This report is about the scoping of the circular economy process of plastic, paper, and agri-food value chains.

Circular economy in selected value chains

A case of Peshawar & Karachi Metropolitan Cities

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Consultants: Dr. Yasir Kamal & Tahir Khan

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ACRONYMS

BCC	Behavioral Change Communications
CE	Circular Economy
CIP	Cities Improvement project
CSR	Corporate Social Responsibility
EPA	Environmental Protection Agency
ES	Environmental Sciences
HH	Household
Kg	Kilo Gram
KP	Khyber Pakhtunkhwa
KSA	Kingdom of Saudi Arabia
LG	Local Government
NGO	Non-Government Organization
PET	Polyethylene Terephthalate
PET	Recycled Polyethylene Terephthalate
PKR	Pakistani Rupee
PP	Plastic polythene
PSF	Polyester Staple Fiber
PWM	Plastic Waste Management
PWMC	Peshawar Waste Management Company
SDG	Sustainable Development Goals
SMEs	Small Medium Enterprisers
SS	Sewerage system
SWM	Solid Waste Management
TMA	Tehsil Municipal Administration
UAE	United Arab Emirates
UCs	Union Councils
UoP	University of Peshawar
WASH	Water and Sanitation, Hygiene
WSS	Water Supply Schemes
WSSP	Water and Sanitation Services Peshawar

Executive Summary

In a linear economy, products are made to be used with residuals. The terms "take," "make," and "waste" are used to describe these production models. The circular economy, on the other hand, is based on preventing waste from entering landfills through product reduction, reuse, and recycling. Instead, it uses a model to narrow the gap between production and the environment's natural cycle. As a result, a long-term sustainable value chain would emerge, having a positive impact on climate change and sustainable development. The primary goals of the circular economy are enshrined in the concept of long-term development. On the one side, it aids in the preservation of natural ecosystems by improving natural resource resilience, and on the other, it aids in the mitigation of climate change by lowering greenhouse gas emissions. The circular economy's most important practices are renewable energy, less polluting fossil fuels, dematerialization, fewer manufacturing processes, a notion that leftovers are useful, less hazardous materials, and fewer production stages.

The purpose of this research was to examine existing and future local and national Circular Economy value chains in Pakistan. The evaluation looked at Pakistan's significant market potential and investment prospects for promoting circular approaches, as well as the environmental and social benefits of investing in these industries. The metropolitan cities of KP and Sindh, namely Peshawar and Karachi, are identified as intervention target locations. Following a literature study and early key informant interviews, the targeted value chains are chosen. Plastic, paper, and agri-food value chains were chosen as study subjects. The scope of the project was limited to the involvement of the following actors in the selected value chains: waste collectors, manufacturers, retailers, resellers, repairers, recyclers, up cyclers, Government, research institutions, community members, activists, green networks, consumers, and climate change experts.

The current investigation has been limited to certain constraints. Due to the study's vast breadth, the field team was unable to zero down on a single value chain. Due to time constraints, three value chains could not be investigated at the full scale. Respondents were hesitant to provide data for a variety of reasons, including concerns about government officials meddling and causing issues for these small and medium-sized businesses, which made data collection difficult for the field team. Data that has been published in a way that is not adequately thorough: It has been challenging to

acquire secondary data. A critical business, such as pulp and paper, likewise has a scarcity of data. More than a decade ago, the most current report on the topic was released.

The assessment's ultimate intake is as follows: The globe is confronted with significant issues, customers "purchase too much," while recycling efforts are woefully insufficient. The "take-use-waste" cycle in the global economy harvests, consumes, and discards natural resources. It is already overburdening the planet, causing climate change, and diminishing resources that future generations will require. In the meantime, the sand is urging a change in corporate practices to avoid waste and contamination. Products and materials are used for considerably longer periods of time, which allows nature to replenish. A collective effort is required to move to a circular economy. Recycling materials involves product and process rethinking. Clients are liable for the impact on the environment. There are two methods for approaching environmentally friendly design and production. The first technique claims to lower a product's environmental impact, whilst the second encourages recycling and reuse. All stakeholders must be involved due to the nature and scope of the change. Governments should focus on implementing or repealing regulations to help consumers and businesses avoid badly designed goods and services, while corporations should design out waste and make things last longer. Assisting legislators in rewriting and enacting important legislation could assist smooth the transition.

Before going entirely circular in their production cycles, the government and other stakeholders should follow a few generic recommendations, which are briefly outlined below.[1] Governments bear a large amount of responsibility for encouraging key stakeholders to adopt new technology and designing waste management regulations that are circular economy compliant. Laws and conventions must be enforced in order to be applied and understood. The community should be educated about the negative effects of plastic and the importance of banning all harmful plastic applications. The local community must be engaged and organised in order to properly handle and classify waste. In addition, waste output limits garbage collectors' capacity, which is need to be enhanced with proper training. Household waste is not properly disposed of and is incinerated, resulting in pollution. Waste management companies in Peshawar and Karachi can recycle a wide range of materials, and this potential will be explored further. Personalized dustbins/waste

[1] For specific recommendations please read the final chapter of the report.

containers with sorting space are also required. The present informal pickers and sorters work without protection and are vulnerable.

Introduction Circular Economy

Every year, more than 100 billion tonnes of resources are introduced into the economy, ranging from metals, minerals, and fossil fuels to biological components derived from plants and animals. Only 8.6% of garbage is recycled or reused, according to the EPA.[2] Since 1970, resource utilisation has more than quadrupled, and if current trends continue, it will more than double by 2050. To maintain our current resource use in a sustainable manner, 1.5 Earths would be necessary.[3] As a result of this excessive consumption, humans, animals, and the environment are all suffering. It is now more important than ever to shift away from linear, "use it up and throw it away" economic paradigms and toward circular economies, in which waste and pollution are planned out, goods and resources are used for longer periods of time, and natural systems may regenerate themselves. A circular economy, it should go without saying, is about creating vast opportunities and benefits across industries, sectors, and people's lives, in addition to repairing environmental damage. The circular economy (CE) is a way of thinking about how things work in real life. The circular economy is a strategy for economic development that focuses on optimising resource consumption while lowering waste management costs and increasing economic resilience. Businesses may save money and come up with innovative solutions in the circular economy by concentrating on resource efficiency as a lens through which they work.

Products in a linear economy are designed to be used with residuals on hand at the end of the process. These manufacturing models are described by the terms "take," "make," and "waste." The circular economy, on the other hand, is built on the reduction, reuse, and recycling of products that do not end up in landfills. Instead, it employs a model to close the gap between production and the natural cycle of the environment. As a result, a long-term sustainable value chain with a positive impact on climate change and sustainable development would emerge. Old products are either disposed of as biodegradable trash or modified (if not biodegradable) before being recycled in a

[2] https://www.epa.gov/smm/recycling-economic-information-rei-report
[3] https://www.unep.org/news-and-stories/press-release/resource-use-expected-double-2050-better-natural-resource-use

circular economy. According to the World Economic Forum, the circular economy combines various concepts of sustainable development such as the industrial cycle with regenerative product designs, renewable energy, the elimination of toxic chemicals from manufacturing, green economy, climate change support, return to the biosphere, and waste elimination through superior design of materials, products, systems, and business models.

In the Circular Economy, products go through two distinct cycles: biological and technical. The biological cycle returns resources to the natural world. In the technological cycle, resources flow in endless cycles. To create systemic change, businesses must establish a take-back programme for products that cannot be disposed of in a household compost or organic waste receptacle.[4]

Biodegradable and non-biodegradable items are distinguished in the circular economy. The circular economy allows biological elements like food and cork to be anaerobic digested and composted, allowing them to be returned into the system. When biodegradable items are reintroduced into the system, they revitalize living sources of sustainable economics such as oceans and soil. The technical cycle is a sort of manufacturing cycle in which products are composted using a variety of techniques with the purpose of reusing the waste in whole or in part in the same or another manufacturing cycle. This type of recycling is more advanced, requiring basic product design with the ultimate purpose of reusing them in disintegrated form.

The circular economy's fundamental goals are included into the concept of sustainable development. On the one hand, it helps to maintain natural ecosystems by increasing natural resource resilience, while on the other, it helps to reduce climate change by lowering greenhouse gas emissions. Renewable energy, less filthy fossil fuels, dematerialization, fewer manufacturing processes, a sense that leftovers are useful, less hazardous materials, and fewer production stages are among the greatest practices in the circular economy.

[4] https://www.hejhej-mats.com/circular-economy/?lang=en

Critiques on CE

A number of complaints have been levelled towards the circular economy. Some think that waste has a contingent, multidimensional, and short-lived value that most people are unaware of. Valuing trash, infinite perfecting of cyclic economic processes, and showcasing waste as alive matter throughout organizational genera, according to the scatolic school of thinking, results in bewildering disarray. The circular economy has also been viewed as an engineering system rather than an economic system, with a greater emphasis on recycling processes than economic contribution, and currently a few research studies are disputing the heart of the CE, namely whether it has lowered primary output or not. Another point of contention is CE secondary production (reuse, repair, and recreate), which some critics see as a form of material relocation. When buyers are unaware of the CE and second-hand materials are utilised instead of virgin resources. The law of thermodynamics and the entropy process are also possible roadblocks to 100 percent material recycling, which needs enormous energy and resources. Under the lens of equality and equal distribution of resources, the circular economy and circular society remain debatable.

However, the criticisms mostly focus on the technological items' recycling element, which undoubtedly necessitates a complete engineering system. However, biological products, on the other hand, do not need a complicated recycling mechanism. Experts also said that recycling is not the sole part of CE, and that the system places a greater focus on repair, reuse, remanufacture, and reduction, all of which are absent from the criticism.

Fascinating Facts about CE

According to the World Bank's report "What a Rubbish 2.0", frightening data of waste dumping have been revealed. According to the research, now 33 percent of garbage is not processed, which will increase the planet's waste load by 70 percent by 2050. The increase from 2.01 billion tonnes per year to 3.4 billion tonnes per year would be significant. Another fascinating fact about the circular economy is that recycling one tonne of solid waste pays 101 dollars more in salary than filling a field. Reusing 1,000 tonnes of municipal solid waste, on the other hand, will result in the creation of 80 jobs. It's incredible to think that 1,000 tonnes of electronic waste might support nearly 9300 employment in Europe. According to estimations, the circular economy will add 4.5 trillion dollars to global GDP by 2030. For example, each year 148 million tonnes of clothing are

discarded, with a value of $500 billion projected by 2030; similarly, electronics and electrical equipment discarded each year are worth 62 billion dollars.

Circular Economy Process (General)

The circular economy concept focuses on sharing, leasing, reusing, repairing, refurbishing, and recycling existing materials and products for as long as possible in order to create a more sustainable and environmentally friendly model of production and consumption, which will improve the product life cycle and add value.

The process starts with the product design phase, with the purpose of making it better for a longer life cycle and increased consumer value. The manufacturing process then preserves the re-use, repair, and recycling options. Following that, recycling actors in the recycling business gather the commodities for recycling purposes. Items are remanufactured, disseminated, and finally sold to customers in the recycling sector. After it has been consumed, the product is re-used, mended, or recycled. During the technique, only a small amount of the product is squandered.

Fig-1 – Generic Circular Economy Model

The Economy of Khyber Pakhtunkhwa

In terms of population and GDP contribution to Pakistan's economy, Khyber Pakhtunkhwa (hence, KP) is the country's third-largest province. It is also Pakistan's second poorest province, after Baluchistan. According to the World Bank, KP's youth account for half of the population. The KP shares borders with Punjab, Baluchistan, and Afghanistan.

Agriculture, mining, oil and gas, tourism, and livestock, as well as housing/real estate, transportation, and manufacturing, make up the economy of Khyber Pakhtunkhwa. Agriculture is the KP's most important economic sector. It contributes between 34 and 81 percent of the KP economy. Mining is also a significant economic sector in the KP economy. The most important minerals in the KP mining sector are marble extraction and distribution, while gemstones are another important mineral. Overall, the mining industry contributed around 3% of KP GDP.

Oil and gas production, in addition to mining, is a substantial contributor to the KP economy. The Southern District's Gas Plants are well-known throughout the country and offer a big potential for further revenue generation. The province of Khyber Pakhtunkhwa is known as Pakistan's tourism capital. KP's northern districts are popular tourist destinations, especially during the summer months. These tourism spots not only bring money into the KP economy, but they also provide various work opportunities for locals. In KP, popular tourist spots include Swat, Abbottabad, Nathia Gali, Naran, Kalam, Gligat, Chitral, Skardu, and lower and upper Dir.

Agriculture continues to be the most important economic sector in the KP, employing the majority of the population. The traditional wheat crop, maize, tobacco, rice, several types of legumes, rice, sugar cane, and a variety of famous fruits are among the most important cash crops produced during the two seasons. These agricultural products not only suit the needs of the province, but they also generate revenue for the KP by being marketed in Afghanistan and elsewhere in the country. In the KP economy, real estate is a large and important source of revenue. Peshawar, Abbottabad, Swat, Bannu, and D.I. Khan are the districts in KP where housing property purchases and sales account for a large portion of the province's revenue. From one year to the next, its demand grows by the day, and its sales volume increases by the day.

The manufacturing sector of the KP economy, as well as the economy of Pakistan as a whole, is critical. There are various industrial estates in KP where virtually every type of manufacturing

business may be found, producing revenue for the local economy. The most well-known economic and industrial zones in KP are the Peshawar/Hayatabad industrial state, Hattar Industrial Area, Gadoon Industrial Estate, and Nowshehra Industrial Zones. Peshawar/Hayatabad is the largest industrial state, followed by Hattar and Gadoon industrial states in District Swabi. Furthermore, special economic zones are being developed in the KP province as part of the China-Pakistan Economic Corridor (CPEC) and a new government plan, which will play a significant role in the province's progress. In addition, various special economic zones, including as Rashaka Special Economic Zone, Hattar Special Economic Zone, and Mohmand Economic Zone, would considerably contribute to the KP GDP.

The Economy of Sindh (Karachi)

Pakistan's second-largest economy is located in Sindh province. It's a coastal province sandwiched between Europe and the Far East, as well as the Middle East, with the potential to become one of South Asia's most important logistical, commercial, economic, and human resource hubs. The province has excellent soils for farming and grazing, surface and subsurface water supplies, 350 kilometres of coastline for fishing and aquaculture, and a climate that allows for the cultivation and early harvest of a variety of crops.

With a per capita income three times that of the rest of the province, Karachi, the country's principal industrial and commercial centre with a sea port, accounted for 54 percent of the province's GDP. (3,200 rupees) Because of Karachi's fortunate position, polarisation developed, with all of the negative consequences for Sindh's economy. Sindh's share of national GDP has risen to almost 32 percent, despite its population share being only 24 percent. Karachi generates more than 42% of the value generated in large-scale industry and contributes 25% of the country's GDP. Sindh's province's GDP (in current prices) is around Rs. 7,308 billion, with a per capita income of Rs. 166,000, according to the most latest anticipated data for 2012-13. The average Sindhi's per capita income has increased eightfold during 1972-73, from $208 to $1,650 in 2012-13. Sindh has a higher per capita income than the rest of Pakistan, about 26% higher. [5]

[5] Karachi: The backbone of Pakistan". September 2020.
Finance Division | Government of Pakistan |
Pakistan and Gulf Economist. "Karachi: Step-motherly treatment.
ECONOMIC AND FINANCIAL ANALYSIS" (PDF). Supporting Public–Private Partnership Investments in Sindh Province (RRP PAK 46538). Retrieved 7 September 2020.

During this time, Sindh's economic structure has shifted. Agriculture now accounts for 17% of the Gross Provincial Product (GPP), followed by industry (36%), and services (36%). Sindh is the most industrialised province in Pakistan, with a far larger industrial sector than the rest of the country. Since the 18th Amendment, livestock, fishing, and irrigation have gotten a lot of attention, but not nearly enough. The main crops are wheat, rice, cotton, and sugarcane. Cotton may be grown in good soil at high temperatures, and sugarcane grown in Sindh contains more sugar than sugarcane grown in Punjab. Mangoes, bananas, dates, onions, and red chilies are all popular in Sindh. Dates in Khairpur, red chillies in Umerkot, bananas in various clusters, and onions in Tando Allahyar, Jamshoro, Sanghar, and Matiari districts, for example, are concentrated in well-defined clusters.

Sindh employs 180,000 people and accounts for 30% of the total number of plastic producers in Pakistan. Livestock and fisheries account for 11% of Pakistan's GDP and 56% of agricultural value added. According to the World Bank, Karachi is Pakistan's financial capital and one of the country's most investor-friendly cities. Karachi generated 65% of national income and 25% of GDP. Sindh Industrial & Trading Estate (SITE), Korangi Industrial & Trade Estate, FB Area, North Karachi Industrial & Trade Estate, Dhabeji, and Port Qasim are only a few of Pakistan's most important industrial complexes. Manghopir is the country's biggest industrial park, with about 4,000 firms. Some of the city's business districts are I.I. Chundrigar Road, Sharah-e-Faisal, Clifton, and Defense. Textiles, chemicals, steel, machinery, cement, maize mills, shipbuilding, refined oil, shoes, and food are among the industries in Karachi that include Toyota, Suzuki, Millat Tractors, Adam Motors, and HinoPak.

Karachi is home to Pakistan's principal stock exchange, international airport, state and private banks, and insurance companies. Here are the headquarters for Geo, ARY, Hum, AAJ TV, KTN, and Sindh TV. Apart from Karachi, the world's most populated port is Port Mohammad Bin Qasim. The city's major fishing ports are Karachi and Korangi. Pakistan benefits from the city's enormous industrial base. The "City of Lights" is a nickname for Karachi, Pakistan's commercial and

Social Policy and Development Center. "Provincial Accounts of Pakistan: Methodology and Estimates.

economic hub. In addition to shipping, it is home to key medical and software development sectors. Karachi generates half of all exports, half of all earnings, and employs half of Pakistan's workforce.

Purpose of the assignment

Conduct an assessment in Pakistan to determine existing and future local and national circular economy value chains. With the primary goal of gaining a better understanding of the significant market potential and investment prospects in Karachi and Peshawar in order to promote circular approaches and identify environmental and social benefits of investing in these areas.

Methodology

General Approach: The complexity of the assignment necessitated a scientific approach in chronological order to produce the desired deliverables. The assignment needed a complete understanding of the project (client requirements), an understanding of the deliverables, and all the above, the local context. The assignment was implemented in different phases. Phase-1 was the planning and development phase, followed by a comprehensive literature review on the subject of circular economy and an understanding of the economy of Karachi and Peshawar. In phase 2, meta-analysis of the published reports was also carried out in order to select the most suitable value chain in Peshawar and Karachi. The shortlisted value chain / waste streams was also authenticated by officials of different relevant departments. The next phase (3rd phase) was all about the development and redesigning of the tested data collection tools in order to adapt them to the local context. In this phase, the enumeration plan was also developed. Two different teams were deployed in Karachi and Peshawar to capture information from key informants, which lasted for three weeks. The collected information is then synthesized by the field team, so they may also record their own observations in addition to the reflections of respondents.

Methodologies of data collection and analysis

1) Data was gathered from the target audience using semi-structured surveys and interviews. The Acted team contributed these questions, which were subsequently adjusted and piloted for better localized findings. However, in order to meet the study's aims, questionnaires were supplemented with frameworks. These frameworks were meticulously built to acquire relevant data in a qualitative data collecting approach. The data collecting team received training on both the questionnaires and the framework, as well as the synthesis of

qualitative data. However, owing to a lack of time and resources, the synthesis information was re-synthesised for better results and rigour by the team lead and put into matrices for improved reading and understanding.

Sampling and targeting approach

a. The data was gathered in three steps. 1) Data was gathered in the first stage using customized questionnaires supplied by the Acted Team. 2) The acquired data was then fed into a framework for comprehension and relevance. 3) The field researchers and lead researchers then synthesize the information gathered.
b. Waste collectors, waste processors, government, municipalities, and other relevant agencies provided the data about all the three targeted VCs.

Limitation and de limitation of the study

The current study was hindered by few limitations, they are as under;

- The wide scope of study kept the field team out of focus on one specific value chain.
- Time constraints: the allocated time for exploring three value chains was not adequate.
- The field team struggled with data collection due to the unwillingness of respondents for various reasons, such as being scared of government officials who may intervene and may create issues for these small and medium-sized businesses.
- Inadequate published data: It has been very difficult to gather the secondary data. Even the data on very important industry i.e. Pulp & Paper is not available. The last published report on the subject is more than a decade old.

Analysis & Discussion

Starting points of waste - Consumer

The circular economy has the ability to revolutionize economic systems and aid in the pursuit of long-term growth. Those that promote the concept of circular economy, on the other hand, are primarily concerned with how manufacturing may become circular through creative business models, processes, and products. Consumption and consumer requirements and acceptability are ignored by the actor(s), obstructing the transformation process. To meet such demand, a thorough understanding of the consumer is required, as well as the processes that modify consumption

patterns and the social activities that come from them. Companies and economies attempting to grow their involvement in the circular economy must prioritise consumption and consumers. One of the most significant obstacles for small and medium businesses is a lack of market backing or consumer demand.

Collection & Sorting

Waste is frequently collected by teams of assistants and sweepers from specific regions. On Friday, the average waste composition is relatively low, whereas on Sunday, it is very high. Residential neighborhoods, apartments, and housing societies each have their own professional sweeper who collects trash from door to door and sorts it before depositing it in one location. He is the first person to deal with issues in the plaza and on a social level. The municipal administration is in charge of collecting rubbish with government vehicles in various colonies. The scavengers (informal stakeholders) play an essential role. They come from the city's poorest areas, and a significant number of them are Afghan refugee youngsters (boys and girls).

Community Tendency & Recycling awareness

The researchers discovered that respondents (end users) had a relatively poor awareness about recycling. Only individuals participating in picking/sorting the collected rubbish are known to the community. The household waste is chiefly consist of cooked food items, and dry bread (Soki roti), metal, plastic, bottles of various products, shampoo, cream bottles, glass, boxes of various items, food waste, and so on are among the waste items generated by the community. They were generally dumped into plastic bags by the community. Soon after gathering up the trash, the cleaning crew, sorts it into distinct categories and sell it to the Local shopkeepers (Kabarya) in the picker's neighborhood. The Kabarya then make arrangement to sell combined material to whole seller(s)..

Culture barriers to circular economy

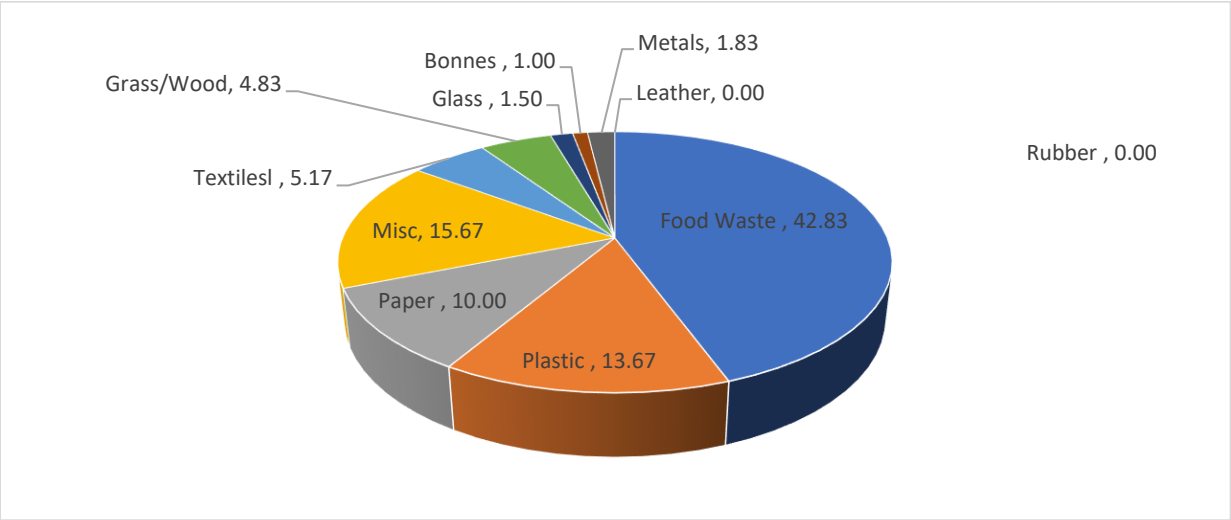
Waste management is a worldwide issue with significant economic, social, and environmental consequences. At the family level, there are various cultural hurdles to the shift to a circular economy. People don't separate their trash, therefore everything ends up in the trash. Currently, in some districts of Karachi, many organisations have begun to share boxes in various sites, plazas, and housing societies for sorting items that will be used for humanitarian purposes. As a result, the concept and significance of a circular economy are growing by the day. However, the endeavor is a drop in the ocean that requires reinforcement.

Individual consumption pattern

The following are some of the most common trash items in Karachi. Kitchen garbage (organic waste) is a big source, accounting for more than 40percent of all the waste created by consumers. Plastics, paper, and cardboard are the other main contributors. Leather, wood, glass, metals, batteries, and rubber tyres were also found in the daily home trash, according to the respondents.

The graph below has been derived from a study (Baseline Study for Solid Waste Management-Karachi, 2012), which attests to the validity of the responses.

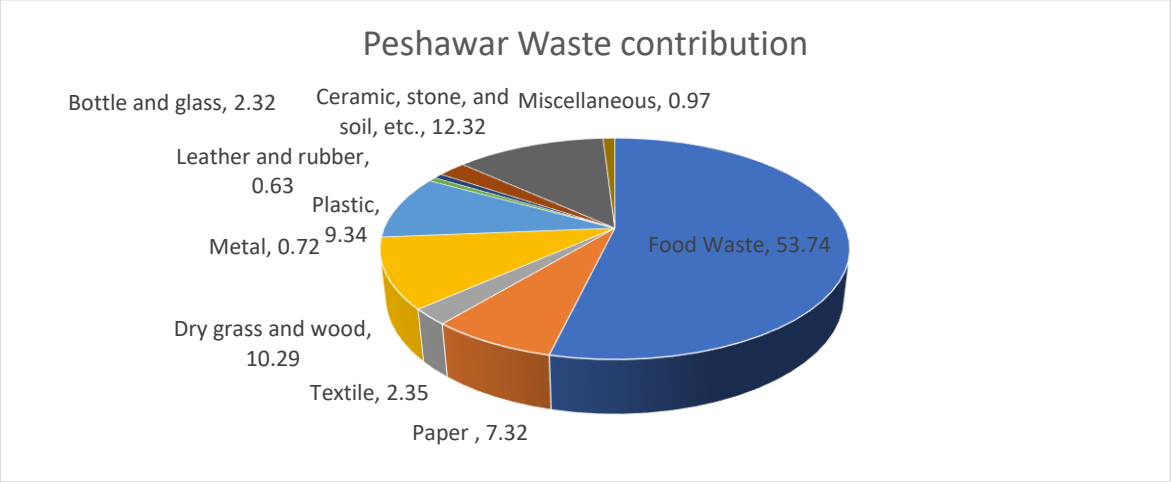
Fig-2 Daily Trash creation patron in Karachi



According to the research, food waste accounts for 42.83 percent of solid waste generated by households, followed by plastic.

The same pattern may be seen in Peshawar's consumer behavior. However, the trash generated by various units, such as residences, offices, and restaurants, differs in nature. Food trash, plastics, paper, glass, metals, and grass/wood make up the majority of household waste, whereas paper, card board, and plastic make up the majority of workplace waste. Kitchen and food waste are the most significant contributions made by restaurants, followed by plastic and paper. The graph below is based on ADP's report on the Solid Waste Management Sector in Pakistan, 2022, which partially reconciles the conclusions of the current study.

Fig-3 Daily trash creation patron in Peshawar



Reuse/Recycle of material

The team discovered that several things were reused, including plastic bags and containers, plastic and glass bottles, and apparel. Fixed things include electronics, furniture, and other stuff.

Consumer preference for recycled items

They prefer to recycle plastic material, according to several replies. The Sunday bazaars of Gulistan, Johar, Lunda Bazar, Saima Plaza market, Lunda Bazar, and Clifton all offer excellent markets for recycled things in Karachi. Lunda Bazar is the most popular bazaar of Karachi, drawing tens of thousands of visitors each year. Reused items include clothing, footwear, bags, leather, toys, certain, floormates, crookery, and other items. Peshawar, like other cities, has designated areas for the sale and purchase of second-hand and reconditioned goods. Boars Bazar, university town, Hayatabad Sunday Bazar, Charganoo Chowk, and other places fall within this category.

Awareness of Stakeholders in Upcycled economy

There is a lack of knowledge and awareness of the upcycled economy among various stakeholders. This appears to be true not only at the human level, but also at the institutional level. That is why the linear economy's take-make-waste model continues to be popular.

Selection of Value Chains

How materials are used has changed dramatically during the previous few decades. This generates a great deal of waste and pollution in Pakistan and around the world. Every year, billions of tonnes of materials are imported into the world economy. If business as usual, just

8.6% of garbage is recycled or repurposed, economic growth will decelerate dramatically in the next decades (The Circularity Gap Report, 2021).

Almost every economic sector in Pakistan employs the linear model's 'take-make-waste' approach, resulting in severe resource scarcity and environmental degradation. Massive amounts of improperly handled garbage, such as plastic, paper, and agricultural/food waste, plague Pakistan.

Food waste, paper and board, plastic, metals (only car components), and electrical and electronic items are the most major value chains that make up the circular economy in Karachi, according to the survey respondents. Food waste, plastic, and paper were also mentioned in the research as areas where policymakers should be concerned. The following data is extrapolated from a baseline study for solid waste management in Karachi conducted in 2012, and it shows that food waste, plastic, and paper should be prioritised for future initiatives. It's worth noting that there's a present data gap on the subject.

Fig-4 Weekly waste creation Patron in Karachi

Material waste	**Low Income Class**			**Middle Income**			**High Income**		
	Friday	Sunday	Ave/Day	Friday	Tuesday	Average	Tuesday	Friday	Average
Food Waste	32	43	37.5	53	60	56.5	34	35	34.5
Plastic	17	18	17.5	14	12	13	11	10	10.5
Paper	11	7	9	12	10	11	7	13	10
Misc	23	19	10.5	3	18	10.5	23	29	26
Textiles	9	5	7	4	0	2	9	4	6.5
Grass/Wood	3	6	4.5	0	0	0	14	6	10
Glass	4	0	2	2	0	1	2	1	1.5
Bones	0	2	1	3	0	1.5	0	1	0.5
Metals	1	0	0.5	9	0	4.5	0	1	0.5
Leather	0	0	0	0	0	0	0	0	0
Rubber	0	0	0	0	0	0	0	0	0
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Source: **(Baseline Study for Solid Waste Management - Karachi, 2012)**									

Similarly, the evidence suggests that the focus in Peshawar should stay on the primary contributors, such as food waste, plastic, and paper. All of the identified value chains are causes of concern for stakeholders, according to a report commissioned by the Asian Development Bank on the solid waste management sector in Pakistan (2022). The table below shows the percentages of garbage and material added to the environment on a daily basis.

Fig-5 – Waster Creation Patron in Khyber Pakhtunkhwa

Material Waste	Peshawar	Mardan	Abbottabad	Kohat	Mingora	Average KP
Kitchen green waste	53.74	62.96	66.74	55.82	49.21	57.69
Paper	7.32	3.91	11.86	8.2	13.1	8.88
Textile	2.35	3.71	1.78	2.75	3.53	2.82
Grass/wood	10.29	1.05	1.47	0.15	4.66	3.52
Plastic	9.34	7.36	9.46	12	14.69	10.57
Leather and rubber	0.63	0.61	1.07	0.723	0.33	0.67
Metal	0.72	0.2	0.08	0.025	0.46	0.30
Bottle and glass	2.32	0.87	0.75	9.73	0.74	2.88
Ceramic, stone, and soil, etc.	12.32	3.09	1.15	0.9	1.3	3.75
Domestic hazardous wastes	0	0.45	0.2	0.4	0.5	0.31
Sieve Remaining>6mm	0	0	0.05	0.76	2.86	0.73
Miscellaneous	0.97	15.79	5.39	8.54	8.62	7.86
Total	100	100	100	100	100	100
Source: Solid Waste Management Sector in Pakistan by ADP, March 2022						

The author used waste analysis and characterisation investigations over the previous decade in roughly 15 cities in Pakistan to produce the above table for a research on the "Solid Waste Management Sector in Pakistan, 2022." Food waste, plastic, paper, dry grass, wood, ceramic stone, and soil are among the most commonly discarded materials, according to the report, all of which deplete resources. Due to a lack of time, we concentrated solely on plastic, food waste, and paper/cardboard.

Plastics sub sector

The global use of plastic is increasing at an alarming rate. According to one estimate, the world consumes more than 500 billion plastic bags each year, with single-use plastic accounting for half of that total. According to WWF-Pakistan, plastic accounts for around 65 percent of the debris that ends up on Pakistan's beaches. In addition, PET bottles and caps, broken fishing gear, balloons, and parcels have also been discovered in Pakistani waste. In Pakistan, plastics are not properly recycled or disposed of, causing major environmental problems. The majority of waste is dumped on undeveloped areas.

SDG 12 (Responsible Consumption and Production) strives to increase resource efficiency, infrastructure development, basic services, green and dignified jobs, and overall quality of life for all. Goal 14 (or SDG 14), "Conservation and sustainable use of marine resources for sustainable development," is one of the two major worldwide initiatives available to address the use of plastic for livelihood and its impact on life below the ocean. Pakistan gets a score of 92.1 for SDG 12, which is somewhat lower than India's (94.5) but much higher than China's (82) and Thailand's (80). (79.5). With a score of 47.6 out of 100 points, Pakistan lags behind both India (51.2) and Thailand (47.6) in SDG 14. (54.7).

According to the Ministry of Climate Change Year Book, 2019–21, Pakistan generates approximately 3.3 to 6 million tonnes of solid waste every year, which is constantly growing on an alarming scale. Plastic accounts for 10–14% of the generated waste. In 2020 alone, 3.9 million tonnes of plastic waste were added to the environment.

In addition to locally generated plastic waste that is dumped into the environment, the West is adding fuel to the fire by diverting hundreds of containers to Pakistan in response to a ban imposed by China and India. In 2019, alone, 587 containers of plastic waste from the United States of America arrived at Karachi port, followed by 23 from Singapore, 12 from the United Kingdom, and 2 from Hong Kong, for a total of 587.All these have a detrimental effect on the Pakistani environment.

3.3 million tonnes of plastic are produced by 6000 manufacturing units across Pakistan. The above table depicts the number of units and workforce involved in the production of plastic across Pakistan. The Punjab has 60% of the total units, followed by 30% in Sindh. Khyber

Pakhtunkhwa has only 7% of the total units, whereas, Baluchistan units only account for 3% of the total working units in the country.

Fig-6 – Number of Plastic Manufacturing Units and worker across Pakistan

Provinces	# of Units	Workforce Engaged
Punjab	3,600	360,000
Sindh	1,800	180,000
Khyber Pakhtunkhwa	420	420,000
Baluchistan	180	18,000
Total	6,000	978,000

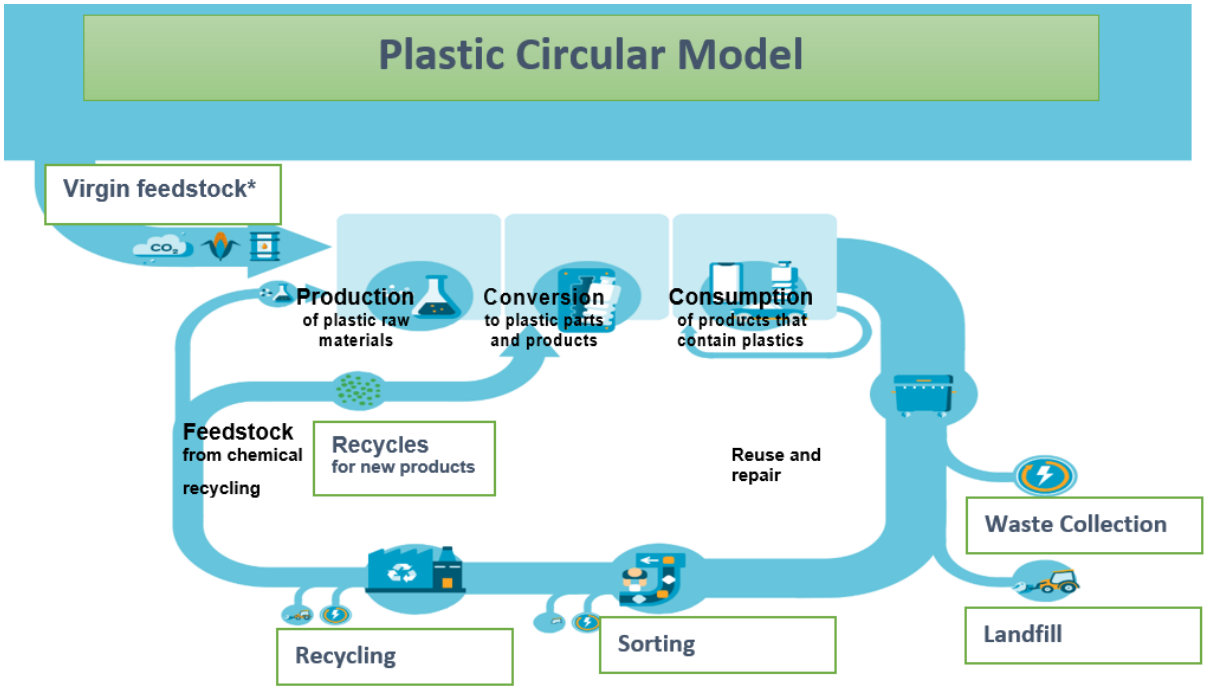
Source: (Ministry of Climate Change Year Book, 2019-2021)

The ministry projects this figure to reach 6.12 million by the year 2050. The ministry further maintains that 70% (approx. 2.6 million tonnes) of plastic waste is mismanaged and only 30% (1.3 million tonnes) is recycled or processed.

Recommended practices to handle Plastic

The focus is on the rise on to encourage the circular process of plastic material. The step involves reusing plastic, reducing waste, increasing value, and avoiding disposal would be a perfect

Fig-7 **Plastic Circular Model**

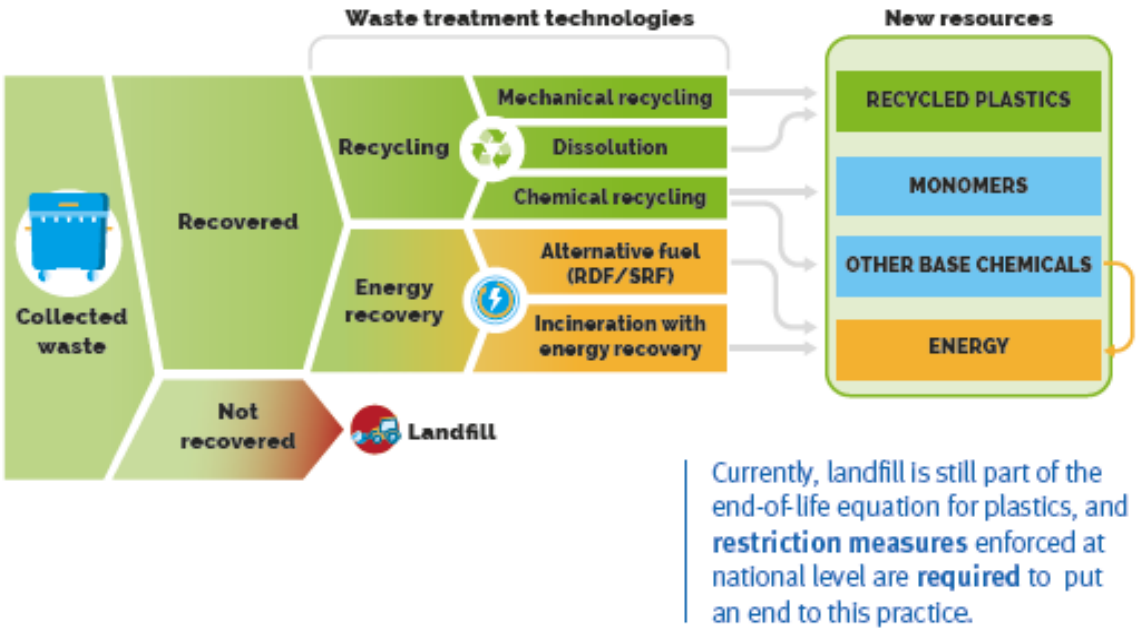


circular process for plastic. Plastic, like other items, is valuable and may be reused, recycled as a raw material for new products, and used to create energy from the plastic's non-recyclable parts. The plastics sector is actively seeking renewable energy sources to replace traditional fossil fuels and reduce CO2 emissions. More plastic garbage is being converted into recycles, increasing resource efficiency and lowering greenhouse gas emissions, according to the industry.

New Treatment of Post-Consumer Plastic Waste

Even non-recyclable plastic debris, such as composite materials, is now collected and converted into energy sources such as heat and power. Recent advances in chemical recycling, on the other hand, predict that this type of waste will be recycled more regularly in the not-too-distant future. Chemical recycling and solvent dissolving are two examples of technological advances that might someday replace mechanical recycling. Combining these recycling technologies is expected to dramatically revolutionize the way rubbish is handled.

Fig-8



Collection of Plastic

The field team recorded the thoughts of available and well-rested respondents, who revealed that a focus on plastic is critical for increasing the circular economy's share of the market. Polypropylene, high density polyethylene (HDP), polyvinyl chloride (PVC), and PETE or PET are the principal forms of plastic that ended up as first stage (collection) in wholesalers' places/Godam dispersed throughout 27 distinct locations in Karachi, according to the field crew. However, Lee Market, Saddar, Sher Shah, Clifton, Municipality, and Malir have the highest concentration of unlicensed companies.

According to the research, scavengers/pickers and small shopkeepers dealing with rubbish collecting in different parts of Karachi supply the following forms of plastic.

Fig-9 Daily collection of plastic materials at main points

Type of Plastic	Kgs
Plastic – Polypropylene	60
Plastic – High Density Polyethylene	70
Plastic – PVC	50
Plastic- PETE or PET	90

They also stated that in the bulk of value chains, Sindh's leading players are primarily engaged with garbage collection and wholesalers. Sher Shah, Korangi, Qadeer, and Landi have the most wholesalers. Punjab is the place to go for product design, processing, and manufacturing. Sindh, on the other hand, has around 1800 industrial units that make plastic.

In Karachi, there are large warehouses (godams) where the material is stored and sorted before being sent to the processing units. These processing units were erected by individuals. This substance is used to produce crystals. The crystals are then purchased by the local agents' wholesalers from Lahore, who then sell them to the industries. In Lahore, there are factories that make plastic products.

The key players in the plastic industry include: Engi Plastic Industries, Mughal Plastic Industries, Lucky Plastic Industry, Engro Asahi Polymer and Chemicals Limited, and the trade body is “Pakistan Plastic Manufacturers Association".

SWOT Analysis Plastic

Strength	**Weakness/Challenges**
• Every year, the plastic sector recycles 1.3 million tonnes of plastic. • The rising supply of repurposed goods • The need for more environmentally friendly products is growing every day. • This value chain's recycling has a moderate level of awareness. • Using cutting-edge technologies to recycle this value chain • There are plenty of informal workers, which ensures a continual supply of waste. • With a moderate degree of investment, the business/enterprise can be established. • Every year, 1.3 million tonnes of plastic are handled through a value chain that has been established.	• The customer dumps unsorted rubbish, resulting in a large percentage of plastic waste ending up in landfills. • Lack of awareness regarding recycling. • There are no waste points in this game. • There is a lack of emphasis and facilitation on the part of the government in terms of increasing recycling units. • They are inconvenient to purchase and carry due to the market's unfixed or low prices. • The development of single-useable things is due to a lack of public understanding about reusable items. • Those who may operate machinery at the processing facility lack technical skills They master their skill on the job. The TVET sector in Pakistan is not producing sector based skilled work force • Single-use plastic bags account for 10% of this garbage (5 billion plastic bags are used annually in Pakistan, totalling 0.376 million tonnes per year). •
Opportunities for growth	**Limitation to growth**
• To improve the circular economy as a whole, and the plastic value chain in particular, policy or regulation is required. • There are number of opportunities exist which may accommodate More people who may contribute to the circular economy, which will result in increased economic activity and employment development. • The product's availability and long-term viability will be improved. If a project/govt intervene in the plastic VC, the 2.6 million tonnes of plastic will bring back to the system every year which may potentially boost the plastic industry. • Every year, 70% of plastic garbage (about 2.6 million tonnes) is mishandled, posing a significant potential for the sector.	• People are only able to focus on the bad aspects of change rather than the positive aspects. The respondents (whole sellers) sound sceptical about any change and were of the view that any intervention by the extrinsic forces specially government will impact their business as usual. • Anti-policy on the aforementioned value chain could stifle growth. • Various government departments intervene unnecessarily The respondents lamented that every now and then officials of different will departments show up and demand something which they cannot produce • High cost of energy • Inadequate supply of electricity and gas

Comparative & competitive advantages	• Plastic materials are currently replacing metallic materials practically everywhere due to their lower cost as compared to metal. People like to alter items in the market since they are long-lasting, low-cost, and recyclable. • In terms of setting up and running processing units, the plastic sector has an advantage over the paper industry. It includes everything from crushing, crystallisation, and polyester production to finished plastic goods. These units are less expensive. • Following China and India's bans on plastic imports, the United States, the United Kingdom, Singapore, and Hong Kong have diverted their used or waste plastic to Pakistan. The same could help the industry grow if the government manages it appropriately (soliciting concessions for at least buying back the recycled items). (Year Book of Ministry of Climate Change, Government of Pakistan, 2020-2021)
Resources and technology needed for processing/reuse/recycle available locally • Human Resource (Labor, Technical staff, skilled staff) • Warehouses • Vehicle/ transportation • Steady Energy, electric and Gas • Machinery (Dumping, sorting, crushing, crystal making, product making)	
Human Resource Information:	

<table>
<tr>
<td>Occupation
• Pickers
• Loaders
• Sorters
• Drivers
• Weight machine operator
• Machine operators</td>
<td>Except for municipal employees, almost all of the workers are either daily pay, task-based, or self-employed and supply the collected waste to wholesalers. A wholesaler's setup includes 5-10 employees who are responsible for collecting and storing garbage. There is a scarcity of dedicated administrative and financial personnel.

The employees in manufacturing units have the following distribution; (Research Report on ‘Plastic Products’ Segment)
<table>
<tr><td>Employees per unit</td><td>Units share</td></tr>
<tr><td>51+ Employees</td><td>2%</td></tr>
<tr><td>24-50 Employees</td><td>33%</td></tr>
<tr><td>10-24 Employees</td><td>35%</td></tr>
<tr><td>0-4 Employees</td><td>9%</td></tr>
</table>
In both cities, child labour are involved in the shape of scavengers which are mostly consist of afghan boys and girls.
The small and as well whole sell scrap dealers are mostly men dominant businesses. Similarly, in the plastic value chain, at the crushing points as well as we hardly notice any women working. The women involvement in plastic dana (granules) making places were also found negligible. The situation for women labour is not that bleak in the plastic manufacturing units.

They need trainings regarding occupational health safety, technical skill upgradation, improved behavior etc.</td>
</tr>
</table>

Plastic Potential Value Chain Matrix

Plastic is an inseparable and integral part of human lives now. Despite all the disadvantages, the amount of plastic used annually has been growing steadily. Its low density, strength, user-friendly designs, fabrication capabilities, long life, low weight, and low cost are the factors behind such phenomenal growth. On the other hand, the problem it creates for the environment and human health is also a point of concern. Therefore, it is imperative to take measures to do away with the negative impact of plastic and let the material contribute to the development process of human beings. The following grid briefly describes the benefits of intervention in the plastic value chain.

Benefits matrix of plastic value chain

Environmental benefits	Estimated municipal waste every day (tonnes)				
	Cities	Overall waste	Plastic	30% recycled	70% untreated

Peshawar	2048	204.8	61.44	143.36
Karachi	16500	1815	544.5	1270.5

The intervention may have made a serious dent in the major environmental polluters. Even if 50% of the untreated plastic gets into circulation, it will have far-reaching benefits for the environment.

Financial and economic benefits	• The value chain has the capacity to increase the export value of plastic by a good percentage from USD 318.8 million (2019) and may significantly decrease the burden of imports from USD 2347.2 million (2019). (Finding Opportunist in Chaos, 2020) • The value chain make input more affordable for the local industry
Proposed contributions to the SDGs	SDG 6: Clean Water and Sanitation SDG 11: Sustainable Cities and Communities SDG 12: Responsible Consumption and Production SDG 13: Climate Action SDG 14: Protection of Seas and Oceans SDG 15: Repair Ecosystems and Retain Biodiversity
Commercial Opportunities	• In Peshawar as well as in the adjacent districts, the crushing of plastic is a profitable commercial opportunity that is seeing an ever-increasing demand in Lahore. • In Karachi, everything is in demand. However, the respondents say that Punjab is another market for the semi-processed waste of Karachi.
Sustainability	• The domestic as well as export business opportunities will keep the demand for plastic very high. • Secondly, keeping plastic in the circular economy will allow the industry to maintain a competitive edge over other industries.
Generate new revenue	Based on the team's observation, certain units/components of the plastic value chain may easily enhance their revenue by embarking upon extra production. which the increase in the supply of raw materials may make possible.
Contribution to CSR	There are enormous opportunities exist for CSR, following are few of them; • The scavenger can be oriented and equipped with occupation hazard safety kits.

- .
-
- The informal workers (scavengers) who happen to be Afghan girls and boys, are considered the vital organ of circular economy at present. These informal workers can receive educational lessons through accelerated learning programmes or TVET courses such as;
  - Occupational Health & Safety competence
  - Basic Literacy and numeracy skills
  -
- Industrial units may collaborate with educational institutions to educate students on the concepts of circular economy, RRR, and so on.

Paper and Cardboard

Despite the fact that we live in the digital age, when new software, gadgets, the internet, and global connectedness have reduced paper usage, the world still produces 490 million tonnes of paper each year. The production of such a large quantity of paper requires a lot of energy, water, and other resources. According to calculations, one tonne of paper requires 24 trees, a lot of water, and 32 million BTUs of energy. In a nutshell, it will have a major impact on climate change, global warming, and environmental issues. Such abnormal resource consumption will have a long-term impact on raw materials, energy, and finished goods availability, as well as being commercially and financially unsustainable for the end user.

Environment and CE

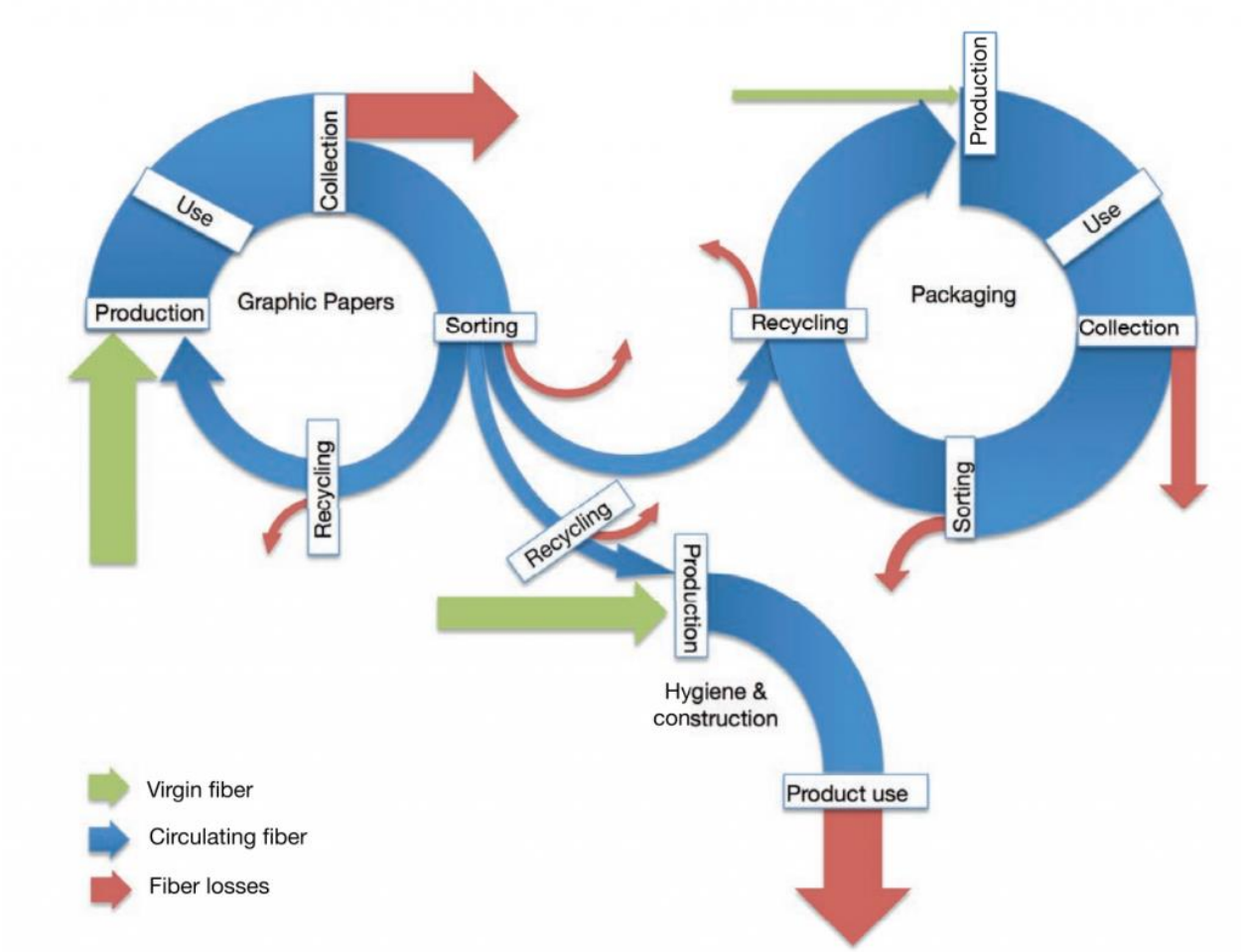
The circular economy is the answer in such a circumstance, where climate change is a problem, resource scarcity is an issue, and affordability is a concern. In the paper circular economy, products turn their worthless trash into valuable materials while maintaining economic and environmental considerations. Multiple industries in the loop collaborate in this arrangement, and one waste becomes a raw resource for the other. CE keeps trash out of the environment and protects valuable natural resources and ecosystems. The European paper industry comes to mind as an example of the circular process in the paper industry. The European paper industry is building on decades of work to make its industrial model circular, making it one of the most ecologically responsible business in Europe. It is built on fundamental resources such as pulp made from wood processing,

which is inherently sustainable since it comes from sustainably managed forests. It has decreased carbon emissions by 26% since 2005 and has become an anchor industry for industrial symbiosis, exchanging resources, heat energy, and water.

Hardship in Paper CE

Paper recycling is difficult because valuable pulp from the paper is spent in bleaching and dying operations. As a result, the sector must ensure that paper is sent to the recycle bin promptly and efficiently without causing major harm. Additionally, there may be an opportunity for adjacent industries to collaborate to make a paper that is less addicted to colouring, bleaching, and dying.

Fig-10



Energy & CE of Paper

Water and electricity are the two most essential resource inputs in the papermaking process, and both require circularity. Due to the increased availability of renewable energy sources, paper mills may be able to use them instead of fossil fuels. Freshwater, on the other hand, is not a renewable

resource, thus solutions for avoiding depletion include recycling it in many production cycles or acquiring it from the discharge of another firm.

Huge inputs to CE

In the case of paper, cellulose pulp and other scraps can be used directly as ingredients in other products. While cross-industrial items such as farm waste or wood chips from a furniture factory will be included into the recycled product manufacturing cycle, Despite the availability of some secondary resources, there is such a high demand for paper that the industry is forced to rely on a large number of primary resources. Furthermore, whether employing primary or secondary resources as inputs, the paper-making process consumes a significant amount of water and energy, both of which must be recycled. Although it is feasible to switch from fossil fuels to renewable energy, fresh paper mills still require water. However, reusing the input water in multiple industrial processes might be a viable option.

Paper Emissions in CE

The paper business creates various materials and emissions outflows that may be utilised to make another batch of paper at the outflow level. Some examples include sludge, oiler ash, and wastewater. Because paper fibres and fillers have been used to keep brick production going for years, cross-industry use of paper is also highly high. Similarly, paper sludge is beneficial to plants and can increase their yield. Some of the components, such lignin and cellulose fibre, are utilised in CO2 neutral fuel cell research.

Paper recycling limitations

Paper that has become obsolete, has been abandoned, or has reached the end of its useful life should be recycled into fresh paper. In 2020, almost 74 percent of all paper consumed in Europe will be recycled. Recycling one ton of paper saves 17 trees, 26000 gallons of water, 2.3 m3 of landfill space, 320 liters of oil, and 4100 kilowatt hours of energy, according to estimates. Paper recycling has its limitations, since recycling more than 5 to 7 times causes fibre loss. The paper trash, on the other hand, may be utilised in a variety of goods. For example, in the cell-u-value project, paper cellulose and other waste were used to generate bio-based chemicals such as monochloroacetic acid.

Paper's incineration

The final alternative is to burn paper waste for heat and energy. Byproducts of incineration can also be utilised for a variety of reasons. The ashes can be used to bleach fresh paper or to stabilise

soil for road building. CO2 may be utilised to manufacture valuable items like polymers, concrete, and biodiesel by incinerating it.

<table>
<tr><th colspan="2">Value Chain-2- Paper</th></tr>
<tr><td>Strength
Demand is high in the marketplace. Paper and cardboard are in high demand in almost every part of life, which makes them appealing to businesses.
People are environmentally sensitive and appreciate the usage of recycled paper and cardboard.
In the market, there is a constant supply of waste paper.
Paper and paperboard are biodegradable.
Recycling paper uses fewer resources than producing virgin paper.
The use of recycled water in paper saves a significant amount of resources.</td><td>Weakness/Challenges
Waste collection stations that are insufficient and improper.
Many people may choose to burn it rather than sell it or give it to waste collectors.
Absence of recycling units to treat;
Coated paper,
Treated paper,
Paper with food waste,
Empty juice boxes & cartons,
Cereal boxes,
Paper cups,
Paper towels,
Paper with laminated plastic,
Magazine laminated with plastic</td></tr>
<tr><td>Opportunities for growth
Every year, about half a billion dollars in pulp and paper are imported, which may be subsidised by the local sector.
It will encourage the creation of more recycling units if external support is made available to enhance collection stations.
Farm trash or furniture waste can also be used to help the industry grow.
Paper can also be used across industries, for example, paper sludge is helpful to plants and can boost their output.
Some of the components are used in CO2 neutral fuel cell research, such as lignin and cellulose fibre.
If the industry receives the necessary support to bring all available materials into use, it has the potential to lessen the import bill load.
If the sector's machinery is energy and water efficient, it will grow as well.</td><td>Limitation to growth
Limited collection points.
Very limited recycling units.
One of the challenges to expansion is that the manufacturing unit requires a lot of resources (capital for establishment as well as for recurring)
Due to a lack of contemporary machinery, more water and energy is consumed, resulting in resource waste.
In comparison to the plastic sector, the cost of establishing a factory is relatively high.</td></tr>
</table>

Comparative & Competitive advantage	1. Due to its expanding use in school and other institutions, the need for recycled paper is growing day by day. While the government is embracing climate and smart usage strategies, such as replacing plastic bags with paper bags, as a result of climate change. This is true not just in Karachi and Peshawar, but throughout Pakistan 2. Paper is nearly the only substance with the ability to be recycled several times. Even after it achieves its peak potential, it may still be useful for supplying energy by burning, and the ashes may be utilised to make new paper or stabilise soil for construction.
Incentive for actors	

Resources and technology needed for processing/reuse/recycle available locally

Resource & technologies:

- Human Resource (labor, skilled, and technical staff)
- Soft Water
- Energy Machinery (pulping, cleaning, screening, deinking, washing, flotation, water treatment, solid waste handling.

Occupations needed in this Value Chain • Pickers • Loaders • Sorters • Drivers • Weight machine operator • Machine operators • Laboratory technicians	Workers in picking and sorting, as mentioned in the previous value chain, are either employed on a daily basis or are self-employed and supply the collected waste to wholesalers. A wholesaler's setup includes 5-10 employees who are responsible for collecting and storing garbage. There is a scarcity of dedicated administrative and financial personnel. A variety of jobs must be completed by competent and highly skilled individuals in the manufacturing industry. The informal approach of training is used by the industry to meet their needs. **Note:** the skill trainings are done in three modes i.e.1) Formal, meaning in the institutes, 2) Non-formal, meaning Ustad-Shagard and Informal refer to on the job training such as apprenticeship In both cities, child labour are involved in the shape of scavengers which are mostly consist of afghan boys and girls. The small and as well whole sell scrap dealers are mostly men dominant businesses. Similarly, in the plastic value chain, at the crushing points as well as we hardly notice any women working. The women involvement in plastic dana (granules) making places were also found negligible. The situation for women labour is not that bleak in the plastic manufacturing units.

Paper Potential Value Chain Matrix

Pulp and paper are one of the largest industrial sectors that consume enormous forest resources across the globe. The sector makes products such as office and catalogue paper, glossy paper, tissue, and paper-based packaging, accounts for 13–15% of total wood consumption and uses between 33–40% of all industrial wood traded globally (source WWF). Despite its capacity to engulf the forest, humans have yet to find another sustainable alternative to paper. which indicates the need for interventions to shift the burden from the forest and bring the potential waste into

circulation. The following benefits matrix depicts the advantages of possible intervention in the pulp and paper industry for enhancing its current share in the circular economy.

Benefits Matrix of Paper value chain

Environmental benefits

Estimated municipal waste ever day (tonnes)				
Cities	Overall waste	Paper	65% recycled	30% untreated
Peshawar	2048	149.9136	97.44384	52.46976
Karachi	16500	1650	1072.5	577.5
Note: The local statistic is not available, therefore the estimation of recycled and untreated paper is based on the assumption				

The following table show adventages for envioremnt and climate change

Impact on	1 tonne of virgin fiber paper	1 tonne 100% Recycled Paper	Environment Saving from Recycled contents
Trees	17-24 Trees	No tree	100%
Greenhouse gas released	5601 pounds	3533 pounds	33%
Wastewater	22853 gallons	11535 gallons	49%
Solid Waste	1922 pounds	1171 pounds	39%
Source: (Kinsell & Susan, 2012) Comparing recycled to virgin paper			

Financial and economic benefits

- If the paper value chain increases its recycling capacity and starts treating the untreated paper waste along with expanding its sphere of input to treat waste (leftover) from the furniture industry, it will reduce the burden of the import bill. The current import bill is more than 0.5 billion USD.
- It is also likely to reduce the use of paper, which will also contribute to a reduced import of pulp and other paper articles.
- Less paper waste in the environment means less effort at the municipality level, less damage to agri-land, etc., which in turn will have an economic impact.
- The value chain will make inputs available as well as affordable to some extent for the local industry.
- The collection of such waste, i.e., cartons, tetra packs, paper with lamination, etc., will increase the income of pickers as well as scarp dealers.

Proposed contributions to the SDGs	SDG 6: Clean Water and Sanitation SDG 11: Sustainable Cities and Communities SDG 12: Responsible Consumption and Production SDG 13: Climate Action SDG 15: Repair Ecosystems and Retain Biodiversity
Commercial Opportunities	• In Peshawar as well as in the adjacent districts, the crushing of plastic is a profitable commercial opportunity that is seeing an ever-increasing demand in Lahore. • In Karachi, everything is in demand. However, the respondents say that Punjab is another market for the semi-processed waste of Karachi.
Sustainability	• The demand for waste paper is increasing every single day. Secondly, if the government is able to reinforce the ban on plastic, paper being the substitute for plastic bags will boost the pulp and paper industry. • The demand for paper is already on the rise and is likely to increase in the coming days. Therefore, the intervention will remain sustainable. • Secondly, the paper value chain is already sustainable and maintains a competitive edge over other industries.
Generate new revenue	• Based on the team's observation, the industry is ready to consider the utilisation of remains/leftover paper pulp, which will surely increase the revenue. • The extra input from the furniture industry and other types of paper such as paper with lamination and carton add to new revenue for the industry as well as for those who pick and transport it to the industry.
Contribution by/to CSR	There are enormous opportunities exist for CSR, following are few of them; • The scavenger can be oriented and equipped with occupation hazard safety kits. • These informal workers can receive educational lessons through accelerated learning programmes or TVET courses. • Industrial units may collaborate with educational institutions to educate students on the concepts of circular economy, RRR, and so on. • Companies may also fund and support various interventions such as; public awareness, building collection points which support good CE practices, design dustbin for house hose and office which segregate the waste.

Agri-Food Sector

A fascinating truth is that the global food system has grown at a greater rate than the human population. Consumers receiving more, and cheaper food has consequences, and this trade-off has come at the expense of fossil fuels, greenhouse gas emissions, biodiversity loss, farmland degradation, monoculture, and increased pathogen susceptibility; eco-system damage; and unsustainable water usage. The facts and figures are strange and alarming; according to the Ellen MacArthur Foundation, the way food is produced has negative health statistics, and every dollar spent on food has increased the health, environmental, and economic costs to two dollars, totaling 5.7 trillion USD per year globally. Agricultural land, on the other hand, covers 50 percent of the earth's habitable surface while contributing 25-30% of greenhouse emissions, 80% of deforestation, 90% of land degradation, 80% of loss of ecosystem services and bio diversity, 70% of fresh water, and over 80% of nitrogen and phosphate pollution.

According to World Bank estimates, the East Asian and Pacific regions generate 468 million tonnes of waste per year, with organic waste accounting for 53% of this total. The majority of the waste, i.e., 46%, is sent directly to landfill and 24% to incineration. The issue of converting products to waste with enormous volume has become a concern in the value chain of the agri-food industry. Immediate conversion into waste products will impact the possible economic value of byproducts. Apart from the economic loss, some parts of the waste created environmental hazards during the process of decomposition while generating methane gas. Agri-food has also had a negative impact on climate change by emitting greenhouse gases during its production and distribution activities.

Operating on the principle of reuse, recycle, and repair, these agri-food products are turned into fertilizers, energy materials, and compounds. This could be of more economic value and environmental concern in the long run, and it will create a more stable stream of profit for businesses. However, it does involve additional cost, and sometimes, organizations dealing with agri-food waste try to focus more on revenue streams than expenses.

The literature has shown different approaches in different countries for the circular processes of agri-food products. Mostly, these approaches are in line with reuse, remanufacturing, and recycling processes. However, distinct approaches are also available where organic waste is utilised in the

making of fertilizers. These fertilizers are then used in farming with less or no environmental impact and high economic value. This organic waste can also be used in livestock farming, as a food source for plant-based food products, which is a highly used waste handling process in the agri-food supply chain. In Europe, agri-food waste is given to other industries for utilization as input materials for other products, e.g., pig blood and butter.

Constraints with Agri-Food sector

The associated constraints with supply chain of agri-food industry are different from other supply chains. The agri-food products are time and session bound, with variable quantity and quality depending upon different external but natural factors such as water and sun energy. The procurement process is seasonal, shelve life is very limited, preservation required utmost efforts, cold storages are needed instead of general storages.

Apart from that, agricultural activities frequently produce undesired by-products, such as livestock excrement, unwanted leaves and stems from crops, which are normally recognized as wastes and disposed of as quickly as possible in the garbage disposal. With a lot of uncertainty in planting and harvesting, a lot of waste output, and preservation concerns, the circular economy process in agriculture and food will be highly useful both economically and environmentally. Animal digestion can be transformed into biomass and biofuel, as well as organic fertilizer, which saves money while also reducing greenhouse gas emissions and enhancing soil fertility. The use of CE in the agri-food sector will help to ensure the sector's long-term viability while also helping to alleviate the food scarcity.

CE in Agri-Food Sector

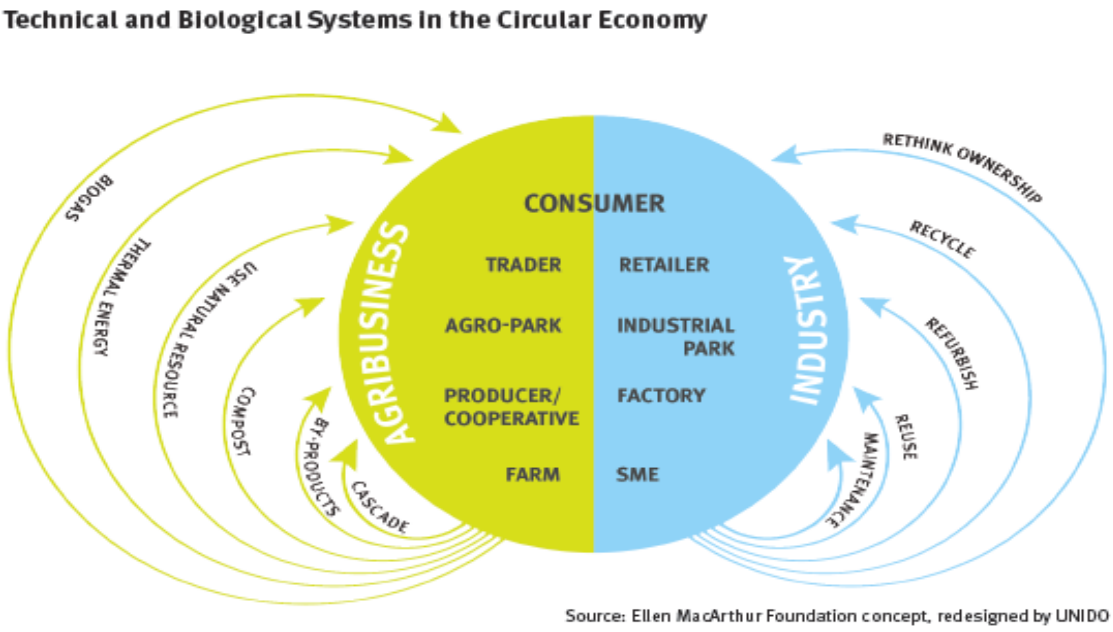
CE is not a single process; rather, it is a multifaceted strategy that can be used as a commercial strategy, a growth lever, a residue valorization plan, or a sustainability effort. Furthermore, it has the potential to ensure food security while also pursuing sustainability in a variety of domains.

Actors in Agri-Food Sector

In the agri-food industry, there are numerous players. Suppliers, processors, traders, retailers, and consumers are among them. Upstream supply chain actors include suppliers and farmers, whereas downstream supply chain actors include distribution actors, merchants, processors, and retailers. These actors transported final food goods to retailers or customers after sending cattle and crops

to processing enterprises. Then there's the food market, which wields the most bargaining power and hence serves as the focal point. They are related to the product's end users in the supply chain. Finally, product disposal, which occurs at all stages of the supply chain, is the responsibility of a stakeholder.

Fig-11



<table>
<tr><td colspan="3">Value Chain-3- Agri-Food</td></tr>
<tr><td colspan="2">Strength
30% of 4.9 million tons of annual waste is consist of food waste in Pakistan
Because agricultural and livestock raising are so important to Pakistan's economy, demand for this value chain is growing.
High number of organic foods in the local sphere can be generated
More consumptions of the food leads to more wastage
High consumption of food waste in livestock and fisheries as a fodder.</td><td>Weakness/Challenges
High wastage of food due to inadequate awareness among the stakeholders
No proper supply, lack of marketing and communication
Lack of recycling units.
Lack of concentration by the people, civil society for being ignorant and administration on recycling of this value chain.
Products are time and season bound as The food item are mostly highly perishable.. Secondly, this food are seasonal</td></tr>
<tr><td colspan="2">Opportunities for growth
Food waste may readily be converted into fertilisers, which can benefit both the economy and the ecology.
A good quantity of food could reach the needy if a robust pick and delivery mechanism is in place, helping the country to improve its hunger index from 92nd.</td><td>Limitation of growth
Shelve life is very limited
Preservation required utmost efforts and special resources as well.
Limited resources and recycling units.</td></tr>
<tr><td>Comparative & Comparative advantage</td><td colspan="2">Items like dried bread/roti are in high demand and easy to handle.
Food waste is the largest in Karachi and Peshawar, accounting for 35-57 percent of total trash produced. This may make this value chain more appealing and suitable for policymakers and development organisations to focus on.</td></tr>
<tr><td colspan="3">Resources and technology needed for processing/reuse/recycle available locally
Human Resource (labor, skilled, and technical staff) The intervention will require to impart training to already skilled workers (welders, mechanical engineers, etc.) for making the organic compost machines. This will also require marketing/communication officers to promote it among the stakeholders.
Machinery to convert the waste into fertilizers – The organic compost machine, which require basic level of expertise to operate.</td></tr>
</table>

Occupations needed in this Value Chain

1- Collectors -2: delivery agents 4. Sorters 5. Drivers, and 5. Machine operators (in future only)

Agri-Food Value Chain Matrix

Food and agriculture waste is the largest source of pollution and poses a very serious issue across the entire world. It's such a big issue that it has impacted everyone in so many ways. World leaders, governments, big corporates and small businesses, community activists, and development partners have been striving to find a suitable and sustainable solution to reduce food and waste, but have yet to achieve the goal to the desired degree. Despite combined efforts and raising awareness, a lot of food still ends up in the trash. In developed countries, the management of solid waste reduces the negative impact of food waste, but in Pakistan, the waste costs money and pollutes the environment, thus creating health issues etc. In light of the explained position, it is a high time to invest in this value chain. The investment will have far-reaching benefits for the environment and the economy, creating commercial opportunities and contributing to sustainability. The following matrices explain the benefits of possible intervention in the food waste value chain.

Benefits matrix of Food Waste & Loss Value Chain

Environmental benefits

Estimated municipal waste ever day (tonnes)				
Cities	Overall waste	Food Waste	65% recycled	30% untreated
Peshawar	2048	1100.6	0	1100.6
Karachi	16500	5692.5	3700.125	1992.375

17% of the total global food production is wasted, with 43% of this waste coming from households, 26% from food service, and 13% from retail (source: UNEP Food Waste Index Report 2021). Apart from the negative impact of food waste, it has grave environmental effects as well. According to World Wild Life, about 6%–8% of all human-caused greenhouse gas emissions could be reduced if we stopped wasting food.

Financial and economic benefits

If a two-prong strategy is adapted to reduce food waste as well as food loss, it will have a far-reaching effect on valuable resources like water, energy, fuel, and human labor. As a result, it will surely produce economic, social, as well as environmental benefits.

	• Producers and consumers are both affected by the phenomenon, and both may benefit financially by reducing food waste.Food waste is cut in half, and consumer kitchen expenses are cut in half.. Secondly, if the waste is converted into energy and fertilizer, it will add salvage value to the trash. • This may also help Pakistan make some progress on land from a serious cohort, as well as nationals on the moderate one. • The value chain make input more affordable for the local industry
Proposed contributions to the SDGs	SDG 12: Responsible Consumption and Production SDG 11: Sustainable Cities and Communities SDG 13: Climate Action SDG 15: Repair Ecosystems and Retain Biodiversity
Commercial Opportunities	• The conversion of waste into compost will create a number of commercial opportunities ranging from producing, marketing, and retailing. In this question, transportation will also be needed.
Sustainability	The current practises are direly against the norms of sustainability where around one billion tonnes of food is wasted every year (source: EPA), whereas on the other hand, two billion people face the menace of malnutrition. In the given circumstances, this will sometimes backfire, and may even trigger unrest in the world. Any intervention that focuses on the reduction of food loss, food waste, or conversion of food leftovers into some valuable input for the generation of the same or other resources will remain sustainable.
Generate new revenue	Based on the team's observation, certain units/components of the plastic value chain may easily enhance their revenue by embarking upon extra production. which the increase in the supply of raw materials may make possible.
Contribution to CSR	There are enormous opportunities exist for CSR, following are few of them; • The scavenger can be oriented and equipped with occupation hazard safety kits. • These informal workers can receive educational lessons through accelerated learning programmes or TVET courses. • Industrial units may collaborate with educational institutions to educate students on the concepts of circular economy, RRR, and so on. • The hotels, restaurants, wedding halls, etc. may donate the excess food to feed the underprivileged.

- The Hotels, restaurants, and wedding venues could help the social enterprise convert kitchen waste into fertilizer.

Conclusion and Recommendations

The globe is confronted with significant issues in purchasing goods. On the one hand, customers engage in "purchasing too much" behavior, while on the other hand, recycling efforts are insufficient. Natural resources are harvested, used, and finally discarded under the global economy's "take-make-waste" process. The current economic paradigm is already overburdening the world, causing the climate crisis and diminishing the resources that future generations will require.

In the meantime, the sand is running out, calling for a change in the way we do business, so that waste and pollution don't end up in the first place. Products and materials are used for far longer, and nature is allowed to come back to life.

Without joint efforts, the transition to a circular economy will be impossible. To employ more recycled materials, businesses must rethink their goods and operations. Clients are accountable for their products' environmental impact. Environmentally responsible design and production can be approached in two ways. The first method says that a product's environmental impact can be cut down, while the second encourages recycling and reuse of the same thing.

Because of the nature and magnitude of change, all stakeholders must participate in the change process. Consumers should think twice before purchasing services and products. Businesses and enterprises should design out waste and ensure that their products last longer, and the public sector should focus on the promulgation or repealing of laws to help consumers and businesses avoid ill-designed products and services. The development organizations could help ease the transition by, among other things, launching initiatives to raise awareness at all levels, advocating for the importance of the circular economy among policymakers, and assisting them in redesigning and implementing essential statutes.

Generic Recommendations

Here, governments have a great duty to provide support to key stakeholders for the adoption of new technology and to develop rules for proper waste management that are aligned with the circular economy strategy.

- There is a dire need to educate people with examples. Secondly, the reinforcement of the relevant enacted laws and policies is highly imperative for both implementation and spreading awareness. The ban on plastic and the way it has been implemented have already conveyed the message to the community about the bad effects that mishandled plastic has on the environment.
- The collection points need to be increased and the community needs to be involved and organized at the grassroot level to play their due role in the proper handling and sorting of waste.
- Another problem is that the waste-collection capacity of waste collectors is limited in proportion to waste output. There is no efficient separation of diverse items from houses to dumping sites. People who work for waste management companies in Peshawar and Karachi can expand their reach by recycling a lot of different types of waste with help from green technologies.
- Measures are also needed to push for customised dust bins/waste containers that provide room for sorting the waste at the consumer level. This also necessitates capacity-building measures at the municipality level.
- The existing informal workers who are involved in picking and sorting are operating without any safety measures and are susceptible to hazards that need measures.

Plastic specific

The plastic value chain is vastly underutilized, despite the fact that it has the capacity to handle massive amounts of unprocessed plastic trash. Currently, the industry recycles 1.3 million tonnes of plastic, leaving 70% of it to pollute rivers and seas, deface our environment, and release hazardous chemicals into the surrounding soil, which can then seep into groundwater or other nearby water sources, as well as the ecosystem.

The actors in Karachi are best interconnected. While the focus in Peshawar is mostly on crushing, Lahore is the destination for conversion to crystal (plastic dana) or other products.

When working with the plastic value chain, there are a few obstacles to overcome. Plastic manufacturers, trash collectors (Kabaria), and crushers are all sources of worry.

1. The waste created at home and offices are directly dumped in amalgamated form thus reducing the values of waste for circularity. Due to the lack of house-level sorting and collection, trash merchants and scavengers claim they can only recover less than 50% of PET recyclables and fewer than 10% of polythene bag waste. It is recommended that a wide spread awareness should be launched to abreast the community about the merits and demerits of treatment/management of waste at the household level. Other interventions may also consider giving incentives such as recycling bins for household etc.

2. The prevailing practices and capacity of waste collector also call for different measures such as providing sorting machinery for effective separation of various products, capacity building of staff and revenue generation mechanism from the waste material,

3. Though, the government is promoting the biodegradable bag which need a careful consideration due to its potential to be harmful for some products such dairy, cooked food, etc. Secondly, biodegradable bags dispose in the open air and sunlight, while in Pakistan, the waste is mostly dumped into landfills. This phenomenon creates room for further research. Educational institutes like University of Peshawar have potential work in research and partnership with these institutes are encouraged to work on plastic research, awareness campaigns

4. The weight of the polythene bag is less than 50 microns, and collection of these plastic bags is one of the major causes that scavengers consider not cost effective, as compared to used PET bottle, government can introduce a policy to consider the minimum weight of the plastic bags or subsidize the collection rates to attract scavengers and junk dealers.

5. Policy level efforts are required to completely ban the laminated plastic products manufacturers and labeling of the materials used and its harmful effects on the environment on the packing plastic should be considered mandatory.

6. The government should consider incentivizing the plastic recycling industry by providing the legal protection, free registration, one window operation and if possible priority in accessing the financial services for improving and expanding their respective businesses

In order to use more recycled materials, businesses must rethink their goods and processes. The environmental impact of a client's goods is the client's responsibility. There are two methods for designing and producing products that are environmentally friendly. The first method assumes that a product's environmental impact can be reduced, while the second encourages recycling and reuse. Consumption should be encouraged to reduce waste and remove packing. Plastic bags choke drains and sewage systems all around the world, especially in highly populated places with inadequate drainage and sewage infrastructure, because they are no longer profitable. As a result, plastic bags should be designed to be reused after being recycled.

Recommendation for Paper value chain;

Paper is an obvious choice for a circular economy. Paper is recycled at a higher rate than any other solid waste commodity. Despite its high recycling rate, Pakistan imports a large amount of wood pulp and other paper products. Pakistani imports of paper and paperboard, articles of pulp, and other similar items totaled $534.63 million in 2021. (Source: UN COMTRADE database). The high rate of import and recycling tendency indicate that the pulp and paper industry requires assistance. As a result, it is critical to support the pulp and paper industry in order to stimulate and strengthen it. The following are some of the suggestions and insights derived from conversations with stakeholders and literature reviews:

- The private sector requires assistance/input in order to purchase resource-efficient machinery that can recycle empty juice boxes and cartons, among other things.
- Advocacy is needed to discourage the use of plastic coated or laminated paper in order to make maximum paper ready for recycling.
- To supply farm waste and furniture trash to the pulp and paper sector, a transitory link must be constructed. This will help the pulp and paper industry by increasing supplies. Second, it will alleviate the furniture industry's waste management problem. Support should be made available for the pulp and paper industry to begin generating agricultural inputs and other materials. This will necessitate capacity-building efforts as well as gear to convert pulp waste into composite material. The paper & pulp sludge is in organic matter which is good a source for healthy and thriving soils. The sludge contains calcium carbonate which is widely used for acid treatment and stabilize acidic soils. The nutrient contents in the sludge often contains

nitrogen, phosphorus, potassium, calcium and magnesium etc, which may make it a good and attractive source for farmers. The reuse of pulp and paper mill sludge would not only divert waste from landfills and incinerators, but it would also create a value-added product. This approach would give pulp and paper producers the opportunity to mitigate disposal costs while improving their environmental standing, and even potentially create an additional source of revenue

- Water reuse and recycling in the pulp and paper sector necessitates considerable oversight and awareness on the part of the authorities.
- Measures to increase capacity in the recycling sector are required so that the following waste materials in the paper value chain can be recycled:
    - Coated paper,
    - Treated paper,
    - Paper with food waste,
    - Empty juice boxes and cartons,
    - Cereal boxes,
    - Paper cups,
    - Paper towels,
    - Paper with laminated plastic,
    - Magazine laminated with plastic.

Agri-Food – waste

In Pakistan, food waste accounts for 30% of the country's overall trash. In Karachi and Peshawar, the share is significantly higher than the national average. On the one hand, Pakistanis waste and overconsume this valuable resource; on the other hand, Pakistan ranks 92nd out of 116 countries in the Global Hunger Index. Pakistan's score in 2021 was 26.7, putting them in a dangerous group. Due to the current scenario, this value chain has the potential to benefit a wide range of society segments, if government and development partners provide systematic support. Because private sector participation in the value chain will be difficult at first, it is advised that the interventions be carried out as social businesses. The following are some of the findings:

- Only a small percentage of food waste gets recycled or reused, with the remainder ending up in landfills. Bread is recycled/reused in both cities and given to livestock, however leftover cooked rice from restaurants is exclusively collected in Karachi and fed to the fish

farm. Several organisations in Karachi have begun an effort to distribute surplus cooked food to underprivileged families.

- Second, the government should make it illegal for hotels, restaurants, hostels, Madaris, and other businesses to treat their food waste on the spot. It's worth noting that the Directorate of Science and Technology (DOST) of Khyber Pakhtunkhwa helped design a machine that turns agri-food waste into compost. However, it does not appear to have a wide range of applications in the market.
- The industry also necessitates concerted efforts to raise awareness, provide support to actors in the form of capacity building, and provide funding for the procurement of machines and equipment to turn waste into gems. This industry has the ability to help the pulp and paper industry by securing the supply of woody and non-woody materials. The pulp and paper industry were previously mostly based on the non-woody input. The industry may get benefit by taking input from the agriculture sector if they start using straws which are the by-products of cereals, similarly bagasse is other agri-waste and has the ability to produce almost all grades of papers. There are number of graces such as Kahi grace which may be a good input to the pulp and paper industry .

Recommendation for further studies

1. It is suggested, to conduct in-depth sectoral analysis for waste tracers and highlighting challenges and opportunities in each sector. The same analysis should also produce sector specific dynamics to attract investment.

2. The policies/laws pertaining to environment, waste creation & management, as well as businesses should be thoroughly analyzed in the context of promoting circular economy in Pakistan. The analysis should enable the government for developing possible legal framework for the circular economy and relate all the relevant rules, regulations, perks and incentives available for the CE and waste collections.

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Annexures


Tool-2.docx


Tool-1.docx


Tool 05.docx


Tool 3.docx


Tool-3 for consumers.docx

Laws, Rules and Regulations for SWM in Pakistan

Major Laws / By-Laws	**Year**	**Scope**
PEPA (Pakistan Environmental Protection Act)	1997	• Protection of the environment: air, water, etc. • Deals with municipal, hospital, industrial, agricultural and hazardous waste; organic and inorganic matters and living organisms, buildings, etc. • All social and economic conditions affecting community life
Hazardous Substance Rules	2003	• Waste management plan pertaining to hazardous waste
Hospital Waste Management Rules	2005	• Holds health care establishment responsible for proper waste management • Sets duties and responsibilities; e.g. planning, segregation, collection, storage, reuse, etc.
National Environmental Quality Standard	2000	• Test and analyze waste samples sent by factories or persons authorized by the Federal or Provincial Agency to ensure they meet NEQS regulations
NEQS Rules	2001	• Self monitoring and reporting by industries
Punjab Local Government Ordinance	2001	• Local Governments' establishments and scope of Services • Declares SWM as within the competences of the Local Governments
PLGO	2001	• Waste collection, transportation, and disposal
Lahore SWM By-Laws	2005	• Declares CDGL responsible for the sanitation of the area within its jurisdiction • Sets duties and responsibilities such as collection, removal, and prohibition from depositing refuse, building materials, etc., in public places
PPP policy	2007	• Guidelines for public private partnership for infrastructure development
PPP Act	2010	• Framework for public private partnership for infrastructure development

Source: Ernst Basler, Partners and ICEPAK (2010)