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ORF OCCASIONAL PAPER

AUGUST 2018

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ISBN : 978-93-88262-18-7

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ABSTRACT

This paper examines two types of waste on which India can explore transboundary waste-trade opportunities and challenges: farm produce waste and municipal solid waste. Using lessons learnt from trade between other countries, the paper argues that while India can augment its economy through increased waste exports or imports, certain conditions must be met for India to benefit from sustained international waste trade practices. The paper recommends that India's policymakers consider the prevailing infrastructural gaps, agricultural practices, municipal functioning, finance and current social conditions, and focus on using its waste judiciously within the country. The aim is to set the house in order before international waste trade can become a progressively tightened, transparent and sustainable advantage.

INTRODUCTION

Legal and illegal transboundary shipments of both non-hazardous and hazardous waste have increased in the past decade.[1] Examples from various countries show that the stakeholder (governments, businesses, publics) mindset is rapidly changing from 'waste as a disposal problem' to 'waste as a resource opportunity'. The primary drivers for waste trade are economic, legislative, technical, in addition to the differences in demography and infrastructure across countries.[2] For exporting countries, economic drivers such as the high cost of treatment and taxes on waste are most significant. For importing countries, reuse of waste and monies made from transporting and disposing waste into their own countries are key drivers. Countries that successfully employ technology to generate biofuel from waste have begun importing waste to make optimal use of their specialised waste treatment facilities. This paper has chosen examples from two areas—farm produce waste and municipal solid waste—to analyse if India is in a position to engage in the legal import or export of non-hazardous waste in an environmentally sound and economically beneficial manner. In the context of farm produce, the unused produce at various stages of the food supply chain has been referred to as 'waste' even though it is perfectly edible and usable; it is therefore not true 'waste' in traditional terms.

Whenever 'waste as a resource' has been used as an economic opportunity without taking into consideration socioeconomic impacts, there have been negative implications on health, environment and economy of the stakeholders or the public at large. However, when waste trade takes into account social and developmental aspects, it brings sustainable advantages to the trading nations. The paper uses examples to highlight both.

While the paper does not dismiss transboundary trade of waste in any area, it addresses specific waste export and import challenges to assess if the advantages associated with the domestic use of waste in India currently outweigh the advantages of transboundary waste trade.

The paper focuses on stakeholder challenges associated with waste creation and waste trade, without specifically citing data on trade of waste volumes:

- Internationally comparable data and statistics on waste is sparse as most countries are in the early stages of developing their databases;

- Researchers use different assessment protocols. Some countries generate data on per capita basis, others in actual volumes or at the level of monetary value attached to the waste product;

- Most of the available data deals with specific stages and waste types and not the whole supply chain of any resource.

I. CONSIDERATIONS FOR WASTE EXPORT

1.1. Culling

The Food and Agricultural Organization of the United Nations (FAO) states that food 'waste' is different from food 'loss'.[3] Food losses occur in the production chain, while food waste is a consumption-related problem, i.e. when food reaches the market but goes to waste due to consumer behaviour. Waste can also occur when food is left unharvested due to overproduction or is rejected due to over-regulations or aesthetic reasons, despite the good quality of the produce

in terms of taste and nutritional value. The primary problem in India and many developing countries is 'food loss' due to poor storage facilities, lack of infrastructure for food distribution, and lack of food-processing facilities close to the production sites.[4] Food loss in developing countries is at an estimated 30–40 percent compared to 5–25 percent in developed countries.[5] In the high- and middle-income countries, 'food waste' happens at both the harvest stage and the consumer retail stage, the latter largely due to the consumer mindset regarding food surplus, food aesthetics and technological requirements for grading food for food processing (United Nations, 2011). FAO data shows that Europe and North America waste 95–115 kg food per capita each year, while sub-Saharan Africa, south and south-eastern Asia waste 6–11 kg per capita in one year.[6]

India is the world's second-largest fruit and vegetable producer after China, but it still suffers from approximately 70 percent food loss due to the gaps in the early stages of harvest and distribution.[7] In October 2017, Harsimrat Kaur Badal, Minister of Food Processing Industries, stated, "India is currently only processing 10% of its food, resulting in enormous food waste."[8] She unveiled India's plan to partner with the United States (US) industry to borrow technologies and innovations for the entire spectrum of food production leading to food consumption. Earlier, in January 2017, India and the United Arab Emirates (UAE) announced a roadmap for increased maritime cooperation and expansion of logistics facilities in India to help export food and perishables to the UAE markets at lower costs.[9] India plans to draw on UAE's investments and expertise in the development of policies, processes, warehouses, digital systems and cold storage networks for the proposed 'farm-to-port' special economic zones.[10]

While the Government of India is taking bold steps to decrease food loss by increasing export of surplus produce directly from farms and food processing units, examples from some countries highlight how aesthetic selectivity in the industrialised food chain systems can create significant loss and waste.[11] The United Kingdom (UK) processes over 65 percent of its food.[12,13] However, around 85 percent (by weight) of the avoidable food waste in the UK occurs in households and food manufacturing companies.[14] Thus, aesthetic and grading selection by importing countries can nullify any increase in the export of raw produce to reduce storage-related losses. The social impact of this is high on small, conventional farmers, who may not able to meet the buyer requirements for uniform shape, colour and size.[15]

Waste Due to Culling for Processing and Packaging

- Culling at harvest stages: According to the National Center for Biotechnology Information, US, each year, over 2.7 million tonnes of fruits and vegetables are not harvested in the US due to poor crop aesthetics.[16] Machine harvest further increases the waste loads per tonne, since they are not capable of sorting and leaving unripe produce in the fields.[17] While mechanised harvesting is process oriented, less labour intensive and fast, handpicking of fruits and vegetables generally results in more uniform picks vis-a-vis quality and maturity.[18] Moreover, produce for transporting to longer distances—especially for exports—is often purposely harvested at less-than-ideal maturity,[19] resulting in wastage during selection, suboptimal taste and lower nutritional value.[20] Highly stringent quality standards for meeting aesthetic requirements can also lead to substantial waste. Japan has been exporting designer fruits and vegetables; cube, heart-shaped and triangular watermelons or

pentagonal oranges are grown as ornamental novelty or for packing ease.[21] Most of the flowers or unripe fruits on the vine that do not meet the brand promise are discarded.[22,23]

- Culling at processing stages: A farm in Yorkshire rejects 25–30 percent of carrots during packing. This is because the photographic sensor machines reject carrots that are not bright orange, or have a bend, blemish or break.[24] The farm says, "Some supermarkets insist carrots should be straight so customers can peel the full length in one easy stroke."[25] Mechanised food processing industries demand size uniformity. For example, in the canning process, machines can only peel pears within a certain range of size and curvature, thus wasting about 45 percent of pears on an average.[26] A French fries processing unit in Netherlands rejects large quantities of potato during size reduction, in which potatoes are cut into equal sized strips. Additionally, once transported to the site, it is cheaper for the company to discard the unused potatoes and trimmings than to reuse them.[27] The European Commission estimates that processing leads to around 39 percent of the total food lost in the food supply chain because of trimming and other technical issues.[28]

- Culling at packaging stages: The packaging industry prefers uniform-sized produce for easier packability. In Europe, regulations on produce sizes became so strict that they met international ridicule: EC Regulation No. 2257/94 stated that all bananas must be "free of abnormal curvature" and at least 14 cm in length.[29] The idea behind uniformity was less to do with aesthetics and more to ensure easier packaging for storage and transport. However, such regulations created classification into

two grades, where goods that met strict criteria on size, shape and appearance were labelled "class one," and retailers thus started focusing less on class two produce. Around 26 of the EU's 36 directives were be abolished in 2009, but the retailers and consumers continue demanding uniform-sized produce.[30] Consumers now link "class one" grade with aesthetics.

Industrial processing of food creates solid and liquid waste. The preparation and preservation of pureed, trimmed, canned, cured and frozen foods also require large volumes of clean water.[31] Thus, water scarcity and pollution abatement strategies need due consideration as well.[32] India must consider multiple ways of minimising food loss instead of relying too heavily on food processing or the export industry.

Minimising Culling Waste (and Loss)

- Vertically integrated plantations and supply chains: Kenya's horticultural exporters have been facing order cancellations of up to 45 percent due to consumer intolerance for food with low aesthetic appeal.[33] The Kenyan government is facilitating whole crop purchasing and vertically integrated supply chains to significantly lower the volumes of export rejects.[34] To reduce rejection rate for pineapple exports in Ghana, for instance, the government is targeting different markets with different expectations. "Relative production inefficiency and moral hazard problems is causing exporters to prefer vertically integrated plantation production."[35,36]

- Awareness-building: Farmers in Kenya are being educated to pick produce at the right maturity stages. The government is supplying greenhouse technologies for protecting delicate

crops.[37] Interesting communication campaigns in Europe are appealing to the public to buy odd-sized, misshapen or weather-bruised vegetables, in an attempt to change people's perception that produce that looks different is only fit for processing into soups or purees.

- Expanding markets: The US government and the European Commission have launched national food loss and waste' goal, calling for a 50-percent reduction by 2030. They intend to work with charitable organisations, faith organisations, the private sector, and local, state and tribal governments to transition towards a circular economy. European markets are helping expand local farmer's markets to reduce transport, storage and supermarket dependencies. The government is also actively educating people on how to reduce their personal contribution to food wastage.

- Linking food with religious philosophy: With the recent increase in food waste, Japan has adopted the philosophical idea of "mottainai," a Buddhist Japanese term that means both "what a waste" and "don't be wasteful."[38] Japanese children are being taught through children's literature to not waste any produce based on looks or size. Children are also encouraged to learn about food shortage during World War II.[39]

1.2. Quality and Standards

Indian farm produce surpluses face frequent and substantial border rejections in key export markets.[40] The rejects create large volumes of waste. In 2014, Russia opened its US$43 billion food import market to India after it put a one-year ban on the import of food items from

several countries in response to sanctions over the crisis in Ukraine.[41] Due to strict phytosanitary controls, India could not use the opportunity. India thus supplies less than one percent of Russia's total import needs. Further, Indian potatoes faced a temporary import ban by Russia after the Russian authorities intercepted 23 consignments with pests and diseases.[42]

The Indian Council for Research on International Economic Relations suggests that, in addition to improving the quality of its fresh and processed products, India could take several other steps to reduce rejects. These include:

- Linking the Ministry of Commerce with the Ministry of Agriculture and Farmer's Welfare to reduce multiple export control bodies that create piecemeal policies and regulations;[43]

- Addressing policy gaps and making agriculture ministry officials and state agriculture promotion boards the key stakeholders in capacity-building initiatives funded by developed countries;[44]

- Extending the role of Food Safety and Standards Authority of India (FSSAI) in exports and farm-level contamination management;[45, 46] and (In India, there is a dual standard: exports have to adhere to the various importing country standards while imports and the domestic market have to adhere to the FSSAI standards.)

- Raising concerns on bilateral and multilateral forums against unreasonably high standards set by importing countries.

An important export from India is human hair. India is the world's largest supplier of human hair to many markets, ahead of China and Russia.[47] Aesthetically, Indian hair is considered highly valuable.[48] However, while it is preferred over Chinese hair for cosmetic uses, and almost all the hair gets exported, Indian hair gets lower prices due to the poor collection mechanism that erodes the quality. Hair is collected mainly from temples in South India. It contains sweat, blood and lice as barbers focus on shaving speed over scalp protection. The warehouses have mildew and fungus.[49] In village households, hair waste from combs is carefully saved to get some money from its sale. Since there is a large opportunity to move up the value chain by exporting well-packed clean hair or hair products instead of raw hair (both for use in the cosmetic and in the industrial sectors), India must take the following steps to organise the sector:

- Government and export-promotion bodies can introduce infrastructural improvements for hair collection, storage, cleaning and auctions. Temples, where devotees shave off their head and donate hair, are not equipped to store large amounts of hair. Since India banned the burning of the hair in the 1990s due to the release of toxic gases,[50] this hair can be exported.

- The sector needs law enforcement support to reduce the exploitation of the poor in villages, who sell their hair at very low prices to gypsies and nomads. The buyers have been reported to sell such hair to smugglers in India and Myanmar.[51]

- Industrial export of waste hair for various purposes such as fertilisers, stuffing for clothes, woven oil filters, and for extracting amino acids used in food or pizza dough, requires consumer awareness, strict quality standards and checks.[52,53,54]

1.3. Composition and Segregation in Municipal Solid Waste

The characteristics and the quantity of municipal solid waste (MSW) are functions of urbanisation and industrialisation.[55] Developed countries discard more packaging material and food than developing countries. The average MSW in developed countries has a calorific value between 8 and 12 MJ/kg, comparable to fresh wood or lignite (low-grade coal). They are thus able to successfully use municipal waste in waste-to-energy plants.[56, 57] Some European countries have even started importing waste to meet plant-capacity needs. "Germans' high recycling rate, which now hovers around 65% of all waste discarded, combined with a declining population, has meant that some German plants are importing trash from neighbours. Sweden too is importing trash to power its grid as residents use less and recycle more."[58]

The calorific value of waste produced in developing countries, including India, is relatively lower as they produce more wet waste. However, India can still avail waste-export opportunities, given the large quantities of MSW it generates. For MSW-export opportunities to be viable, India will have to enhance its municipal functioning to segregate and pre-process the waste at collection sources, since only some segregated waste materials can be burnt safely without creating public health hazards or environmental degradation. The following case illustrates the problems India faces in running its own waste-to-energy plants using the same technologies as Europe.

The Danish International Development Agency financed and installed a waste-to-energy plant for New Delhi's municipality in 1986. The agency used business case metrices and data science to simulate the generation of 3 MW energy per month. The plant ran into losses as the calorific value from municipal waste in India was half that of the calorific value

from the same amount of waste in Denmark.[59] Residents near a waste-to-energy incinerator in Okhla, Delhi,[60] filed a case against the operators of the plant, citing risks to public health and environment due to the plant's violation of emission standards on dioxins and furans from Poly Vinyl Chlorides (PVCs). The waste-to-energy technologies imported from the West work on door-to-door garbage pick-up and segregation system to allow PVCs to be separated at the source.

Given its calorific value and segregation challenges, India's municipal waste is not export-ready for developed countries. At the same time, developing countries in Asia that import waste for recycling look for certain recyclable materials for their industrial sectors, and India's waste might not be of much use to them either, as it is likely similar to their own. India must thus look for domestic measures to deal with its large volumes of municipal waste while taking into account the social realities. It must introduce advanced waste-treatment facilities after a comprehensive local waste survey, using technologies that most suit its requirements.[61] To obtain value-added products from waste and achieve upcycling, India must make use of R&D and smart technologies. For example, China has developed the circulating fluidised bed (CFB) technology to recover energy from low calorific value waste.[62] Japan, Sweden and Denmark have demonstrated the viability of energy recovery from halogenated plastics using fast pyrolysis methods without damaging the environment.[63]

1.4. Sourcing and Traceability

South Korea began importing high volumes of wood pellets from Canada and some Asian countries in 2012 to meet its mandatory alternate energy needs.[64,65] Wood pellets are a cost-effective fuel as they are made from timber wastes and burn cleanly, with high combustion

efficiency. They are easy to transport, and their geometrically uniform shape allows them to go into automatic fuel feeders in industrial setups.

However, the wood pellet exports from Vietnam were found to contain trace amounts of rice husk, which caused mechanical issues in the boilers of the biomass power plants in South Korea. The Vietnamese pellet producers had provided fraudulent Foreign Stewardship Council (FSC) certifications on occasions to the South Korean Ministry of Environment, which regulates rice husk and other such agriculture refuse under a separate category.[66] After this incident, to ensure the purity of the wood pellets being imported, the Korean government implemented new import requirements including certifications under the Apostille Convention.[67] This sudden change in requirements created issues for Canada. Since it is not a signatory of the Apostille Convention, Canada could not legally comply.[68] After several rounds of negotiations with Canada, South Korea abandoned the Apostille Convention and shifted the responsibility for verification of sourcing on to the exporters.[69] However, the onus of responsible sourcing and certification being solely on the suppliers, Canada lost its competitive advantage of being a strict sustainability requirements follower. Canadian suppliers moved towards European and Japanese markets, and now consider South Korea only an opportunistic market. South East Asian exporters are no longer governed by restrictions. Cheaper quality pellets are flooding South Korea, defeating its clean air goals.[70] Thus, a sudden policy change, causing documentation confusion, has not benefitted South Korea in the long run.[71] It could instead have worked with the Vietnamese government to resolve fraudulent certifications.

On the other hand, the improvement in sourcing practices of a Finnish company, Neste Corporation, is a good example of adequate due

diligence by the government and private stakeholders to understand and manage the alternate fuel markets sustainably. Under the US' tradable credits system design, renewable fuels qualify for credit values in the mandatory Renewable Fuel Standard programme. Additionally, low-carbon fuel standard credits are given to renewable fuels in California,[72] and Blender's tax credit to renewables imported from outside the US.[73] Renewable fuels can be made from crop-seed oils, waste fat or their mix. Those that require cultivation of crops to source oil as raw material can have a potential negative impact known as indirect land use change (ILUC).[74] ILUC can lead to environmental damage or risk food security.[75] For example, when produced as raw material for biofuels, palm oil can lead to deforestation of palm plantations. The US includes ILUC in lifecycle emissions accounting. Renewable diesel made entirely from waste oils and waste fats is a preferred option to reduce ILUC.

Neste exports large volumes of renewable diesel to California from its Singapore-based refinery. In 2012, the company sourced 35 percent of its raw material from waste. The remaining 65 percent was palm oil purchased from Indonesia and Malaysia.[76] By 2017, waste and residues already accounted for nearly 80 percent of its raw materials, and the company is now moving towards 100 percent waste-based products.[77] By improving verifiable ILUC mitigation practices, Neste has increased the volume of waste-based fuel trade between the US and Singapore.[78] Californian importers are leveraging the seaport infrastructure on the state's coast to get easy access to renewable diesel from Singapore. The state is meeting its clean air goals while also becoming a competitive supplier of imported renewable diesel in parts of the US.[79]

In India, the production of renewable fuel from waste cooking oil and fats is in its nascent 'product development' stages. The Mahatma

Gandhi Institute of Rural Energy and Development in Bengaluru sourced used cooking oil from the Taj group of hotels in 2016 to make fuel, which was sent to some engineering colleges to test for engine performance.[80] Mass adoption of the technology and the product is not yet reported. India can also use a lot of cooking-oil waste and animal- and fish-fat waste to spur growth in the renewable fuel production, both for domestic consumption and exports. However, it will have to take into account the current sourcing gaps such as social taboos in collecting and handling such waste in large scale. The collection strategies from households or industrial outfits will require the training of municipal staff, businesses and citizens.

1.5. Geopolitical Considerations

Waste exports are prone to geopolitical fluctuations. For example, since 2015, mango pulp exports (primarily made from bruised fruits) from India to Saudi Arabia, Dubai and Kuwait have declined drastically. The importing countries exported Indian pulp to Yemen, Syria and Jordan. However, terrorism-led political instability in the region has disturbed the flow of trade.[81] Since 80 percent of pulp export from India goes to West Asia, several mango farmers have had to let the pulp go to waste. Currently, India lacks any domestic measures to deal with the volumes of pulp lying in stock.[82] In a more recent development, China has banned imports of 24 categories of municipal solid waste and industrial waste from foreign sources. The exporting countries must either quickly search for alternate export destinations or enhance domestic use and disposal of their waste.

1.6. Stakeholder Awareness Considerations

Currently, India faces a major challenge in managing its crop stubble waste (rice and wheat straw left standing in fields after harvesting). It

has neither a domestic waste strategy in place for the stalks and stubble nor large export markets for straw waste, and it thus resorts to burning such waste. Mass-scale field burning is causing environmental and soil degradation.

England and Wales used to burn up to 41 percent of their wheat straw in the field until a ban on burning was enforced in 1993 (Silgram and Chambers, 2002).[83] Other European countries too, banned field burning in the 1990s (except in small amounts with due permissions).[84] This section analyses straw-waste trade between some countries to show why transboundary waste trade remains limited for almost all countries and how countries are making use of the waste domestically. For India too, exports can continue on a small scale while most of the waste can be—and must be—managed domestically.

Reasons for Field Burning

Mechanised harvesting leaves behind nearly 40 cm-long sharp stalks that injure grazing animals as well as migrant labours, who manually try and plough out the stubble. Straw management machinery such as the rotavators, zero tillers, hydraulic ploughs, bailers and mulching machines are very expensive.[85] Farmers dismiss the use of waste for fodder and other purposes due to the time, transport and financial constraints: the sowing window between two crops is barely three weeks,[86] and the absence of market linkages to sell fodder at economically viable costs is a further disincentive.[87] Moreover, there is a cultural acceptance for burning in India, as it is associated with purity. The lack of law enforcement against burning leads to further complications. Penal action can raise the cost of compliance and may be a politically unwise decision.

Straw Waste Trade is Opportunistic and Limited

- Countries limit straw imports due to phytosanitary challenges of pests in large volumes of straw. The US imports dried wheat stalks only from Canada, New Zealand and Norway. Japan imports rice straw or rice husks only from the Korean Peninsula and Taiwan to prevent accidentally importing harmful pests.[88] For similar reasons of quality and reliability, Australian wheat and hay fodder exports to Japan, China, Korea and Taiwan are replacing Asian straw exports.[89]

- In 2016, French livestock producers imported wheat, barley and rape straw from the UK to offset the impact of rising feed costs during dry weather.[90] Ireland also sought straw imports from the UK to meet the bedding needs for its cows and sheep at calving and lambing time.[91] As a result, Britain suffered a shortage of straw for feedstock, animal bedding and biofuel industries.[92,93]

- Pakistan exports its wheat straw and hay to the dairy and beef industries in UAE, Kuwait, Qatar and South Korea.[94] Pakistan's exports to Saudi Arabia grew when Saudi Arabia banned the domestic production of fodder due to water scarcity.[95] Soil scientists and farmers in Pakistan have been protesting against the growing exports, as it increases the domestic prices of wheat straw.[96] The livestock within the country is undernourished, and the farmers are resorting to taking out even the residues of wheat stubble and selling them. This leaves the soil totally dependent on chemical fertilisation.[97] Pakistan burns a large amount of rice straw on fields for the same reasons as India, even though the rich reserves of potassium and silicon in rice husk helps amend the soil and improve soil bulk density. In the UK,

substantial portions of straw get incorporated into the soil to enhance it (Anon, 2010; Nicholson et al., 1997; Powlson et al., 2011).

- India exports large quantities of de-oiled rice bran and oil cakes every year without understanding the domestic needs for the same. According to Rahul Kumar, managing director, Amul Dairy, Anand, "This should be retained in our livestock feed system to keep feed prices in check. We have a 25% deficit in dry fodder. The export of farm residue raises costs for dairying and poultry in the country. As a result, milk, poultry and egg prices go up."[98]

Arguments in Favour of Domestic Use of Wheat and Rice Straw

Europeans are making domestic use of straw waste to improve soil quality, fodder, generation of biofuels and bedding of livestock. Studies in China show that the rotational cropping system for rice and wheat can be replaced by farming green manure crop or a summer legume just after harvesting wheat, to manage stubbles.

For India, the challenge lies in educating farmers on the demerits of burning straw and the methods of proper extraction, baling, storage, transportation and usage, without losing money. India announced in 2016 that the NITI Aayog is taking initiatives to manufacture ethanol from agro-waste based biomass[99, 100] While some rice husk gasifiers are operational in a dual fuel mode for some years, they have not proliferated due to a variety of reasons. Gasifiers themselves produce husk ash and wastewater that is difficult to manage. Moreover, grid power is cheaper than alternate fuel.[101] The government must therefore invest in farmer education before introducing technology at a large

scale. In a progressive step towards sorting the challenge of transporting baled straw, an Indo-US team is working on introducing torrefaction units that can convert agrowaste into 'biochar' in the fields, without requiring external energy.[102] Biochar is charcoal used for soil amendment as well as for fuelling puposes. Multiple low-cost, locally made, mobile torrefaction units deployed in fields could be profitable without government subsidies.[103]

II. WASTE IMPORT CONSIDERATIONS

2.1. Health and Economic Degradation

The consumption of livestock and poultry wastes such as blood, bones, skin, body parts and internal organs is dependent on sociocultural and socioeconomic aspects. Europeans and Americans largely discard chicken neck, back, legs, wings and offal. In the 1990s, some coastal towns of Africa started importing waste chicken parts from the US and the EU. However, these imports had significant negative imapcts. The domestic poultry industry in several countries of Africa collapsed and led to loss of income for women who were self-sufficient through rearing of chicken at home on food scraps.[105] Anti-dumping negotiations by South Africa carried on for several years without desired results, as illegal exports from some markets continued entering the South African market.[106] Frozen food waste would frequently rot during the multiple exchange of hands from processing to packaging and shipping, and the breaks in cold chains created a hospitable environment for germs.[107] Moreover, exported poultry were usually subjected to large doses of antibiotics and growth hormones, leading to antibiotic resistance in consumers.[108] When South Africa insisted that the US increase safety standards of waste poultry exports, the US put pressure on South Africa to reduce its food safety standards instead.[109]

In 2016, India conformed to the World Trade Organisation (WTO) ruling for the import of poultry after the US threatened to levy sanctions.[110] Four lakh Indian poultry farmers are currently protesting against poultry waste dumping possibilities.[111] India must learn from Africa's experiences to institute checks and balances.

2.2. Environmental Degradation

China is modernising its industrial processes and, at the same time, putting in measures to reduce the environmental footprint of its industries. It is instituting more stringent regulation of pollutants across the country.[112] In July 2017, China notified the WTO that effective 31 December 2017, it would stop accepting waste shipments of 24 types of wastes, including waste plastic, paper, slag from steelmaking, waste wool, ash, cotton and yarn.[113] Earlier, as China's industrial growth was taking off, it had welcomed waste imports from developed countries to spur the growth of its recycling industry.[114] While recycling was touted as an environmentally sound practice by businesses (recycled steel, for example, requires 60 percent less energy than steel produced from iron ore[115]), the recycling process itself was considered highly polluting within China.[116] Imports are dirty, poorly sorted and contaminated with hazardous substances from e-waste. Small-scale recycling industries often lack adequate awareness and resources to manage health and environmental impacts from such waste, and the unusable remains after recycling are often dumped in rivers.[117] Though the recycling industry in China will undergo a major economic and employment-related disruption by this sudden waste import ban, China feels the long-term benefits of such a move far outweighs the short-term disruption.

Earlier, China had launched two other operations—Operation Green Fence and Operation National Sword—to improve inspections and better prevent imports of illegal and low-quality industrial and electronic waste.[118]

III. RECOMMENDATIONS

Developing countries traditionally produce less per capita waste than developed countries. India's policymakers must focus more on reducing waste creation instead of merely focusing on waste management and waste trade options. While this paper has analysed legal waste trade possibilities and challenges in only two sectors—farm waste and municipal solid waste—the learnings from these examples can be applied across sectors, wherever waste trade is possible.

The author has not discussed the important topic of illegal trade of hazardous waste, as it is not within the scope of this paper. The paper also does not take into account the negative externality associated with waste trade in the form of environmental footprint from packaging, transportation, refrigeration and other energy-intensive processes that accompany trade. Some suggestions for improving cyclical management of waste domestically are given below:

- Instead of relying heavily on strategies to manage waste, focus must be on consumer awareness strategies to create less waste. India can learn from the West and understand why they create more per capita waste.

- The country must make use of available foreign expertise, partnerships and investments to improve learnings in waste management by:

  - Linking various ministries and municipalities to help them understand that technologies come with their own challenges that may not be visible upfront. Therefore, it is necessary to perform due diligence before a transition is made towards adopting any new technology from another country.

  - Understanding its own waste composition to find/fund/develop local innovations and working with other developing countries that have similar waste composition challenges to adopt technologies they may have invented to resolve them.

- There is a need to grow up the value chain by manufacturing goods out of waste and exporting value-added products.

A few suggestions for improving value from waste export/import opportunities are listed below:

- India must understand social and environmental implications of imports.

- The country must learn and address policy gaps in its own systems, link ministries and departments to reduce multiple export control bodies that create piecemeal policies and regulations, and challenge unreasonable import standards on bilateral and multilateral platforms.

- It must take into account geopolitical uncertainties in export/import markets and develop parallel waste-use systems in domestic markets.

IV. CONCLUSION

India has an opportunity to leapfrog from a linear to a cyclical waste management model. It can learn from the waste-trade experiences of both developed and developing countries to reduce waste creation while improving waste management. India must recognise that since waste imports have traditionally flown into countries that have weaker environmental regulations, most waste imports have not given importing nations any major environmental or economic advantage. Any import must thus be cautiously evaluated and negotiated to avoid negative impacts. With regard to export, Indian policymakers should consider the prevailing infrastructural gaps, agricultural practices, municipal functioning, technical challenges, finance and current social conditions to improve domestic waste-management practices. The country must recognise the gaps in its own systems to set its house in order before attempting to turn international waste trade into a sustainable advantage. Until such a time, it is more beneficial for India to use its own waste within the country. ORF

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