

**IDIN Summer Research Fellowship
Final Report Template**



*Analysing the impact of bio-mass energy generation in Rural Punjab
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PART 1: Summary of Research Conducted

Research Focus and Objectives:

A local firm in Rural Punjab (Pakistan) has partnered with local farming communities, to set up a bio-mass based boiler at their paper plant. This initiative will use crop residue such as corn stalks, wheat straw, rice straw and cotton sticks to generate bio-mass fuel.

This is an interesting practice, but its impact is yet to be quantified. This research was oriented towards understanding how the Boiler project would interact with existing economic conditions as well as checking the extent of local community involvement in Biomass Supply Chain i.e. suppliers, sub-suppliers and their associated labour. The magnitude of farmers' involvement in the supply chain, and the value of this activity to the farmer was also an area I got some information on. While the Biomass project should theoretically create more employment opportunities for the locals in the end, it became important to quantify not only its economic impact, but also the impact on changing attitudes and current practices especially sustainable farming by utilizing an important source of energy production which was previously being wasted or burned. Thus the main motivation behind this research is to study the socio-economic impact (both positive and negative) of the biomass boiler on BSP's supply chain.

Since crop production is seasonal, I could only get access to the corn-stalk supply chain in the summer and that became my case-study for this project.

Research Activities:

I partnered with the organization to benefit from their existing networks, and knowledge of the area. With their team, I designed the methodology of the study ensuring that it complied with the lean research framework. The first step was understanding the supply chain, and its different actors. We collectively mapped out the processes and stakeholders of the Corn stalk supply chain (attached in the annex), and considered what information we had for each. Access to all the individuals working in every tier was not possible, so we decided to survey a sample of individuals from each tier of the supply chain, at the 6 Corn Stalk supply center the organization was running. I also wanted to isolate the impact of the bio-mass boiler from the general paper production activities of the company, research was only conducted in BSP centers where corn stalk was being collected specifically for the boiler.

This was also a data-scarce area with no records of the wage rate suppliers were paying their labour, and the employment they were generating. Thus, the biggest challenge was getting creative about how to procure data which didn't exist currently, and how best to extrapolate finding from a smaller sample. In the end, we decided to separate each tier of the supply chain and realistically limit the information we could get of each.

For the main Centre, we obtained employment lists, and log books of suppliers. We augmented this information through direct observation, and a survey instrument to capture social perceptions, attitudes and information on the supplier's and farmer's own supply chain. We went through numerous iterations of the survey to ensure there weren't any superfluous questions which would waste the time of our respondents.

At each center, two main suppliers, two sub-suppliers, one farmer and other local community representatives were interviewed. Organized like focused group discussions, the interviews gave us insight into the socio-economic context in which we were operating and also helped us glean information regarding the perception of our supply chain.

Research Findings:

The organization I did my research with, is committed to creating a wide-scale impact from its economic activities. While measuring the exact trickle down effect of any economic initiative is difficult, I was able to measure the general income and employment being added to the local economy of the area where the centers exist. Through its 6 centers, BSP will have injected Rs. 22897824 (approximately \$228,978) in 2015 into the local economy just through 116 Centre Staff salaries alone (Rs.197395 or \$1973/person). Add to this, the Rs. 76371414 (\$763714) to be added through the 377 suppliers and sub-suppliers associated with the centers (Rs.202576 or \$2025/person). For the most part, suppliers and sub-suppliers pick up the residue for free from farmers. At most, they pay a negligible amount of Rs.500 (\$5) to clear the entire area. This means most of what BSP pays suppliers goes towards the suppliers income and the wage of the labour they hire which comes to Rs. 4028923 (\$40289) for 2015. It generates 50 Labour jobs in the area paid by day, based on the number of trolleys that they load/unload from (Rs.80578 or \$805/person). To put this money into perspective, an average rural household (not individual) in Punjab will make Rs.60000 in a year (\$600) from wages or salaries. One employee doing the same types of agricultural sector jobs in this organization earns a wage 100-300% the average.

The economic impact of course, was not uniform by area, but varied considerably depending on the collection capacity of the centre as well as the economic context of the area. The attached table represents this disaggregated information:

Centre Name	2015- Collectio n Target (mond)	No. of Centr e Staff	Staff Income 2015 (Rs.)	Tot_Supplier s		Labour Income 2015 (Rs.)	Supplier+Su b Supplier Income 2015 (Rs.)
				Main	Sub		
Depalpur	334800	39	819360 0	36	12	180915 4	24807446
Pakpattan	187550	17	280680 0	71	24	348175	14562050
Hujra Muqeem Shah	100775	9	144000 0	5	30	415020	7596593
Dhing Shah	97450	9	192662 4	4	72	778917	6968358
Sahiwal	100775	14	298800 0	71	24	404972	7606641
Chiniot	189975	28	554280 0	19	9	272686	14830327

Depalpur is the centre which generates the most income for Labour and Suppliers. It is also the largest centre with 39 staff members and 334800 mond of collection target. Pakpattan and Sahiwal have the most suppliers and sub-suppliers but with smaller collection targets, the total income of suppliers is not as high as Depalpur's. Dhing Shah is the smallest centre, with the lowest collection target. Yet, income of labour is relatively high there because of the prevalent labour shortage (which came up in our survey) even with lower collection rates.

The purpose of this study was not just to understand the economic impact, but also see how this project might in the future transform attitudes, perceptions or economic practices related to farming. The utilization of corn-stalk residue is a relatively new practice, and we wished to see how farmers would react to this change. It seems from the survey that in all the centers, farmers were willing to give their crop residue to suppliers but very few were currently selling them for money. So while suppliers are benefiting from this economic activity, farmers have not yet realized there is a market for it.

Overall, the social impact perception of this intervention indicated optimistic results. Most suppliers felt their employment opportunities had increased, and more people would join this line of work in the future. However, interestingly the local context came to play even in this aspect as the 2 suppliers from Dhing Shah, felt that this activity would create a shortage of labour or make labour more expensive in the future. This anxiety correlates

with our numbers, which show higher labour wage rates in Dhing Shah as it is. If there is a current shortage of labour in Dhing Shah, the intervention might create a further upsurge in wages.

It was also evident that the organization is providing an alternate source of income for suppliers which is expanding the local economy as well as the options available to the workers. The suppliers mostly mentioned better working conditions and cooperative staff as a reason to have joined this supply chain. So not only this expanding people's choice set of where to work but also might impact the work culture in other firms.

Next Steps:

The first extension would be understanding the impact of the bio-mass boiler on the supply chain for other crops like wheat and cotton. This would be an interesting comparative exercise, to see if the different market contexts of various crops impact the supply of the residue and limit or enhance the benefits to the supply chain evident in the corn-stalk case.

I was also not able to study the impact on farmers specifically, since farmers weren't really selling their residue yet. Perhaps a longitudinal study over time could see if attitudes of farmers change once they realise their crop residue can be monetized now.

PART 2: Findings Related to Local Innovation

My interest in this project was not specifically to study the process of innovation, but the impact of it when an innovative project has been put in place. The innovation in question was a bio-mass boiler which was utilizing crop-residue to produce energy for a paper-making firm. This would allow the firm to become self-sustainable when it comes to energy, but was also a more green solution than most energy production sources. It was also a form of introducing sustainable farming in the area, since more of this crop residue is either burnt, or fed to animals.

I wanted to measure both the economic impact in terms of employment, added income for the local community but also impact of local innovation on changing traditional practices in an area.

The project was in an early stage, but those I interviewed seemed cognizant of the benefits of this innovation and were happy that crop residue could not be utilized instead of wasted. To what extent this will continue in the future is yet to be seen.

The source of innovation was also interesting. Innovation in this case was coming from a for-profit albeit socially responsible private actor. It was heartening to see that not all private for-profit innovation needs to be exclusive, but if done right, can have long term impact on making a community more sustainable.

PART 3: Lessons Learned and Recommendations

The first challenge was the lack of data available. Working in the US, one can become used to the plethora of data available, recorded and used. However, in this case we had to get creative with the sources of our data. I had no data for previous years, which meant I could not do a comparative study and my findings are limited to 2015. We had to compound various sources of data together, from time-sheets from the Centre, to supplier log books as well as surveys.

There was a trade-off between validity or accuracy of the information (since we had to extrapolate wages for labour through interviews), and the practical constraints of not having a lot of time or resources to interview 300 suppliers.

Survey questions had to be short, easily understood and precise without seeming too direct or interrogatory. I had to be aware of the power dynamics at play, since I was working directly with the organization who had employed these individuals. There was of course bias in the answers the suppliers and farmers were providing me, but I tried to counter this through additional followup questions and trying to have an open conversation with them.

If another student were to conduct a similar project, what would be several key recommendations you would make, based on your experience this summer?

In the future students should be cognizant about the following:

- 1) Trying to think of as many data sources as possible. Data will not always be readily available so be prepared to compromise your research aims, and desire for an airtight research design.

- 2) Prioritize the information you must get at any cost, and information you can do without to help with the research design.
- 3) The timing (which month you choose) of your research may limit the people you can have access to, especially in agricultural settings.