Stakeholder Analysis of Recycling Businesses Contributions in Swat at Bottom of Pyramid Markets

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Abstract

The study aimed to analyze stakeholders' contributions of recycling intermediaries operating at bottom of pyramid markets in District Swat. In the context of Pakistan's weak waste governance and its role as a global recipient of imported waste, the research investigates how local recycling intermediaries reclaim value from waste materials through lifecycle assessment-based resource recovery cycles (RRCs). Utilizing an inductive qualitative research design rooted in grounded theory, the study identifies key stakeholders involved in recycling waste such as textiles, waste electrical and electronic equipment (WEEEs), and post-harvest agricultural materials. The findings of study indicate that frugal innovation which refer to cost-efficient recycling practices known as jugaad is prevalent among low-income communities termed as below the base of pyramid markets. Through semi-structured interviews and three-tiered grounded theory-based codification (open, axial, and selective), the study reveals that intermediaries operate with minimal resources yet significantly contribute to local economies and inwardly to environmental sustainability. The study further indicates the existence of recursive, resource recovery cycles (RRCs) used by intermediaries, which encompass both upcycling and down cycling type of recycling. The study proposes a logic diagram that discusses contributions of specific stakeholders, emphasizing the critical role of frugal innovation in driving recycling efforts in district Swat. This study contributes to understanding how recycling intermediaries create value in resource-constrained environments and offers insights into enhancing waste management strategies in developing countries.

Keywords: Frugal innovation, Lifecycle assessment, recycling intermediaries, waste management, resource recovery cycles, Botton of Pyramid markets.

Introduction

Pakistan has become the favorite destination for developed countries to export their waste and use it as dumping ground for their waste disposal (Gutberlet, 2023). In the absence of formal recycling industries, weak waste governance and poor socio-economic

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indicators in Pakistan, the country uses scrap material from other countries to recover, re-use, refine and recycle materials for its indigenous use by elevating itself to the status of an informal industry in Pakistan (Nawaz, Yousafzai, Khan, et al., 2021). The emergence of term Anthropocene is necessitated by considerable impact of anthropogenic activities on human lives in the light of anthropogenic global warming theory (Brown et al., 2017). The global volume of waste per day is estimated around 6 million tons by 2025. The waste gap is ever rising as evident from the accumulation of waste in the Great Pacific Garbage patch almost 1.6 million Sq Km in the ocean which is as big as twice the size of United States of America (Gutberlet, 2023).

The global Climate Risk index, 2021 positions Pakistan among other countries such as Haiti and Philippines as most vulnerable to effects climatic change (Eckstein et al., 2021). Likewise, Pakistan is also ranked amongst top ten nations affected by extreme weather events (Yousafzai et al., 2020) due to rising anthropogenic pressures coupled with exponential population growth rate. These factors further contribute to excesses beyond thresholds of the population carrying capacity of a country which can have severe repercussions. Thus, acknowledging the efforts of various eco-friendly stakeholders involved in recycling is much needed than ever realized before in order to motivate them.

The desire for the circular economy is widespread among both developed and developing nations (Global North vs Global South) as part of the sustainable development goals (SDGs) and in pursuance of the guidelines for achievement of vision 2030 targets as envisioned in SDGs at Rio de Janeiro conference in 2012. According to Wilson and Velis (2015) almost more than 02 billion people across the world lack access to proper structured approach to waste collection and around 3 billion people lack access to controlled waste collection. On the one hand, it is interesting to note that some nations are leading exporters of waste. On the other hand, there are other less developed countries such as Pakistan which imports waste in huge amounts from friendly countries with the expectation to reclaim the residual value by way of recycling such materials. Although, there is movement from one country to another, the total carbon footprint and greenhouse gases are part of the same planet, due to transboundary movement of pollutants (Nawaz, et al., 2021).

Pakistan seems to have become a favorite destination for dumping municipal waste for affluent nations. There is also phenomenon of reclaiming value from such imports or from indigenous municipal solid waste through stockpile recycling by rag pickers. These stockpile agents/rag pickers are known as Kebaryan in Pakistan, which vary in size, volume and frequency. They work in unanticipated ways to reclaim valuable material from the municipal

solid waste in a creative yet very primitive manner (Yousafzai et al., 2020). These people work with people below the base of pyramid to stockpile dozens of materials such as Waster electric and electronic waste (WEEE), Textile waste, agriculture waste and so on. These materials are then upcycled, downcycled and transported to recycling centers in larger cities and industrial economic zones for final value addition. This transportation increases the transaction costs of running the recycling business which is a serious issue confronted by a number of recycling businessmen as well as government. According to Hennart and Verbeke (2022) transaction costs are actually costs of operating the economic system. The transportation of consolidated bulk waste creates externalities such as road hazards for general public as well as reduces the useful life of roads maintained by National Highway authorities in Pakistan. Hence, it is crucial to examine the contributions of recycling stakeholders in district Swat in order to improve existing recycling system.

The current municipal solid waste management (MSWM) practices run by the Governments in Global South also called oriental cultures is below par international standards (Gutberlet, 2023). Likewise, the MSWM of Pakistan are inadequate to support proper dispense of municipal solid waste in Pakistan without impacting the public health. This has caused informal sector to bricolage on this opportunity by using low-tech and autonomous mechanisms of recycling in both rural and urban areas of Pakistan (Nawaz, Yousafzai, Khan, et al., 2021). The issue of recycling warrants particular attention in Swat valley due to its enormous population of 25 million. The district Swat in terms of population density lack adequate formal apparatus to carry out value extraction from waste material produced. Hence, this situation calls for interventions to map and assess the existing mechanisms of recycling stakeholders in district Swat is germane.

This study endeavors to figure out the contributions of recycling intermediaries (stakeholders) in study areas and determine the contributions of such stakeholders to the gross domestic product (GDP) of Swat which is a need of the day towards financial formalization. However, existing mechanisms are inadequate to deal with burgeoning amount of waste created in areas having higher population density (Gutberlet, 2023). The global production of MSW will reach a staggering 6 million tons daily. In order to address this grand challenge and associated impact such as diseases a comprehensive understanding of the direct and indirect stakeholders is of importance for sustainability (Gutberlet & Uddin, 2017).

Freman's stakeholder theory proclaims the significance of identifying and assessing the important role of stakeholders in an industry (Szyszka, 2024). The concept of stakeholder salience, entails the identification of most important stakeholders and their

contributions. In the context of recycling intermediaries, this study identified several stakeholders such as stockpile agents, aggregators, waste pickers and the municipalities. The stakeholder theory lens is best suited for examining the contributions of informal stakeholders such as those who contribute to recycling in the context of this study (Magness, 2008). In the District Swat most of the stakeholders of recycling value chain are in the unbanked, unregistered and informal economy due to the special status of tax exempted territory (Nawaz, Yousafzai, Khan, et al., 2021). These people use low tech Kriznerian innovation to create value from trash by way of consolidation of recyclables (Yousafzai et al., 2020).

These recycling stakeholders do not use safety equipment yet contribute towards sustainable development goals as mandated by Vision 2030 of United Nations SDGs (Wilson & Velis, 2015). There is no long-term planning when it comes to informal business and the recycling intermediaries are no exception. They employ frugal technique called "jugaad" which is an indigenous form of quick fix hacks used mostly due to resource scarcity (Hossain, 218). The frugal innovation was cited in Sharma and Kumar (2024) in their recent paper, wherein they contend that quick fix approaches often face long term sustainability issues as well as quality standards are compromised. The jugaad innovation in popular in Global South due to the resource scarcity in these countries. In the global North most of the recycling practices are sophisticated and utilizes artificial intelligence to work efficiently (Pansera, 2018). The popularity of Jugaad type frugal practices in countries like Pakistan is due to its low cost of operation which appeals to a greater stratum of population living below the base of pyramid (Ullah, 2024). However, recent trends show the popularity of frugal innovation in Global north countries due to its minimal resource utilization in terms of water, electricity and time as well as ability to give more accessible and quality laden products (Agarwal & Brem, 2017).

Recycling stakeholders are mostly material oriented such as textile, WEEE waste electrical and electronic equipment dealers, Post harvest waste dealers, vehicular recycling, construction and demolition waste recyclers, plastic recyclers and general stockpile agents and aggregators. Some metals and liquid can be recycled indefinitely. However, a cradle to grave approach is hard to document. Instead, the lifecycle assessment is used such as those for textiles which are both upcycled and down cycled. There is a specific industry of coloring and dyes which uses frugal innovation to refurbish old textiles which are often times exported again (Koszewska et al., 2020). Likewise, WEEEs are recycled and valuable items are re-used by local technicians. In regards to agriculture waste the post-harvest waste is utilized by the farmers as fodder for their cattle as Pakistan is among the top ten livestock producing country (Yousafzai et al., 2024). Other

types of waste stakeholders specialize in Eid Ul Azha feat of sacrifice relate leather accumulators and those who deal in construction and demolition waste.

Although recycling has several advantages, there are also associated dis-advantages. The foremost issue pertains to the quality of items, especially the down cycled materials in particular. The second issue pertains to unhealthy processes, wherein additional energy enters the atmosphere to convert the recyclables such as steel and iron ore extraction from construction and demolition waste (Mejía-Marchena et al., 2023). Most of the processing factories use inordinate amount of water, which goes to rivers and streams without any treatment. This is a significant source of environmental pollution (Neelab et al., 2022). In this regard Edward De bono proposed an innovation approach that every factory should be downstream of its itself (Mäki, 2020). Such innovative approaches are required to attain the true spirit of recycling for ensuring sustainable development. It is worthy of mention that extended producer responsibility can solve many of the issues we are confronted today. But there are climate deniers who oppose legislation regarding extended producers' responsibility (EPR) such as bottle bill case in USA created intense resistance from big firms (Mann, 2021).

Pakistan being an agriculture country also contributes little to environmental pollution in seemingly benign ways such as Co2 from animal respiration, fermentation and manure as well as belching of methane by cows (Mann, 2021). Other than this, globally around 80 billion animals are slaughtered including those during feat of sacrifice called Eid Al Azha excluding fish. The calories they generate account for 18 Percent of total energy but they consume 80 % of earth farmlands. It is predicted that by 2030 more than half of Pakistan population will live in urban areas i.e., cities. Despite minimal contributions to ghg emission in Pakistan a third of its population do not have access to clean drinking water let alone its cattle (Markey, 2013). These facts in mind there is a dire need to plan and map the various stakeholders of recycling in order to document their contributions to society for long term sustainability (Markey, 2013).

Prior researchers have studied the role of waste picker sustainopreneurs or ecopreneurs in Peshawar district with a quantitative research design (Yousafzai et al., 2020; Khan et al., 2020). In the same vein, other researchers such as Nawaz, Yousafzai, Khan, et al. (2021) have studied formal and informal mechanisms of waste recycling in District Swat. Although specific categorization of waste recycling intermediaries and their stakeholders is conspicuous by its absence, especially those which higher volumes in target area of study. This has led to creation of research gap, which warrants examination in the form of a stakeholder analysis of various recycling intermediaries' contribution in respect to Construction and Demolition

Waste, Agriculture waste, Electrical and electronic equipment waste, Textile recycling and post-harvest agriculture waste. More efforts for formalization and upgradation of their processes are required in this underappreciated sector to acknowledge their pro-environmental services in target area of study.

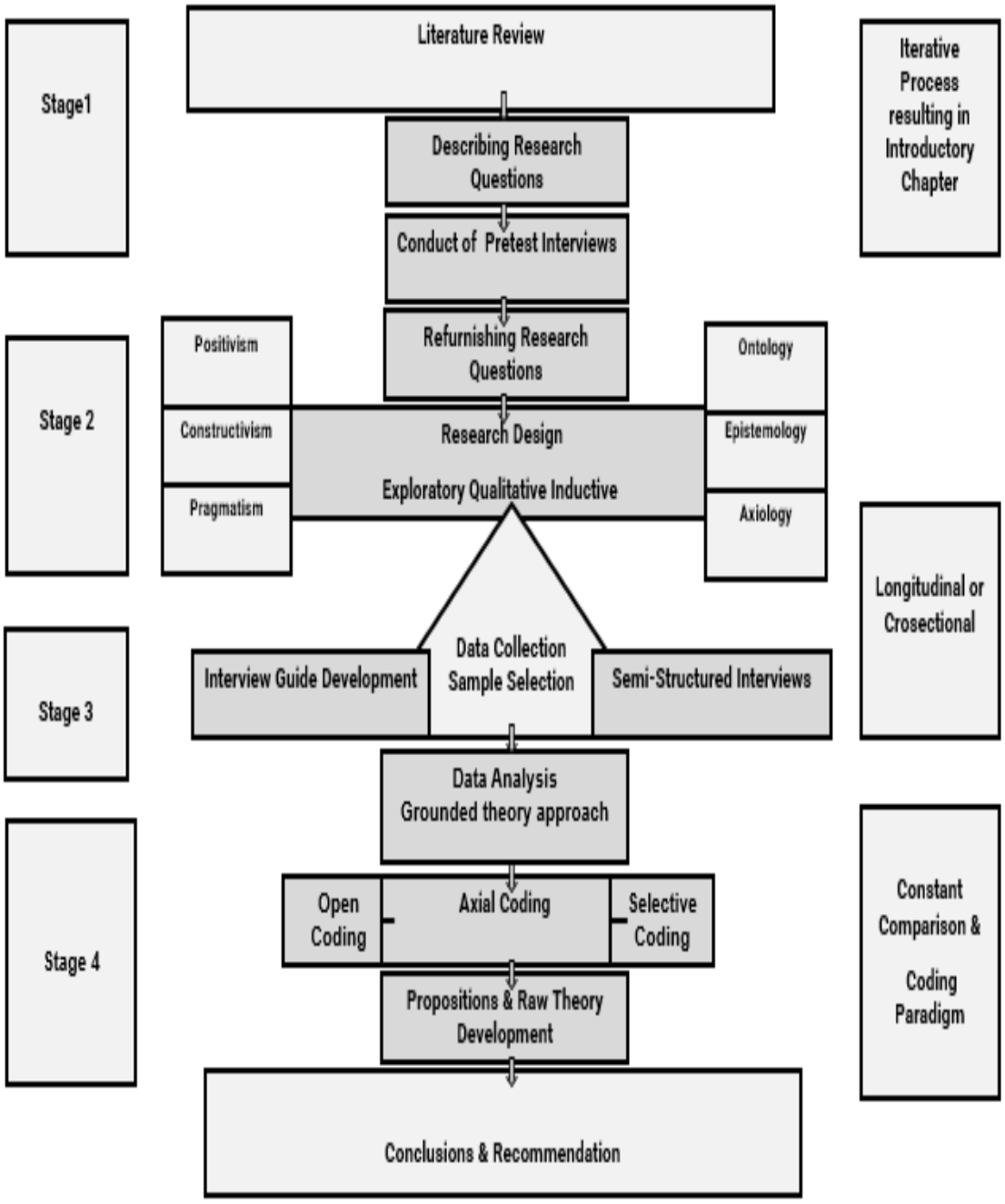
Methodology

This study uses an inductive qualitative research design with grounded theory as strategy of investigation. This is appropriate research design due to the exploratory nature of the study wherein, there is a serious dearth of apriori theories to conduct deductive studies. According to Creswell and Poth (2016) inductive qualitative research design is preferred choice, when there are no existing theories to test as well as the study topic is relatively unexplored such as the current topic of the study pertaining to contributions of recycling intermediaries operating below the base of pyramid markets.

Stage 1 (Iterative Process of Refining Research Questions)

The figure (1) explains a generic road map of the methodology chapter used for this study. In the stage (1) initially, we explored the pertinent literature to the topic of the study in order to determine initial topic and title of the study. In the light of these, the initial research question was framed and pilot interviews were done to refine the research questions through an iterative process of refinement. This means that there were two stages of data collection. The first one undertaken at the pilot phase of the study and the second phase of data collection was undertaken in the full-fledged data collection phase (Nawaz, Yousafzai, Khan, et al., 2021; Tariq, 2018).

Figure 1 Road Map of Methodology Chapter



Source: Adapted from (Tariq, 2018; Yousafzai et al., 2022)

Stage 2 (Research Design and Philosophical Worldview)

In the second stage of the study, the research design was created. Design means putting known things together in a new combination to achieve desired outcomes. In this regard the researchers considered their own positionality in reference to various philosophical world views as well as ontology (view of reality) and epistemology. The rigor and relevance related to axiological values were kept in mind as research without ethics is unethical in itself (Iqbal et al., 2018). Out of the four contending views of positivism, pragmatism, advocacy and constructivism we espoused the social constructivism in line with the nature of the topic under study.

Stage 3 (Data collection and Sample Size Determination)

In the third stage, we decided upon data collection from the participants of the study. In this regard, it was decided that semi-structured interviews will be conducted from recycling intermediaries in district Swat. The interviews were transcribed non-verbatim and back translated into English language. Due to time limitation, it was feasible to collect cross sectional data from participants in the field with the help of an interview guide. The interview guide was recursively refined in order to improve the elicitation of relevant response from participants of the study. In regards to sample size determination we used the concept of theoretical saturation used in grounded theory studies (Ullah, 2024; Yousafzai et al., 2017). Point of theoretical saturation refers to notion when addition interviews cease to generate new insights. In this research point of theoretical saturation started unfolding after the 20th interview. According to leading scholars there is lack of consensus on number of interviews in grounded theory based studies such as (Creswell & Poth, 2016) advocates 20-30 interviews. (Charmaz, 2006) advocates 25 and (Bryman & Burgess, 2002) call for conduct of 50 interviews. Pertinent to note that a total of 20 interviews were done across two phases i.e., 4 interviews in pilot phase and 16 interviews in the full-fledged data collection phase.

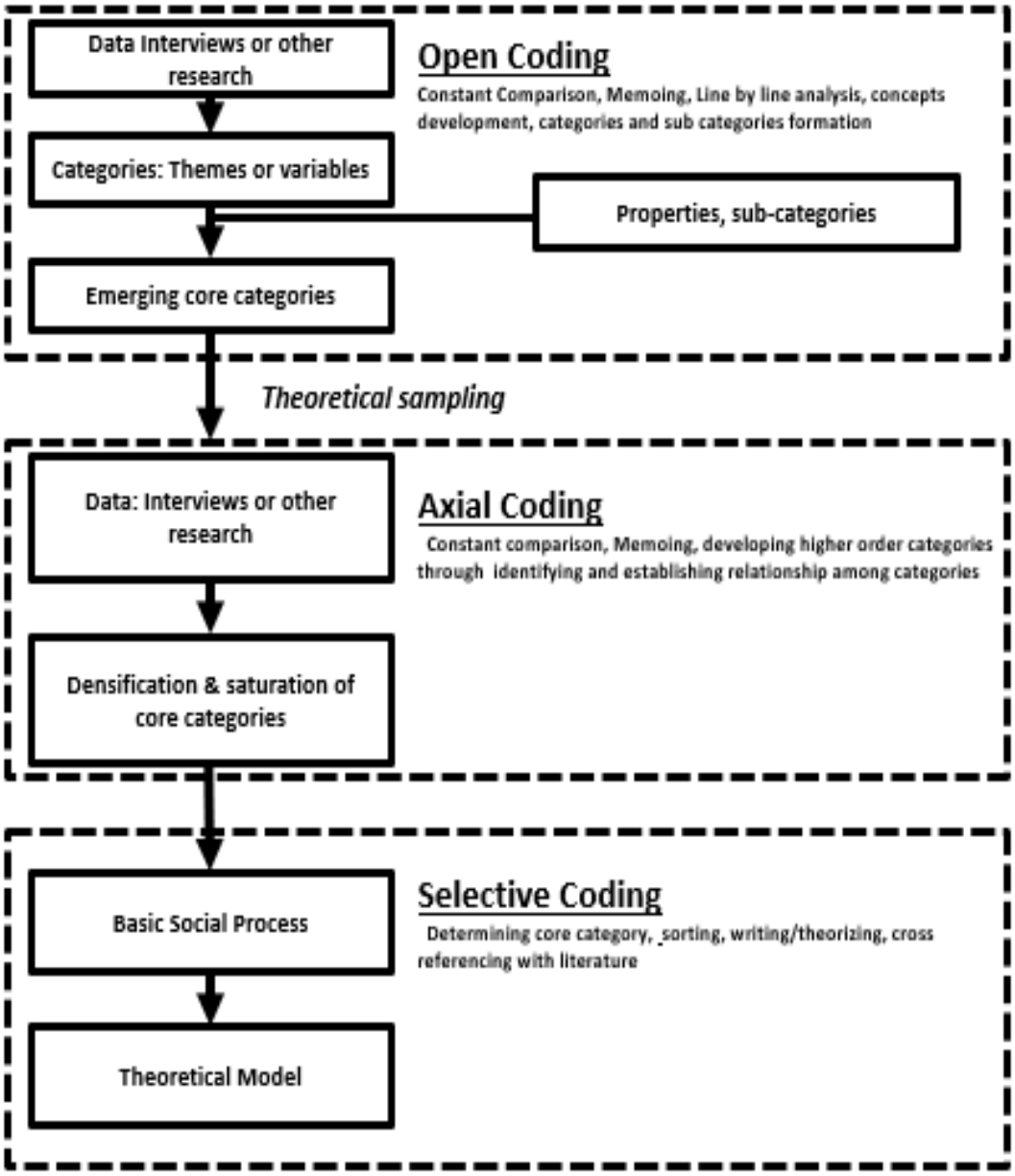
Stage 4 (Grounded theory analysis through open, axial and selective coding)

The grounded theory analysis comprises of three stages of codification with employs theoretical sampling in a constant comparison method complemented by memoing and reflexivity to arrive at substantive level theory in the form of propositions or a logic diagram (Creswell & Poth, 2016). It is pertinent to note that grounded theory inspired studies as the name indicates does not result in grand theories rather it serves as a stepping stone for development of theories through the creation of substantive level theories (Marwat, 2023; Yousafzai et al., 2020). The process codification across the open

coding followed by axial coding and finally selective coding stages is shown in figure 2 below. The codification process was preceded by data collection, display and data reduction as asserted in Miles and Huberman (1984) as well as Saldana (1984) coding manual was used for reference. As evident from the figure 2 below the grounded theory-based analysis comprises of three stages of codification, wherein sampling is purposive in open coding, selective sampling was used in axial coding and deliberate sampling was used in final selective coding (Nawaz, Yousafzai, Shah, et al., 2021; Yousafzai et al., 2020).

In the open coding stage, emerging categories were formed without any filtering and exclusion of any data as line-by-line analysis is conducted through a constant comparison method of data collection and analysis. Several codes were identified, denoting relevant issues. We used coding manual by Saldana (1984) and Wicks et al. (2017) for codes classification. In the axial coding, new interviews were conducted in the light of preceding analysis, which results in densification of categories through saturation to lead to core category formation. In the selective coding, we weaved together categories to form propositions or storyline in the form of a theoretical framework model which explains a social process of interest such as the topic of this study.

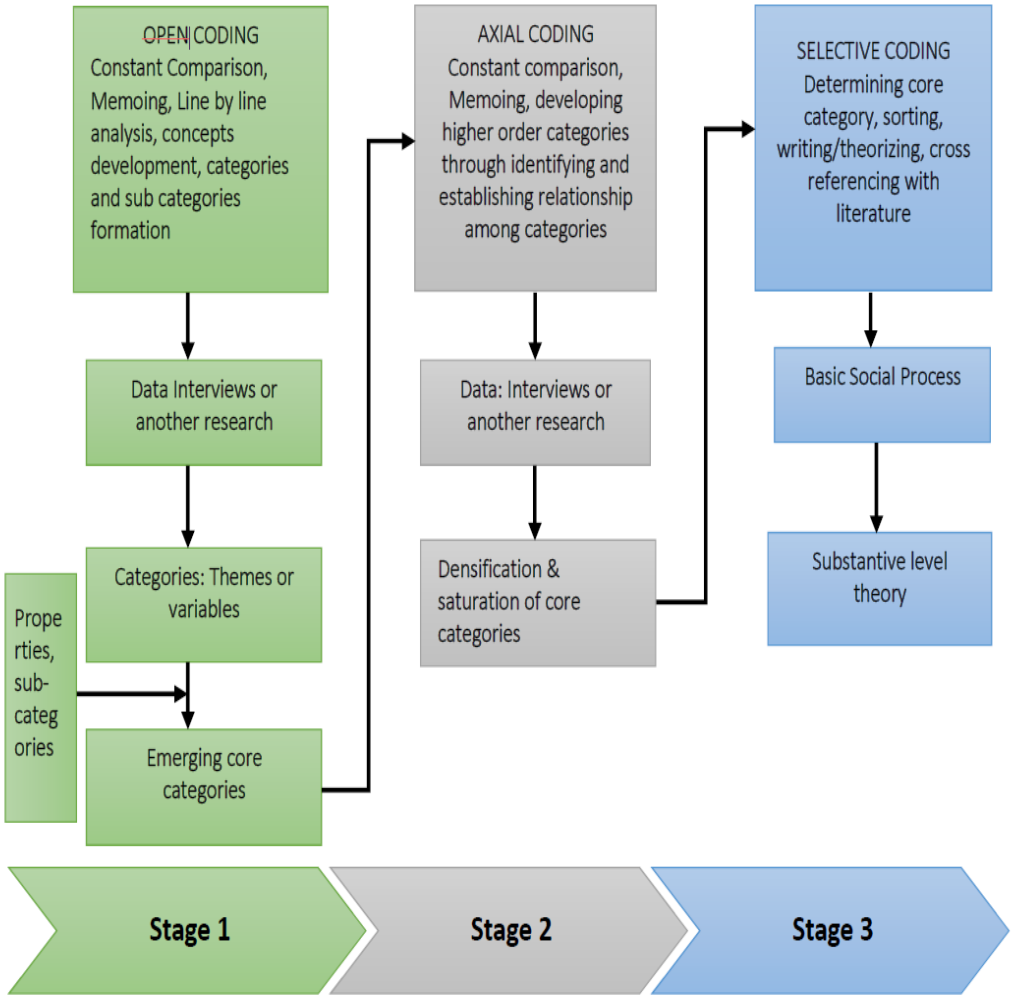
Figure 2. : Codification stages in GT



(Abridge version)

Adapted from (Yousafzai et al., 2020)

Figure 3. : Codification stages in GT



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Source: Adapted from (Nawaz, Yousafzai, Khan, et al., 2021)

To sum up in a few words, this study uses an inductive qualitative research design due to the absence of apriori theories to be tested as is the case in quantitative research (Creswell, 2018). With a social constructionist world view, this inductive qualitative research design uses abridged version of grounded theory as strategy of inquiry (Charmaz & Belgrave, 2019) with three levels of codification. Moreover, we followed standards of qualitative research reporting (SRQR) in order to adhere to the standard procedure for the ethical conduct of qualitative studies (Ullah, 2024).

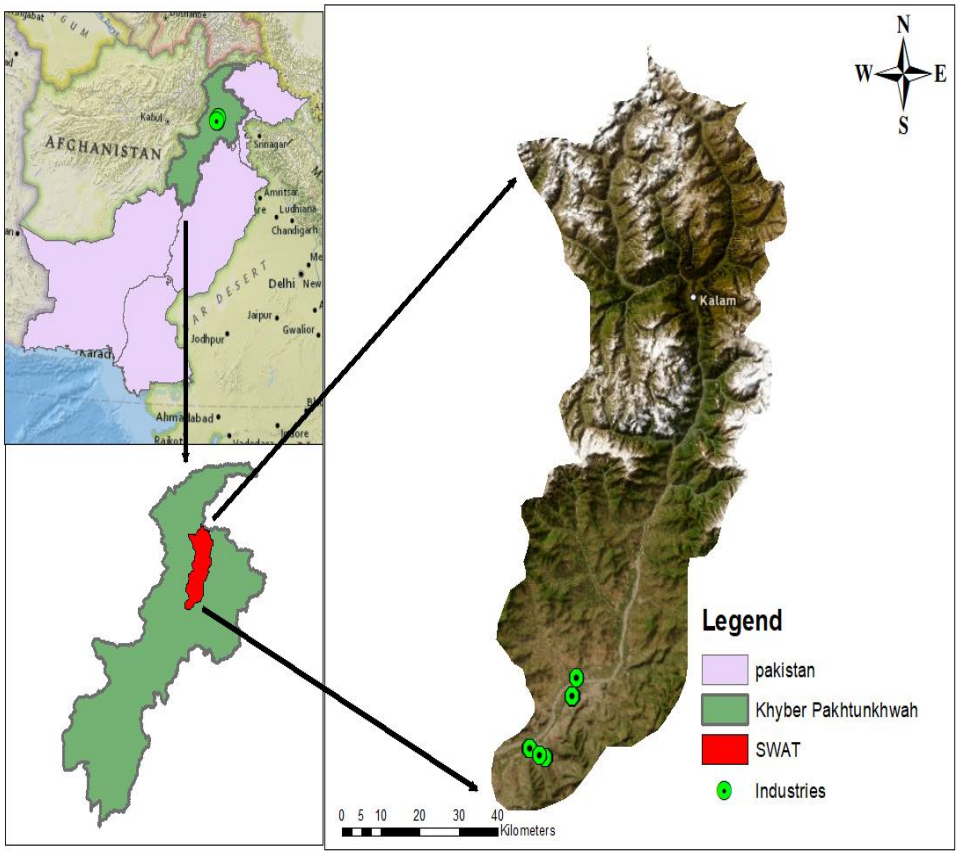
Ethics of Research

Informed consent was sought from the participants of the study by way of collection of cell phone and NIC numbers. Most of the respondents were middle pass hence they were not forced to signing the consent forms, rather implicit consent was obtained through rapport establishment and constant interaction through follow up interviewing in order to improve the trustworthiness of the study.

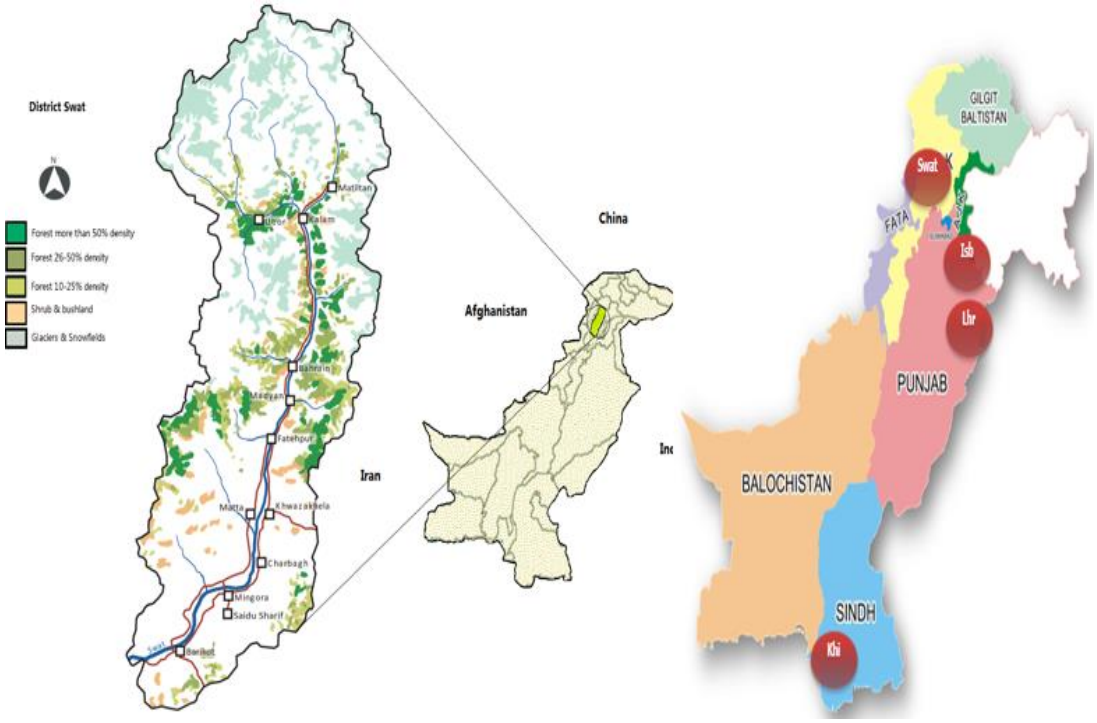
Jurisdiction of the Study

The study was conducted in the District Swat of Khyber Pakhtunkhwa province of Pakistan as shown in figure 3, which is a historical city located alongside the bank of river Swat. The study aimed to analyze stakeholders' contributions of recycling intermediaries in District Swat operating at bottom of pyramid markets. The bottom of pyramid refers to workers who earn a few dollars per day and represent largest but poorest socioeconomic group (Yousafzai et al., 2024). The total area of district Swat is 5337 Squar Kms and a total population of 2309570 population. The capital of Swat is Saidu Sharif (KPBIT, 2024). The main area of the study from where data is collected comprises of Mingora, Balogram (Koladher road) and Saidu Sharif. The data collection was confined to stockpile agents, aggregators, kebaryan and personnel of municipal committee.

Figure 4 Map of district Swat



Source: *Adopted from (Nawaz, Yousafzai, Khan, et al., 2021)*



Source: *adapted from (Ullah, 2024)*

Results

The study utilized the interview guide to elicit information from the participants of the study in the sequence of determination of stakeholders, followed by various types of specialized (salient) stakeholders dealing in textile waste recycling, WEEE recycling and Agriculture and post-harvest recycling. In the same vein, the first sub question of the interview asked was regarding the salient stakeholders of the recycling intermediaries in District Swat. A recurrent pattern which emerged during three tier analysis of open axial and selective coding suggests that stakeholders of various types are working both in formal and informal mechanisms. For instance, the municipality workforce although are not directly linked to recycling practices do involve in collection of recyclables especially during the last week of the months. The take-out recyclables upfront and divert the rest to landfills. Other than this, there are part time waste aggregators such as small shops and waste picker sustainopreneurs who collect recyclable from landfills in order to reclaim recyclables as well as specialized dealer or consolidation agents who specialized in various types of

materials such as textile, WEEEs, Agriculture waste, Construction and demolition waste, Plastic and Paper/cardboard aggregators. Based on the three-tier coding it has been learnt that those who delve in recycling are mostly aggregators who sent forth recyclables by way of transportation to cities in Lahore and Peshawar as well as some of them sell them within the district to small scale industry. Hence, it is established that both formal and informal stakeholders are involved in recycling, although the nature of the work is highly inclined towards informal economy.

In the same continuation, the next question asked was regarding the lifecycle recycling or resource recovery cycles (RRCs) employed by textile aggregators. The empirical evidence generated through the three stages of open, axial and selective codification stages of analysis entails that namely three types of salient recycling stakeholders operate in the study area namely textile waste intermediaries, waste electrical and electronics intermediaries and post-harvest agriculture related stakeholders. In regards to Textile waste life cycle assessment-based resource recovery cycles (RRC) can be divided into five cycles. This recursive pattern or theme entails that textile related stakeholders are working efficiently in the study area of District Swat. As observed in the literature review, Pakistan is a huge market of the second-hand textile apparel. Interestingly, the local workers are able to refurbish and upcycle the garments which are then re-exported to low-income countries in Africa. Some people also trade old clothes for low grade utensils offered to them at doorstep by Kebaryans. This is interesting form of entrepreneurship; wherein low-grade items are transformed via frugal low-cost innovation to re-create value for oneself as well as save useful foreign exchange. Moreover, the foreign items are re-converted into local items through skilled tailors/artisans and re-used in a recursive manner. Even the residual value is extracted by way of using the fabric in creation of pouches and packaging material for the local industry. There is also a phenomenon of *"laat ka maal"* which refers to overrun material which are sold and resold in local market. Finally, there is an established industry of dying and re-dying of apparel, which upcycles the textile material in a recursive manner. With these patterns in minds, it is obvious that textile sector recycling industry is thriving in the district swat due to its innovative use of frugal innovation called jugaad. The jugaad uses quick fix mentality to create value by upcycling materials in a recursive process of resource recovery cycles. The study through its three-codification observed that generally five cycles of value extraction from recyclables are in vogue, which is a novel yet cost-effective form of recycling. Such recycling practices appeal to price conscious people of rural area living below the base of the pyramid in Pakistan.

Table 1

Lifecycle assessment based five resource recovery cycles of Textile stakeholders

Category	LCA Resource Recovery Circulation Cycle (1)	LCA Resource Recovery Circulation Cycle (2)	LCA Resource Recovery Circulation Cycle (3)	LCA Resource Recovery Circulation Cycle (4)	LCA Resource Recovery Circulation Cycle (5)	Estimated value contributions in PKR
1. RECYCLING STAKEHOLDERS SPECIALIZING IN TEXTILE WASTE RELATED INTERMEDIARIES	Post Consumer-Textile waste, Left over from Tailors (marginal waste) Cloth Swap in families, Freecycling and gift economy such as Single use custom of apparel in women, Shorts from old jeans.	Used by mechanics, Handkerchiefs, Head scarfs, napkins, Recycling and refining by coloring specialists, Cloth and fabric material Looms industry: Producing fabrics and other material by looms	Sold in second hand market or donated, imported articles (2nd Hand) Flea markets, cut piece cloths in manufacturing overruns, mattresses, carpet, wipers,	Reused and donated again to below base of pyramid, Bought again by dealers, Stuffed Toys, Quilts. Belt and bags, Laat ka maal, fishing nets Tokri, Refurbished sofas stuffing	Dyed and resold again amid release of toxicants Production of Kapra, Darri, Khais, Tarpal, Jaye Namaz Upholstery furniture padding, webbing and fabric covers	400 million across 5 cycles with 250 first tier intermediaries

Source: Empirical Evidence generated from interviews

Moving ahead in the same sequence, the next sub question asked was regarding the life cycle assessment related to resource recovery cycles RRCs of Waste from Electrical and electronic equipment (WEEEs). A recurrent pattern of responses which emerged through the open, axial and selective codification stages of analysis, entails that on average the value of recyclables from waste electrical

and electronic equipment was estimated around 600 million PKR across the five resource recovery cycles with more than 250 first tier intermediaries involved in this sector. Although the second and third tier intermediaries run in thousands. These are very modest estimates in the light of the empirical evidence generated from interviews. The selective coding in the light of preceding open and axial coding suggests the use of innovative magnet cycling by waste pickers and aggregators to collect ferrous metals (iron, steel) from the streets and repair markets. This theme is recurrent and refers to the prevalence of frugal type innovative practices called jugaad which are not only cost efficient but also effective reclamation of value related strategy. Other than this, the local handymen and repair shops extract copper and other valuable items from computers and cell phones which are sold in bulk at the end of the summer season to waste recycling consolidators and aggregators in district Swat. Innovative use of nose cut body parts of vehicles are welded together to create value for transportation purposes due to the tax exemption in vogue in district Swat. Another recurrent theme was regarding the reuse by way of refurbishing of old batteries by local workmen and Air conditioners. Even materials of damaged solar panels are reclaimed by the waste recyclers and put innovative usage. A recurrent pattern which emerges during the analysis of waste of electrical and electronic equipment (WEEEs) entails that jugaad based innovative hacks are in vogue. These recyclers work in a self-organized manner which creates value for them as well as general public and also reduces the burden of municipal solid waste management for the government machinery. Their pro-environmental work is beneficial yet stigmatized due to the untidy nature of their work.

In the same vein, the next question of the interview guide was pertaining to the agriculture waste-based recycling. A recurrent theme which emerged during the selective codification stages in the light of preceding codification categories of open and axial coding refers to the prevalence of resource recovery cycles in a manner which conforms to the seasonal lifecycle variations of various crops grown in the study area. The emerging categories entail that much of agriculture waste is organic in nature, hence quickly converted into fertilizer through composting and fermentation processes. The majority of the income of people in District Swat is contingent upon agriculture, tourism and animal husbandry. Hence, the waste from agriculture is recursively recycled by way of a biological process to create much needed avenues of energy reclamation for their animals in most of the cases. This trend is mostly evident in the off-season fodder preservation and re-use of indigenous waste create post-harvest.

Table 2: Lifecycle assessment based five resource recovery cycles of Waste from electric and electronic equipment related WEEE stakeholders

Category	LCA Resource Recovery Circulation Cycle (1)	LCA Resource Recovery Circulation Cycle (2)	LCA Resource Recovery Circulation Cycle (3)	LCA Resource Recovery Circulation Cycle (4)	LCA Resource Recovery Circulation Cycle (5)	Estimated value contributions in PKR
2. RECYCLING STAKEHOLDERS SPECIALIZING IN WASTE FROM ELECTRICAL AND ELECTRONIC EQUIPMENT	E-Cycling, ferrous metals through, magnet-cycling, such as steel, Planned Obsolescence New Branded Products have low useful life, Non-ferrous materials There are a large number of non-ferrous materials, covering every metal and alloy that does not contain iron. Non-ferrous metals include aluminum, copper, lead, nickel, tin, titanium and zinc, as well as copper alloys like brass and bronze.	2nd hand products and appliances are imported and reused, Computer and Mobile Phone waste (Madhav Govand)	Recollected by Kebaryan such as window ACs, Old computers, UPS batteries and motors	Repaired and refurbished in other products and sold again, Window Air conditioners,	Recycled to the extent of useful life or melted into ballets. Production of Nut, bolt, bars, rods, covers etc. Solar panel waste recycling	**600 million across 5 cycles with 250 first tier intermediaries**

Source: Empirical Evidence generated from interviews

Even there are innovative hacks used to convert the plant leaves into usable items through the cottage industry workers as well as furniture products. For instance, some of the useful products such as hats, fans, bread spread, ropes are weaved together using the Maziri plant branches which is a source of income for recyclers using indigenous inputs. In addition to this biogas is also extracted from plant debris as energy source as well as incineration of dun cakes are in use. Moreover, the yard waste and agriculture waste are utilized by the free moving shepherds a kind of Agro-pastoralists who exhibit rent seeking behavior yet in the process end up cleaning the yards and farmland of farmers in a manner which resembles recycling. This goes to show that how in resource constrained environments the human agency by way of its agents works in highly unanticipated ways to create value by scavenging on the residuals from agriculture waste with minimal energy usages and environmental externalities. Again, this pattern, exemplifies the prevalence of jugaad based frugal innovation which is a feature of poor economies in global south yet it is gaining much popularity in global north due to its effectiveness in terms of costs and environmental benefits. Finally, there is also issue to post harvest residual burning which pollutes the environment and referred to stubble burning which is a frugal innovation for downcycling of leftover material yet has server environmental consequence as evidence from the reports in media (Dawn, 2024; The News, 2024).

Table 3
Lifecycle assessment based five resource recovery cycles of agriculture stakeholders

Category	LCA Resource Recovery Circulation Cycle (1)	LCA Resource Recovery Circulation Cycle (2)	LCA Resource Recovery Circulation Cycle (3)	LCA Resource Recovery Circulation Cycle (4)	LCA Resource Recovery Circulation Cycle (5)	Estimated value contributions in PKR
3. AGRICULTURE WASTE	Yard waste, Hay Stacking in Fields such as rick husk leftover, Floor Stack (Bhusa), Compostables, Plant debris recycling composting	Household Combustion, Tree Branches cutting season, Shepherding, Agriculture Waste and residuals through Natural recycling	Fencing, Stable Burning, Sorting and shredding of organic waste combustible, Manure of ruminants and cows Dung Trollies as organic fertilizer.	Daily Grass for livestock such as sheep farmers, cow and buffalo feed. Hats, hand fan, crop residuals. Poultry Manure, Agropastoralism based manure	Maziri (Aich) plant branched to hats, bed spreads, hand fans and ropes as well as furniture. Sugar cane trash, rice husk, cotton waste, mate from dates leaves, biogas, lumber, Yard Waste, Grass clippings Leaves Weeds Twigs and branches Fruits and vegetables	100 million with more than 1000 first tier intermediaries

Source: Empirical Evidence generated from interviews

Discussion

The current study used an inductive qualitative research design with grounded theory as a strategy of inquiry. The grounded theory-based studies result in propositions or logic diagram also called storyline framework which act as substantive level theory (Tariq, 2018; Ullah, 2024). This substantive level theory differs from mid-range or tested grand theories and serves as a proposition or stepping stone for development of new perspectives of theory from data. In order to integrate the study findings by way of discussion the following logic diagram is distilled by integrated the various emergent categories during codification stage of grounded theory-based analysis (Creswell & Poth, 2016).

The current study proposes the following bi-directional framework to describe the contributions of the recycling stakeholder intermediaries in the district Swat as mandate in the objectives of study. The diagram shows that jugaad based frugal innovation is

employed as basic idea for lifecycle assessment by way of resource recovery cycles (RCCs) in order to reclaim value from waste. This process results in upcycling wherein the value of recycled material is higher than original material processed. On the other hand, in case of downcycling the re-claimed or recycled value of items is lower than original value of the material processes. In terms of recycling the value is on parity terms as against upcycling where the recaptured value is higher and lower reclaimed value in terms of downcycling as shown in the figure 4 below.

In the same vein, the recycling intermediaries are listed in order of their importance and potential to create recycling (both upcycling and downcycling) based value as shown in the figure above. It has been learnt that the potential for upcycling is higher in terms of textiles wherein most of textile items are upcycled and even exported. This is even true for the discarded material waste imported from affluent friendly nations. In the same vein, the waste from electrical and electronic equipment related recycling value is on parity with original materials such as remolding of ferocious and non-ferocious metals. Other than this, the residual value in terms of agriculture waste is downcycling more often although

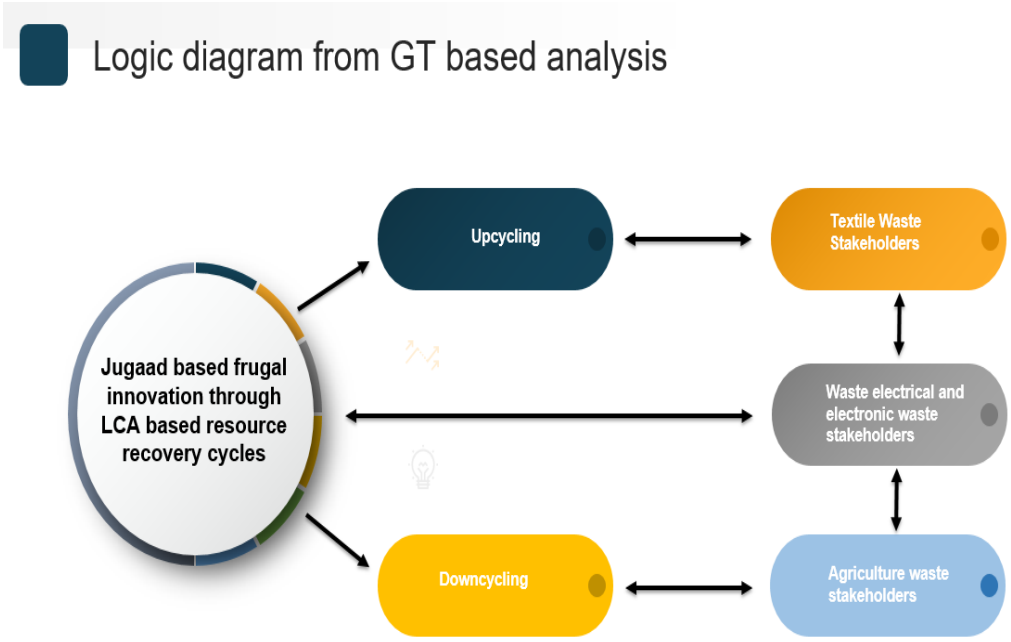


Figure 5 Distillation of empirical analysis (self-created)

sometimes upscale recycling also occurs such as those in case of using Maziri branches to create useful articles. This novel framework offers

a simple yet holistic view of the recycling stakeholders' contributions of district Swat. Some of the materials such as construction and demolition waste recycling intermediaries, institutional waste recycling intermediaries and hazardous as well vehicular waste recycling intermediaries can be added by way of extending the number of variable or constructs in the model which the authors leave to future researchers.

Conclusion

The study aimed analyze the contributions of salient recycling intermediaries' contribution in terms of recycling in district Swat using an inductive qualitative research design with grounded theory as a strategy of inquiry. The study has identified that both formal and informal stakeholders are working in the recycling businesses although the informal recycling by way aggregation and consolidation of recyclables is considerably larger. The salient stakeholders generally specialize in dealing one type of material such as textile waste consolidators, waste from electric and electronic equipment (WEEEs) related consolidators and post-harvest agriculture related recyclers.

In addition, there are other dealers such as plastic and bottle dealers, paper and cardboard related recyclers as well as those specialized in construction and demolition waste recycling. However, the scope of the current study was confined to textile, WEEE and agriculture related salient stakeholders. The study has found that recycling a big industry in the District Swat, although much of the upcycling type of recycling occurs outside the territorial jurisdiction of Swat in larger cities, wherein the recyclables are transported by road. The estimated number of recycler stakeholders are around 250 first tier aggregator businesses and several times more 2nd and third tier recycling stakeholders whose annual turnover run-in hundreds of millions of rupees.

This study offers an opportunity to document stakeholders of recycling in district Swat and describe their specialized work and working patterns with estimated value of businesses contributions. The limitation of the study pertains to limited number of interviews due to time constraints and lack of funding. We leave the conduct of quantitative and mixed method studies with even a greater sample size to future researchers. The study contributes by unveiling the innovative approach of resource recovery cycles RRCs in vogue at district Swat in tandem with Frugal innovation practices which are locally called jugaad. This jugaad based frugal innovation is a quick fix to the issues of environmental challenges posed by excessive consumerism and offers a cost effective yet efficient solution, wherein the recycle i.e. both upcycled and downcycled material appeal to price conscious population living below the base of the pyramid in district Swat.

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