
The Role of the Informal Sector in a Rurbanised Environment

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Abstract

Economic activities performed by rural populations linked to informal trading and markets have not received a broad attention in the literature. Thus, the question of the present investigation is the role of the informal sector in a rurbanised environment, and if there are differences in the waste management activities of the informal sector in cities and in an urbanised rural environment. To obtain information about the informal waste pickers in the rural areas, data were collected directly through a questionnaire from the following countries (sorting in alphabetic order): Austria, the Czech Republic, Germany, Jordan, Mexico, Nepal, South Africa and Vietnam. The methodology used for the data collection consisted of a background analysis (with a literature review), complemented with the collection of empirical evidence, field interviews and partially local field analysis. The informal collection of waste is a phenomenon that results in principle from social differences within society and the population. Therefore, it is not surprising that the perception of the activities of informal waste collectors in the scientific literature refers to developing and emerging countries, since social differences are more pronounced. These informal waste management systems in low- and middle-income countries exist usually in parallel with formal waste management systems, a fact that applies for urban as well as rural areas, and might be considered as a result of rurbanisation. The case studies show the development of the informal sector as an important part of the waste management activities, when a country evolves. With increasing economic development, the importance of the informal sector is shrinking step by step in relation with the improvement of the formal activities. Even this development goes faster in urban areas; the conclusion applies also to rural areas.

Keywords: informal waste collection, informal recycling, waste collection in rural areas

1. Introduction

The term 'rurban' refers to a region which has both urban and rural characteristics. Rurbanisation may be due to either urban expansion or rural migration, leading to urban-rural interactions, which result in an urbanised lifestyle in rural areas. This development manifests in rapid urbanisation of the rural population—lifestyles and mind sets—perceiving cities as a source of income, stability and a possibility for better living conditions. The perception of rurbanisation goes back nearly a century. The term was firstly used by Sorokin & Zimmerman [1]. Also, Parson [2] highlighted the idea of rurbanisation, describing rurban communities as rural socio-geographic spaces where styles of life and the standard of living have changed so much that they resemble those in urban localities. This phenomenon also found in massive migration from rural to urban areas. Later research on rurbanisation by Chapuis & Brossard [3] described a population growth phenomenon observed in the rural environment due to the effect of changing the rural-urban migration patterns from the urban to the rural direction. This phenomenon was named 'rural rebirth', characterised by community policies [4], receptivity, land use [5], utilising neighbours [6], agricultural development [7], tourist sites, secondary residences and available homes [8], as well as endless options [9].

Rural rebirth describes the migratory flow caused by the effects of rurbanisation on rural livelihood [9]. The rural rebirth phenomenon also reflects a special economic situation: the financial potential to afford to live a separated life in the countryside. The definition of rurbanisation exposes its effect on rural patterns: '*rurbanisation is a process of altering rural forms with pre-selected urban patterns and lifestyles, which creates new genetically altered rurban forms*' [10, 11]. Nowadays, both types of migration are observed in parallel: rural-urban migration mainly in emerging countries resulting in the formation of megacities, and urban-rural migration mainly in industrial countries. Also, the medial impact forces the urbanisation of rural livelihood through advertising and sales strategies. Rurbanisation leads to a habit change in waste generation: while poor population from rural areas mostly produces organic and fast biodegradable wastes, the more rurbanised population is consuming in a different way, causing a double consumption in comparison to traditional lifestyle and an increased waste generation of plastic, glass, metal and electronics [12]. Recyclable materials are of interest for recyclable waste dealers, leading to the situation that rurbanisation causes activities of informal waste pickers also in the rural area.

The term 'informal' does not give a clear definition in the literature yet. According to Chi et al. [13], informal activities are possible to be carried out '*due to lack of legislation, structure or institutionalisation in a way out of the different levels and mechanisms of the official governmental power*'. Furthermore, they can be characterised as '*not registered, and characterised as illegal*'. Informal actions can therefore not be equated with such illegal acts, since the term 'informal' additionally involves legal grey zones. The term 'informal' thus also includes non-regulated acts and unclear defined rules [14]. The informal sector is characterised by labour-intensive, largely unregulated and unregistered, low-technology manufacturing or provision of waste collection services [15]. Informality is usually associated with undesirable developments such as tax evasion, unregulated enterprises and even environmental degradation [16]. Mainly in low- and

middle-income countries, the informal sector especially in the urban area reaches a significant proportion of the waste collection activity in solid waste management (SWM) as reported by Scheinberg et al. [17]: Belo Horizonte, Brazil—6.9%; Canete, Peru—11%; Delhi, India—27%; Dhaka, Bangladesh—18%; Managua, Nicaragua—15%; Moshi, Tanzania—18%; Quezon City, Philippines—31%. For rural areas, information on the percentage of informally collected waste is very rare. Even informal sector entrepreneurs in the past did not pay taxes, not have a trading license and are not included in social welfare or government insurance schemes [18], since a few years there are strong activities in many developing countries to include the informal sector into the official waste management system [19, 20]. This leads to the situation that the informal sector generally achieves high recovery rates (up to 80%) because the ability to recycle is vital for the livelihood of people involved [19, 20].

The official waste management system in urban and urbanised areas could not be managed without waste pickers, scrap collectors, traders and recyclers. Although not officially recognised, they often perform a significant percentage of waste collection services, in many cases at no cost to local authorities, central governments or residents. By its nature, the activity of the informal sector is market-driven, leading to highly adaptable and flexible demand-driven informal waste collection forces. Generally, the volume of waste generation in rural areas is smaller than in urban areas due to the different consumption habits of inhabitants caused by a generally smaller income. Depending on the country development level, the mean rural waste generation is reported between 0.1 (countries in Asia [12], the Middle East [21] and Latin America [12]) and 0.4 kg/cap/d (rural areas in Eastern Europe [22], the Middle East [21, 23], Asia [24] and Africa [12]). The waste generation in rural areas increases rapidly up to 0.9 kg/cap/d when a touristic infrastructure is installed, becoming comparable with urban waste generation rates in developing countries, as documented for instance from Cyprus [25] and Romania [26]. In a variety of countries, only a small share of rural population has access to waste collection services [27]. Usually, informal waste collection is carried out by poor and marginalised social groups who decide for waste picking for income generation and some even for everyday survival [28].

Although urbanisation takes place in rural areas, still there are typical rural waste streams caused from rural industries like agriculture. Rural industries create waste that can be problematic to manage, like silage wrap, chemical drums and chemicals. Anyhow, those materials are not of interest for potential informal collectors as they cannot be valorised by them. As in urban areas, the main focus of waste pickers of the informal sector is on recyclable materials, especially metals and plastics, sometimes also glass as well as paper and cardboard. The waste generation rates in rural areas of developing countries are quite comparable in the range of 0.3 (Shah et al., [2, 29], for rural areas in India) up to 0.8 kg/cap*day, as reported from several sources. In countries where rurbanisation goes faster, the waste generation rate is in the upper range, for instance 0.75 kg/cap*day (with a content of mineral recyclables of about 22%) in Iran [30].

Economic activities performed by rural populations linked to informal trading and markets have not received a broad attention in the literature [31]. Thus, the question of the present investigation is the role of the informal sector in a rurbanised environment. Are there differences in the waste management activities of the informal sector in cities and urbanised rural areas?

2. Research methods

The methodology for data collection consisted of a background analysis (with a literature review), complemented with the collection of empirical evidence, field interviews and partially local field analysis. For data collection, the interviews included the following questions:

- Which are the rural waste generation rates, especially in comparison with those of urban areas?
- What is the waste composition in rural areas?
- What is the percentage collected by informal waste pickers?
- General organisation of the rural collection systems, and especially the informal sector (informal waste pickers on the streets/landfills)?
- What kind of waste do informal waste pickers collect?
- Are they an official part in the official waste management system?

Generally, the status of the informal sector is hardly documented in the literature, and most of the available data on the informal sector were collected for urban areas. Some information for rural areas is from Latin America (Colombia, Brazil), and from Africa, which was collected for this study. The reason for the poor documentation is supposed to be the informal status of the waste pickers and their 'hiding' from the statistics. To obtain information about the informal waste pickers in the rural areas, the information was collected directly by a questionnaire from the following countries (sorting in alphabetic order): Austria, the Czech Republic, Germany, Jordan, Mexico, Nepal, South Africa and Vietnam. **Figure 1** shows the location of the investigated countries in the UNICEF map of the urbanised population percentage by

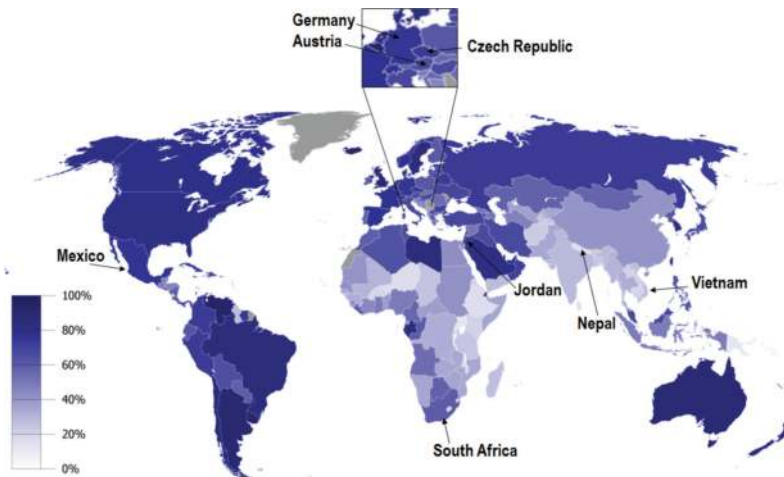


Figure 1. Urbanised population percentage by country in 2006. Map source: UNICEF, *The State of the World's Children* 2008 (p. 134) [32].

country in 2006 [32]. As is visible from the map, the urbanisation percentage in Austria, the Czech Republic, Germany, Jordan and Mexico was high (up to 80%), while South Africa's level reached approximately 50%, Vietnam 30% and Nepal 10%.

The information was collected from the Czech Republic, Mexico, Nepal, Vietnam, South Africa through the indicated information sources and methods:

Austria: local data collection from primary and secondary sources, as well as information collection at a Resource Management Workshop in Austria in April 2017,

Czech Republic: local data collection from primary and secondary sources,

Germany: local data collection from primary and secondary sources, as well as interviews with representatives of local waste management authorities,

Jordan: local data collection from primary and secondary sources, as well as information collection in March 2017,

Mexico: local data collection from primary and secondary sources,

Nepal: local data collection from primary and secondary sources, information received from the Solid Waste Management and Resource Mobilization Centre (SWMRMC) in Nepal. The SWMRMC made an investigation in each municipality [33], categorised them into urban and rural wards as smallest administrative unit. The rural wards are characterised through lesser population density than urban areas and without commercial activities, where the representative households in each municipality were selected randomly by employing the right-hand-rule technique (Asian Development Bank [48, 49]).

South Africa: local data collection from primary and secondary sources, as well as field research and interviews with the waste pickers from the informal sector in February 2017,

Vietnam: local data collection from primary and secondary sources, as well as information collection at the National Farmers Union in January 2017.

By nature, the collected data had inhomogeneous composition, due to two reasons: firstly, the data availability strongly varied in the countries, and even concerned the type of data; secondly, not all types of data could be collected from all countries. Anyhow, for the recent scope of the investigation, the data were sufficient, as the aim of the chapter is to give an overview on the variety of settings for the informal sector.

3. Investigation results

The results are a summary of the collected data for each country, which gives information on the collection scheme, as well as the involvement and the activity of the informal sector in the respective countries. Generally, it was observed that the informal sector existed in urban and rural areas; even the quantity of waste collected was smaller in the rural areas. Furthermore, settlements of the informal sector can be found in the areas of communal dumpsites and landfills, collecting already recyclable materials before the waste goes to the dumpsite and

landfill. Furthermore, the extent of the activity of the informal sector depends on the type and structure of the collection system in the country. Usually, when the collection system is not a selective system separating the recyclables, there is a larger activity of the informal sector. This is usually the case in low- and middle-income countries. In high-income countries like Germany in Central Europe, a real informal sector does not exist.

3.1. Situation in high-income countries: Germany, Austria, and the Czech Republic

According to OECD information, Germany has 80.6 million inhabitants with an average household income of 34,700 US\$. The average waste generation rate varies between 0.65 and 1.37 kg/cap/d in rural areas, in comparison to urban areas with waste generation rates between 1.37 and 2.2 kg/cap/d, having a total average of 1.68 kg/cap/d [34]. The waste collection system is a selective system, which separates recyclables (glass, paper, plastic (PET) bottles, other plastics, metals and biodegradable waste) from residual waste. The waste management system is operated by municipal or communal operators, and only exceptionally by private operators, a situation which applies for rural and urban areas.

The activities that can be considered as a type of informal sector activity are some private poor people who collect bottles and cans from the streets in order to transfer them to the bottle deposit refund system, which exists in an automated way in each supermarket or rural discounter. For instance, in Germany, the refund for one PET bottle or one metal can is 0.25 € (0.27 US\$), while the refund for a glass bottle is 0.08 € (0.09 US\$). The deposit refund was calculated according to the environmental risk (PET bottles) or the material value (metal cans), and is equal in rural and in urban areas. In Germany, a deposit-refunding system for bottles of alcoholic beverages does not yet exist, but it is under governmental preparation (status as of February 2017). For that reason, the waste bottles most often found in the environment are bottles of alcoholic beverages which are not of interest to informal collectors. Formal collectors provide glass containers, where consumers put those types of bottles and packaging glass for material valorisation. The existing system fulfils the scope of a clean environment, and private bottle pickers are the exception. Furthermore, all municipal landfills were closed by law in 2005, and landfills for the disposal of untreated municipal waste have not existed anymore since then. All generated waste has to undergo a pre-treatment, before recycling or re-using as priority options, and only hazardous waste is disposed of. The described situation is the reason that informal waste collectors on landfills do not exist at all in Germany.

Other waste is not collected by private waste pickers, as all waste streams are collected in selective collection schemes through formal collection systems of the municipalities, which is valid for urban as well as for rural areas, centralised in civic amenity areas. In zones which are close (up to 50 km) to the East European border (with Poland or the Czech Republic), there are informal East European waste collectors (especially from Romania, Hungary, Poland and the Czech Republic) [35] waiting outside the civic amenity centres to collect usable waste directly from the customers who are bringing waste to the centres. Usually, they are collecting household appliances, textiles, toys and other items for children, sports equipment, electrical appliances such as TV sets, washing machines or refrigerators, tires, scrap metals and other

bulky waste, for instance from furniture. The transfer of this kind of waste is free of charge, and even if it is not really allowed, it is tolerated, and in this way informal by nature.

A comparable situation does exist in Austria. The country has 8.5 million inhabitants with an average household income of 45,500 US\$. The average waste generation rate being 1.58 kg/cap/d is slightly lower than in Germany, having generally comparable dimensions to Germany for rural and urban areas. A visit to Austria in April 2017 indicated a certain percentage of waste bottles in the urban area spread around public collection bins while there was nearly no waste in rural areas in the environment. The result of the interview indicated that there is a comparable deposit refund system like in Germany, but obviously it appeared not to be efficient everywhere, maybe because the deposit refund was too small. In Austria, bottles are partly pledged. For simple reusable beer bottles, 0.09 € (0.10 US\$) are refunded and 0.36 € (0.40 US\$) for special types of beer bottles. For reusable PET bottles as used by some mineral water and lemonade manufacturers, a 0.29 € (0.33 US\$) deposit is charged, as well as for 1-l mineral water glass bottles. Anyhow, relevant informal activities are practiced for the same materials as in Germany, which can be considered as a particularity of a high-income country. Also an informal waste transfer from Austria to Eastern Europe countries by informal waste collectors does exist. According to Obersteiner et al. [35], 69% of the informal waste collectors in Austria originate from Hungary and 19% from Austria. The rest comes from Bulgaria, the Czech Republic, Slovenia, Slovakia and Romania. Istvan et al. [36] reported that informal waste collectors from Hungary even travel for waste collection to the Netherlands. According to Obersteiner et al. [37], a verification at the Hungarian border showed that the collected items were 47.21% by volume of furniture, 18.77% by volume of electrical appliances and 13.19 Vol% of metals.

Also, the Czech Republic is considered a high-income country; even waste collectors from the Czech Republic come to the neighbouring countries like Germany and Austria, as the income there is even higher. The Czech Republic has 10.5 million inhabitants and an average household income of 17,542 US\$. According to the income, which is proportionally lower than in Germany or Austria, the average waste generation rate is also lower: 0.8 kg/cap/d, and also significantly lower than the EU average of 1.3 kg/cap/d. No refund is applied for aluminium cans or plastic bottles in the Czech Republic, only some kinds of glass bottles are refunded for 3 Kč (approximately 0.11 US\$). That is why the 'secondary' collection of this type of waste is negligible there.

The Waste Law of the Czech Republic orders the municipalities and communes to arrange waste collection places so that some parts of the waste (esp. glass, paper, plastic, metals and biowaste) should be collected separately. All rural areas are administrated by their central municipalities, meaning that law and waste management in rural and in urban areas are the same. The informal waste collectors are active in the Czech Republic, even being gypsies like in Romania and Hungary. The waste proportion collected by them is finally included into the waste that is recycled by the recycling companies and in that way included into the statistics. The informal sector usually collects metals that can be simply sold. They sometimes also steal some metal parts of working systems (electrical wires, railway security systems, monuments, sewer covers, etc.) and sell them as metal waste. They are not foreseen to be a part

of the official system even there are some laws and procedures to prevent them. Generally, the informal waste pickers are much more active in the poor areas of the country (Northern Bohemia or Northern Moravia) than in the rich regions.

An investigation carried out by Tydlitova et al. [38] in several rural communes in the Czech Republic on the impact of the implementation of the system pay as you throw (PAYT) showed that the villages, which applied Local Tax system, produced 47% more of mixed municipal waste. The villages that applied Local Tax generated an average of 0.52 t of mixed municipal waste per 5 years, and more than the villages that applied the fee by Act on Waste [38]. The results according to Tydlitova et al. [38] are given in **Table 1**. The example from the Czech Republic shows that not only the average household income has an impact on the waste generation rate but also the system of payment of waste fees. Higher fees have a regulating impact and cause lower waste generation rates.

Municipality	Population (2011)	Applied waste law (2011)	Fee per person or dustbin	Fee per person or dustbin	Distance to landfill, km
Horažďovice	5578	Local Tax	CZK 600/person	US\$ 24/person	43
Horoměřice	3335	Local Tax	CZK 480/person	US 19/person	6
Jílové u Prahy	4222	Local Tax	CZK 500/person	US\$ 20/person	1
Mnichovice	3069	Fee by Act on Waste	CZK 1750/120 l	US\$ 70/120 l	35
Pšáry	3331	Fee by Act on Waste	CZK 2145/120 l	US\$ 86/120 l	53
Říčany	13,499	Contractual form by Act on Waste	CZK 2520/120 l	US\$ 101/120 l	36
Statenice	1261	Local Tax	CZK 600/person	US\$ 24/person	6

Table 1. Waste management system in several rural municipalities [38].

In the following discussion, the focus is on low- and middle-income countries which all face the issue of informal waste pickers, in the urban as well as in the rural areas. The respective countries are considered in alphabetic order.

3.2. Jordan (lower middle-income country)

Jordan is a lower middle-income country in the Middle East, with an original number of inhabitants of 6.5 million in 2013 (data of OECD), which increased through migrants from Iraq and Syria recently by at least 2 million; 21.2% of the inhabitants live in the rural areas [39]. The annual average household income is approximately 5160 US\$, with a large variation. The average waste generation is 0.9 kg/cap/d in urban areas and 0.6 kg/cap/d in rural areas. Jordan is quite densely populated, and the existing informal waste collection sector has undergone an even higher competition after a large number of migrants entered the country to search for possibilities to ensure their income for living, as reported in interviews in March 2017. This kind of situation was recently also observed in Turkey, where the existing

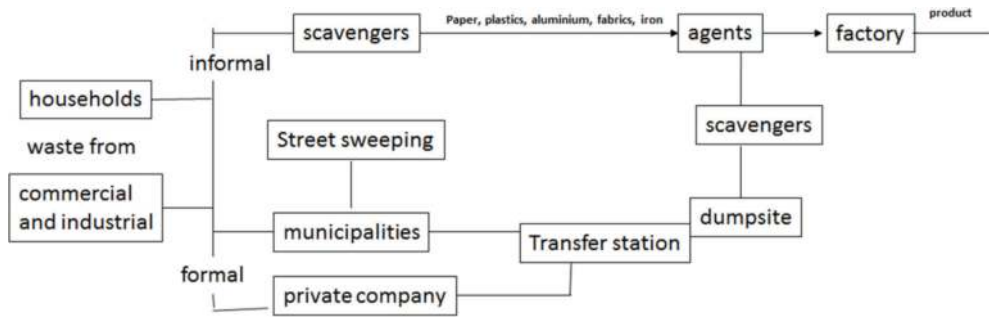


Figure 2. Flow chart for solid waste streams and scavengers role in Jordan ([39], adapted).

well-organised informal sector got quite under economic pressure caused by a stronger competition. Resource recovery and recycling are practised in a limited way, even those of urban areas are clean and free from street waste. In the rural areas, there is a higher percentage of waste beside the roads, and it is obvious that there is cleaned or collected much more seldom.

A well-documented study on the informal sector in the rural and rurbanised environment of Jordan was provided by Aljaradin et al. [39], which analysed the informal recycling activities carried out by a scavenger in the Tafila region of Jordan. The general situation is given in **Figure 2**, and it is a typical situation for a variety of low- and lower-middle-income countries.

There is no legislation which forbids scavengers to pick and recycle waste but the Ministry of Social Development always tracks them for children working as waste pickers [39]. The informal recycling in Jordan was estimated to be around 10% from the total municipal solid waste (MSW) generated. As shown in **Figure 2**, their activities are carried out before the solid waste reaches the final disposal sites for the separation of recyclable materials, but the majority of informal collection is done at the disposal sites. The informal waste collectors are welcomed as they reduce the cost of formal waste management systems. The materials most often collected are aluminium, plastic, paper, cardboard, glass, copper and iron [39]. The average quantity collected by 100 scavengers per day is reported with 150-kg soft drink cans, 5-kg aluminium stripes, 2-kg copper wires and 90-kg scrap metals.

The average waste composition contains biodegradable waste (52%), plastics (17%), paper/cardboard (14%), glass (3%), metals (1%) and others (17%) (Karak et al. [40]). The composition of the scavenger crowd in the Tafila region is 99% men and 1% woman [39], with 80% being less than 25 years old. The majority of the informal waste pickers in Tafila (78%) obtain a monthly income of >250 € (268 US\$), the others <250 €. As Aljaradin et al. [39] reported, scavengers usually have no concept of the essential role of their work in the waste management activities, and their social status is very low.

3.3. Mexico (upper middle-income country)

Mexico is a country in Latin America with 122 million inhabitants. The annual average household income is 12,800 US\$. The average waste generation in rural communities is 0.68–1.09 kg/cap/d [41]. In other studies, carried out in rural communities in Mexico the interval found is between

0.28 and 0.58 kg/cap/d [41, 42], indicating urbanised behaviour. It can be assumed that the differences result from the consideration of agricultural wastes. A study carried out in eight communities from Michoacan, Mexico [42], points a composition of 44% of food scraps, 8% of yard trimmings, 2% of cardboard, 2.8% of paper and 0.6% of textiles [41]. In comparison, the per-capita MSW generation in the urban area ranged from 327 to 361.35 kg/inhabitant/year from 1995 to 2012 [43].

As in other developing countries, also in Mexico, the informal sector exists, which is concerned with the recovery of waste, but an investigation to quantify the contribution regarding the recovery of recyclables [44] would be necessary. According to Taboada-González et al. [41], in some rural communities of Mexico, waste collection is provided by the municipality through the Department of Waste Management (DWM) at no charge. The waste is collected once a week at the curbside where residents place their garbage bins. Afterwards, waste is disposed of in each community's dumpsite. The percentage of coverage of waste collection services in the rural area is 60%, making it clear that the DWM does not totally collect the waste generated by the communities, being inefficient in most of the cases. The rest of the waste is usually mismanaged and burned outdoors or discarded at ravines, uncultivated land and canals. Also, an unquantified fraction is collected by informal collection services that offer their services in exchange of a gratuity. Also in Mexico a deposit refund system exists.



Figure 3. Informal refuse collection in Netzahualcoyotl, Mexico. Photo by Medina [45].

In Mexico, scavenging and informal refuse collection (IRCs) is very common (**Figure 3**) [45]. In many cases, rag pickers recover some valuable materials (aluminium, tin can and ferrous waste) and the rest is dispersed to be burned outdoors. Waste picking is done near the source, that is, after collection has taken place at the generating sources and previous to being transported to the dump or landfill. The most common way of selling the collected material is directly to the companies that attend the site daily [43]. Materials such as aluminium, tin cans and ferrous waste are collected by waste pickers in rural communities [41]. Waste pickers working in

the landfill collect mainly plastic (PET), also aluminium cans, plastic (HDPE) and metals. The material is selected for collection in terms of the market for each product [44]. According to Medina [43], in some towns, informal refuse collectors pick up garbage and charge each home a fee between US\$ 0.10 and 0.50 (Figure 4). In many cases when they operate in a place far from the municipal disposal sites, they take the collected waste to privately operated transfer stations and pay a fee of US\$ 1–4 for unloading wastes there, depending on the amount. Hence, in addition to collection fees, they recover recyclables from the wastes, which, considering the fees they pay, results in an average income of US\$ 9–15 a day, which is between three and five times the minimum wage. Being so, in many cases IRC is a highly paid activity.



Figure 4. Informal refuse collection in Tultepec, Mexico. Photo by Medina [45].

	MXN Peso/kg	US\$/kg
Paper	3.00	0.156
Newspaper	1.50	0.078
Glass	0.60	0.031
Plastic PET	3.00	0.156
Cardboard	2.00	0.104
Aluminium	17.00	0.884
Food tins	17.00	0.884
Metal	2.00	0.104
Magazines	3.00	0.156

Table 2. Recyclables prices in Mexico [46].

In many towns not just in Mexico but in Latin America, the informal sector has been used as a semi-official tool to bring services to low-income areas, which offers a more open system, responding to basic needs and demands [44]. **Table 2** shows the recyclable prices in Mexico [46].

Generally, there is a direct relationship between producers and consumers in the informal sector, requiring low capital, which allows for more rapid growth. However, this peculiar nature of the informal sector makes monitoring and regulation more difficult, for which it has resulted in the inefficiencies previously mentioned. Hence, as stated by Medina [45], incorporating informal collection services into the municipal waste systems and formal programmes could bring some control over their operations and stop illegal dumping.

3.4. South Africa (upper middle-income country)

The country located in the Southern Africa has 70 million inhabitants with an annual average income of 5845 US\$. The average waste generation is 1.7 kg/cap/d in urban regions and 0.35 kg/cap/d in rural regions [47]. Results of a topic-related research of the Council for Scientific and Industrial Research South Africa on the informal waste sector indicated that between 60,000 and 90,000 waste pickers earn a livelihood from the recovery of recyclables from municipal waste in South Africa. This intensive informal sector, which especially also works in the rural areas, provides a valuable, and low-cost recycling solution. While the informal sector in the urban areas is going to be formalised step by step, the informal sector in rural areas is mainly living from the activity of private recycling companies. Generally, the situation in the urban area is easier and more economic for an informal waste picker than in the rural area. In the urban area, for instance, in Bloemfontein, the informal sector was somehow formalised through green T-shirts, which must be bought, and represent the official allowance to collect recyclables. In this way formalised, the waste picker can act as glass recycler and earn up to 12,000 ZAR/y (approximately 923 US\$/y).

In the rural areas, the informal collection is a very difficult job. Usually, the informal sector collects the recyclables at landfills, means on landfills with an informal allowance to enter them, or in front of the landfill at the entrance, or on the rural road, which is connecting the landfill. There, the informal recyclers even stop cars, which are on the way to the landfill. Besides those activities, also conventional collection activities in the villages do exist, even they are not the majority of the activities leading to income for the informal waste recyclers. Generating income with informal activities in South Africa is a quite unpredictable activity. As the waste collectors reported in interviews in February 2017, they do not know when the private waste recycling company sends the trucks to collect the waste of the informal sector, which usually happens twice a year, sometimes only once a year, but the date is not announced.

This leads to the situation that the informal waste collectors need to establish waste storage sites (usually outside landfills), where the recyclable waste fractions are already pre-sorted and packed to be ready for the collection by the recycler in each moment. Such constellation leads to informal settlements for the purpose of waste collection and manual pre-sorting. The payment is small: 2 ZAR per kilogram metal (0.15 US\$), 1 ZAR per kilogram plastics (0.08 US\$) and 1 ZAR per kilogram glass (0.08 US\$). If the collection activity goes properly, and the private recycling company sends the collection truck, an informal waste recycler can earn approximately

6000 ZAR/y (approximately 461 US\$/year). This annual income of an informal waste collector in the rural areas compares to half of an average monthly income of a worker in an urban area. There are nearly no women doing this kind of job in the rural recycling settlements.

Figures 5–7 show impressions of an informal waste recycling settlement in the rural areas of eMalahleni, taken in February 2017.



Figure 5. Informal waste-recycling settlement in the rural areas of South Africa, close to eMalahleni: PET collection (photos taken by the authors on 26 February 2017).



Figure 6. Informal waste-recycling settlement in the rural areas of South Africa, close to eMalahleni: glass collection (photos taken by the authors on 26 February 2017).



Figure 7. Informal waste-recycling settlement in the rural areas of South Africa, close to eMalaheni: living conditions at the informal recycling village (photos taken by the authors on 26 February 2017).

3.5. Nepal (low-income country)

Nepal is a country in Eastern Asia which consists of mountains, hills and a lowland region which is called Terai. The country has 28 million inhabitants and an annual average household income of 701 US\$. For the study of the Solid Waste Management and Resource Mobilization Centre [33], a total sample size of 3330 households from 60 municipalities in the rural areas selected from all ecological zones was considered, having 55 households that gave an average per-capita household waste generation of 0.12 kg/cap/d [33]. The data base for Nepal shows that the household waste generation rates in new municipalities varied depending upon the economic status. The average waste generation correlates with the monthly available household income. Households with a monthly budget of NRs $\geq 40,000$ (about 389 US\$) generate 0.88 kg/day, in comparison to 0.4 kg/day for households with a monthly budget of less than NRs ≤ 5000 (about 49 US\$) [48]. The results of the study indicated a per-capita household waste generation from a minimum of 0.07 kg/cap/day (Bheriganga Municipality) to a maximum of 0.22 kg/cap/day (Bhojpur Municipality) [48].

The characteristics of MSW collected from any area depend on various factors such as consumer patterns, food habits, cultural traditions of inhabitants, lifestyles, climate, economic status, and so on. Composition of urban waste is changing with increasing use of packaging material and plastics. The average household waste composition investigated in 60 municipalities in terms of the eight determining waste components (organics, plastics, paper and paper products, glass, metal, rubber and leather, textiles and others like inert and dust) is presented in **Figure 8** [33].

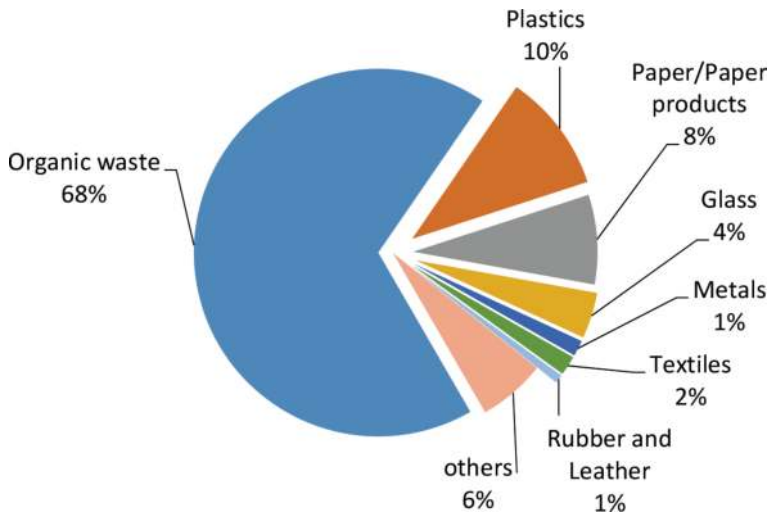


Figure 8. Average composition of household waste of 60 rural municipalities, with average values by % wet weight [33].

The average composition of household waste comprises as highest fractions organic matter (68%), followed by plastics (10%), paper and paper products with 8% as well as other types of waste with 8.6% [33]. The rest, being below 4% wet weight, was glass, metal, rubber and leather, and textile components [33].

Of total surveyed households from 60 municipalities, 51% responded that they are practicing segregation of waste at sources, which is higher than that of survey findings from 58 municipalities conducted in 2012 [33]. The higher segregation at sources in new municipalities is because of rural nature of these municipalities where almost all households were found to segregate kitchen waste for their own purpose, for example, feeding cattle and using for traditional type composting, and so on. Moreover, only 33% surveyed households have composting practices of segregated waste while 37% do not have such composting practices in their households, which means that the segregated waste at source is mixed again during collection and transportation due to the lack of separate collection and treatment methods [48].

In many of the new municipalities, a solid waste collection system does not exist, and if the system exists, it is not satisfactory due to unscientific composting, or open burning, or throwing the waste in the open space around [33]. Only 2% of surveyed households sell segregated non-biodegradable fraction to informal sectors. 52% respondents told that they do burn of segregated non-biodegradable waste like plastics and papers, while remaining either throw into road drains or do both [49]. Collection, city cleaning and sweeping do not happen on a daily basis [33], and only main market and roads are served daily. Other areas are served intermittently, from twice a week to twice a month [33]. Many areas in the rural environment are neglected due to inefficiency and inadequacy of service [49]. Although a concept of material recovery from MSW with legal provisions of sorting waste at sources has been

already introduced in Nepal through the new solid waste management act (SWMA) promulgated in July 2011, no formal municipal waste recovery and recycling programme exist in the municipalities [48]. Because of municipal budget constraints, municipalities try to create a sound budget without increasing cost-efficiency option, but arrive at the point that MSW has become environmental, financial and social burden to each municipality [33]. The conclusion of the investigation was that only 2% of surveyed households sell segregated reusable and recyclable fraction to informal sectors, being considered as very minimum resource recovery activities in the surveyed municipalities [33].

Figure 9 shows informal workers collecting recyclable materials, Belabari Municipality, Nepal.



Figure 9. Informal workers collecting recyclable materials, Belabari Municipality, Nepal (photo source: Solid Waste Management Technical Support Center [33], with friendly permission of SWMRMC Nepal).

3.6. Vietnam (low-income country)

Vietnam is a country in South East Asia, having a population heading towards 90 million inhabitants. The annual average household income was 1912 US\$ in 2014. The economy of Vietnam is agriculture with paddy rice as major crop cultivated on 4.5 million ha land. In addition to the main product, rice grain, by-products such as rice straw and husk (renewable resource) are also produced, estimated to be around 38 million tonnes of straw and 6 to 7 million tonnes of husk per year for whole Vietnam [50].

The country is very densely populated. People live in all types of organisational forms, covering sizes from the rural community to megacities. The agricultural sector in the rural areas plays a fundamental role in Vietnam, as it provides the nutrition for the growing population. The average waste generation in the rural area is 0.4–0.5 kg/cap/d (excluding agricultural wastes). The organic content of the generated waste is very high, up to 90%. Plastic bags form

a percentage up to 15%. A serious problem is the percentage of hazardous waste, especially bags, bottles and cans which contained pesticides. In private households, the waste is often burned. Only a small percentage is composted.

The waste collection is organised in different ways in the provinces, usually comprising two levels:

- (a) Waste collection from the households through companies, NGOs (e.g. Farmers Union, Women Union, Veterans) or private waste pickers (informal sector). The waste collection fee is stipulated by themselves, as well as the determination of the collected fees (payment for employees or investments). Informal waste pickers exist everywhere in the rural areas, and they mainly collect plastics, paper and metal. Only a small percentage of the collected waste is recycled, the majority is put on landfills. In areas, which are far from the official collection and recycling infrastructure, the waste is deposited into illegal dumpsites.
- (b) Waste collection at the landfills of the province. The central waste management company URENCO allows private waste pickers to collect recyclables from the deposited waste and pays for this service.

Vietnam produces many biodegradable wastes in the rural areas, which are mainly not recycled in the current state. The biomass contributes to the rural waste generation, and even it is recyclable, it is not yet properly valorised. For the informal sector, it is not an interesting waste stream. Currently, in the urban and rural areas in Vietnam, a bottle deposit refund system for beer and soft drink bottles does exist. The bottles refund for one box with 20 beer or 24 soft drink bottles is 20.000–40.000 VND (0.88–1.76 US\$). The recyclable materials are bought by collectors from households with the following prices:

Cardboard: 3000–4000 VND/kg (0.1–0.18 US\$)

Paper: 4000–5000 VND/kg (0.18–0.22 US\$)

White cleaned covers from nylon and plastics: 12,000 VND/kg (0.53 US\$)

Coloured cleaned covers from nylon and plastics: 10,000 VND/kg (0.44 US\$)

Dirty covers from nylon and plastics: 2000 VND/kg (0.09 US\$)

PET bottles: 4500 VND/kg (0.20 US\$)

Iron scrap: 4800–10,000 VND/kg (0.21–0.44 US\$)

Aluminium scrap: 20,000 VND/kg (0.88 US\$)

Copper scrap: 60,000–90,000 VND/kg (2.65–3.97 US\$).

Figures 10 and **11** show informal workers collecting recyclable materials in the Mekong region in Vietnam.



Figure 10. Informal workers collecting recyclable materials, Mekong region, Vietnam (photos taken by the authors on 14th august 2017).



Figure 11. Informal workers collecting paper and cardboard, Mekong region, Vietnam (photos taken by the authors on 14th august 2017).

4. Discussion

The informal collection of waste is a phenomenon that results from social differences within society and the population. Therefore, it is not surprising that the perception of the activities of informal waste collectors in the scientific literature refers to developing countries and emerging countries, since social differences are more pronounced. These informal waste management systems in low- and middle-income countries usually exist in parallel with formal waste management systems, and this applies for urban as well as rural areas and might be considered as a result of rurbanisation. The case studies show the development of the informal sector as an important part of the waste management activities, when a country starts to develop. With increasing economic development, the importance of the informal sector is shrinking step by step in relation with the improvement of the formal activities. Even this development goes faster in urban areas; the conclusion applies also to rural areas. Although organic waste is the main waste stream in rural areas, there is a relevant proportion of informal activities on recyclables like metals, plastics, papers and glass.

One of the main focuses of the formal waste management activities in the urban areas is to find solutions for the inclusion of the informal sector into the formal activities, and in this way, it is formalisation. In order to support the consideration of formalisation options of the informal sector, a further literature search was carried out. The aim was to reconcile the approaches used in other countries and to consider as far as possible a wide range of ideas. Thus, in principle, the following approaches exist in the literature:

- Incentive systems for the disposal of certain wastes.
- Umbrella organisation for informal collectors outside the waste regime.
- Incorporating informal waste collectors into a commercial waste management company.
- Establishment of an umbrella organisation within the waste regime.
- Second-hand goods trading through municipal waste management.
- Consideration in national ReUse concepts.

The following basic options for the integration of the informal sector were determined in the literature research in the form of case studies (in accordance with the investigations of Hold, [14]):

- (A) Involvement of informal waste collectors with the municipality by means of a contracted subcontract to an unionised unit, for example, for certain geographically defined administrative units and/or for the lower-income areas. An example is Maputo (Mozambique): The informal waste collectors supply the recyclable waste to a centre for the sorting and pre-treatment of valuable substances. The recycling centre sells high-quality, recycled plastics to the local recycling industry and is independent of external financial support.
- (B) Involvement of informal waste collectors by specialising in a specific type of waste. In Delhi and Bangalore (India), numerous informal workers recycle electrical and electronic

waste. The informal recyclers received training in the risk of their work and appropriate recycling techniques. Finally, several small recyclers of electronic waste joined together and were able to register themselves officially. In the treatment of hazardous substances, the new company cooperates with an experienced, formal recycler. The newly founded and registered company has established itself on the market and offered its employees an improved job situation.

- (C) Specified waste refunds for certain recyclable waste types and quantities. In Bogota (Colombia), informal waste collectors receive 28.78 US\$/tonne of waste collected at officially authorised collection points in the city; 13,754 informal waste collectors are found in Bogota, 58% of them are women; 1200 tonnes of waste are collected daily by them. The average income per collector is 3.41 US\$/d.
- (D) Official recognition of the waste collector is a profession. In Brazil, the waste collector was recognised as a profession. There are three types of organisations: (1) unorganised and anonymous waste collectors, which are not affiliated with any organisation, (2) organised waste collectors organised in cooperatives and associations, and, as a rule, at least 10 years of professional experience, as well as contract-bound waste collectors, mainly working in scrap metal, in metal works and also in the municipal sector. In Brazil, there are 229,568 waste collectors, of which 67% are men, 25% are between 50 and 64 years old and 7% are over 65 years old. Only 14% of them have a school-leaving certificate. Approximately 4.5% work in a formal contract, which include 11,781 people. The contractually employed persons have a median income of about three to four times higher.
- (E) Another possibility to improve the problematic situation of informal waste management would be to take account of informal collectors with the introduction of a national re-use system. The informal collectors could fulfil the need for new capacity in waste collection centres, such as storage areas and labour, or take over the transports between the municipal collection points and the socio-economic enterprises, or assist the employees of social economy enterprises with their repair knowledge.
- (F) Integration of the informal sector into the development of re-use and repair networks in co-operation with socio-economic integration companies. In this formalisation, the informal collectors function according to Scherhauser et al. [51] as transporters for socio-economic enterprises. A separate collection of reusable items is carried out in the waste collection centres in question, which are then transported to the ReUse plants by the informal collectors. The delivered items are then sorted according to their functions in ReUse operation. They are divided into items with or without the need for repairs [14].

The mentioned general options could be applied also in the rural areas; even the probability of the feasibility of some particular options is higher (in accordance with the investigations of Hold, [14]), as there are:

- Option (A) could be applied also on communal basis in rural areas.
- Option (B) appears not as an applicable option as the waste volumes in rural areas are smaller, and with this the proportion of usable recyclables is smaller. The example from South Africa shows a remarkable volume of recyclables needs time to be collected in the rural areas.

- Option (C) is an interesting option, which could allow for a constant cash flow or income.
- Option (D) is a challenge. It would be useful to recognise waste recycling as profession, especially for the informal sector. This option could be combined with the special clothing of the waste recyclers in order to recognise them faster as officially working people.
- Option (E): this option would work also in rural areas, but it requires as precondition that the country is already in a certain developed stage.
- Option (F): this option applies to a higher-developed society which already has a developed waste management infrastructure.

5. Conclusions

Scope of the current investigation was to collect data from literature and through field studies in order to obtain information on the informal sector activities in the rural areas, working in a rurbanised environment. A general conclusion from the questionnaires and field visits is that the informal sector exists also in rural areas; even the generation of recyclable waste is smaller than in urban areas. Therefore, the income of rural informal waste pickers is lower than that of urban waste pickers. As the informal sector in the rural area is usually concentrated near the landfills, they use recyclable materials going to the landfill in several ways to make their living. Usually they collect metals, glass, PET bottles and sometimes also papers. Potential differences in the waste management activities of the informal sector in cities and in an urbanised rural environment can be stated at this investigation stage that the urban sector shall be usually formalised at a certain development stage, while this is usually not yet the case in the rural area. Further, like in other commercial sectors, the income in rural areas is usually less than in urban areas. The percentage of women in this sector is negligibly low.

Most of the middle- and low-income countries deal with an informal waste sector. And usually, each respective country faces a number of unique socio-economic and political circumstances that may influence the integration of the informal sector into a formal secondary resources economy. Anyhow, one question in this regard is: What model of social inclusion of waste pickers would be most appropriate in the respective country, means integration and/or formalisation? A discussion in a recent workshop at the Chamber of Commerce, held in Istanbul in October 2016 was on the subject of the inclusion of the informal sector into the official waste management system. The informal sector also participated. Surprisingly, not all of the members of the informal sector agreed to be included in the formal waste management organisation. Most of them told the freedom of their working conditions as reason.

Having in view the process of rurbanisation and the economic development of the low- and middle-income countries, informal waste pickers are at present an important part of the system. It is to be expected that with increasing economic infrastructural development, their relevance will be decreasing on the long term, but not necessarily. In Vietnam, for instance, the informal sector is included in the waste management system as official power

already to collect recyclables from landfill (e.g. Nam Son in Hanoi). On the other hand, it might be possible that the informal sector covers especially rural regions, which are less developed in infrastructure and/or which are far from the next recycling centres and not economically manageable with formal waste management activities. In such case, the informal sector could be able to manage those regions with its technical means, for instance horse carriage (like in several East European countries), or smaller motorised vehicles. Anyhow, the main waste stream in rural areas which will not be managed by the informal sector is the organic waste.

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