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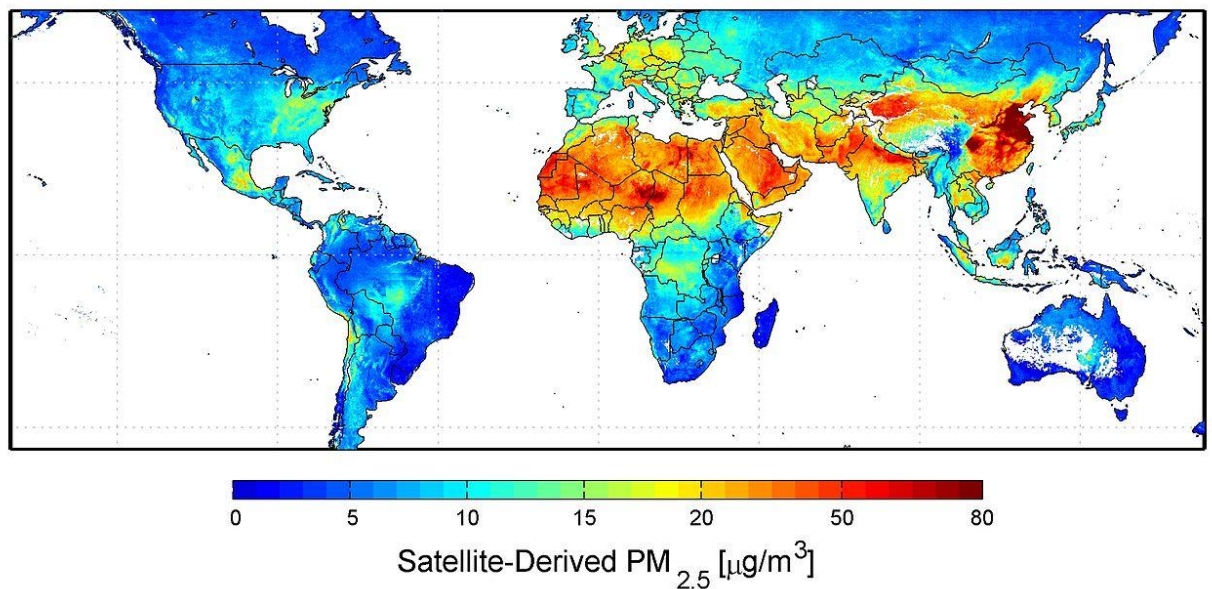
Data Science Final Paper

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### Research Proposal

A major topic of concern is the impact of Straw Utilization in China. This has been a growing problem and has serious potential consequences. With China expanding their agriculture sector and now being the largest producer of wheat in the world, they have a major responsibility to alter the extermination of their remaining crops in an alternative fashion. China also happens to be one of the most polluted countries in the world and the topic of burning straw adds to that continuing problem. There are many issues that are a result of this process, but also future solutions to help assist in damage that has been made to the environment and human development. On the topic of human development, Amartya Sen says in his *Development as Freedom*, “development consists of the removal of various types of unfreedoms that leave people with little choice and little opportunity of exercising their reasoned agency.” Straw burning is a primary burden on the development of China economically, environmentally and socially and the citizens of China face these problems everyday and are desperate for some sort of reform.

The negative acts from farmers in China limit the progress of human development that could be achieved in China. Burning of straw committed by the farmers has led to serious problems in the environment. China is the largest polluter in the world, polluting over ten billion metric tons of carbon dioxide in 2018 alone and steadily on the rise. According to Zhang Hefeng et al, the harmful toxins of ethene, ethyne, propene, benzene, ethane, toluene, propane, alpha-pinene and 1-butene have all increased to significant levels that are dangerous and risk the result of climate change and poor health quality on top of being the most polluted nation in the world. Another reason human development is being held back is due to societal effects. The PM<sup>2.5</sup> chemicals that get released into the air have a negative impact on the development of humans. According to a study done by Wangyang Lai, et al, they found that the harmful chemicals affect the development of the brain. The test that was conducted found that people aged 55 and above scored poorly on a cognitive test compared to others who were similarly aged but not exposed to the chemicals. Concluding that the PM<sup>2.5</sup> chemicals affect humans. Looking at the image attached, it compares the emission levels from other countries around the world. It shows that China has the highest PM<sup>2.5</sup> emissions by appearing the darkest red on the map.



Considering all of these setbacks to human development in China, there must be an attempt to change the norm of straw burning. The research idea that is attempted to be answered is what are the solutions to the problem of straw burning and how will it affect the environment? Answering this question in an effective manner will allow for Amartya Sen's idea of human development to prevail in China. This would limit the amount of PM<sup>2.5</sup> emissions being released into the environment and because of that, global warming would be limited as well as cognitive implications from surrounding people.

The Solution to answering that question would be to implement many changes in order to limit the negative effects from burning. If the implemented changes of creating a sustainable strategy for straw recycling were developed in China, the air quality would significantly evolve and negative cognitive effects would disappear. In order for the

research proposal to be carried out, there would first need to be an incentive option given to farmers so that the solutions can be tested and experimented on, this would allow for research to track data and see if it's a valuable option. Another objective would be the solution that is being implemented would need to be present during the experiment. The solution that is being introduced is to use the straw as a fertilizer and or mulch, instead of burning it off. This would greatly reduce the amount of air pollution and could be a valuable option. In order to see if this is effective, research and experiments would need to be done to see if the straw used as mulch is effective and by how much it will save the environment in a designated time period.

Implementing this change would affect so many different people and factors. There would be many benefits that come from this implementation. The first benefit is that it would reduce the amount of harmful emissions released into the air by a large amount. Reducing the amount of emissions will also have a positive effect on nearby people and their cognitive abilities will be improved. According to a study published in the journal Science, they reported greenhouse emissions would reduce by about 78 percent. Another benefit as a result of the implementation would be keeping the health of the soil. The last benefit that would come would be the improved health for people living in the areas. According to Lai Wangyang et al, there is a direct correlation between  $PM^{2.5}$  emissions and negative effects on cognitive abilities. This study can help to address those concerns and possibly introduce new solutions. There are also obstacles that could prevent this change from happening. The first is the cost burden on farmers. The opportunity cost for farmers to reuse their straw is not as appealing

compared to burning it off. With only about 20 days in between crop seasons, manual labor is often impossible to use to clean the fields for the next harvest. Over the course of a 1-3 year period, there would be suggestions to research and following the implementation of this product. The research that would need to be done would be to measure the Air Quality Index in the areas where straw burning takes place. This would need to be done before the solution is implemented as well as during the 1-3 year time period and following the time period. This measurement would give researchers an idea of how polluted the air is and therefore, track the improvements the proposed idea may provide. Aside from measuring how polluted the air quality is, using a gravimetric weighing method is an option to measure the  $PM^{2.5}$  levels in the air. This would be done by drawing air into a transparent air filter and the particles in the air would be collected into the filter. This would allow researchers to understand how the implemented solution has an effect on the particle levels. According to Chong Liu et al, they found that the efficiency of PAN transparent technology is the most efficient in securing  $PM^{2.5}$  and  $PM^{10}$  emissions. Using this same technology would allow researchers to study the cognitive functions of nearby people and see if they have improved at all and to what extent. People that would benefit from these results would be people who live in the area because they are most affected by the emissions. Farmers would see first hand how effective this new method is and can continue to pursue new improvements.

There are many reasons as to why funders should be involved in this project. One reason why it should be funded is because according to a study done by Shi

Tingting et al, they found that straw burning had harmful effects on visibility and created travel concerns. They also found that as temperature rises, organic matter in the soil is reduced eliminating soil water content and microbes, causing the soil to harden.

Another reason it should be funded is because the research can lead to positive strides into implementing solutions to combat cognitive and environmental health. Comparing the methods of research that are being proposed with the past research models that have been made there are many pros and cons. According to Changsheng Qu et al, they found that the highest levels of  $PM^{2.5}$  are over two times the annual limit during the summer harvest. The annual limit is  $75g/m^3$  and many cities including Nanjing, Yangzhou and Zhenjiang reach levels of  $200g/m^3$  and sometimes  $225g/m^3$ . These negative results from the listed studies are reasons why funders should want to support a research project that would combat these results. The solutions they have proposed have been trying to develop ways of high-efficiency, low cost and less secondary pollution that can reduce emissions and also improve utilization value. The cons with this method is that it can take time and requires lots of funding in order to be achievable. In the near future, it may not be achievable.

In the proposed research plan, there are expected objections for the plan. According to Jiqin Ren et al, they state that one of the challenges is the different consciousness levels of farmers toward utilization in different regions. Another that was stated was a very short time window between harvesting and planting crops especially in southern China. To combat these objections, there must be cooperation in order to

carry it out. First, the intended method that is being researched on will still allow for farmers to transition from different crop seasons. The intended method takes about thirty days, making it a little longer than what the farmers are accustomed to but if adjusted correctly, the solution can be very useful.

In order to carry out this research proposal, there is an in depth budget that must be met. The first part of the budget would be to address the costs of paying researchers and workers for a three year term. This cost would amount to about 60,000 dollars per year for each researcher and worker. For example, if we have three researchers and six workers, this would amount to 360,000 for wages alone. The next part of the budget would consist of the data collection. In order to collect the data, air filtration systems for  $PM^{2.5}$  emissions would need to be present. This would cost around 5,000 per unit and to record accurate data, having about five units would be ideal to account for variables. This would cost around 25,000 dollars. Another cost would be to pay farmers an incentive to account for potential losses in their crops so the hypothesis can be tested. This would amount to around 30,000 dollars considering the research is done with multiple farmers and the incentives are distributed equally. Another part of the costs would be to address travel/accommodations/food. According to the Bureau of Labor Statistics the average spending of food in the US is about 4700 dollars. Spending 90,000 on food for three years would be sufficient for the researchers and workers and the last cost would be around 50,000 dollars for miscellaneous reasons. All together the project would cost around 555,000 dollars.

In conclusion with the research proposal, it answers the central question of what are the solutions to the problem of straw burning and how will it affect the environment? This is a major problem for the environment and affects many different characteristics in its area. This proposed research proposal would help produce more statistical analysis into how the solutions work and if they are effective, it's also necessary for the progress on the topic of straw utilization.



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