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India, Infrastructure

The Importance of Transport Infrastructure for Small-Scale Farmers

India is a country of extremes. It's home to some of the world's tallest mountains and some of its flattest wetlands; the richest man in Asia is Indian, yet the per capita income is only 1,764.56 dollars a year (*BusinessToday.in* 2020). India is also a rapidly developing country; according to the World Bank, 90 million Indians managed to escape extreme poverty in just 2011-2015. Since the 21st century, the Indian economy has developed from an agrarian society to a well-diversified mix of high-tech services, manufacturing, and agriculture. However, most Indians still depend on small-scale farming for their livelihood. Farming in India is a far-from-perfect system—and one of the scourges that plagues India's farmers is untenable transport cost and unreliable access to markets. If farmers aren't able to sell their crops, or have to shell out an arm and a leg to get their crops to the market, the foundation of their entire livelihood is endangered. However, a new road technology that makes use of plastic waste has proven itself to be an excellent contender for solving these issues—these plastic roads are cheaper and stronger than traditional roads. While India has begun to adapt this technology, if the plight of India's farmers is to be improved, it is critical that India fully utilizes and promotes these new roads. And in order to do this, India must drastically improve its recycling capacity in order to provide road developers with the plastic they need.

Before we can understand the situation faced by Indian farmers, however, it is important that we understand a little bit about India itself. Firstly, despite a rapidly expanding number of Indians that are completing high school and obtaining degrees, most Indians still work in agriculture. Although India is modernizing and changing astonishingly quickly, traditional family structures are still alive and well in much of rural India. Indian family traditions are complex, and differ wildly from one region to the next, as well as between the many different religious groups; though as a general theme across these groups, people marry young, with the bride usually living with the groom and his family. Arranged marriage is still prevalent, but far less so than a few decades ago, and for Hindu families, many adhere to the 3000-year-old caste system (BBC 2019). The caste system is essentially a birthright system; families are born into their caste. Persons are only supposed to marry within their caste, and typically aren't allowed to share food or amenities with other castes (BBC 2019). These factors have resulted in a somewhat stratified society in many conservative rural areas, where families don't frequently intermix. Discrimination based on caste is constitutionally outlawed in India, but this is not effectively enforced in more remote parts of the country (BBC 2019). Although the caste system still has influence in India and on its Hindu families, a lot of modern Indian families have begun to ignore the caste system and other traditional restrictions placed on families. Nonetheless, for the typical rural family whose livelihood is dependent on subsistence farming, traditional family values often still play a large role.

For these families that are reliant on farming, having access to proper agricultural amenities is vital. Without the ability to sell excess crops, many families are placed into serious financial insecurity. For this reason, it is crucial that the Indian government provide unfettered access to markets where farmers can sell their crops with as little trouble as possible. And in addition to having access to these markets, farmers also need to be able to easily transport their crops to markets. This is why infrastructure is such a central part of a well-oiled agricultural system. Since crops are not sold where they are grown, it is essential for countries to have accessible systems in place so that farmers can easily transport their goods

to both domestic and foreign markets. In most developed countries, farmers generally do not transport their own crops. Instead, farmers will sell their products to distributors who then transport the farmer's products to their destinations. India uses a similar structure to this, in the sense that Indian farmers sell their crops to intermediaries who then sell it elsewhere. But India's agricultural situation differs significantly from the developed world in the fact that 70 percent of rural households depend on agriculture for their livelihood, of which 82 percent of this number are small-scale operations—a substantial difference compared to the United States, where less than 2% of people are employed in farming (FAO, 2017). Furthermore, Indian farmers have little purchasing power, with the average farmer making only 1,008 dollars per year (Jha, 2016). Because of their low purchasing power, Indian farmers deal with a system where intermediary traders wield significantly more market influence than them. This results not only in farmers receiving less for their crops, but also in consumers paying more for those same crops (Healy, 2018). It's important to understand this situation, as infrastructure has played a large role in shaping it. According to Healy, infrastructure ranging from market locations, transport costs, and lobbying and collusion among traders all contribute to a far from ideal system for farmers (2018). Clearly, building roads cannot remedy such a deep-rooted issue, but in Healy's investigation on the effect of highways on agricultural market activity, he finds that the construction of a major highway in India led to "a significant increase in rice prices received by farmers" (2018). Moreover, he also claims in his investigation that his findings are consistent with a considerable amount of literature around the same subject. Taking these results into consideration, it is evident that the construction of transport infrastructure has a major and beneficial impact on the livelihoods of farmers and the markets they contribute to.

Now that we understand the importance of adequate infrastructure for farmers and general agriculture, we can focus on how to address the issue of insufficient infrastructure in India.

In 2001, the Indian chemistry professor Dr Rajagopalan Vasudevan invented a solution to reduce plastic waste—he made roads out of it. Through his research, he discovered that plastic polymers were surprisingly similar to that of bitumen, a tar-like substance combined with gravel to lay roads. This plastic-bitumen mix not only made roads more durable and flexible, but also prevented pothole formation (Thiagarajan 2018). In addition to being stronger than typical roads in most cases, plastic roads also use 6-8 percent less bitumen, resulting in a significantly more cost-effective road (Thiagarajan 2018). Furthermore, since each kilometer of plastic road uses up to a ton of plastic waste, the technology also has the capability of being a terrific plastic sink for the non-recyclable plastics that bury the streets of cities and pollute the coasts and rivers of India. Plastic roads are in fact so effective at using plastic waste that Almitra Patel, a member of India's supreme court committee for solid waste management, has said that "If [this technology is] seriously adopted in all cities for all multi-film laminates, it has the potential to achieve near-zero landfill, leaving almost nothing for final disposal" (Thiagarajan 2018). The advantages of this technology have not been lost on the Indian government either. In 2015, the Indian road transport minister said in an interview with the Times of India that "We are going through the details and are keen that the waste is utilized efficiently. Delhi will get rid of these [garbage] mounds and we will get the material for laying base with little expense. We have to take steps to ensure nothing goes to waste" (TNN).

India has since made it mandatory for road constructors to utilize plastic waste in any road development projects, and according to New Delhi Television Limited, India has constructed 100,000 kilometers using Dr. Vasudevan's process (2018). A large portion of these roads are in the South Indian state of Tamil Nadu, where cities like Chennai and Indore have used hundreds of thousands of pounds of plastic waste to build its roads. Yet despite its progress, its cost-effectiveness and strength, and a mandatory decree for

building roads out of plastic polymer, plastic roads make up only 2% of India's 4.699 million kilometers of roadways. By all means, the development of plastic roads in India has been marvelous and inspiring, but it has faced roadblocks: some states have had difficulty implementing the technology,¹ claiming that segregating plastic waste and obtaining contractors for the project has been difficult (Chandran, 2017). Furthermore, some corporations and cities that have been rolling out plastic roads have found that they're unable to collect enough plastic from households. The committee member Patel has even said that "The real challenge lies in collecting all of the voluminous post-consumer packaging" (Thiagarajan 2018).

Although a plastic waste deficit seems bizarre and ironic for a nation swimming in plastic waste, this issue brings light to an endemic deficiency in India's infrastructure: recycling facilities are underused and underdeveloped. Plastic roads may present a great opportunity for reusing plastic waste and improving the livelihoods of rural farmers, but without an adequate ability to recycle plastic waste, the rollout of plastic roads will be severely hampered. Currently, only 60% of plastic is recycled in India; this is profoundly below international benchmarks (Samaddar 2018). In order to increase this number, there needs to be a coordinated effort from both state and federal institutions to provide greater access to recycling services across India. In addition to this, it is crucial for recycling services to be advertised and publicized so that citizens become aware of their existence. Even beyond this, monetary incentives will need to be provided to encourage citizens to actually use the advertised services. If these efforts are implemented, even if it's just in a few states, India could both begin to raise its abysmal recycling rate and start to produce a culture of social awareness among its people about the importance of recycling, which is something that Samaddar claims that India lacks (2018). Moreover, if these issues are publicized, citizens will begin to recognize the dangers plastic waste poses to their country and further support the creation of plastic roads.

However, the issue with any solution to this is that the underlying problems it attempts to address are complicated. There are many barriers to the implementation of plastic roads, and not all of them can be easily resolved. Everyone essentially agrees that plastic roads should be built, but once we go beyond that step, there is little direction as to how anyone's supposed to go about doing it. But there are maybe some first steps that could be taken to realistically aid the construction of more plastic roads.

Getting federal funding from the Indian government may be wishful thinking, but it's the best way to increase funding for plastic road production. The federal Indian government would be able to assist by providing tax credits or subsidies for companies that construct plastic roads. Although the Indian government has made it mandatory for most new roads to be built from plastic polymer, they have not provided any significant assistance for construction companies to help them meet these mandates. By providing some sort of subsidy/credit to these companies, the Indian government would both incentivize more companies to take on contracts for plastic roads, as well as help address some of the funding shortages contractors face when attempting to complete plastic roads. I believe these subsidies wouldn't need to break the bank either: meeting just 1-5% of the cost of construction could help cover the expenses of building plastic roads. It may seem counterintuitive to subsidize a type of construction that's actually cheaper, but since plastic road construction requires slightly different technologies than traditional roads, these technologies present an upfront cost that can be off-putting to potential contractors (Thiagarajan 2018). In other words, plastic roads are cheaper in the long run, but require a sizable investment, and a subsidy could help to smooth over these initial expenses as well as to incentivize companies to take on plastic road contracts. This isn't the only approach we could take, though. These subsidies don't necessarily need to be from the Indian government itself. State and city governments would also be able to implement this. Although these subnational governments are already the ones responsible for constructing new plastic roads, diverting more money into these projects from other sources could be beneficial considering the economic benefits of plastic roads and infrastructure in general (Healy, 2018).

It may be the case that plastic roads will pay themselves off via increased economic activity, and thus be worth it for municipal governments to place more money into this technology.

Part of the reason plastic roads can be difficult to build is because, as previously mentioned, India's recycling infrastructure isn't tremendously developed. A lot of state governments find segregating plastic wastes to be challenging. The issue in addressing this problem lies in recycling infrastructure's steep costs and difficulty to manufacture. India's technology sector is not quite robust enough to make widespread the kind of recycling plants we see in countries like Japan or Germany. However, the fundamental idea of separating plastic waste is very simple. All that needs to happen is that plastics that can be used for plastic roads are separated from those that can't (Thiagarajan, 2018). This is an arduous task for a machine to carry out, but luckily, it's quite easy for humans to do. There already exists a large informal economy in India based on workers who sort trash for materials they can sell, so one way to address the difficulties states face when segregating plastic waste could be to hire and train these informal workers to filter out usable plastics, instead of relying on expensive and complicated machinery. This would probably work: the existence of an informal economy of people who already sort waste for a living would indicate that there would be demand for a more dependable job doing the same thing. Plus, it has the added benefit of giving stable jobs to workers who labor in a typically impoverished field.

Ultimately, a combination of state and federal efforts for promoting and incentivizing recycling as well as providing access to recycling bins and facilities may be the best option. Though in honesty, the issue of recycling infrastructure in India is inherently tied to the development of India's economy and capacity for high-tech manufacturing. Many parts of the recycling process are currently prohibitively expensive to carry out on a mass scale in India. It could take decades before India's recycling infrastructure operates at a threshold that could sustainably reduce contamination and meet the demand for plastic roads domestically. However, recognizing this issue and taking small steps to encourage communities to participate in recycling efforts will be an invaluable first effort to build upon. And if necessary, other options for cheap plastic are available. For instance, developed nations often export their plastic waste to Asia since it's cheaper than expanding landfill capacity. While normally these endeavors tend to be unsustainable since most of the exported waste is at risk of contaminating waterways, importing European/American plastic waste for use in plastic roads might be a viable option for India, since plastic roads are non-contaminating provided they are constructed correctly. This would serve not only to provide plastic road construction with the necessary plastic, but also to ensure that exported plastic waste doesn't end up in untenable landfills.

If these solutions are taken in tandem, India would almost certainly be able to provide plastic road developers with the necessary plastic that they require, while simultaneously reducing the inefficiencies that a lack of material sows in the implementation of a type of road that is both more durable and unprecedentedly inexpensive. If recycling services are properly expanded through the increased promotion, incentivization, and accessibility of recycling, then India will be able to expand its roadway network significantly, which—in addition to providing Indians with safe and reliable transport and connecting the nation—will enhance the lives of local farmers across the nation, providing them with dependable access to markets and helping to secure their livelihoods.

Works Cited

- “Ag and Food Sectors and the Economy.” *USDA ERS - Ag and Food Sectors and the Economy*, www.ers.usda.gov/data-products/ag-and-food-statistics-charting-the-essentials/ag-and-food-sectors-and-the-economy/.
- Annamalai, S., and Jacob Koshy. “Solving Bad Roads and Plastic Waste Problems in One Shot.” *The Hindu*, The Hindu, 25 Nov. 2018, www.thehindu.com/news/national/recycling-opens-new-road-to-stave-off-plastic-threat/article25587139.ece.
- Asia-PacificIndia. “What Will It Take for India to Reach Its Infrastructure Goals?” *Knowledge@Wharton*, 18 Feb. 2020, knowledge.wharton.upenn.edu/article/will-take-india-reach-infrastructure-goals/.
- Chandran, Rina. “Sturdier, Safer, Cheaper: India Urged to Build More Roads with Plastic Waste.” *Reuters*, Thomson Reuters, 25 Oct. 2017, www.reuters.com/article/us-india-environment-construction/sturdier-safer-cheaper-india-urged-to-build-more-roads-with-plastic-waste-idUSKBN1CU24W.
- “FAO.org.” *India at a Glance | FAO in India | Food and Agriculture Organization of the United Nations*, www.fao.org/india/fao-in-india/india-at-a-glance/en/.
- “Five Things to Know about Plastic Waste and Recycling in India.” *Phys.org*, Phys.org, 2 Oct. 2019, phys.org/news/2019-10-plastic-recycling-india.html.
- Healy, Paul. “Transport Infrastructure and Agricultural Markets: Evidence from India's NS-EW Highway.” *Centre for the Study of African Economies*, University of Oxford, 28 Aug. 2018, www.csae.ox.ac.uk/materials/papers/csae-wps-2018-13.pdf.
- “India.” *Poverty & Equity Brief*, Oct. 2019, databank.worldbank.org/data/download/poverty/33EF03BB-9722-4AE2-ABC7-AA2972D68AFE/Global_POVEQ_IND.pdf.
- “India's per-Capita Income Rises 6.8% to Rs 11,254 a Month in FY20.” *Business Today*, 7 Jan. 2020, www.businesstoday.in/current/economy-politics/india-per-capita-income-rises-68-to-rs-11254-a-month-in-fy20/story/393333.html.
- Jha, Abhishek. “Rs 6,000 Is 6% of a Small Farmer's Annual Income, According to NSSO Data.” *Hindustan Times*, 6 Feb. 2019, www.hindustantimes.com/india-news/rs-6-000-is-6-of-a-small-farmer-s-annual-income-according-to-nssso-data/story-rddMw0hk6cSbxjo7E1GyKK.html.

Kandhal, Prithvi S. "Use of Modified Bituminous Binders in India - Current Imperatives." *Scribd*, Journal of the Indian Roads Congress, 2011, www.scribd.com/doc/81350307/Use-of-Modified-Bituminous-Binders-in-India-Current-Imperatives.

Karelia, Gopi, and Sonia Bhaskar. "One Lakh Kilometres Of Roads In India Are Being Made From Plastic Waste, Is This The Solution To End Plastic Crisis?: World Environment Day." *NDTV*, 26 Oct. 2018, swachhindia.ndtv.com/plastic-waste-roads-one-lakh-kilometre-india-20274/.

"The Paradox of India's Infrastructure." *BHP*, 5 July 2018, www.bhp.com/media-and-insights/prospects/2018/07/the-paradox-of-indias-infrastructure/.

Philip, Christin Mathew. "Plastic Shortage Hits Corporation Road-Laying Plan: Chennai News - Times of India." *The Times of India*, TNN, 26 Jan. 2012, timesofindia.indiatimes.com/city/chennai/Plastic-shortage-hits-corporation-road-laying-plan/articleshow/11635224.cms.

"The Plastic Waste Trade in the Circular Economy." *European Environment Agency*, 10 Dec. 2019, www.eea.europa.eu/themes/waste/resource-efficiency/the-plastic-waste-trade-in.

Samaddar, Sujeet, and Ajeya Bandyopadhyay. "There's Much to Gain from Recycling of Waste." *@Businessline*, The Hindu BusinessLine, 28 Aug. 2018, www.thehindubusinessline.com/opinion/columns/theres-much-to-gain-from-recycling-of-waste/article24802735.ece#.

Subramanian, Sribala. "Plastic Roads: India's Radical Plan to Bury Its Garbage beneath the Streets." *The Guardian*, Guardian News and Media, 30 June 2016, www.theguardian.com/sustainable-business/2016/jun/30/plastic-road-india-tar-plastic-transport-environment-pollution-waste#maincontent.

Thiagarajan, Kamala. "The Man Who Paves India's Roads with Old Plastic." *The Guardian*, Guardian News and Media, 9 July 2018, www.theguardian.com/world/2018/jul/09/the-man-who-paves-indias-roads-with-old-plastic.

TNN. "Waste from Landfill to Be Used for Laying Roads: Delhi News - Times of India." *The Times of India*, 29 Dec. 2015, timesofindia.indiatimes.com/city/delhi/Waste-from-landfill-to-be-used-for-laying-roads/articleshow/50359872.cms.

"Traditional Family System." *UTC Wordmark*, www.utc.edu/faculty/sarla-murgai/traditional-family-system.php.

“What Is India's Caste System?” *BBC News*, BBC, 19 June 2019,
www.bbc.com/news/world-asia-india-35650616.

“The World Factbook: India.” *Central Intelligence Agency*, Central Intelligence Agency, 1 Feb.
2018, www.cia.gov/library/publications/the-world-factbook/geos/in.html.