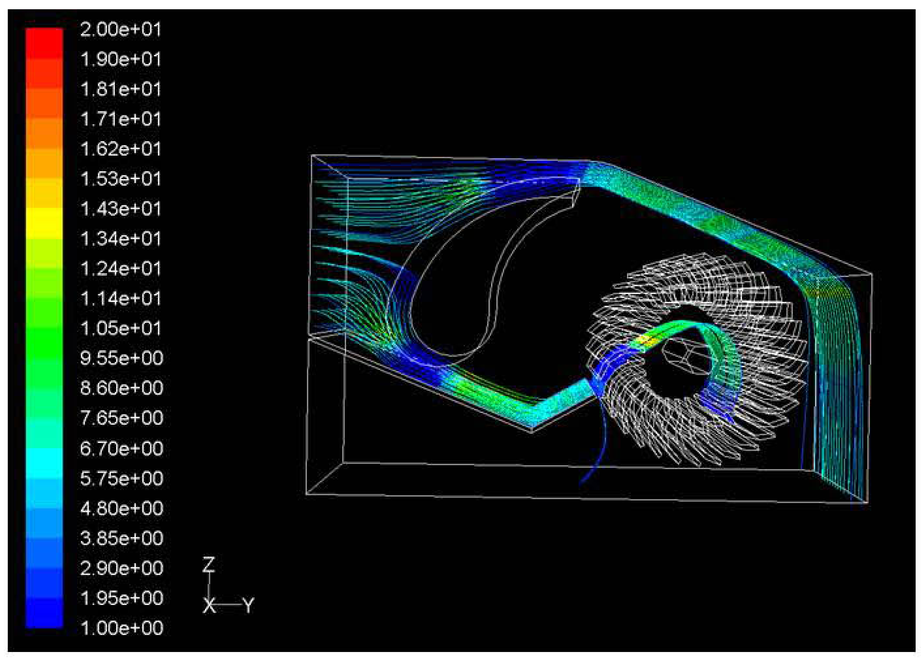
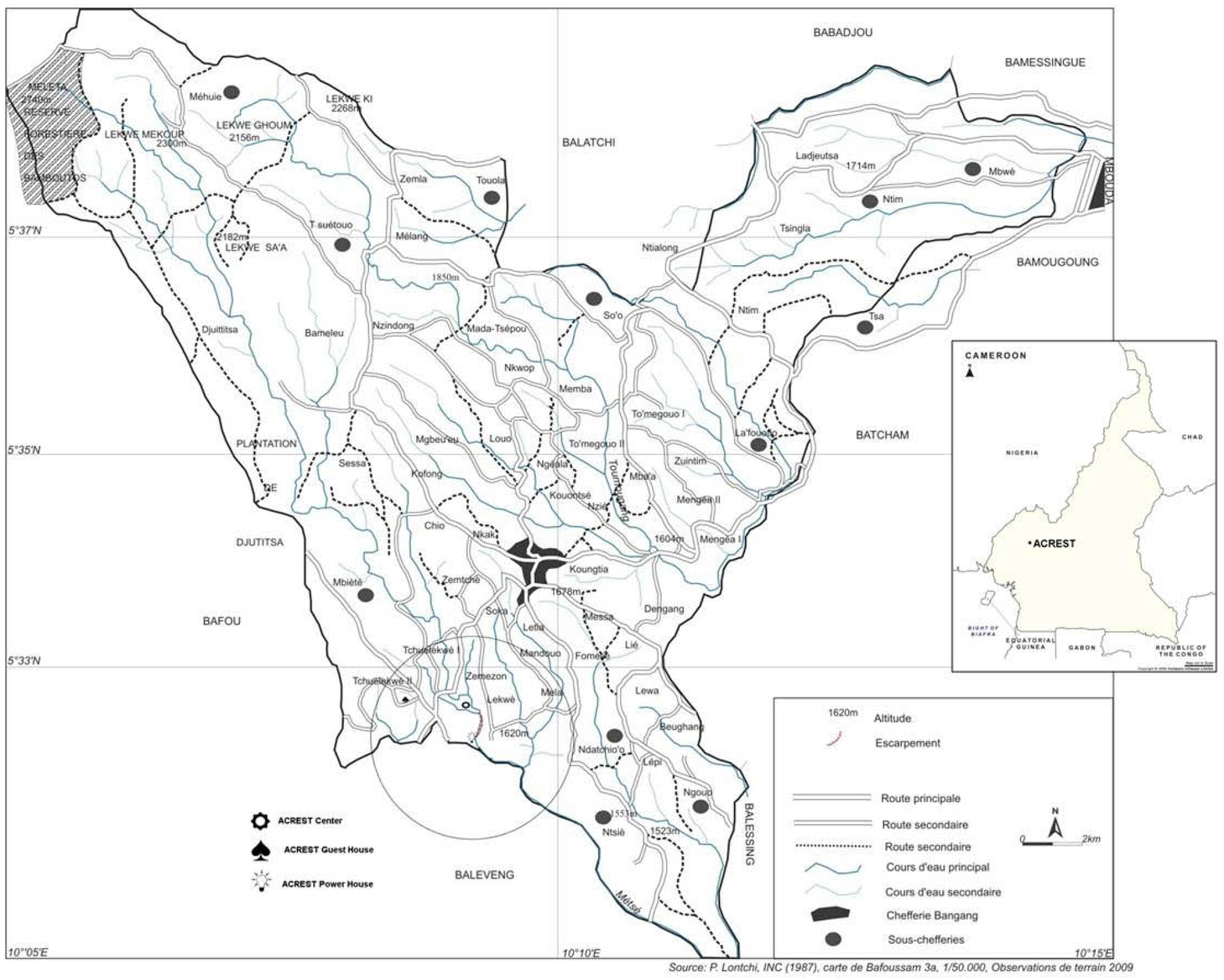


Figure.4. The existing turbine modeled in Fluent showing pathlines.



Source: P. Lontchi, INC (1987), carte de Bafoussam 3a, 1/50.000, Observations de terrain 2009

Figure. 5. Map of Bangang chiefdom, Cameroon

Site Analysis

- Evaluate feasibility of current site as well as potential future sites within the village.
- GIS tools used for watershed delineation.
- Data collection in collaboration with ACREST: rainfall, GPS data points, maps, stream flow rates and water head.
- Create a step-by-step procedure for conducting site analysis.

Alternator

- This particular alternator we are using was purchased by the village in the past.
- This is a three phase model that outputs 30kW, 240V, and 60 Hz when all systems are running at correct and peak values.
- Originally believed to be unable to hook directly into the power grid based on information given and needed a control panel designed.
- In actuality the control panel that they have been having problems with is unnecessary unless the alternator has been broken.
- Correct interface for linking alternator to turbine needs to be determined.

Figure. 6. Dingol alternator Model DG18H

Our Design

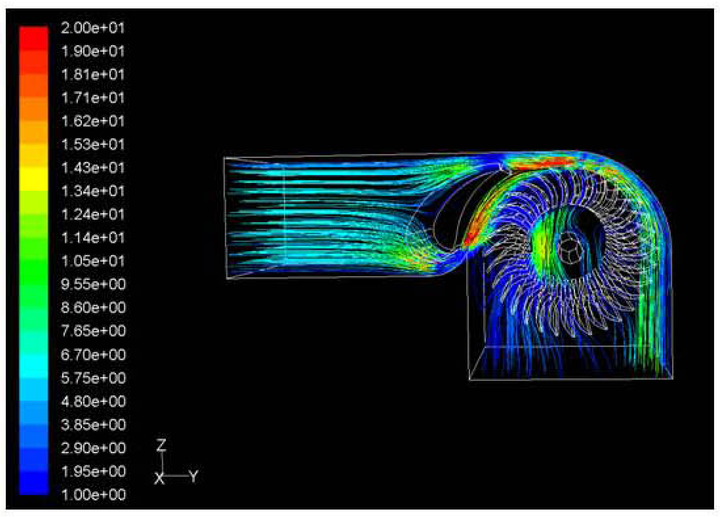
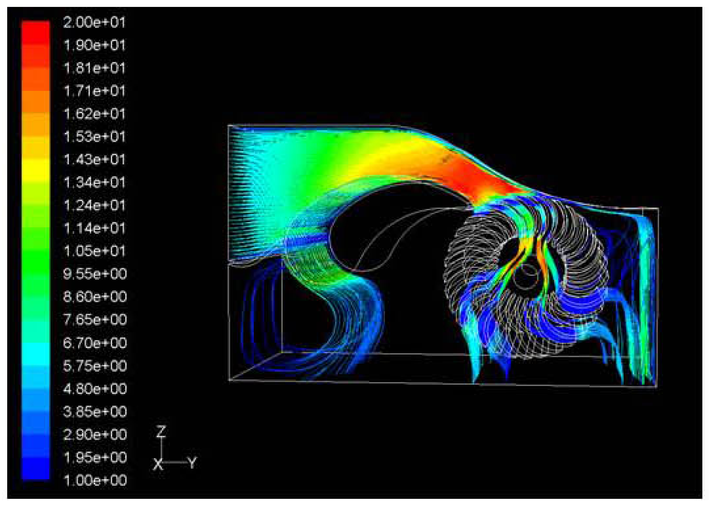
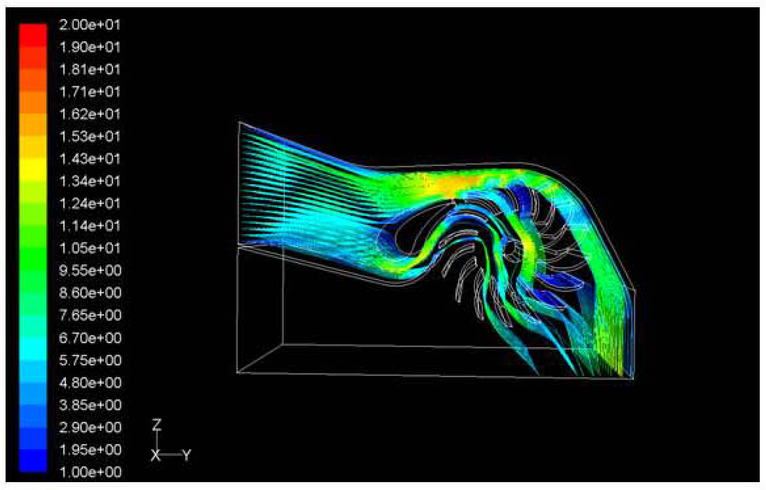


Figure 7. Simulation runs for a few preliminary designs showing velocity pathlines.



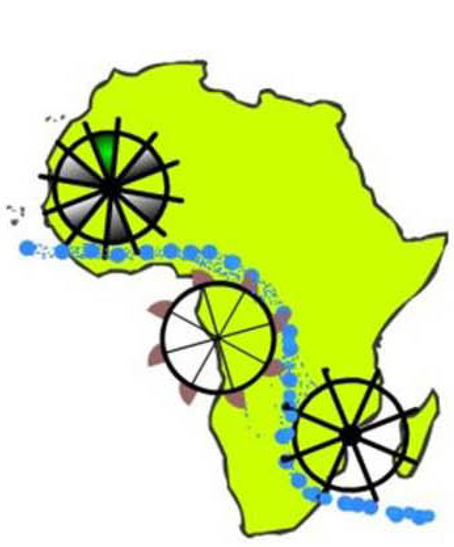


New Design Concept

- Problem of water splashing on blades of the turbine has been addressed from earlier designs.
- Various simulations have been run with the Fluent CFD software package to help select the best design.
- Preliminary calculations show that the output torque will be sufficient to power the alternator.
- RPM calculations will be made to find the correct gear ratio between the turbine and alternator.

Impact of Project

- Improvement in the quality of life in Bangang village.
- Improvement of educational training.
- Connection with the rest of the world through access to internet.
- Development of a design manual for technology transfer to other communities in the region.



PURDUE GLOBAL ENGINEERING

A.C.R.E.S.T.

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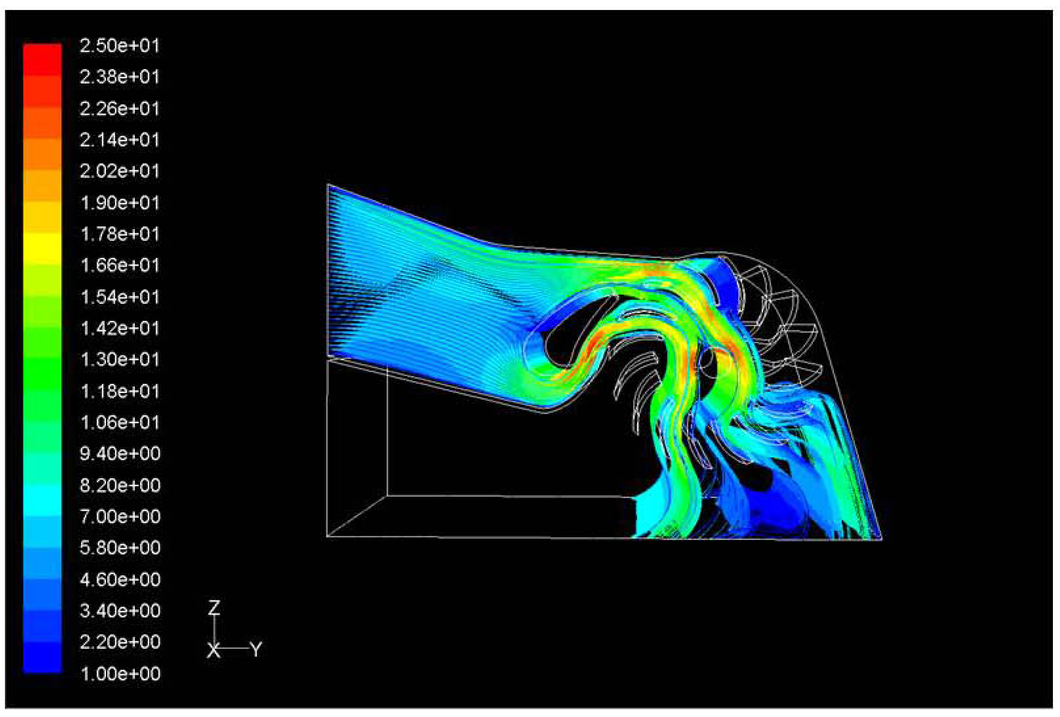

Figure 8. The current design modeled in Fluent by velocity pathlines.