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TRANSITION OF SERBIA'S WASTE MANAGEMENT

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ABSTRACT:
Transition of Serbia's waste management
Serbia's waste management is in its initial state. This paper focuses on the transition of the waste management system in the period 2006 till 2016 giving a projection on future developments till 2019. Using the phase-model of waste management - introduced by Klampfl-Pernold and Gelbmann in 2006- the current state is evaluated. Moreover, important factors and drivers for the transition are detected and analysed. The assessment showed an improvement of the overall situation of the waste management. A gradual transition towards an integrative waste management can be observed. The main tasks detected are comprehensive and regular data acquisition, implementation of a separate waste collection with higher level of coverage, sanitation of landfills, waste recovery and awareness raising.

KEY WORDS
Waste Management, Transition, Phase Model, Serbia

1.Introduction

In the Republic of Serbia, the generated amount of waste is projected at a value of approximately 2,4 Million tonnes for the year 2010. It results in 0,87 kg of generated waste per capita and day. This classifies Serbia in the category of developing countries (0,5 kg – 0,9 kg of generated waste per capita and day). The waste quantity and morphology is directly proportional to the average income and level of urbanization. Therefore, the regional amount of waste generated per capita and day differs between 0,28 kg and 1,54 kg. Almost 50% of the municipal waste is made up of biodegradable material, 13% plastic and 14% paper and cardboard. (Vujic et al. 2010, 1021 and 1027)The Statistical office of the Republic of Serbia estimates 2,6 Million tonnes of generated waste in 2010 and a quantity increase of 53% from 2006 till 2010. (Vukomirovic 2012, 15)

2.Methodology

This paper aims at positioning Serbia's waste management and evaluating its transition in the last decade. Therefore, an assessment was carried out using the phase-model of waste management proposed by Klampf-Pernold and Gelbmann *(Figure 1)*.The hierarchicphase model describes the state of a country's waste management and classifies it in the phases of *no attention*, *coverage and disordered disposal*, *ordered landfilling*, *collection logistics*, *recycling solutions* and *industrial cycle*. (Klampfl-Pernold and Gelbmann 2006, 27)

Figure 1: Phase-Model of Waste Management after Klampfl-Pernold, Gelbmann modified by Danko Simić (Klampfl-Pernold and Gelbmann 2006, 27 and 70)

Twelve indicators are used to evaluate the position of a country's waste management in the phase-model. These indicators are grouped in economic (GDP per capita, inflation rate, level of industrialization), social (unemployment rate, HDI, green movements), juridical(data collection, separate collection, reporting duty) and ecological criteria (landfilling, further processing, contaminated sites). All indicators together define the phase in which a country's waste management is at the time of the assessment. Moreover, the indicators inflation rate and unemployment rate are used to underline the validity of the indicators GDP and HDI. Therefore, they are represented as arrows in the visualisation and displaypositive, neutral and negative tendencies. (Klampfl-Pernold and Gelbmann 2006, 49 and 52)

An assessment for Serbia's solid waste management after Klampfl-Pernold and Gelbmann was carried out in 2006. In the first step of this paper the results of this assessment are discussed. In the second part the evaluation of the waste management system is repeated with the same methodology to define the current state. Besides the recent assessment, the goals and plans set in the national waste management strategy for the period 2010 till 2019 are used to give a prospectus for 2019 and the phase which the Republic of Serbia can reach by the implementation of all intend activities. It represents the best-case scenario. With this time series, the process of transformation of the waste management system can be described. It can be used to evaluate the performance of a country's waste management policy. Furthermore, the findings of this research are used to detect the main drivers of the development. The applied method is based on a varied literature review of mainly waste management strategies, scientific papers on waste management in Serbia, assessment reports by the European Union and legislative texts by the government of the Republic of Serbia.Statistical datais used to underline the statements of this paper. It is mainly data provided by the Statistical Office of the Republic of Serbia and official reports by the Republic of Serbia, but also data from Eurostat, the World Bank and the National Bank of the Republic of Serbia.

3.Assessment of Serbia's waste management by the phase-model 2006

The state of Serbia's waste management in 2006 is described in its initial phase: coverage and disordered disposal*(Figure 2)*. Landfilling and the absent awareness for the environment were identified as the main problem areas. In 2006 the key tasks of the government were to rebuild and revive the economy and stabilize social structures in the country.Waste management and ecology were not yet noticed as an important future topic in this period. (Klampfl-Pernold and Gelbmann 2006, 72 and 76)

Economic indicators are determined negatively by the political events in the nineties and early two-thousands. The GDP per capita amounted3.521 € in 2004. The inflation rate was running at 15,5% (2005), showing a decrease of – 83 % in the period from 2001 with an average of 91,1 %. In 2006 the inflation rate reached an average level of East and South-East European countries. The level of industrialization is following this trends and allowing to embed the economic indicators in phase 1. (Klampfl-Pernold and Gelbmann 2006, 72 and 73)
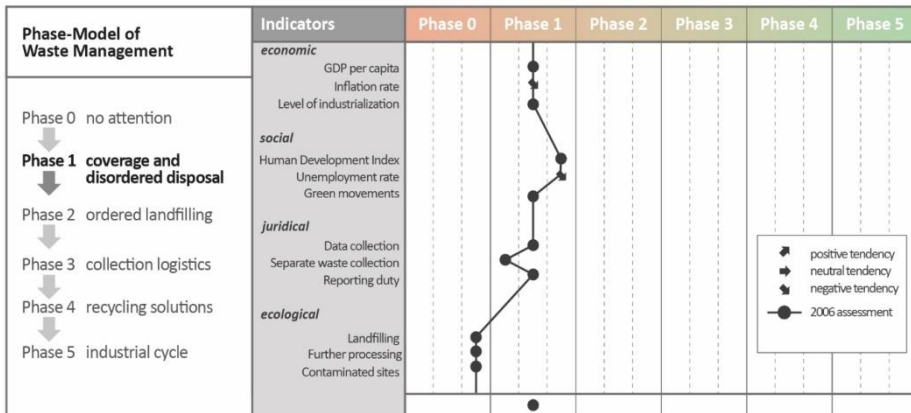

Figure 2: Assessment of Serbia's waste management by the phase-model in 2006 modified by Danko Simić (Klampfl-Pernold and Gelbmann 2006, 76)

The social indicators also locate Serbia's waste management in phase 1 with tendencies towards phase 2.Due to a lack of data the HDI is estimated at a maximum average level of Romania in 2005 with 0,792. Therefore, this indicator is classified as an intermediate value, in phase 1 with tendencies towards phase 2. (Klampfl-Pernold and Gelbmann 2006, 72) In the Human Development Report 2015 Serbia's HDI in 2005 is 0.741, which would result in the same classification as the threshold of 0,800 would not be reached in any case.

In 2005 the unemployment rate reached 31,6 % in Serbia and was even higher in the south and east of the country. Focusing green movements,phase 1 covers countries which have scattered environmental institutions and is characterized by single green movements. Here it is necessary to capture that Serbia has a ministry for environment only since 2002. As in many other states the first green movements result from protests against nuclear power. The first green party was formed in 2001, with the aim to enter the parliament. (Klampfl-Pernold and Gelbmann 2006, 73)

Considering the juridical indicators data acquisition and report duties are the main problems. As there is no comprehensive waste collection the amount, typology and morphology of waste is only estimated by the municipalities. Only 60 up to 70 % of Serbia's inhabitants (estimated value) are provided with organized waste collection. It is especially rural areas which do not have any access to waste collection. Disordered disposal – mainly illegal landfill – is the result.(Klampfl-Pernold and Gelbmann 2006, 78 and 79)

When it comes to the ecological indicators Serbia is classified in phase 0 – no attention. The only approach to handle accruing waste is landfilling without any pre-processing including all types of waste. Not even commercial or industrial waste is processed.There is already an initial awareness for contaminated sites, but no concrete actions are set by the government. (Klampfl-Pernold and Gelbmann 2006, 75)

Figure 3 depicts the comparison of the states of former Yugoslavia which were considered in the assessment by Klampfl-Pernold and Gelbmann in 2006. The development of Serbia's waste management system is far behind Croatia and Slovenia. This development is mainly resulting out of two factors: Already in times of Yugoslavia a north-south and west-east gradient in developmentexisted. Resulting Slovenia and Croatia were already more developed in socialistic times. These gradients are persistent till today. Initially more developed regions grew faster than initially less developed regions.(Kukic 2015, 2 and 3)Slovenia is far ahead – apart from contaminated sites (50.000 – 60.000 illegal deposits) – due to the early accession to the European Union in 2004 and adaptation of strategies towards a sustainable waste management in the years before. It is especially the economic and social indicators which rank Slovenia further ahead. (Klampfl-Pernold and Gelbmann 2006, 126)
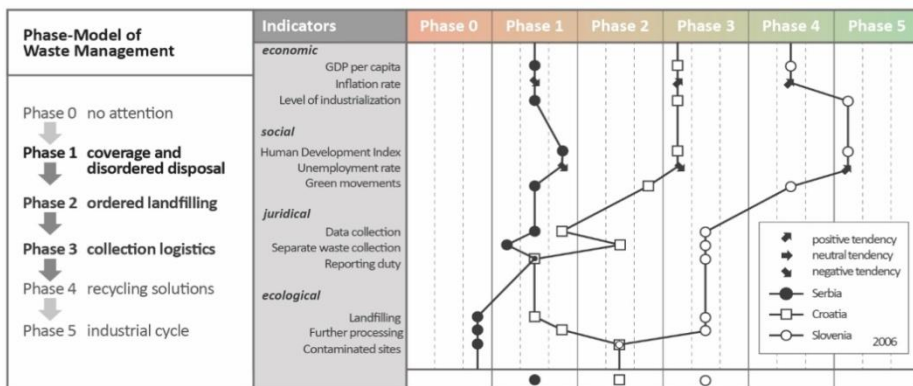

Figure 3: Comparative assessment of selectedformer Yugoslavian countries in 2006 modified by Danko Simić (Klampfl-Pernold and Gelbmann 2006, 76, 97 and 126

Croatia can be localised in the phase of ordered landfilling. By economic and social indicators - particularly because of its extensive tourism - Croatia could be easily classified in phase 3, collection logistics. A lack in the juridical and especially ecological indicators rank Croatia at the beginning of phase 2. (Klampfl-Pernold and Gelbmann 2006, 97) This dichotomy shows a transition: Higher economic and social standards foster the enhancement of juridical and ecological factors by higher involvement and awareness. In general, less developed countries are localized close to phase 0, countries which reach out through more phases are in transition and developed countries are usually located in only one phase at the very end of the model. Regarding the neighbouring countries Hungary in the north and Bulgaria in the south-east, as member states of the European Union, the same gap in evolution is recognizable*(Figure4)*. Hungary entered the European Union in the same year as Slovenia. Bulgaria accessed in 2007.
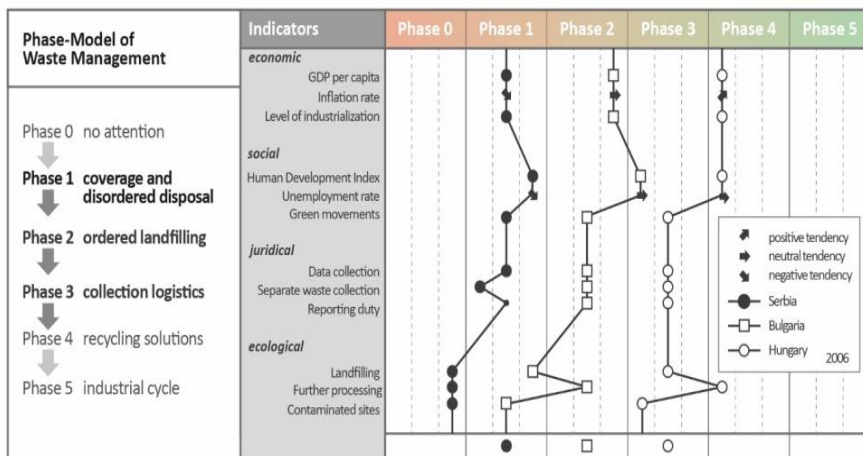

Figure 4: Comparative assessment of Serbia and selected neighbouring EU-countries in 2006 modified by Danko Simić (Klampfl-Pernold and Gelbmann 2006, 76, 92 and115)

4.Assessment of Serbia's waste management by the phase-model 2016

As mentioned before the evaluation of Serbia's waste management was carried out using the same method as in 2006 to define the current state in the phase-model of waste management and to detect the achievements which were attained in the last decade. Therefore, this chapter will emphasise on the transition of the waste management according to the indicators.All economic indicators show a positive development over the last decade. The GDP per capita increased with a rate of 33,5% from 3.521€ (2004) to 4.700 €. (2015, EUROSTAT 4.700 €, Statistical Office of the Republic of Serbia 4.694 €)

The inflation rate is running at 1,6 % showing a stabilization of the economic situation and positive tendencies. (2015, EUROSTAT 1,5 %, Worldbank 1,4 %, National bank of Serbia 1,7 %) The level of industrialization also increased, still the limit value of 2.400 € for entering phase 2 was not reached. Although there is an improvement in all three economic indicators the Republic of Serbia remains in phase 1. The social indicators also enhanced, resulting in a transition to phase 2. The HDI amounts 0,771 in 2014. (Human Development Report). The unemployment rate declined from 31,6% (2005) to 19,7% (2016, Statistical Office of the Republic of Serbia). Still the unemployment rate shows a negative tendency. However, it is almost reaching the limit value of 15 %. If the trend is continuing it willreach a neutral tendency in soon future, showing an economic stabilization.

Focusing green movements, phase 2 covers countries where green movements occur out of the population. Individuals start to show interests on environmental topics and start to take actions. It is recognizable, that those movements – which are usually led by young, higher educated people, mostly students - are concentrated mainly on the urbanized region in the northern part of Serbia. There is already a marginal green-party-landscape with minimal political influence. The green party entered the national assembly with one mandate – out of 250 – in May 2016. (Narodna skupstina Republike Srbije 2016) The political programme of the green party includes the protection of the environment and a promotion of green technologies towards a sustainable development. Considering waste management, the programme focuses dominantly on recycling and further processing of waste. (Zelena stranka 2016) There is also a growing number of political associations, for example the Levica Srbije founded in 2015. The left-wingorganisationputseducation and ecology as one of their pivotal topics. Considering waste management, they claim a modernization of waste dumps, new technologies for recycling and strict regulative against environmental lawbreakers. (Levica Srbije 2016)

One of the key problems defined in 2006 was data acquisition and report duties, as reliable data is indispensable for a successful waste management. In the law gazette on waste management no. 14/2016 the realm of waste management is regulated. It is specially the distribution of care duties, responsibilities and compulsory reporting which are tools that will sustain the development. (Republic of Serbia 2010)Although statistical data on waste management is exciting it is not published comprehensively and on a regular base. Different authors state a lack of data: "[…] data, are mostly unreliable and incomplete […]" (Batinic et al. 2011, 513), "[…] lack of information on waste qualitative and quantitative analysis, i.e. data base of quantities, characteristics, especially content, and classification […]" (Prokic, Mihajlov 2012,83) and "[…] situation in Serbian local […] units is characterized by unreliable and incomplete data on the quantity of municipal waste generation

[…]"(Republic of Serbia 2010).   On the other hand, there is an increasing number of methods for the estimation of waste amount and typology.By implementation of laws and simultaneous estimation with improved methods this problem can be solved.

Initial ideas of separate waste collection are also considered in the law gazette as well as some EU directives and laws and the hierarchy principle of waste. Still the amount of waste collected separately is unsatisfactory. An estimated number of 65-72% of the municipal solid waste is collected in Serbia in 2010. (Vukomirovic 2012, 12) The main problems in collection logistics where localized in the number and distribution of the waste containers and a lack of appropriate dustcarts and collection routes. (Republic of Serbia 2010)

First steps are set towards a reporting system for waste management. Altogether the juridical indicators improved and almost managed to transform from phase 1 into phase 2. First regulative are set for ordered landfilling: By the law gazette landfilling is only anoption if there is no other possibility considering the waste hierarchy. Landfilling is only allowed at approved waste dumps which have a high technological standard. Before the disposal, the waste must beregistered, analysed, classified in inert, not hazardous and hazardous waste and deposited after these criteria. (Republic of Serbia 2010)

However, the actual situation is that waste disposal on local landfills is still the most applied solution. Local landfills - with just a few exceptions - do not fulfil any technical or sanitary requirements. There is a sanitation programme for some dumps. A positive fact is that a landfill cadastre was established and 164 landfills were detected. (Vukomirovic 2012, 26 and 27, Tot et al. 2016, 1) This number is more than questionable as the official waste management status of 2010 exemplifies up to 4.481 landfills. (Republic of Serbia 2010) This big range in the values results out of different definitions of a landfills and particularly its minimum size.

Other investigations show that there are more than 3.582 landfills, of which75% are not bigger than 1.000m³. There are 14 landfills that are bigger than 500.000 m³ and they store 65% of the total detected landfill volume in Serbia (total landfill volume 44.057.045 m³) and cover a surface ofaround 200 ha. The spatial distribution shows that there are less landfills in autonomous province of Vojvodina compared to Central Serbia and most of them are concentrated in dominantly rural areas. (ISWA 2012, 2 and 3)The main problem besides the high number of landfills is that those unordered disposals are located near settlement areas, not fenced and that there are no facilities for controlling gas or waste water emissions into the environment. (Prokic and Mihajlov 2012, 85)

There are no comprehensive plans for the sanitation of landfills which increases the risk for contaminated sites, but there is already a marginal awareness for the ecological problems which may occur. (Republic of Serbia 2010)As landfill is the common practice only 2 % of the generated waste was recycled or energetically recovered in 2009. (Vukomirovic 2012, 40) In 2011 it was 5% and in 2013 the amount of recycled or recovered waste increased to 8%. (Batinic et al. 2011, 516 and Anthouli et al. 2013, 26)Serbia's waste management can be classified in phase 1 coverage and disordered disposal with tendencies towards phase 2 in 2016*(Figure 5)*. All indicators improved over the last decade. Main driver of this development is Serbia's transition towards the European Union. (Wilson 2007, 201) In 2012 the European Council granted Serbia the status of a candidate country and accession negotiations were launched in early 2014. (European Commission 2016a, 4)

Already in the Waste Management Strategy for the period 2010 – 2019 the main objective of the action plan was the harmonisation of national and EU wastemanagement legislation. Moreover, waste management and linked ecological issues are seen as a vast potential for the European integration. EU waste management standards and EU funds were detected as opportunities to foster this development towards an integrative waste management. (Republic of Serbia 2010) For 2016 the process of adoption of waste policies was described as a positive alignment to the principal directives with special progress regarding the waste framework, landfills and increased rates of municipal waste collection and sanitary landfilling. Apart from landfills and contaminated sites, investments in waste separation and recycling and the development of an integrated waste management plan are perceived as the main challenges for the future. (European Commission 2016a, 76)
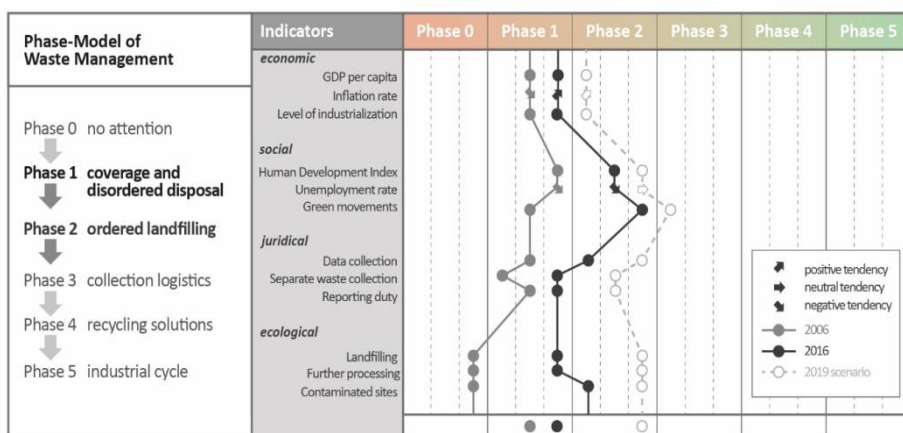

Figure 5: Comparative assessment of Serbia in 2006, 2016 and 2019
Modified by Danko Simić (Klampfl-Pernold and Gelbmann 2006, 76)

5.Assessment of Serbia's waste management by the phase-model 2019 scenario

By using the given values in 2006 and 2016 it is possible to extrapolate tendencies for the scenario for 2019*(Figure 5)*. It is important to underline that this prospectus shows only trends and not specific values. The economic indicators will exceed phase 1. The GDP in 2016 is already just at the threshold of 4.800 €. The inflation rate is expected to increase in the next five years, nevertheless the tendency will remain positive (less than 5% inflation rate).The level of industrialization is gradually following this trends. (National Bank of Serbia 2017)The social indicators are improving constantly. Still the HDI will not exceed the limit value from a high human development to a very high human development country. The unemployment rate was rapidly decreasing over the last decade. This trend is persistent till 2019 with less decline than in the previous years. Implementing an organized waste management system could create more jobs for the future and help to decrease the number of unemployed people.

Already now informal waste pickers contribute significantly to waste and resource efficiency. By integrating the informal sector in a low and middle income country's waste management system social, environmental and economic advantages emerge. The informal sector is naturally developed over a longer period and therefore it is highly adaptable, flexible and vastly reactive to regional demand-driven forces. It recovers a huge variety of waste types at very high recovery rates.(Gunsilius 2010, 1-3) Moreover, an integration of informal waste workers can foster the reintegration of the Serbian society. Informal waste pickers are usually from minorities and marginal social groups. By integrating them in the lifecycle of a good the negative perception of waste workers can be changed. Therefore, it is necessary to raise the informal worker's self-confidence and build new trust between the participating parties.

Driver of the social improvement is public awareness and perception. Only a high awareness in the broad mass can foster a sustainable development towards an integrative waste management.The "not my backyard" principle results in a lack of understanding of processes, followed by an underdeveloped position on waste. The key to higher awarenessis environmental education. (Fischer and Simić 2016, 18 and 19 and Tot et al. 2016, 1 and 4) With a rising common awareness for the environment, green movements will gain importance in the next five years and consequently reach phase 3.Special efforts are set on the juridical indicators in the current waste management strategy. The goal is to develop regional and local waste management plans for all regions, including inter-municipal agreements on joint waste management, the establishing of local institutions and reliable data acquisition.

Moreover, the number of persons covered by waste collecting systems should increase to 75% by raising the public awareness and offering adapted waste management infrastructure and facilities.43% of the objectives of the waste management strategy 2003-2008 were already implemented during the last period. It was mainly the preparation and adoption of basic waste policies. The current strategy is more specified and enables the decision makers to include more detailed actions with concrete output. (Republic of Serbia 2010) By 2018 full transposition should be reached, full implementation by 2034. (European Commission 2016b, 5)

The juridical indicators show a positive trend till 2019, still phase 2 will not be exceeded. Phase 3 is characterized by contemporary waste management plans, based on comprehensive and reliable data, separate collection logistic and recovery. Serbia will not reach this state till 2019. As mentioned above the problem of landfills and contaminated sites was already recognized. First steps towards closing and ecological sanitation were already initiated. This programmes are mostly co-funded by the EU. By revitalizing a bigger number of landfills a higher capacity of dump-volume is generated. This evolution can be contradictive to the development in waste recovery, energetic valorisation or recycling, by making these opportunities less attractive. Such trends were already detected during the assessment of Hungary in 2006. (Klampfl-Pernold and Gelbmann 2006, 115)

6.Results and Discussion

In 2006 Serbia's waste management was classified in its initial phase of coverage and disordered disposal. Main problems were detected among the ecological and juridical indicators, i.e. separate waste collection, waste recovery, landfilling and contaminated sites. In 2006 Serbia had a typical profile of a developing country: Driver of the development are the economic and social indicators, which are gradually stabilizing in this period. Ecological indicators are usually far behind in this very initial state. Over the next decade all indicators improved. Still Serbia is ranked in phase 1 with serious tendencies towards phase 2 in 2016. The main driver of the development is the transition towards the European Union. Noticeable is, that the social indicators exceed the profile of 2016. It is mainly higher public awareness and level of involvement. Although juridical and ecological standards improved, they are detected as main challenges also in this period. By implementing actions and policies stated in the waste management strategy 2010-2019Serbia can reach phase 2 ordered landfilling till 2019. The scenario shows an untypical profile as the economic indicators (usual drivers) areshifted behind the other indicators. This can be explained by EU funds, knowledge transfer and adopted best practice examples.

Serbia will manage to stabilize its position in phase 2 in the next decade. Still an economic growth is needed to sustain the development to higher phases. In fact, a stabilized and growing economy is indispensable on the way towards an integrative waste management system. Only with sufficient investments in education and innovation of technologies the situation can be improved. Separate waste collection and connected report duties can be noticed as main action fields for the future. The first sanitations and closing of landfills show their first results with a better assessment in the ecological category.

Table 1: Overview of drivers and weaknesses during the transition of Serbia's waste management from 2006 - 2019

Year	Phase	Main driver	Weakness
2006	Phase 1 *Coverage and disposal*	Economy and social standards	separate waste collection, waste recovery, landfilling and contaminated sites
2016	Phase 1 *Coverage and disposal tendencies towards phase 2*	Transition towards European Union, harmonisation of waste policy	Juridical and ecological indicators
2019	Phase 2 *Ordered landfilling*	EU funds and knowledge transfer	Economic growth, missing investments in education, innovation and technologies

7.Conclusion

The paper on hand analysis the transition of Serbia's waste management from 2006 till 2016 giving a prospectus to 2019. The overall situation of Serbia's waste management system improved in the last decade. For future developments, a balanced mix of top-down and bottom-up approaches is needed to foster this positive trend, i.e. implementation of a new waste policy and awareness building campaigns. Main drivers in the transition of Serbia's waste management system also changed in the last decade. In the recent period its mainly the transition towards the European Union. Financial aid and knowledge transfer represent the main opportunities in this cooperation. The same factors also hold risks by misutilization and privatization of this funds. Therefore, a serious implementation and adequate screening are needed to accomplish the targets set for the near future. Although insufficient sectors are still existing – landfills, waste recovery, data acquisition – Serbia's performance in waste management transition can be evaluated positively in the last decade with positive tendencies in the future.

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