Chapter 2
Territorialising Circularity

Cecilia Furlan, Alexander Wandl, Chiara Cavalieri, and Pablo Muñoz Unceta

Nowadays, the circularity concept dominates the debate on resource management in cities and territories. The idea is often used as a vehicle towards a more sustainable socio-ecological transition, based on the circular economy (CE) framework. Unlike other sustainability frameworks, CE originates in ecological and environmental economics and industrial ecology. It focuses on developing an alternative economic and technological model for production and consumption, avoiding natural resource depletion and redesigning processes and cycles of materials (closed-loops). However, when CE is translated to cities and territories, its environmental, economic and design agency is often neglected. On the one hand, it demands to acknowledge the need for a relational understanding of space, place and actors involved and, on the other, to explore the spatial specificity of CE. Therefore, there is a need for a broader theoretical discourse on the CE's territoriality as the predominant. Research on circular urban and territorial development demands more than merely upscaling industrial ecosystems diagrams and generating circular businesses. Consequently, what is the role of territory in the CE conceptualisation in the urbanism literature?

C. Furlan (✉) · A. Wandl
Department of Urbanism, Faculty of Architecture and the Built Environment, Delft University of Technology, Delft, The Netherlands
e-mail: C.Furlan@tudelft.nl

A. Wandl
e-mail: a.wandl@tudelft.nl

C. Cavalieri
LAB, Research Institute on Landscape, Architecture and Built Environment, Université Catholique de Louvain, Louvain-la-Neuve, Belgium
e-mail: chiara.cavalieri@uclouvain.be

P. M. Unceta
Institute for Advanced Architecture of Catalonia, Barcelona, Spain
e-mail: pablo.munoz@iaac.net

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Therefore, territory, its role and meaning in the CE contribution to urban regeneration is the key focus of this text.

2.1 Introduction

Global economic growth, urbanisation processes and the depletion of natural resources are interrelated systems. Their relationship is grounded by a linear growth model, which transforms resources into waste by reducing values from natural resources and environments (EMF, 2013; van der Leer et al., 2018). However, worldwide there is a recent acknowledgement that this linear way of producing, consuming and disposing of resources is economically, environmentally and socially impracticable. Hence, there is a need to re-plan and deploy new strategies to face this challenge (Turcu & Gillie, 2020). The adoption of a 'circularity' framework is undoubtedly one of such approaches.

Circularity is bound to the circular economy (CE) concept. The CE concept originates in ecological and environmental economics and industrial ecology (Ghisellini et al., 2016). It conceives any waste stream as a resource that can be reused through sharing, reuse, repair or re-cycling (upcycling or downcycling) (EMF, 2013; Marin, 2018).

Despite being an increasingly popular concept among planners and policymakers, the academic and professional debate on CE is only recently emerging within the urbanism field.

According to Turcu and Gillie (2020), how urban design discipline integrates a CE approach in urban and territorial intervention is still unclear, three main streams of criticism emerged. First, most of the understanding is dominated by small-scale economic and technological developments. These developments often stay at the business level, mainly providing end of pipe strategies and solutions, without reflecting on their relations with their surrounding urban environments. Secondly, there is limited knowledge of if and how public administrations, such as municipalities, provinces or regions consider implementing CE strategies at the urban-planning level. Only, little can be drawn from the few well-known examples of Amsterdam, London, Glasgow municipalities, on how to develop policies and governance strategies concretely and on which stakeholders are involved in the process. Thirdly, despite recent academic reflections on the CE, land and territory's role is somewhat absent from the current conceptualisation (Williams, 2019a, 2019b). In this sense the notion of territory as a subject is key: the territory is the space that we live, the way we inhabit its shapes and its dynamics, and ultimately a surface that results from long processes of transformation (Cavalieri & Lanza, 2020). With the long term process of urbanisation, territory increasingly changes its cultural and historical dimension as a subject. It progressively moved from being shapeless technical support, on which placing functions regardless of its form and transformations and ultimately to be administrated despite its ecological framework.

Within this framework, this chapter explores the gap between design thinking and circular economy studies, showcasing how the territorial dimension of circularity may be approached through specific spatial components.

This chapter ultimately aims to reply to two questions, one exploratory and one explanatory:

- What is the role of territory in the CE conceptualisation in the field of urbanism?
- How to interpret territories through the lens of circularity, which tools, methods are needed?

The following text is hence divided into three main sections. Section 2.2 frames the role of territory in the current conceptualisations of a circular approach to waste and resource management in territorial context by examining 29 urban-planning pieces of research on CE. Section 2.3 describes the necessity of representation and the mapping tool to integrate a territorial dimension in the CE debate. Lastly, Sect. 2.4 discloses and discusses a set of mapping operations for the explicit purpose of 'territorialising circularity'. It focuses on the Amsterdam Metropolitan Area (AMA)[1] case study, and it makes use of the tool of 'resource cartographies', a notion that juxtaposes the status quo of flows and stock of a specific flow, namely wood waste, with the territory's ecological and morphological features. This set of cartographic operations allows:

1. to identify alternative images towards the potential CE transition in space;
2. to reframe CE as a multidimensional place-based issue, by the detection of a territorial footprint of waste flows, and by the identification of waste-resource sheds.

Lastly, throughout this reflection and critique, the article ultimately discusses an alternative approach to integrating the territorial dimension in the CE transition.

2.2 Framing the Territorial Dimension in the CE Debate

Nowadays, cities and territories have merged into an original mix in which urban, rural, productive and infrastructural landscapes merge into a complex territorial construction (Cavalieri & Viganò, 2019; Tafuri et al., 1962; Wandl et al., 2014). The contemporary territory is the result of urbanisation processes, one of them the establishment of extensive urban infrastructures. By superseding traditional urban borders and thus embracing regional and national dimensions, the territory suggests a different space of investigation that does not stop at administrative borders but rather follows ecological ones. Defining borders 'i*s perhaps the most instinctive way by which humans have learned to understand the built environment (and also,*

[1] The AMA region consists of the city of Amsterdam, the provinces of North Holland and Flevoland with 36 municipalities, and a population of over 2.4 million inhabitants.

much earlier, natural landscape)' (Habraken, 2000, p. 126). Moreover, a territory is also a geographic and morphological space, a physical collection of qualities and different materials. Lastly, it is a social artefact. Reflecting on the territorial dimension or territorialism of any process means to observe the material nature of a site and simultaneously its appropriation. Moreover, it means to reflect on territory at a high conceptual level as a system of socio-economic and ecological relationships, grounded in a situated reality (Viganò, 2014).

In light of this perspective, reframing the role of territory in CE debates is fundamental. A literature review was used to discuss whether the CE conceptualisation already integrated territorial components. This process highlighted the need to tracing CE theoretical aspects and to track the significant channels of publications. A literature search was conducted using the keywords *circular economy*, *land* and *territory* simultaneously on titles or abstracts of journal articles, books and book chapters published between 2016 and 2020 (January 31st). Following the method adopted by Korhonen et al. (2018), we used the Web of Science (WOS) database. The reasons to follow this method are fourfold:

1. WOS provided a scientifically reliable and recognised search method,
2. WOS gave the authors the possibility to search and filter the findings using several bibliographic parameters,
3. WOS provided suitable navigation possibilities and institutional access to the full texts of the examined papers,
4. despite the limitations of using a single database, the WOS method offered sufficient coverage for our purpose.

Through WOS, we obtained 108 entries in English, of which only 29 papers were scientifically relevant for discussing the actual concept of CE in cities and territories. The selected articles were manually checked. Table 2.1 provides a summary of the identified documents.

The analysis shows that the papers on CE are mainly published in journals in the category of green, sustainable and science technology fields. Urban and planning articles follow this trend, indicating the first attempts to integrate the CE concept in the planning debate. However, they mostly stay on a theoretical level of discussion. Two-third of the total reviewed articles, observe circularity either through existing tools and methods or through case study analysis. In contrast, five papers propose the development of new urban design tools. For instance, Marin and De Meulder (2018) claim the necessity of developing new design tools, as systemic sections and resource maps. These instruments aim to better integrate CE in everyday planning landscape and urban design practice, for which the existing system diagrams are insufficient. On the same line, Turcu and Gillie (2020), highlight the weaknesses of CE in the urban-planning governance policies, emphasising the necessity of systematically studying ongoing practices and simultaneously develop alternative tools.

The remaining five papers propose a different conceptualisation of CE by arguing the limitation of the existing conceptualisation and the necessity to consider the space and land's fundamental role. These papers refer to the particular school of thought of Ellen Macarthur Foundation (EMF) and the ReSOLVE concept. By analysing the

Table 2.1 Publications on CE by journal research area

	Title	Authors	Year	Approach to CE	New tool	Concept
1	A Geodesign Decision Support Environment for Integrating Management of Resource Flows in Spatial Planning	Arciniegas, G.; Sileryte, R.; Dabrowski, M.; Wandl, A.; Dukai, B.; Bohnet, M.; Gutsche, J.	2019	resource flow integration within city	x	
2	A perspective on a locally managed decentralized circular economy for waste plastic in developing countries	Joshi, C.; Seay, J.; Banadda, N.	2019	waste/resource management in city		
3	Advancing City Sustainability via Its Systems of Flows: The Urban Metabolism of Birmingham and Its Hinterland	Lee, S. E.; Quinn, A. D.; Rogers, C. D. F.	2016	resource flow integration within city		
4	Beyond Wastescapes: Towards Circular Landscapes. Addressing the Spatial Dimension of Circularity through the Regeneration of Wastescapes	Amenta, L.; van Timmeren, A.	2018	land as support of CE strategies		x
5	Building Sustainable Cities in China: Experience, Challenges, and Prospects	Kang W.; Wang M.; Liu J.; Lv X.; Zhang Y.; Luo D.; Wang D.	2019	CE as sustainability principle, governance		
6	Changes of human time and land use pattern in one mega city's urban metabolism: a multi-scale integrated analysis of Shanghai	Lu, Y.; Geng, Y.; Qian, Y.; Han, W.; McDowall, W.; Bleischwitz, R.	2016	resource flow integration within city	x	
7	Circular cities	Williams, J.	2019a	resource flow integration within city		x
8	Circular Cities: Challenges to Implementing Looping Actions	Williams, J.	2019b	resource flow integration within city		x
9	Circular Cities: Challenges to Implementing Looping Actions	Prendeville, S., Cherim, E., & Bocken, N.	2018	resource flow integration within city		x

(continued)

Table 2.1 (continued)

	Title	Authors	Year	Approach to CE	New tool	Concept
10	Containing urban expansion: Densification vs greenfield development, socio-demographic transformations and the economic crisis in a Southern European City, 2006–2015	Salvati, L.; Lamonica, G.R.	2020	land as support of CE strategies		
11	Facilitating Circular Economy in Urban Planning	Remoy, H.; Wandl, A.; Ceric, D.; van Timmeren, A.	2019	resource flow integration within city		
12	Global urbanization and food production in direct competition for land: Leverage places to mitigate impacts on SDG2 and on the Earth System	Barthel, S.; Isendahl, C.; Vis, B. N.; Drescher, A.; Evans, D. L.; van Timmeren, A.	2019	land as support of CE strategies		
13	Governing the Circular Economy in the City: Local Planning Practice in London	Turcu, C.; Gillie, H.	2020	CE as sustainability principle, governance		x
14	Industrial Symbiosis in Brownfields in Kranj, Slovenia	Cotic, B.	2019	land as support of CE strategies		
15	Infrastructure for China's Ecologically Balanced Civilization	Kennedy, C.; Zhong, M.; Corfee-Morlot, J.	2016	CE as sustainability principle, governance		
16	Material metabolism and lifecycle impact assessment towards sustainable resource management: A case study of the highway infrastructural system in Shandong Peninsula, China	Guo, Z.; Shi, H.; Zhang, P.; Chi, Y.; Feng, A.	2017	resource flow integration within city\ life cycle		
17	Planning, transformation and development of resource based industrial cities	Pang, M.	2017	land as support of CE strategies		

(continued)

Table 2.1 (continued)

	Title	Authors	Year	Approach to CE	New tool	Concept
18	Proposal of a dynamic model to evaluate public policies for the circular economy: Scenarios applied to the municipality of Curitiba	da Silva, C. L.	2018	waste/resource management in city		
19	Quantifying and mapping embodied environmental requirements of urban building stocks	Stephan, A.; Athanassiadis, A.	2017	resource flow integration within city	x	
20	Regional spatial planning, government and governance as a recipe for sustainable development?	Frank, A.; Marsden, T.	2016	resource flow integration within city	x	
21	Reliability and economic analysis of moving towards wastes to energy recovery based waste less sustainable society in Bangladesh: The case of commercial capital city Chittagong	Islam, K. M. N.; Jashimuddin, M.	2017	waste/resource management in city		
22	Reuse of Waste from the Perspective of Circular Economy	Liu Y.; Zhang S.	2018	land as support of CE strategies		
23	Securing a port's future through Circular Economy: Experiences from the Port of Gavle in contributing to sustainability	Carpenter, A.; Lozano, R.; Sammalisto, K.; Astner, L.	2018	land as support of CE strategies		
24	Social-Ecological-Technical systems in urban planning for a circular economy: an opportunity for horizontal integration	van der Leer, J.; van Timmeren, A.; Wandl, A.	2018	resource flow integration within city		x
25	Solid Waste Management in Ho Chi Minh City, Vietnam: Moving towards a Circular Economy?	Schneider, P.; Anh, L.H.; Wagner, J.; Reichenbach, J.; Hebner, A.	2017	waste management in city		
26	The Circular Economy Concept in Design Education: Enhancing Understanding and Innovation by Means of Situated Learning	Wandl, A.; Balz, V.; Qu, L.; Furlan, C.; Arciniegas, G.; Hackauf, U.	2019	resource flow integration within city		

(continued)

Table 2.1 (continued)

	Title	Authors	Year	Approach to CE	New tool	Concept
27	The imperative for regenerative agriculture	Rhodes, C. J.	2017	land as support of CE strategies		
28	The role of urban agriculture for the governance of high natural values areas. New models for the city of Turin CollinaPo	Genovese, D.; Battisti, L.; Ostellino, I.; Larcher, F.; Battaglini, L. M.	2017	waste/resource management in city		
29	Urban landscape design exercises in urban metabolism: reconnecting with Central Limburg's regenerative resource landscape	Marin, J.; de Meulder, B.	2018	resource flow integration within city	x	x

ReSOLVE framework, Williams (2019a, 2019b) argues that this approach is inadequate when applied to cities, because cities and territories are complex ecosystems, and cannot be simplified as economic structures. Moreover, she observed that land and infrastructure should also be considered scarce resources and directly included in the well-known EMF butterfly scheme. Recognising that cities and territories are constantly adapting complex systems and that the physical structures are artefacts resulting from past interaction of multiple relational systems also influence future systemic relations. Therefore, planning needs to recognise the fundamental role of scales and locations of CE to provide structural continuity and systemic flexibility, for a future economic system, with a still unknown territorial morphology.

Following the same line, Prendeville et al. (2018) list several limitations of current circular approaches to cities including the predominantly focus on small-scale business-oriented economic activities; the limited reflection upon flow dynamics in cities; the absence of going beyond the administrative cities boundaries; and the scarcity of place-specific observations.

In general, the literature review highlights that the territorial dimension in CE debates is still minimal and marginal compared to the technological and economic discussion on the topic. Although territorial dynamics are slightly described, ecologies of infrastructures and territorial morphology are not taken into consideration. The metabolism of cities and regions is only observed within administrative boundaries. Municipal, regional and national boundaries constitute the limits of investigation in each of the seven papers discussing circularity through a case study approach.

Often, territories are considered merely support for allocating products and functions (Wandl et al., 2019). This approach overlooks their intrinsic spatial and physical characteristics, as well as their mutability through time. Territories are therefore not considered resources, but a background where activities take place.

In conclusion, one crucial observation emerges from these criticisms. The studies above acknowledge the gap between CE conceptualisations and implementation, underlining the absence of integration of space, land and territories in CE outline. As Korhonen and colleagues (2018) suggest, there is a need for a new paradigm concerning norms, values and tools. According to this, urbanism requires a reinvention of design investigation instruments that supports new ways of looking at the territory. For this purpose, in the next sections, this chapter approaches the territory as a system of stocks and flows of resources, through the reinterpretation of classical cartographic representations.

2.3 The Necessity of Representation: Towards Spatialising and Contextualising Circularity

If the previous section of this text articulates the need to integrate more territorial perspectives on circularity, section three focuses on the tools of the abovementioned integration: positioning the necessity of representation central.

In other words, this section illustrates and discusses the agency (Corner, 1999) and the capacity of mapping as a research tool. Thereby in complementing and integrating the CE approaches based on numbers-driven economies and technologies as drivers for building circularity in urban territories. The question of representing territories within a CE urbanism framework, that is to say of territorialising circularity, discloses three levels of reflection: that of adequately framing the object of analysis, that of translating flows into space, and ultimately that of activating the different roles of cartography.

First of all, the territorial lens calls for a close reading of urban contexts going beyond the more traditional limits imposed by data-driven analysis. If numerical operations are based upon an understanding of cities as administratively bordered surfaces, within the urbanism field, cities and territories are framed by a different unit of analysis, such as geographical, ecological or morphological units. As it is evident, administrative borders are tied to an undeniable necessity and hence availability of data, including resource and waste management information; however, a territorial approach forces to inscribe the unity of analysis within a larger, and more complex footprint.

Secondly, the method of using cartographies as research tools—mapping operations—calls for reflecting on the diverse role that cartographies can assume in the process of knowledge construction. In the language of architects and urbanists, mapping means at the same time recording, retracing and processing, whereas these operations are not always performed in chronological order. According to Friendly and Palsky (2007), we can distinguish three functional roles for cartographies: exploration, analysis and presentation. The work of the following paragraphs make use of a set of cartographies that responds to this threefold structure, where: exploratory maps refer to the idea of revealing the pattern of qualitative or quantitative information otherwise invisible on the ground; analytical maps respond more to operations such as selecting, synthesising, combining and processing existing features; and ultimately presentation maps are driven by the idea of visualising findings.

Thirdly and most evidently, the notion of territorialising circularity highlights the projective focus of this work: representing dynamics, and drawing geographies that vary in space and time. The following paragraph (4) addresses the often formulated gap, that cities and urban areas are considered '*as metabolic black holes embedded in a functionally subordinate territory*' (Vandenbroek & Dehaene, 2013, p. 5) and therefore, often represented—although not spatialised—as a system of inputs and outputs.

2.4 Resource Cartographies: The AMA Case-Study

This section showcases how to 'territorialise circularity' via four mapping operations. A set of maps highlights specific spatial components that are relevant to the definition of wood waste flows in the AMA under a circular economy approach.

Building upon the definition of resource cartography of Marin (2018), the objective of the mapping exercise is to visually identify the territorial dimension of one specific waste flow, namely wood, and its material stock. By overlapping waste flow data of economic activities, with urban tissues and infrastructures in a map, the exercise discloses the potential to geographically locate future wood resources and stocks from wood wasted material. The final result is four diachronic cartographies (Figs. 2.1 and 2.2), one per each operation.

2.4.1 Mapping the Flow

There were 15ktons of wood waste produced, processed and treated in the AMA in 2016 (Geldermans, 2020). Through the first mapping operation (Fig. 2.1) wood waste flows are mapped according to a methodology called Activity-based Spatial Material Flow Analysis (AS-MFA) (Furlan et al., 2020; Geldermans et al., 2019). Under this method, lines represent flows of wood waste between geographically located actors. The width of the lines is relative to the volume of wood waste. The identification of actors follows the *Activités Économiques dans la Communauté Européene* (NACE) categorisation.

The map (Fig. 2.1 top part) visualises a network space much larger than the AMA extended across the entire country and even beyond, questioning if administrative boundaries are the correct parameter for understanding and analysing waste movement. However, the image presents two main limitations: waste flows are represented abstractly, detached from the surrounding environment, and overlooking potential physical interrelations between them.

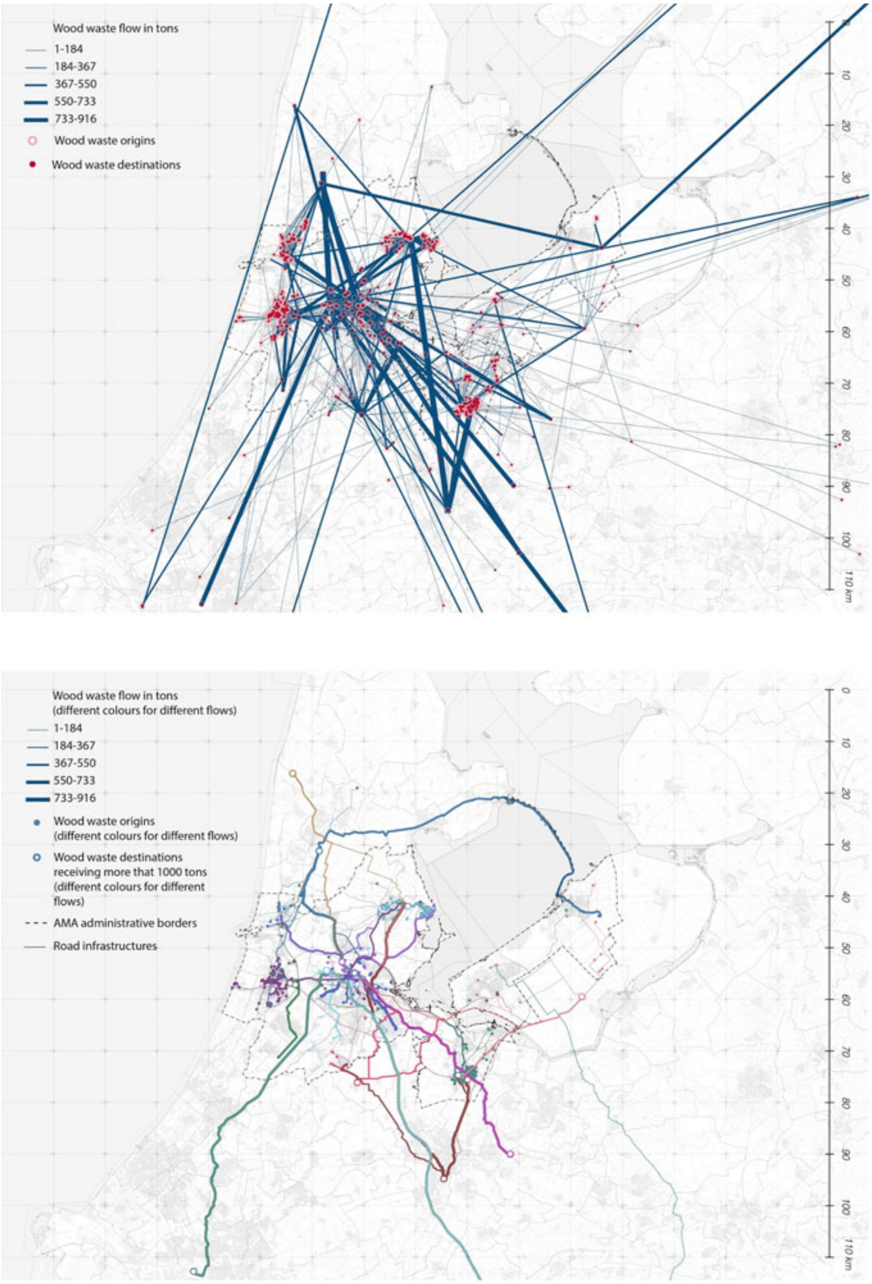

Fig. 2.1 Top: Wood waste flows. Wood waste flows from and to the AMA are represented according to AS-MFA, including origin and destinations; Bottom: Wood waste flows on the road network. Wood waste flows are selected by destinations that received more than 1000 tons of discarded wood material. Flows are represented on the road infrastructure, according to the shortest routes between each origin and destination

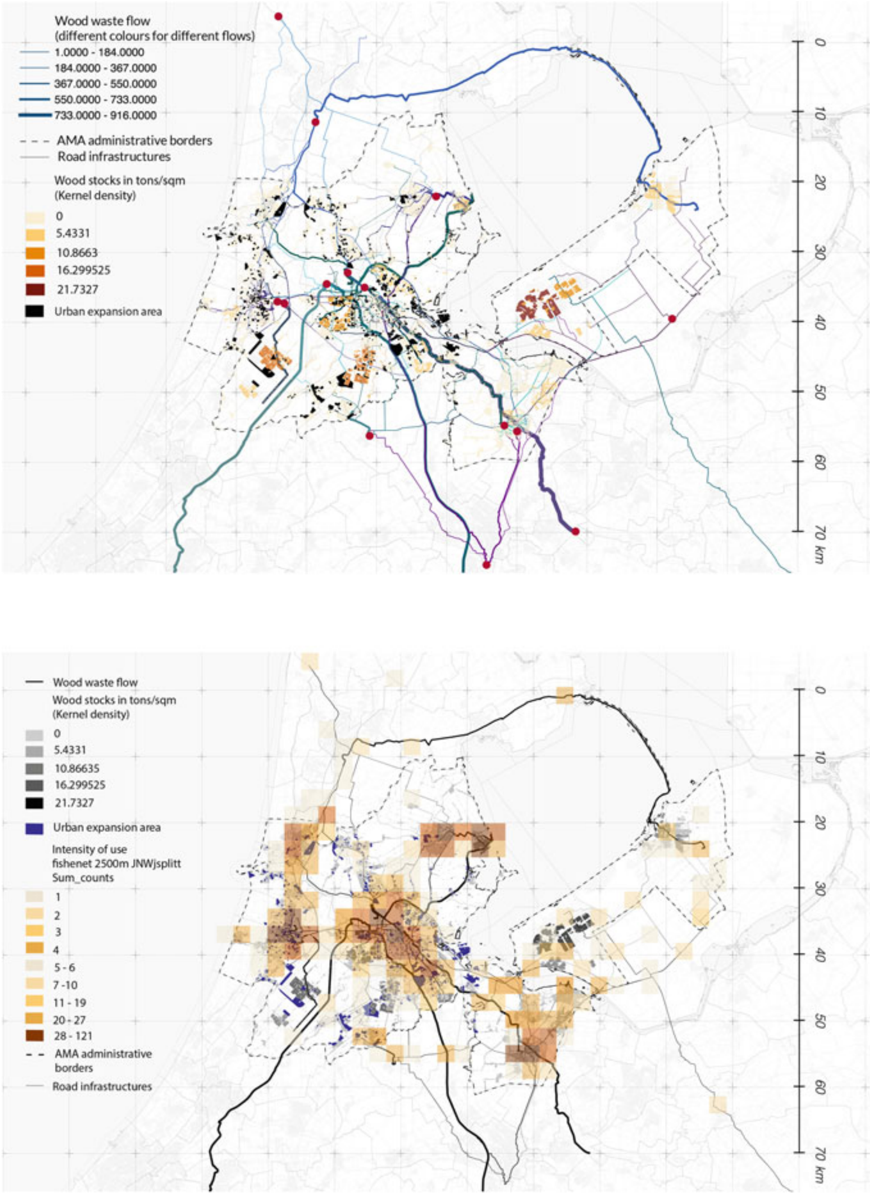

Fig. 2.2 Current wood waste flows and projected origins and destinations. Wood waste flows are represented as in Fig. 2.1-bottom. The existing stock of wood is represented according to the urban mining analysis, and the future building expansion areas are added. Bottom: Map of resource sheds referring in particular to the observation wood material in the AMA. The intensity of the road network's intensity is calculated according to the number of current intersections of flows. The resulting image is juxtaposed on Fig. 2.2-top

2.4.2 Justaxposing Flow and Infrastructural Network

To overcome the limitation mentioned above, this second operation aims at territorialising wood waste flows on the road infrastructure network.

Firstly, assuming that the totality of wood waste in the AMA is transported on roads, wood waste flows were selected according to destinations that received more than 1000 tons of discarded material. The resulting 16 paths were identified by hypothetically selecting the shortest road routes connecting the origin and the destination of each waste flow. Distinctive colours represent the flows to each destination, while the differences in line thicknesses indicate precise ranges of amount of waste, as reported in the legend (Fig. 2.1 bottom part).

This cartographic operation allows understanding on which territorial portions, landscapes, and cities the selected flows intersect. In particular, the map showcases the most used infrastructures, the most pertinent destinations to process and treat wood waste, providing a theoretical understanding of each destination's areas of influence. However, this mapping process highlights two additional limitations of the current approach aiming at including a territorial perspective in CE. The first constraint refers to a structural choice of the AS-MFA method, which considers the location of waste flow origins and destinations only based on economic identification (e.g. the company's headquarters). Therefore, where the waste is produced, processed and treated might not correspond exactly with the mapped points, generating possible misleads on the streams' spatial trajectories of the streams and consequently on the interpretation of the flow basins. Secondly, nowadays there is no interconnection between the use of infrastructure, the points where the waste is treated and the future location where the recycled wood could be used. If streams are dynamic elements that change in time, the process of territorialisation should include a projective dimension that refers to the future origins or destinations of flows.

2.4.3 Unfolding Stock and Flow Relationship

Under a circular approach, demolition and disassembly materials (rather than future construction and demolition materials) can be considered as future wood stocks. These stocks represent materials that can be capitalised in the coming years. The current wood stock can be thus unlocked as an 'urban mine'. Within the Amsterdam case, the notion of 'urban mining' has been integrated into new policy strategies and explorative studies, against the backdrop of regional CE ambitions. Wood materials currently locked inside the built stock of the AMA are approximately equal to 9,000 ktons (Geldermans, 2020).

The third mapping operation (Fig. 2.2, top) aims at introducing a projective dimension by overlapping the trajectories of wood waste movements defined in Fig. 2.2 with the wood materials currently 'in stock' i.e. locked inside the built fabric of the AMA and their potential future destinations.

The method adopted to calculate and map the wood stock is presented and described in the Addendum to the Deliverable 3.3 of the REPAiR project, produced in co-development by the building inspection company SGS Search and the sustainability consultant Metabolic. The method is based on an estimation of the proportions of different building materials according to six building types—'row-houses', 'semi-detached houses', 'apartments', 'free-standing houses', 'offices' and 'other utility'. Buildings in the AMA are then classified under each type and stocks are calculated according to building sizes, using the Dutch Key Register for Addresses and Buildings (BAG). The BAG includes the georeferenced polygons of all buildings, their respective size, how many accommodations (Dutch: 'verblijfsfunctie') are situated within one building, and what is the usage function (Dutch: 'gebruiksfunctie') of each building (Geldermans et al., 2019).

From the 9,000 Ktons of wood stock inside the AMA's built stock, this article only considers buildings constructed after 1945, excluding most heritage structures in the area. In contrast to the use of economic activities, considering wood stocks as potential future origins for the wood waste flows adds a spatial layer to the definition of flow origins, overcoming the potential constraints of economic identification of activities in the AS-MFA method. Under this same rationale, this mapping operation (Fig. 2.2 top part) considers future urban expansion areas in the North Holland Province as potential destinations of the wood waste flows. For the scope of this text and in a circular perspective, the latter represent where the processed wood waste could be redirected, reused and recycled in the construction sector.

In conclusion, this third mapping operation (Fig. 2.2 top part) outlines new spatial relationships, in which business activities, infrastructures, urban conditions and future urbanisation tendencies are brought into proximity within a given geography.

2.4.4 A Circular Stock and Flow Relationship: Defining Resource Shed

Following Marin (2018), the new spatial interrelations described in 4.3 are named as resource shed. Sheds are considered '*geographies within which elements of a specific system retain a high degree of interrelation and interdipendness*' (Thün et al., 2015, p. 31). Similar to watersheds collecting water from a geographical area into the same river or water basin, under a CE perspective, sheds collect potential future waste material that could be processed and redistributed through existing activities and infrastructures as raw material for another application.

The identification of resource sheds adds a spatial layer to an economy-oriented model, usually defined through technical, statistical and organisational factors:

1. By displaying alternative synergies at different spatial levels, resource sheds help identify the optimal operation scale to develop circular strategies.

2. By going beyond administrative borders, resource sheds primarily consider the interrelations between elements in space, i.e. waste flows, in this case, rather than political boundaries.
3. Resource sheds are shaped by variables related to current and potential future interrelations and, therefore, include the temporal perspective.
4. Resource sheds enquire the current definition of economies of scale, in which the cost advantages that enterprises could obtain are only due to their scale of operation (typically measured by the amount of output produced), with cost per unit of output decreasing with increasing scale.

The cartographic representation in Fig. 2.2 (top part) combines linear elements (wood waste flows sorted by destination) with polygons (potential stocks and expansion areas). Nevertheless, current linear flows may change in time. It might, thus, be more relevant to consider their current effects rather than their current paths.

In the fourth mapping operation (Fig. 2.2, bottom part), linear elements representing flows are replaced by the intensity of use of the infrastructural network. The spatial analysis carried out in the last operation provides insights into how a spatial approach could be used in the delimitation of a resource shed. By analysing the intensity of use of the network, specific areas of the territory and their related elements already become differentiated geographies.

The intensity of use of the network is calculated according to the amount of current intersected flows. A grid is used to display the areas where there are additional intersections. In the bottom part of Fig. 2.2, the colour gradation of the tiles corresponds to the intensity of use of the network by current wood waste flows.

The analysis of the lower part of Fig. 2.2 identifies three different types of resource sheds within the AMA:

(a) Firstly, areas like Amsterdam water banks close to Westpoort or cities like Haarlem in the West show a high intensity of use of the infrastructure network as well as a high potential wood stock. Furthermore, the map indicates expansion areas scattered in the regions of Haarlem and Westpoort. This configuration shows potential for these areas to be redefined as resource sheds, by connecting stock, flows and expansion areas at the local scale.
(b) Secondly, areas like Purmerend in the North display a high intensity of use of the infrastructure, a low to medium level of wood stocks and very few expansion areas. In this case, the definition of a resource shed would imply a more detailed evaluation of the stock amount and the definition of new destinations for it. Therefore, the shape and dimension of resource sheds may change according to the inclusion of future materials' origins and destinations beyond the local scale.
(c) Lastly, areas in the east, such as Lelystad or Almere, show a low intensity of use of the infrastructure but a high potential of wood stock. Potential new wood waste destinations in new expansion areas are far from these areas, often across the water. In this case, the definition of resource sheds and a low-intensity use of infrastructures highlight the necessity of considering alternative modes of transport on water, even going beyond the AMA's administrative borders.

These three examples of resource shed's definition illustrate how overlapping in a visual form essential layers of spatial information provides alternative insights to envision new CE coalition and strategies for business companies, urban designers and policymakers.

2.5 Reflection and Conclusion

This chapter unfolds how a place-based analysis of waste flows, and its interrelation with the infrastructural network offers a potential lens to reinterpret the territory under a CE approach.

The literature review in Sects. 2.1 and 2.2 highlights how CE research in urban planning mainly focuses on circular business and indicators, whereas broader socio-ecological and spatial contexts are rarely part of the reflection. Nevertheless, CE is taking place in specific spaces and regions. Consequently, there is a need for understanding the territorial aspect of circularity.

Sections 2.3 and 2.4 discussed a mapping approach to fulfil this necessity. It presents a preliminary method to intertwine material streams, namely wood waste, in the specific territorial and infrastructural context of the AMA. In the AMA study, the provided mapping approach functioned as an analytical and projective instrument towards identifying waste-material flows and the optimal scale in which to develop context-specific circular strategies. Following Marin's (2018) reflection, maps, here named resource cartographies, are optical instruments, synthesising on paper existing dynamics and highlighting future potentialities to explore place-specific transitions to CE and context embedded alternative circular futures. The AMA resource cartographies highlight three main results:

- Waste flow movements exceed the AMA administrative boundaries.
- The visual analysis of waste flows origin, destination and material stock displays alternative synergies at a different spatial level.
- The definition of resource sheds helps to identify the optimal operation scale in which to develop circular strategies.

Unlike other traditional planning policies defining comprehensive regulations, and business-oriented solutions, resource cartographies highlight the essential elements in space, designing and speculating alternative economic-environmental coalition. Moreover, the tool of mapping reframes circularity also as a spatial, territorial issue, addressing interdependencies between urbanisation, resources flows including waste and.

The process of territorialising circularity can act as a medium to imagine alternative futures, to mediate between academic discourse, design and economic oriented and planning policies.

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