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Socio-technical transformations of Indore's waste management

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Abstract: Today the problem of waste is the focus in the planning agenda of the Indian government. With the aim of improved waste management, sanitation, and hygiene in 2014 the Swachh Bharat Mission was launched. This Mission has created a behaviour change in the MSW perspective and changed the scope and scale of privatisation into waste management systems. The waste in India, not simply a material, but it is associated with a complex negative connotation of the class and caste. Traditional waste management provides employment and low entry-cost opportunity for deprived people struggling for their livelihood. The privatisation of SWM services increases the penetration of formal or private into the domain of the waste pickers. This paper takes the case of Indore City which shown a positive response in MSW management as compared to other cities of the country. This paper highlights how the waste pickers and informal sectors of Indore City are affected (positively or negatively) by the formal rights-designation system with an institutional policy change, previous an open-access regime. The key finding highlights the traces and dynamics of transformation. This paper also highlighted that the city has the potential for becoming environmentally, socially, and economically sustainable with possible changes.

Keywords: informal waste sector; municipal solid waste; privatisation; urban commons; Swachh Bharat Mission; Smart City Mission.

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1 Introduction

The term ‘waste’ has been understood and reported with different meanings by different researchers, experts, and scientists from different fields of studies. Waste is conceptualised and perceived from socio-economic as a valuable commodity or resource (Schindler and Demaria, 2019; Whitson 2011) and a source of livelihood for a number of people in developing cities (Rahman, et al 2020; Steuer et al. 2018; Guarnieri and Streit, 2015; Masood and Barlow 2013). From the environmental/ecological context waste is perceived as a threat to the environment and human health (Gutberlet 2013, Marelllo and Helwege 2018). The waste is regarded both as “Rubbish” and “Resource” (Cavé 2014). These varied definitions of waste across different discipline made waste studies more complex.

At present, the world annually generates municipal solid waste (MSW) more than 2 billion tonnes, and it is projected by 2050 it will increase to 3.40 billion tonnes (Kaza et al. 2018). By 2050 it is projected that in Global North and Global South countries per capita waste generation will grow by 19% and 40% or more respectively (Kaza et al. 2018). Also, predominantly ASEAN region major energy consumption is non-renewable (Nathaniel and Khan, 2020). Therefore, the management of waste is the biggest challenge for cities around the world, and cities are under pressure to tackle this problem. This pressure of managing waste on governments and urban local bodies opens the door for private sector inclusion. In the Indian context, many institutional policy changes implemented recently for waste management.

For addressing the waste management crisis of Indian cities, waste to energy is the preferred solution (Randhawa et al, 2020). Across the country, many municipalities for managing the growing amount of waste, are outsourcing the services like door to door collection, transportation, and treatment. What used to function traditionally for the informal sector and waste pickers of cities as urban commons of waste are now privatised. The informal waste picker’s livelihood is threatened with the enclosure and modernisation (i.e., capital intensification, formalisation, and mechanisation) of the municipal solid waste management system. This new form of modernisation and institutional policy change in MSW can create a conflict or struggle for waste access in cities for waste pickers, especially during transition phase. This type of struggle can be avoided if government policies (Smart City Mission, Atal Mission for Rejuvenation, and Urban Transformation) are properly applied as per local needs.

The transformation and modernisation of places, infrastructure, and institutional policies present another opportunity and favourable condition to deprived people struggling for their livelihood, but risks of exploitation, discrimination, and under par of them to newer technology and infrastructure will also present threats to them. This paper by taking the case of Indore City is an attempt to highlight the impacts (positively or negatively) of the institutional policy change and modernisation of MSW on the waste pickers, itinerant waste buyers, and informal sector waste. This paper aims to highlight the dynamics and traces of transformation, multiplied views of the weakest link of the Indore’s waste circuit, and opens the door for a more inclusive and sustainable city. The novelty of this study is that it takes the case of MSW modernising during a transition period and drawing on traces of transformation and providing a systemic readable description. The first phase of the paper highlights the existing literature review on the informal waste sector. The second phase presents the history of the city’s Informal waste sector which created densities of imagination with the transformed places over the

passage of time. It also describes their connection with other cities' formal network of recycling. It shows their contribution to city recycling, carbon footprint reduction, and sustainability outcomes. The third phase of the study is based on rigorous fieldwork, observation, and document analysis.

2 Material and methods

This paper displays some of the real-world events of informal sector actors and waste pickers of the city during the period of transition of waste from open access to restricted access. Forgoing into deeper skin of issues, waste pickers, and informal waste actors' daily practices of Indore city were analysed in depth with help of semi-structured interviews, observation, and following their actions on different city locations, streets, and landfill. Several interviews were collected at different periods (2016–2017) so that each step of transformation can be recorded and analysed systemically.

Table 1 Schedule of interviews

<i>Interviewees</i>	<i>Number</i>	<i>In text reference</i>
Informal waste sector		
Waste pickers	18	Waste picker 1,2,3,.....,20
Junk shop dealers	10	Junk shop dealer 1,2,3,.....,10
Kabadiwala	9	Kabadiwala 1,2,3,...9
Middleman	5	Middleman 1,2,3,4,5
Waste contractors	4	Waste contractor 1,2,3,4
Indore Municipal Corporation (IMC)		
Managerial staff	4	Managerial staff 1,2,3,4
Door to door collection workers	2	Collection worker 1,2
Total	52	

These interviews included recycling industry owners, big traders, and local government officials/ representatives. The direct field observation was also useful for the study. Additional to these interviews and observations in fields, several informal talks with local government officials, local junk shops, dealers, and waste pickers are a useful and important source of data. A large amount of ethnographic material is collected during twelve months of fieldwork, but a total of 52 interviews was used for the study and analysis. The study is based on rigorous and continuous observation of the daily routines of informal waste sector workforces during the transition period of the open-access regime to the recent expansion of privatisation and modernisation of waste management circuits. The government reports, documents on the history of Indore, smart city reports, municipal documents, and newspaper articles were also referred for paper. Table 1 shows the schedule of interviews (framework of indicators).

3 Literature review

Worldwide around 15 million people depends on recyclable waste material retrieving (Samson 2009; Medina 2010). In some of developing countries around 2% of the population for their everyday survival depends on waste picking (Medina, 2007). By collecting recyclable, waste pickers not only earn their livelihood, but they also contribute to landfilled waste amount reduction (Parra, 2020; Colombijn and Morbidini, 2017), lessen municipal waste collection services operational costs (Parra, 2020), carbon emission reduction (Chen, 2020), poverty reduction and urban development (Uddin et al., 2020). In India, the informal waste sectors collect around 15–20% of MSW and around 1.7 million urban poor work in this sector round (Annepu, 2012). The informal waste sector in New Delhi collects around 12–15% of its solid waste adding the benefit per year of 4–5 million USD to the city (Aleluia and Ferrão, 2016). These informal waste sector also adds an environmental benefit of carbon foot reduction (Wilson et al., 2009), recovering resources (Ferronato et al., 2020; Navarrete-Hernandez and Navarrete-Hernandez, 2018), conserves non-renewable resources, save landfill space (Nzeadibe and Mbah, 2015) and in Delhi alone these reductions are around 1 million tons annually greater than government recycling services achieved (Chintan, 2009). In low- and middle-income countries, the informal waste sector is major stakeholder and plays a significant role (Wilson et al., 2010). The waste pickers ranked lowest in the informal waste sector Hierarchy and they are poor and vulnerable (Blaauw et al 2020; Samson, 2009). The Informal waste picking generally performed by marginal groups of society (Rahman et al 2020; Waste et al 2020; Oates et al, 2018; Rankokwane and Gwebu, 2006). Despite of support provided by waste informal sector and its beneficial nature to a large of marginalised people it is discouraged and unacknowledged by local governments (Shreeves, 2020; Rankokwane and Gwebu, 2006). And often for the waste management of the city the informal waste sector is the unobserved contributor (McFarlane and Silver 2017). Informal waste sector for both Minority and Majority world is essential part of society (Lane, 2011; Nzeadibe and Mbah 2015). In most of the cases for the image of modern city waste pickers are considered as incompatible and excluded (Sassen, 2014). In this conventional system, waste pickers are often exploited as they are weakest link of the system (Aparcana, 2017).

The privatisation and outsourcing the MSWM is clear trend worldwide transforming the legal status of garbage (Samson, 2009). The inclusion of private actors in waste management services dispossessed and displaced many actors working for informal waste sector (Chaturvedi and Gidwani, 2010). The privatisation and modernisation of certain services like door to door collection extended the reach of private actor into the waste management system (Schindler et al., 2012). In India historically door-to-door collection was performed by waste pickers (Samson, 2009). In literature many cases of informal waste sector workers livelihood loss and transformation of waste from urban common resource to restricted accessed public good due to modernisation and privatisation of MSWM services is reported, which often leads to struggle for right to access (Fahmi and Sutton, 2010; Samson, 2009; Sandhu et al 2017; and Lane, 2011).

4 Institutional policy change and modernisation of Indore's MSWM and its impacts on informal actors

Indore is the most populated city and commercial/business capital of Madhya Pradesh in India. It is situated almost centrally on the fertile Malwa plateau with an altitude of 553 m above sea level and with its cardinal points as 22° 43' N latitude and 76° 04' E longitude. It is hub for all the major commercial activities of the state. The MP stock exchange founded in 1919 market previous known as Indore stock exchange is third oldest in India. One of the country's largest hub of automobile and vehicle industries is Pithampur also known as the 'Detroit of India' is near to Indore. The Indore is also the education hub of the state having both Indian Institute of Technology Indore (IIT) and Indian Institute of Management (IIM), the only city in India having both. The Indore Development Authority (IDA) of the city is the main institution involved in development and planning. The Indore Municipal Corporation (IMC) is the urban local body of Indore. Presently the city is divided into 85 wards and 19 zones.

Specifically coming to the city MSW scenario, during 2012–2013, an average 641.85 metric tonne of waste was generated per day; in 2013–2014 it grew to 796.26 metric tonnes per day and further to 967.16 metric tonnes per day in 2014–2015. Presently the city generates over 1,100 MT of garbage per day. The above data shows an upward trend in waste generation. The city has eight ultra-modern transfer stations located at Kabithkedi, Star Square, Crystal IT Park, Rajshahi Dakkanwala Kua, Lalbagh, Sirpur, Dhar Road Sangam Nagar, F-sector Sanwer Road, and one Landfill at Devguradia.

4.1 Informal waste management in Indore

The history of informal waste economy is very old in the city, 70 year back few families migrated from Maharashtra in search of employment and settled in Chander Bhaga Nagar (Chandra Prabha Shekhar Nagar of now) also known as Guatampura. More families after few years from Maharashtra migrated to Indore city. These families mostly belong to schedule caste communities, having long history of marginalisation. They most engaged in junk dealing, waste picking, daily wage jobs, begging, construction work, cleaning job and few joined IMC for sanitation jobs. Then around 1976 they got cards related to their identities, which followed by services like road, electricity, and water supply to these people. In 1984 under Madhya Pradesh Nagariya Kshetro Ke Bhoomihin Vyakti Adhiniyam many of these people got lands (Patta), which later renewed. In between these they faced many resettlements which changed the dynamics of informal waste circuit. Similar trend of resettlement and impacts are seen due to recently implemented urban development initiatives and policies in the city under Swachh Bharat Mission, Smart City Mission, Atal Mission for Rejuvenation and Urban Transformation (AMRUT), and Municipal Solid Waste Rules 2016.

This network of the informal waste economy of Indore has assemblages in the other part of the country one such is of paper waste. The city has linkages to the resource requirement for Morbi's (City in Gujarat) packaging paper industry which over 1.5 million tonnes per annum. This packaging paper is a requirement is for the ceramic mills. Apart from this, Morbi in India is the largest producer of wall clocks. Morbi also produces a significant amount of CFL bulbs in India. The plastic waste in the city is prepossessed here at adjoining industrial areas mostly in Sanwer and Palda. This material is the raw material for big industries in Gujarat mostly in Surat and Ahmedabad. The

metal waste is used as raw material by Industries situated in Pithampur Industrial area. The electronic waste and machine/motor goes to Delhi. Apart from this waste from adjoining cities also comes to Indore city for trading.

The Informal waste collection activities of the city are regulated through the unwritten scripts of codes. The informal waste collectors in the city follow these unwritten scripts of codes in daily work with waste which involved assembling things, people, different places, and people. To understand these scripts and their contribution to the city's waste management needs to uncover the role of multiple actors, norms, rules, and social practices that regulate the city waste informal economy. By studying these unwritten scripts in detail, the city waste network can be explored (includes various actors like middlemen, manufacturing industry and processors, etc.).

On the periphery of the city's mainstream society, living in Indore for many years, a community of waste pickers (over 3,000 in number) is earning their livelihood by transforming renewable waste. Traditionally for the city, they are engaged in recovering recyclable items from thrown on streets, open bins, low lying areas, markets, and other open places. They are people how came to the city from their native places in search of better life and jobs. The waste of the city was accessible to the displaced and dispossessed poor. The no-man's land of waste for waste pickers in the city is their living land with a resource informal network that enables them to earn their livelihood. These waste pickers created values for waste which is neglected by states and urban local bodies. This value attached to waste transformed it into a common for marginalised communities of the city. Indore's informal waste collectors have been settled and resettled from one place to another by authorities for decades, therefore ending in crisis for their livelihood and business. Amongst these, few resettlements also impacted positively on people of Indore.

4.2 Modernisation of waste infrastructure

The circuits of waste management in the city are changed due to Swachh Bharat Mission, Smart City Mission, AMRUT, and Municipal Solid Waste Rules 2016. The modernisation of waste management system under the umbrella of Swachh Bharat, smart city project was started with door to door garbage collection (dry and wet waste categories) and leasing equipment at transfer station and landfill facility of the city. The city started 'separation at source' as a pilot project and soon rolled in entire city. Whole city was divided in different zone and these zones was covered under different sorting station. The competition among the private companies for working with IMC reflects the waste as resource recognition. Due to this free access to waste (urban common resource) is limited to waste pickers and private players gained privileged access to waste. These access to the city waste was the significant support to picker's livelihoods. The city of Indore is considered as cleanest city in India (as per various Swachh Survekshan Survey) and IMC tried to put appropriate infrastructure for waste minimisation. The much of the efforts is to monitor the practices whether it is door to door collection, transportation and treatment overall promoting effectiveness of eco-friendly practices. These efforts to increase green practices can significantly contributes to organisational, environmental, and economic performance (Khan and Yu, 2020). The type of actors enrolled in the system (Table 2) with their resources are follows:

Table 2 Type actors enrolled in the system with their resources

<i>Actor enrolled</i>	<i>Resources</i>	<i>Goal</i>
Non-profit organisation	Expertise, organisational capacity	Integrating the informal sector to sort waste
Waste management consultant	Expertise, information	Sustainable waste management
Private partner(company)	Entrepreneurial space, labour capacity, authority, technical machinery such as automatic segregation, density sensors, gravity separator, conveyor belt	Sustainable waste management
IMC	Route Map, GIS Map, transfer station, automatic voice device installed on garbage vehicle by waste collectors, real time data monitoring, construction and demolition debris waste processing plant, bimethanation plant, hydraulically operated hopper, colour bins (blue-non-biodegradable, green- biodegradable, black-domestic hazardous waste), authority	Sustainable waste management and to maintain city clean
Forum of Cities that segregate	Expertise, information sharing	Assessment performance parameter like the inclusion of informal sector in municipal systems, wet and dry processing, enforcement of SWM bye-laws and enforcement of Plastic Waste Management Rules 2016

These waste minimisation measures are visible as city municipality awarded cleanest city. Under this process of modernisation of city (messing with both Swachh Bharat and Smart City Project), official said they would not allow waste pickers to pick waste in city, the new facility of transfer station and Landfill. The IMC allowed only those waste pickers, who agreed the condition of private company at the landfill facility. The IMC offered them fixed salary, identity cards, health checks ups.

Prior to the opening of a new transfer station facility for different zones waste pickers were given unofficial access to waste pickers to collect waste (waste pickers divided them into groups) and after few months a fence or wall was built around the facility. The role of the pickers was important at that time because municipal was benefited as they reduced the waste amount thereby diverting the waste been transported to a landfill, hence saved the cost of transportation and thereby increasing the life of landfill facility. During this period of transition in modernisation of waste, waste pickers argued that their livelihood is in danger and privatisation inclusion in the system is monopolising waste of the city. The waste pickers of the city forcefully were displaced to the outer part of the city, this attempt by local government to resettle them was to become more organised in terms of beautification of the city for various serve taken place in the country under Swachh Bharat Abhiyan. This process of modernisation subjected them to waste amount fluctuation, competition, and changing relations with actors involved and forced them to identify the new function. The transition of waste management facilities in city due to modernising and institution policy change during fieldwork is shown in Figure 1 (a, b, c).

Table 3 The places of importance and reason for transformation

<i>Places</i>	<i>Reason</i>	
Azad Nagar	construction of a garbage transfer station and Construction of a sewage treatment plant (Swachh Bharat Mission)	• Waste Picker 1 • Shifting to (Bangarda near Gomatgiri) affected whole business” • Waste Picker 2
Machhi Bazaar (Figure 2)	Road-widening (smart city project), Riverfront development project between Harsiddhi and Machhi Bazaar	• “Previous our condition was good, now our condition is very poor. The shifting has added addition cost of 80–100 Rs/day of Transportation” • Junk Shop dealer 1
Sangam Nagar area	Road widening	• “More 2000 people will be impacted by Shifting of market from Machhi Bazaar, Biyabani and Loharpatti.”
Bhuri Tekri	Pradhan Mantri Awas Yojana (PMAY)	• “Land and proper facilities are needed, as we are not educated, only business of waste management are now impacted by redevelopment projects”
Champa Bagh	Road widening	• Waste Picker 3
Ahirkhedi	construction and demolition collection and transfer center (Swachh Bharat Mission)	• “Source of income is decreased, since 20 year I am doing this. Vehicles of Nagar Nigam has created problems, they completely take our waste • Waste Picker 4
Chatripura area	Slum clearance	• “Since childhood I am working”
Kumedi Kakad	Master Plan road	• “30 meter land (CP shekhar Nagar) is needed for development and whole society is shifted 16 km way from the city and whole business of waste picking is affected by it. Before shifting I am earning 400-500 Rs/day, now it is 70-80 Rs/day. Again, if shifted to this place, will be good for business”.
Gadi Adda	Bridge construction	• “1223 family is shifted, livelihood is lost”.
New Prakash Nagar, Chothram Vegetable Mandi	Swachh Bharat Mission and Smart city	• Waste Picker 5 (women)
Biyabani and Loharpatti	smart city project	• “Machines once installed our jobs are over, and I do not want this business (waste picking) to be closed”.
Sitlamata Bazaar and Gorakund	Road widening, Smart City Mission	• Middleman 1
Chander Prabhas Shekhar Nagar (Figure 3)	Smart city project	• “Half of our work is now taken by Nagar Nigam
Sukhniwas Road	For the Swachh Bharat Mission	

Source: based upon derivations from Interviews

Figure 1 (a) Transfer station at Kabit Khedi (November 2017) (b) Transfer station at Kabit Khedi (December 2018) (c) Biomethanation plant at Kabit Khedi (see online version for colours)



(a)



(b)



(c)

Source: Fieldwork

The scenario shown in the pictures above highlighted the transformation takes place due to the modernisation of the solid waste facility of the city. The scenario highlighted shown above forced the informal economy to build new alliances to run their livelihood. The technological inclusion (non-human actors) into the system changed the modes of regulation¹ in the formal system of waste management in the city, which is now a hot topic in media as the cleanest city of India. This inclusion of the technology in the system was to provide favourable conditions for Private partnerships. Also, IMC tried to transform its public transportation to more sustainable form by converting its organic waste to fuel. The use of renewable energy can attract foreign investment (Khan et al., 2020a). Improved logistics also improve industry value-added activities and per capita income (Khan et al., 2019). These facilities were installed by IMC on the Viability gap funding model in which 30% of the installation cost was taken care of by IMC and the rest by the supplier operating the facility. The supplier, under operation, and maintenance contract will run these facilities for 20 years then this will be transferred to IMC.

5 Result and discussion

The following section highlights the impacts of institutional policy change and modernisation of MSW on the waste pickers, itinerant waste buyers and informal sector waste based on detailed fieldwork conducted. This section also highlights the fluctuation, competition and changing relations between different actors in Indore's waste management.

6 Loss of spaces and impact on income

The places which are transformed under Smart City Mission, Amrut, Swachh Bharat Abhiyan, are bound through its own metaphor forces. The community which are bustling with activity of waste picking and trading are disappeared or displaced. The places which undergone through the beautification process under Smart City Project and institution policy change was the places of importance to waste pickers and informal waste economy of the city, as their relationship with these workspaces acted as facilitators for their work. The places of importance to them are well connected to city as they mostly situated in the city centre and was economic hub to the city. The resettled households for informal waste pickers are very far from fair market and city centre. The places of importance or operational spaces for informal waste sector and reason for transformation are highlighted in Table 3.

A decline in incomes of Informal waste actors was reported due to loss of waste access from door to door, roadside municipal bins, landfill, and other open informal dumpsites by the interviewees. Apart from these, the cost of transportation, unfamiliar communities, increased distance from inner city and increased distance from customers due relocation of housing impacted their livelihood. Apart from this area like Panchsheel Nagar, Gwala Colony, Ganesh Nagar, Khajrana Ring Road, Banganga, Pragati Nagar, Budh Nagar, Sneha Nagar also impacted the livelihood and changed the circuit of waste management which forced them into increased competition due lesser access to waste.

These transformed places are unknowable spaces or places of no importance to local governing bodies till Smart City Mission was launched. The word 'unknowable spaces' used because these places are outside the city's effective circuits. Another reason for not utilisation of these places is lack of funds of local government. The Smart City Mission and Swachh Bharat Mission lubricated local urban bodies to investigate these unknowable places and redeveloped from the scratch. The local government used these places to generate funds by land monetisation schemes. But these places are not simple spaces of piece of land, but these are filled with densities of imaginations by the slum dwellers. So, these are not neutral or inert containers. These pieces of land contain so many arrays of stories and so many arrays that are built with passage of time few of them highlighted in this study. These places became the site of war or disagreement and negotiation because of negligence and failure of urban bodies to capture the density of imaginations. These densities of imagination were created especially by communities which are inclusive by culture and based on their social status in the society, since their inception to these places.

Figure 2 Waste picker explaining about C.P Shekhar Nagar resettlement and its impact on them (see online version for colours)



Figure 3 Machli Bazar (transformation phase) (see online version for colours)



6.1 *Impact of waste infrastructure transformation on women waste pickers*

The Gender and caste also play important role in the city informal activities. The waste picking most done by women and children of the family. Due to shifting of waste pickers

to outskirts of the city (Bada Barganda) which about 16 km way from the city and almost 45 km from the landfill, livelihood of women gone down due to addition cost of transportation. The waste pickers of the Indore their work around 5:00 am to 1:00 pm and then sell their waste to small junk shop or middlemen, but to non-availability of transportation from these places their working hours is reduced which resulted in reduction of amount of waste collected. Most of kabadiwala earlier use to come with from cycle cart from CP Shekar Nagar to city are now forced to change their collection area as they are now unable to travel long distance. Most of women waste pickers has no option but stay in the city for two– three days for collecting waste in the city as per day transportation is costly. Whereas to some women pickers these policies are helpful as they got jobs at transfer station and landfill facilities on fixed salary basis, Identity cards and health check-ups.

Table 4 Glimpse or summary of the transformation of waste infrastructure and its impacts

<i>Impact categories</i>	<i>Before transformation phase</i>	<i>After modernisation of infrastructure</i>
Impact on Income and Space	Better access to waste, no addition cost of transportation as working site are near to their residential area, customary right to waste, lesser timing of work, safe and suitable environment for women pickers due to shorter distance to workspace.	Resettlement added addition cost of transportation, no longer access to door to waste, street and open dumpsites, right claimed by private company, mixing and compaction of waste, addition of Entrepreneurial space, Labour capacity, Authority, technical machinery such as automatic segregation, density sensors, gravity separator, conveyor belt and increased competition, safer environment to waste pickers who agreed with IMC
Impact on relationship between stakeholders	Harassment and collusion by police and IMC	Collusion and harassment by private actors, rupture in social fabric due their resettlement and increased competition

Source: Based upon derivations from interviews

6.2 *Impact on relation with other actors*

The informal waste sector workers claimed during interviews that their earning depends on social network. These networks based on well-established relations and patterns, are highly intermeshed system and complex since Indore city has long history of commercial activities in the country. These relationships of waste pickers which is formed during course of time is depend on space and time dimensions. These local factors have given strength to their relationship with different stakeholders. This relationship is important factor for their livelihood generation. Their livelihood is heavily dependent on junk shops dealers, wholesalers and middlemen located in the places mention in above section or other inner parts of the city. Most of the pickers mentioned that they could not ably maintain their relationship with stakeholder as they now relocated to larger distance from their previous locations. Few waste pickers have reported during fieldwork, that as they loss access for waste from door to door, roadside municipal bins, landfill and other open informal dumpsites, competition amongst them is increased tremendously, which leads to internal conflicts and struggles. The Table 4 provides a glimpse or summary of the

transformation of waste infrastructure and its impacts on the Indore's informal waste sector.

The studies systematically presented the case of transition and its dynamics. Most of the similar studies either highlighted that waste weakest links of the traditional solid waste management system are waste pickers but they failed to capture the power of transformation and what choices this community has against the forces of institution policy changes and modernisation processes. Many authors pointed out the vulnerability of workers but failed to highlight that what outweighs one factor over others. To overcome the forces of transformation and its impacts on society either positive or negative needs closed during its richness. The study not only presented the case of waste pickers inclusion and exclusion but also suggested possible measures.

7 Conclusions

The case of transformation of Indore's waste infrastructure brings out a deeper analysis of issues of the informal sector involved in waste management which needs to address on an urgent basis. Though lots of positive impacts of Indore city waste transformation are seen in recent years as it is awarded the cleanest city of the country but there are still few points where the city needs to consider for more sustainable transformation. The reason for highlighting this issue is to capture all the density of imaginations by multiplying all the points of view and reshape transformation towards a more inclusive and sustainable form. Though many studies highlighted vulnerability and livelihood concerns, and the contribution of waste pickers, dynamics during the rich transition period of period is missing. The results systematically highlighted the issues and gap needs to reconsider while putting a large centralised technical system in course of modernisation. The results obtained from field work pointed out how large centralised technical system interacted with the community which is vulnerable to all the fluctuation induced into the system.

The city municipality which is working well as compared to others needs to reconsider development corridors and its private investments for a more successful integrated design of waste infrastructure. The municipality tried to offer waste pickers jobs on a fixed salary, but there still scope for improvements. An increase in economic activities within poorer areas nodes (where they resettled) is the need which will connect them to the rich node of the city, as intense development happening under projects in the city. The housing for the poor is a good initiative of the Indian government, which the city is implementing but there should be more emphasis on the development of community centres for slum dwellers, physical space for community mobilising. The few upgradations like the door to door collection job and new skill development program under skill India development and digital India will be extra support to waste pickers. Also, Indore city has a huge economic activity possibility as its waste informal sector has links to big manufacturing industries of the country. Therefore, Indore's city waste management has lots possibilities of not only becoming environmentally sustainable but also socially and economically sustainable with some possible changes.

References

- Aleluia, J. and Ferrão, P. (2016) 'Characterization of urban waste management practices in developing Asian countries: a new analytical framework based on waste characteristics and urban dimension', *Waste Management*, Vol. 58, pp.415–429, <https://doi.org/10.1016/j.wasman.2016.05.008>.
- Annepu, R.K. (2012) *Sustainable Solid Waste Management in India*, Vol. 2, No. 1, Columbia University, New York.
- Aparcana, S. (2017) 'Approaches to formalization of the informal waste sector into municipal solid waste management systems in low-and middle-income countries: review of barriers and success factors', *Waste Management*, Vol. 100, No. 61, pp.593–607.
- Blaauw, P., Pretorius, A., Viljoen, K. and Schenck, R. (2020) 'Adaptive expectations and subjective well-being of landfill waste pickers in South Africa's Free State province', in *Urban Forum*, March, Vol. 31, No. 1, pp.135–155, Springer Netherlands.
- Cavé, J. (2014) 'Who owns urban waste? Appropriation conflicts in emerging countries', *Waste Management and Research*, Vol. 32, No. 9, pp.813–821, <https://doi.org/10.1177/0734242X14540978>.
- Chaturvedi, B. and Gidwani, V. (2010) 'The right to waste: informal sector recyclers and struggles for social justice in post-reform urban India', in *India's New Economic Policy*, pp.137–165, Routledge.
- Chen, M. (2020) 'COVID-19, cities and urban informal workers: India in comparative perspective', *The Indian Journal of Labour Economics*, Vol. 63, No. 1, pp.41–46.
- Chintan (2009) 'Cooling agents: an analysis of climate change mitigation by the informal recycling sector in India', *Report prepared in association with The Advocacy Project*, Washington DC.
- Colombijn, F. and Morbidini, M. (2017) 'Pros and cons of the formation of waste-pickers' cooperatives: a comparison between Brazil and Indonesia', *Decision*, Vol. 44, No. 2, pp.91–101.
- Fahmi, W. and Sutton, K. (2010) 'Cairo's contested garbage: sustainable solid waste management and the Zabaleen's right to the city', *Sustainability*, Vol. 2, No. 6, pp.1765–1783, <https://doi.org/10.3390/su2061765>.
- Ferronato, N., Portillo, M.A.G., Lizarazu, G.E.G. and Torretta, V. (2020) 'Formal and informal waste selective collection in developing megacities: analysis of residents' involvement in Bolivia', *Waste Management and Research*, DOI: 0734242X20936765.
- Guarnieri, P. and Streit, J.A.C. (2015) 'Implications for waste pickers of Distrito Federal, Brazil arising from the obligation of reverse logistics by the national policy of solid waste', *Latin American Journal of Management for Sustainable Development*, Vol. 2, No. 1, pp.19–35.
- Gutberlet, J. (2013) 'Briefing: social facets of solid waste: Insights from the global south', in *Proceedings of the Institution of Civil Engineers-Waste and Resource Management*, August, Vol. 166, No. 3, pp.110–113, ICE Publishing, <https://doi.org/10.1680/warm.13.00011>.
- Kaza, S., Yao, L., Bhada-Tata, P. and Van Woerden, F. (2018) *What A Waste 2.0: A Global Snapshot of Solid Waste Management to 2050 (Urban Development Series)*, World Bank, Washington, DC, <https://doi.org/10.1596/978-1-4648-1329-0>.
- Khan, S.A. and Yu, Z. (2020) 'Assessing the eco-environmental performance: an PLS-SEM approach with practice-based view', *International Journal of Logistics Research and Applications*, Vol. 24, No. 3, pp.303–321.
- Khan, S.A.R., Sharif, A., Golpîra, H. and Kumar, A. (2019) 'A green ideology in Asian emerging economies: from environmental policy and sustainable development', *Sustainable Development*, Vol. 27, No. 6, pp.1063–1075.
- Khan, S.A.R., Yu, Z., Golpîra, H., Sharif, A. and Mardani, A. (2020a) 'A state-of-the-art review and meta-analysis on sustainable supply chain management: future research directions', *Journal of Cleaner Production*, DOI: 123357.

- Khan, S.A.R., Zhang, Y., Kumar, A., Zavadskas, E. and Streimikiene, D. (2020b) 'Measuring the impact of renewable energy, public health expenditure, logistics, and environmental performance on sustainable economic growth', *Sustainable Development*, Vol. 28, No. 4, pp.833–843.
- Lane, R. (2011) 'The waste commons in an emerging resource recovery waste regime: contesting property and value in Melbourne's hard rubbish collections', *Geographical Research*, Vol. 49, No. 4, pp.395–407, <https://doi.org/10.1111/j.1745-5871.2011.00704.x>.
- Marello, M. and Helwege, A. (2018) 'Solid waste management and social inclusion of wastepickers: opportunities and challenges', *Latin American Perspectives*, Vol. 45, No. 1, pp.108–129, <https://doi.org/10.1177/0094582X17726083>.
- Masood, M. and Barlow, C.Y. (2013) 'Framework for integration of informal waste management sector with the formal sector in Pakistan', *Waste Management and Research*, Vol. 31, No. 10, pp.93–105, <https://doi.org/10.1177/0734242X13499811>.
- McFarlane, C. and Silver, J. (2017) 'Navigating the city: dialectics of everyday urbanism', *Transactions of the Institute of British Geographers*, Vol. 42, No. 3, pp.458–471.
- Medina, M. (2007) 'Waste picker cooperatives in developing countries', in *Membership Based Organizations Of The Poor*, pp.125–141, Routledge, London.
- Medina, M. (2010) *Solid Wastes, Poverty and the Environment in Developing Country Cities: Challenges and Opportunities*, No. 23, Working paper/World Institute for Development Economics Research.
- Nathaniel, S. and Khan, S.A.R. (2020) 'The nexus between urbanization, renewable energy, trade, and ecological footprint in ASEAN countries', *Journal of Cleaner Production*, Vol. 272, p.122709, <https://doi.org/10.1016/j.jclepro.2020.122709>.
- Navarrete-Hernández, P. and Navarrete-Hernández, N. (2018) 'Unleashing waste-pickers' potential: supporting recycling cooperatives in Santiago de Chile', *World Development*, Vol. 101, pp.293–310.
- Nzeadibe, T.C. and Mbah, P.O. (2015) 'Beyond urban vulnerability: interrogating the social sustainability of a livelihood in the informal economy of Nigerian cities', *Review of African Political Economy*, Vol. 42, No. 144, pp.279–298.
- Oates, L., Sudmant, A., Gouldson, A. and Gillard, R. (2018) 'Reduced waste and improved livelihoods for all: lessons on waste management from Ahmedabad, India', in *Coalition for Urban Transitions*, London and Washington, DC [online] <http://newclimateeconomy.net/content/cities-working-papers>.
- Parra, F. (2020) 'The Struggle of Waste Pickers in Colombia: from being considered trash, to being recognised as workers', *Anti-Trafficking Review*, No. 15, pp.122–136, Issue – Everyday Abuse in the Global Economy.
- Rahman, M.Z., Siwar, C. and Begum, R.A. (2020) 'Eradicating poverty among the waste workers through waste collection? A case study of Dhaka City', *Int. J. Environment and Waste Management*, Vol. 26, No. 1, p.85.
- Randhawa, P., Marshall, F., Kushwaha, P.K. and Desai, P. (2020) 'Pathways for sustainable urban waste management and reduced environmental health risks in India: winners, losers, and alternatives to waste to energy in Delhi', *Front. Sustain. Cities*, Vol. 2, p.14, <https://doi.org/10.3389/frsc.2020.00014>.
- Rankokwane, B. and Gwebu, T.D. (2006) 'Characteristics, threats and opportunities of landfill scavenging: the case of Gaborone-Botswana', *GeoJournal*, Vol. 65, No. 3, pp.151–163, <https://doi.org/10.1007/s10708-005-3122-3>.
- Samson, M. (2009) 'Combining forces – networks and federations of waste picker organizations', in Samson, M. (Ed.): *Refusing to be Cast Aside: Waste Pickers Organising around the World*, WIEGO, Cambridge.

- Sandhu, K., Burton, P. and Dedekorkut-Howes, A. (2017) 'Between hype and veracity; privatization of municipal solid waste management and its impacts on the informal waste sector', *Waste Management*, Vol. 59, pp.545–556, <https://doi.org/10.1016/j.wasman.2016.10.012>.
- Sassen, S. (2014) *Expulsions*, Harvard University Press, London.
- Schindler, S. and Demaria, F. (2019) 'Garbage is Gold': waste-based commodity frontiers, modes of valorization and ecological distribution conflicts', *Capitalism Nature Socialism*, Vol. 31, No. 4, pp.1–8.
- Schindler, S., Demaria, F. and Pandit, S.B. (2012) 'Delhi's waste conflict', *Economic and Political Weekly*, Vol. 47, No. 42, pp.18–21.
- Steuer, B., Ramusch, R. and Salhofer, S.P (Editors) (2018) 'Can Beijing's informal waste recycling sector survive amidst worsening circumstances?', *Resources, Conservation and Recycling*, Vol. 128, pp.59–68, <https://doi.org/10.1016/j.resconrec.2017.09.026>.
- Uddin, S.M.N., Gutberlet, J., Ramezani, A. and Nasiruddin, S.M. (2020) 'Experiencing the everyday of waste pickers: a sustainable livelihoods and health assessment in Dhaka City, Bangladesh'. *Journal of International Development*, Vol. 32, No. 6, pp.833–853.
- Waste, R.D.I., Samson, M., Timm, S., Chidzungu, T., Dladla, N., Kadyamadare, G and Ndlovu, L. (2020) *Lessons from Waste Picker Integration Initiatives: Development of Evidence Based Guidelines to Integrate Waste Pickers into South African Municipal Waste Management Systems* [online] https://wasteroadmap.co.za/wp-content/uploads/2020/03/1-Wits_Final_Report_Johannesburg-Technical-Report.pdf.
- Whitson, R. (2011). Negotiating place and value: geographies of waste and scavenging in Buenos Aires', *Antipode*, Vol. 43, No. 4, pp.1404–1433, <https://doi.org/10.1111/j.1467-8330.2010.00791.x>.
- Wilson, D.C., Araba, A.O., Chinwah, K. and Cheeseman, C.R. (2009) 'Building recycling rates through the informal sector', *Waste Management*, Vol. 29, No. 2, pp.629–635.
- Wilson, D.C., Rodic-Wiersma, L., Scheinberg, A. and Alabaster, G. (2010) 'Comparative analysis of solid waste management in cities around the world', *Proceedings Waste 2010: Waste and Resource Management – Putting Strategy into Practice Stratford-upon-Avon, Warwickshire, England*, 28–29 September.