

Research Plan to Evaluate Steer Manure and Sawdust Fuels for Jiko Stove in Developing Countries

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Cooking in Developing Countries

- Roughly three billion people with lake access to energy [1]
- Rely on burning woods and charcoal for daily cooking purposes [2]
 - Indoor
 - Outdoor
- Women are responsible for cooking and collecting wood



Figure 1: Photo taken by Dr. Dianne McDonnell

Health Effects of Cooking in Stoves in Developing Countries

- Exposure to air pollutants [4]
 - Particulate Matter
 - Lung Diseases
 - Cancer
 - Deaths
- Physical stress [1]
 - Carrying a heavy loads of woods
 - Distance travelled



Figure 2 [3]: Smoke from cooking in stoves

Particulate Matter Emissions

Total global exposure to particulate matter pollution

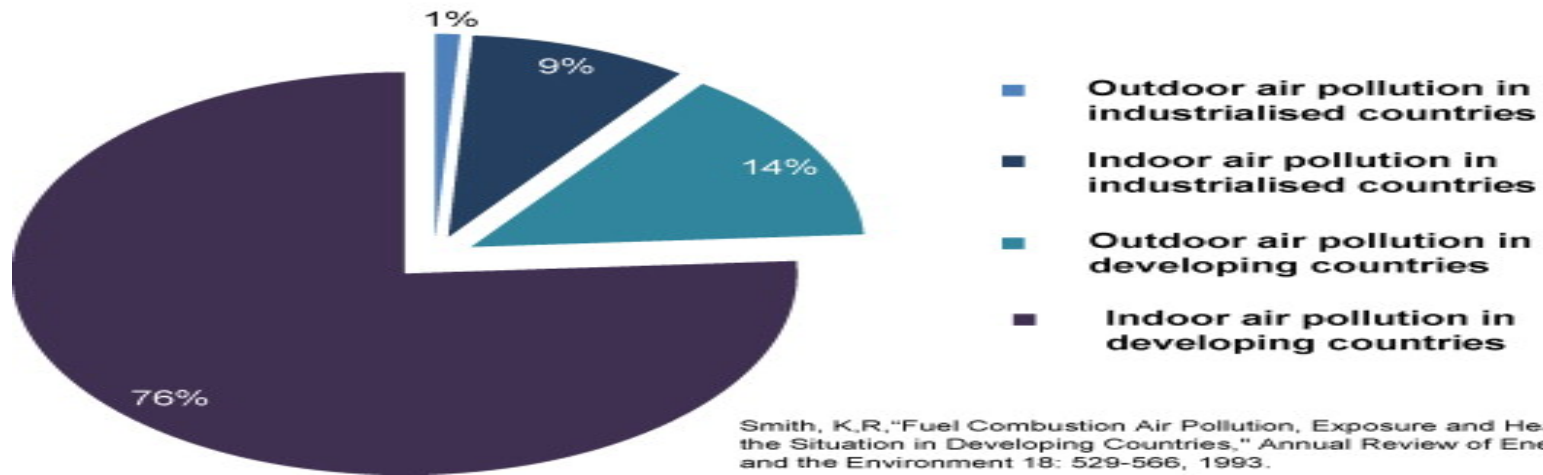


Figure 3 [4]: Particulate Matter Emissions Chart

Methodology

1. Prepare site
 - a. Torrota's farm near NAU
 - i. 10*10 tent
2. Prepare sample
 - a. Obtain materials
 - i. Sawdust
 - ii. Steer Manure
 - b. Design dry briquettes
 - i. Dry Steer Manure
 - ii. Mix fuels
 - Add water
 - iii. Dry fuels
- 3 Start testing
 - a. Have a PM counter above the stove
 - i. Cold start
 - Start fire the fuels
 - Bring water in the cold stove to boil
 - ii. Hot start
 - Refill the hot stove with water
 - Bring it to boil
- 4 Analysis
 - a. Excel Spreadsheet

Trotta's Farm Map



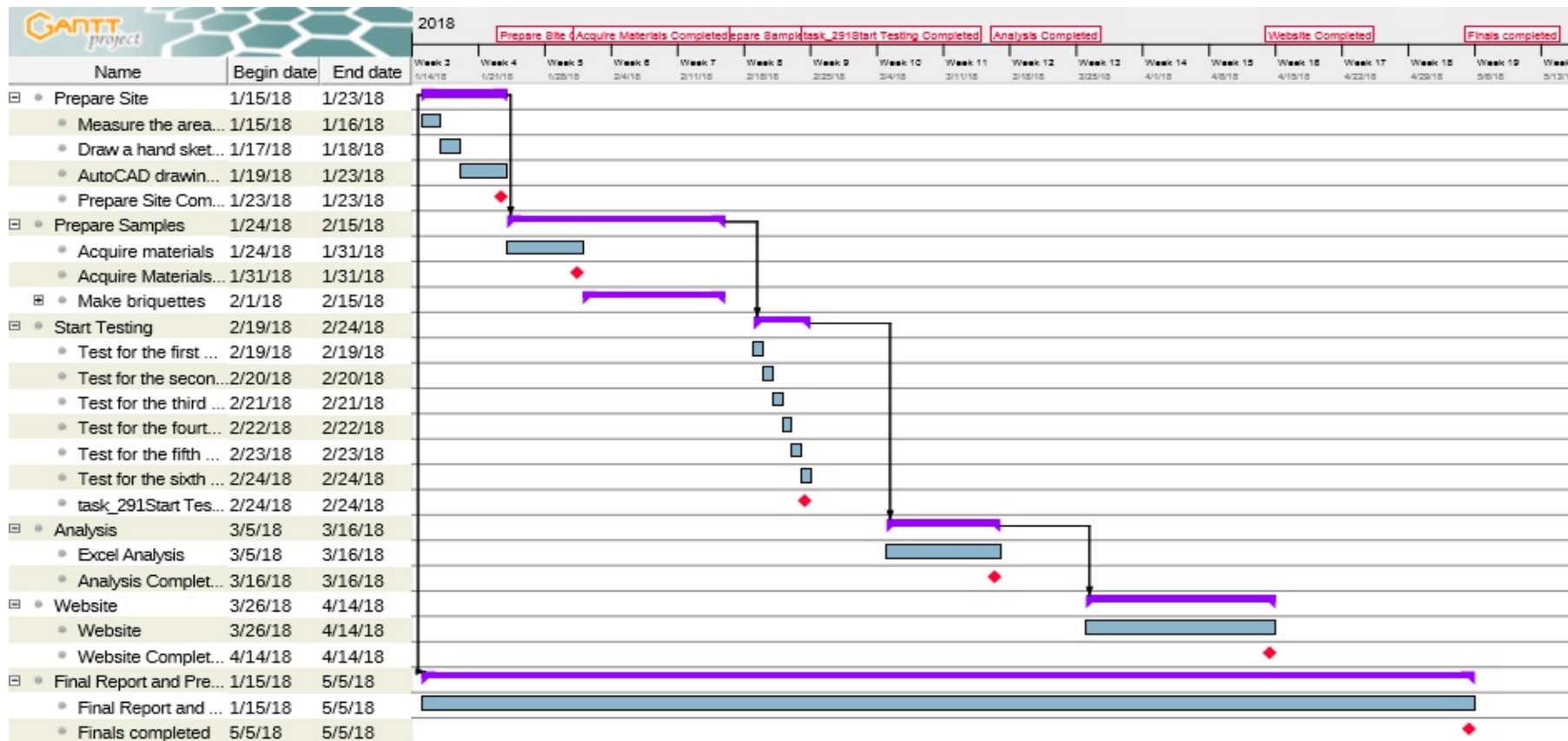
Figure 4: Trotta's farm

Trotta's Farm



Figure 5: Trotta's farm taken by: Xiaoying Tang

Schedule



Cost of Materials

Table 1: Cost of Materials and Equipments

	Quantity	Unit	Unit Cost	Total
Sawdust	10	Pounds (lbs)	\$2/lbs	\$20
Steer Manure	2	Bag (CF)	\$1.47/bag	\$2.94
10x10 Tent	1	N/A	\$109.99	\$109.99
			Total Cost	\$132.93

- Sawdust will be obtained from A P Sawmill and Lumber Prod.
- Steer Manure will be obtained from a local Home Depot Store
- 10x10 Tent will be obtained from a local Walmart Store

Cost of Engineering Service

Table 2: Cost of Service

	Unit Cost	Total Hours	Cost	Adjusted Cost
Senior Engineer	\$51/hr [6]	85hr	\$4335	\$5635.5
Lab Manager	\$46/hr [7]	50hr	\$2300	\$2990
Project Manager	\$70/hr [8]	70hr	\$4900	\$6370
Junior Engineer	\$30/hr [9]	90hr	\$2700	\$3510
			Total Cost:	\$18505.5

- The cost of employee's must be adjusted by 1.3 times their pay to account for overhead costs, benefits, vacations, etc [10].
- The total cost of the team member's service, materials and equipment is **\$18638.43**

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References

- [1] J. Parikh, "Hardships and health impacts on women due to traditional cooking fuels: A case study of Himachal Pradesh, India", *Energy Policy*, vol. 39, no. 12, pp. 7587-7594, 2011.
- [2] J. Langbein, J. Peters and C. Vance, "Outdoor cooking prevalence in developing countries and its implication for clean cooking policies", *Environmental Research Letters*, vol. 12, no. 11, p. 115008, 2017.
- [3] M. Petronzio, "The cookstove that could save 4 million lives per year", *Mashable*, 2017. [Online]. Available: <http://mashable.com/2015/04/20/ecozoom-cookstoves/#PLLtgCTA5Pq1>
- [4] D. Fullerton, N. Bruce and S. Gordon, "Indoor air pollution from biomass fuel smoke is a major health concern in the developing world", *Transactions of the Royal Society of Tropical Medicine and Hygiene*, vol. 102, no. 9, pp. 843-851, 2008.
- [5] "Senior Engineer Salaries in the United States | Indeed.com", *Indeed.com*, 2017. [Online]. Available: <https://www.indeed.com/salaries/Senior-Engineer-Salaries?period=hourly>

References

- [6] "Salary.com Salary Wizard- Do you know what you're worth?", *Swz.salary.com*, 2017. [Online]. Available: <https://swz.salary.com/salarywizard/Laboratory-Manager-Hourly-Salary-Details-PHOENIX-AZ.aspx>
- [7] "Salary.com Salary Wizard- Do you know what you're worth?", *Swz.salary.com*, 2017. [Online]. Available: <https://swz.salary.com/SalaryWizard/Project-Manager-I-Salary-Details-PHOENIX-AZ.aspx?&fromevent=swz.selectjob.freepop>
- [8] J. Engineer, "Junior Engineer Salaries in the United States | Indeed.com", *Indeed.com*, 2017. [Online]. Available: <https://www.indeed.com/salaries/Junior-Engineer-Salaries?period=hourly>
- [9] J. Hadzima, "How Much Does An Employee Cost", *Web.mit.edu*, 2005. [Online]. Available: <http://web.mit.edu/e-club/hadzima/how-much-does-an-employee-cost.html>