

CARPOOLING AND TRANSPORT EXCLUSION IN BÉKÉS MEGYE: ENHANCING TRANSPORT ACCESSIBILITY THROUGH INNOVATIVE PRACTICES

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Abstract – The research article examines the challenges of transport exclusion in Békés Megye region in Hungary and explores the potential of carpooling as an innovative solution to enhance transport accessibility in the region. It investigates the factors contributing to transport exclusion, assesses the feasibility and benefits of carpooling initiatives, and provides evidence-based recommendations for policymakers and transportation authorities. Rural areas out of the main roads especially remote single housing unit called tanya-settlements (hamlets) are the least connected to the local centers, are the most exposed on the transport exclusion consequences. The gaps in the accessibility to the mobility which bus, train, city transport networks, same as the diffused modes of transport such as bikes and electric scooters and incentives of Magyar Falu Program & Falubusz are not able to cover by providing a quality service to all the population. Therefore, the alternative carpooling solutions such as Demand-Responsive Transport, Institutionalized carpooling integrated within public transport system and Ridesourcing were tested. Those carpooling based solutions are compared by features regarding to characteristics and needs of tanya-settlements such as costs, reliability, ease to find drivers, accessibility, and adaptation to special mobility needs.

Key words – transport exclusion in remote areas, carpooling, transport accessibility in rural areas, Bekes Megye, tanya-settlements

JEL Classification – O18, R41, R42, R51

INTRODUCTION

Békés Megye, situated in the southeastern part of Hungary has a public transportation system that plays a pivotal role in providing mobility to its inhabitants and fostering economic and social activities. The development of an effective public transport system in Békés Megye is a multifaceted endeavor that requires a deep understanding of the region's unique characteristics. Békés Megye is marked by diverse geographic, demographic, economic, and social factors that significantly influence the accessibility and mobility of its residents. Békés Megye is primarily a rural region with expansive agricultural landscapes, villages with buildings closely packed together, and dispersed Tanya-type settlements. Its geography, intersected by rivers and characterized by varying population densities, poses both challenges and opportunities for transportation planning. Population distribution in Békés Megye is heterogeneous, ranging from densely populated urban centers to sparsely inhabited Tanya-type settlements. An aging population and varying needs among different age groups underscore the necessity for tailored transport solutions. Agriculture forms the economic backbone, influencing settlement patterns and transportation requirements. While agricultural activities are widespread, industrial centers are limited, impacting employment opportunities and commuting demands. Social cohesion and community ties are prominent features, especially in rural areas. Access to education, healthcare, and communal facilities is vital for residents, emphasizing the role of transport in ensuring social inclusivity.

It is possible to differentiate three main types of settlements with specific features requiring different

approaches providing mobility to its inhabitants and visitors:

- Tanya-Type Settlements: dispersed agricultural settlements, lacking extensive infrastructure, particularly vulnerable to transport exclusion.
- Villages: each with its unique transportation needs, depending on its proximity to urban centers and local facilities, usually with closely packed buildings and fields surrounding the inhabited area.
- Towns: serving as economic and social hubs, face challenges related to urban congestion and the need for efficient public transit systems.

In Békés Megye, the diversity of settlement types presents varying challenges and opportunities in terms of mobility accessibility. Urban centers like Békéscsaba benefit from extensive rail and bus systems, ensuring a high level of connectivity and mobility options for residents. Villages, although not as well-equipped as towns, are served by regional or agglomeration bus systems, linking them to nearby urban hubs and facilitating essential travel needs. However, the unique challenge lies in the tanya-type settlements, remote agricultural areas often excluded from comprehensive public transport services. The absence of regular bus services in these regions creates a significant barrier, leading to transport-related social exclusion. Residents in tanya-settlements, especially those without private vehicles, face difficulties accessing vital services, employment opportunities, and educational facilities. Addressing this issue necessitates innovative solutions, such as community-driven transport initiatives, enhanced road infrastructure, or on-demand transit services, to bridge the mobility gap and ensure equal access to opportunities for all residents in Békés Megye¹.

1. RESEARCH PLAN

1. Literature Review: Analyzing the current state of knowledge, including aspects of transport exclusion, existing variants of public transport organization were presented through a method of literature analysis and critique.
2. Field Research: Using the method of field analysis, local conditions were identified and correlated with the knowledge base constructed in the first stage. Observational and document analysis methods were employed to identify existing challenges in tanya-type settlements.
3. Verification of Carpooling model in excluded settlements: Utilizing a project procedure based on the research findings, a functional model for car-pooling within public transportation for exploring the possibility of implementing car-pooling services in public transport in areas prone to transportation exclusion.
4. Analysis, Compilation, and Presentation of Results essential for the research were formulated based on the field studies.

2. TRANSPORT-RELATED SOCIAL EXCLUSION

Transport-related social exclusion is a phenomenon in which certain individuals or social groups lack full access to services, the job market, healthcare, education, etc., leading to their inability to participate fully in the economic, political, and cultural life of society [1-3]. This phenomenon impacts the economic and socio-economic structure of the region in which it occurs [4]. The consequences of dysfunctional or lacking public transportation, result in several negative socio-economic phenomena [5-6]. Researchers have observed this phenomenon in non-urban areas typical of rural regions. The consequences of transportation exclusion affect not only passengers but also service providers and recipients, workers, and goods suppliers—all of whom interact mutually [7]. The problem of transportation exclusion in rural areas cannot be solved by providing every citizen access to individual means of transportation. This is because the access roads and parking infrastructure would be overwhelmed, and the problem of transportation exclusion arising from the inefficiency of the public transportation system would be replaced by the problem of transportation exclusion caused by congestion, increased demand for fuel, and vehicles. A limitation on mobility can stem not only from the low frequency of trips but also from their high costs [8]. From the perspective of transportation exclusion issues, free rides reduce the entry threshold for using services while simultaneously easing access to employment, education, and services, thereby minimizing the risk of social exclusion and its consequences for individuals and the communities or society that funds these services.

Transport-related social exclusion in Békés Megye predominantly affects the following social groups:

- Low-Income Families: Individuals and families with limited financial resources often struggle to afford

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personal vehicles or pay for expensive transportation options, making it difficult for them to access employment opportunities and essential services [9-10].

- Elderly Population: Elderly residents, who may no longer be able to drive or prefer not to, can experience isolation [11] and limited access to healthcare and social activities due to transportation challenges [12].
- Youth and Students: Young people and students who rely on public transportation to attend school, college, or vocational training may face difficulties when public transit options are insufficient [8].
- Rural Communities: Residents of remote villages and rural areas are particularly vulnerable to transport-related social exclusion due to limited public transportation services and the necessity of traveling long distances for various needs [13].

This exclusionary phenomenon in Békés Megye is characterized by several factors:

- Limited Public Transportation: In some areas of Békés Megye, particularly rural villages and tanya-settlements, public transportation options are limited or infrequent. This restricts residents' ability to travel conveniently to urban centers for work, education, healthcare, and leisure [14].
- High Dependence on Personal Vehicles: Many individuals and families in Békés Megye heavily rely on personal vehicles for transportation [15]. This dependence can be challenging for those who cannot afford to own or maintain a car, such as low-income families and elderly residents.
- Limited Public Transportation Infrastructure – Inadequate public transportation infrastructure, particularly in rural and remote areas of Békés Megye, is a significant factor contributing to transport exclusion. Some villages may lack access to regular bus or train services, making it difficult for residents to reach essential services and employment centers. As some settlements (especially tanyas) does not have access to the asphalt or paved road.
- Low Population Density – Békés Megye has areas with relatively low population density. Sparse population distribution can lead to reduced demand for public transportation services, making it economically unfeasible to operate frequent routes to these areas [16].
- Inefficient Transportation Routes – Inefficient transportation routes and connections can result in long travel times for residents. The absence of direct routes or convenient transfers between different modes of transportation can discourage individuals from using public transit. Therefore, some of the solutions allowing to reach many tanya-settlements are making potential service more expensive and increasing the overall travel time.
- Economic Constraints – Economic constraints, especially among low-income individuals and families, can restrict access to transportation [9]. The cost of purchasing and maintaining a vehicle, along with fuel and insurance expenses, can place a significant burden on households [17].
- Aging Population – An aging population in some parts of Békés Megye faces transport exclusion due to reduced mobility, limited access to driver's licenses, and challenges associated with using public transportation [12].
- Limited Operating Hours – Reduced operating hours of public transportation services, especially during evenings and weekends, can hinder individuals from accessing social and recreational activities, further contributing to transport exclusion.

Transport-related social exclusion in Békés Megye has significant consequences for both the region and individuals:

- Economic Impact: Limited access to transportation can hinder economic participation and employment opportunities, perpetuating poverty, and economic disparities within the Megye.
- Healthcare Disparities: Lack of access to healthcare services due to transportation limitations can lead to health inequalities and delayed medical treatment, negatively affecting individuals' well-being.
- Educational Barriers: Students who face transportation challenges may struggle to access quality education, limiting their prospects and perpetuating educational inequalities.
- Social Isolation: Socially isolated individuals, including the elderly, may experience loneliness and reduced participation in community life, impacting mental health and overall quality of life.
- Reduced Regional Development: Transport-related social exclusion can impede regional development efforts, as it restricts individuals' ability to contribute to the local economy and community.

Efforts to address transport-related social exclusion in Békés Megye include the development of more accessible public transportation options, the promotion of alternative transportation modes. These measures aim to enhance mobility, reduce disparities, and improve the overall well-being of residents.

3. TRANSPORT SYSTEM IN BÉKÉS MEGYE

Bekes County, located in southeastern Hungary, spanning approximately 5,500 square kilometers, with a population of around 350,000 people, the county's inhabitants are spread across its various towns and villages, contributing to a diverse distribution of transport needs and accessibility challenges.

Public transport in Bekes County primarily serves as a vital link between its urban centers and rural communities. Major towns like Békéscsaba, Gyula and Orosháza act as hubs for both residential and industrial activities, drawing significant commuter traffic. The transport infrastructure connects these hubs with smaller villages, facilitating daily travel for work, education, and commerce.

Industrially, Bekes County is notable for its agricultural production, food processing industries, and manufacturing sectors, influencing the flow of goods and workers across the region. Schools and healthcare facilities are dispersed throughout the county, demanding reliable transport connections to ensure accessibility for residents, particularly in more remote areas.

The county's transport network, comprising bus routes and regional railways, plays a crucial role in meeting these diverse needs. Bus services are pivotal in linking smaller settlements to larger towns, accommodating both local commuting and regional travel. Meanwhile, the railway system, including lines connecting Békéscsaba, and Gyula supports broader mobility and economic activities.

RAILWAY SYSTEM

The train system in Hungary, including Békés Megye, is primarily owned and operated by the Hungarian State Railways (Magyar Államvasutak, MÁV). MÁV is a state-owned company responsible for managing the railway infrastructure and providing passenger and freight services. MÁV oversees the operation and upkeep of the railway infrastructure, including tracks, stations, and signaling systems. Hungarian State Railways (MÁV) is responsible for setting and maintaining train schedules within Békés Megye.

Békéscsaba-Szeged Line:

The railway line connecting Békéscsaba to Szeged is essential for regional travel within Békés Megye. Szeged is a significant city in the southern part of Hungary, and this line ensures efficient transportation between these two urban centers. The line also connects to other towns and villages in the Megye.

Gyula Line:

The Gyula Line provides rail access to Gyula, a historic town and popular tourist destination in Békés Megye. This line is part of the broader regional network and connects Gyula to Békéscsaba and other towns in the region.

Lines to Romanian Border Towns:

Békés Megye shares a border with Romania, and there are train lines that connect several border towns. For example, the line to Lókösháza offers connectivity to the Romanian town of Salonta. These international railway connections facilitate cross-border trade and travel.

Integration of Lines:

The railway lines in Békés Megye are integrated into the broader Hungarian railway network, facilitating seamless travel within the Megye and connecting it to other regions of Hungary. Passengers can easily transfer between different lines at major railway junctions. The main railway lines in Békés Megye serve as vital transportation arteries for both passengers and freight. They enable efficient travel and the movement of goods within the Megye and to major Hungarian cities. Additionally, Békés Megye's railway network connects to international railway lines, fostering trade and transportation links with Romania.

Békés Megye's train system is complemented by an integrated transportation network that includes buses and, to some extent, cycling infrastructure. Buses often provide last-mile connectivity to areas not directly accessible by train. Additionally, the Megye has been developing bike lanes and paths in some urban areas, offering an alternative and eco-friendly mode of transportation that can complement train travel.

Békés Megye a railway network that links it to Hungarian cities and neighboring countries. Although it does not fully electrified, modern, nor the fastest, but are widely used by passengers. The railway network is relatively dense, and most settlements have access to the railway with passenger traffic [18]. Long-distance trains provide efficient connections from Békéscsaba rail hub to Budapest (16 connections) and Szolnok (16 + 3 connections), Szeged (12 connections) and Hódmezővásárhely (12 + 4 connections) and international trains into Romania (in total 10 connections), Arad (3 connections), București (3 connections), Brașov (3 connections),

Salonta and Timișoara (1 connection). The well-developed connection network in almost all directions is making Békéscsaba a transfer center allowing the dwellers from the region to freely exchange continue the travel to West and East. Complementing the long-distance services are local trains that serve as the lifeblood of intra-Megye transportation. These trains ensure that even remote communities within Békés Megye have access to essential services and opportunities in larger towns and cities: Mezőhegyes (12 connections), Vésztő (11 connections), Lőkösháza (6 connections), Kötegyán (next to the Romanian border 4 connections), Orosháza (2 connections) and Mezőtúr (1 connections). In the local rail transport, some of the towns are served both by local, country, and international trains. The local train transport is providing the major settlements in the Békés Megye the connection and accessibility to train services mainly on the pick hours, the number of connections is enough to serve as a demand creation.

Nevertheless, there are the rail connections in between Hungary and Romania, the further development of the cooperation of neighboring states is needed in areas of fares and services, especially regarding the currencies and language, which may enhance the economic and social development of the regions [19]. One of the key problems is lack of integration and in effect a competition between bus and railway systems. As these subsectors are competing instead of complementing themselves [20].

BUSES

In Békéscsaba and its agglomeration, regional bus transport, long-distance bus services, and rail transport are integrated within Volánbusz, the state-owned bus company in Hungary. Volánbusz operates as an umbrella organization overseeing various forms of public transportation in the Békés region. Volánbusz manages the local and agglomeration bus routes within Békéscsaba, Gyula. These routes cover the city and its surrounding areas. Volánbusz operates regional bus services connecting Békéscsaba to other towns and villages within Békés Megye. These regional routes facilitate travel between different settlements. Volánbusz operates long-distance bus services that connect Békéscsaba to other cities and regions in Hungary. The bus transport is operating solely by Volánbusz since the presence of other market participants is symbolic [21]. While Volánbusz primarily deals with buses, rail transport within Békés Megye is also coordinated to some extent. The integration involves ensuring that bus and rail schedules are complementary, allowing passengers to transfer between bus and train services. While rail transport is operated by Hungarian State Railways (MÁV). Ticketing system in between municipal and regional bus lines is integrated, and it is possible to acquire a ticket for both regional and municipal buses.

In Békéscsaba, there are several local bus routes that roughly cover the entire city area. However, from the analyses of the schedule it is possible to assume that there are some with inadequate frequency of connections. Most buses depart from the bus station (which is connected and integrated with the MÁV railway station), and major stops include Andrássy Gimnázium, Malom tér, Petőfi liget-Jókai utca, Szabadság tér, and Szeberényi tér. Due to the city's geographical layout and low population density, it's challenging to operate efficient public transportation in Békéscsaba. The city covers a large area with relatively low population density, requiring the maintenance of several routes with low demand on public transport. Additionally, the railway line that cuts through the city hampers effective public transport. Jaminai neighborhood (Erzsébethely) can only be accessed via two overpasses and one underpass which is not accessible by high vehicles. In Gyula there are two municipal lines going around the town and heading to Ajtósfalva and Dénesmajor. In Békés there are three municipal lines within the town. In Gyomaendrőd there is no municipal transportation, but the regional buses are operating with extended bus stops performing the functions of the municipal transport. In Mezőberény there are three municipal lines operating within the town. In Orosháza there are seven municipal lines operating, but the regional buses are playing an important role the local transportation within the city.

The regional bus network covers the entire country, including both urban and rural areas. However, there are some settlements, particularly in remote areas, where service is not provided or is provided at minimal level. Nevertheless, there are the housing units and settlements where the regional bus service is not provided or provided at minimal level:

- Small settlements: Volánbusz typically does not provide service to settlements with small number of inhabitants.
- Remote areas: Volánbusz may not provide service to settlements that are in remote areas, like puszta, swamps or tanyas on the fields.
- Settlements with low demand: Volánbusz may reduce or eliminate service to settlements where there is low demand for bus transportation.

Carpooling and transport exclusion in Békés Megye: enhancing transport ...

In addition to these types of settlements, there are some settlements where the regional bus service is not provided or is provided at minimal level due to other factors, such as poor road conditions or budget constraints.

The regional public bus transport system in Békés Megye is operated by public Volánbusz company. The administration of regional bus lines in Békés Megye falls under the jurisdiction of local government authorities, including Megye and municipal governments. These authorities oversee the coordination, planning, and regulation of bus routes within their respective areas. The bus lines in Békés Megye are generally integrated into the broader regional and national transportation networks. This integration allows for seamless travel between different modes of public transportation, such as trains and buses, at key transportation hubs. They provide access to employment centers, healthcare facilities, educational institutions, and recreational areas within the Megye. Additionally, some international bus lines connect Békés Megye to neighboring countries, supporting cross-border travel and trade. The international connections may be served by other than Volánbusz bus private companies.

BIKES AND ELECTRIC SCOOTERS

Békés Megye has is perfectly suited for the development of sustainable and eco-friendly transportation options. Environmentally conscious mobility is easily possible to implement through development of the bike infrastructure. Network of bike lanes and paths crisscross may be implemented in urban areas and countryside, offering residents and visitors an alternative means of transportation. Additionally, there are added electric scooter-sharing services into Békéscsaba urban landscape. Electric scooters can provide a convenient and environmentally friendly option for short-distance travel within towns and cities. Riders can easily locate and unlock these scooters using smartphone apps, making them a solution for last-mile transportation. Békés Megye offers favorable conditions for the usage of bikes and electric scooters. Its mild climate, relatively flat terrain, and well-developed road network make it an ideal region for active transportation options like cycling and scooting.

MAGYAR FALU PROGRAM & FALUBUSZ

The Falubusz program, part of Hungary's rural development initiatives, aims to provide essential transportation services to remote villages and hamlets (including tanyas). These specialized buses connect underserved communities, ensuring that the most isolated inhabitants such as disabled people, seniors, small kids, and people with the special needs of areas have access to vital resources and services. The Falubusz part of Magyar Falu Program is an effort to support rural development and enhance transportation access in less densely populated areas as a part of social care programme by providing the municipalities funds for purchasing of the vehicles prepared for serving social excluded groups in places where they cannot access mobility because of their health conditions [22].

The Falubusz program holds immense social importance in Békés Megye and similar rural areas across Hungary. It addresses the critical issue of transport exclusion, ensuring that residents in smaller villages and remote areas have access to healthcare facilities, educational institutions, and employment opportunities. Falubusz programme is aiming to increase the accessibility of small rural areas for the excluded groups. The Falubusz is operating by financing the procurement low-emission 8-seat cars that must be capable of carrying at least one electric wheelchair and equipped with a ramp or lifting device and a 4-point securing system by the self-governments [23]. The self-government may organize the on-demand passenger transport services by purchasing the vehicle and establishing the rules of the service provision:

- area of operation,
- operation hours,
- regular services provision (delivering students to school),
- rules and limitations of providing for the service.

The self-government is responsible for providing:

- fuel costs,
- insurance and maintenance expenses,
- costs related to the vehicle's registration (e.g., technical inspection, registration fee),
- tangible costs related to the proper use of the vehicle (winter/summer tire set, snow chains).

The Falubusz and Magyar Falu Program, specifically in addressing the transportation needs of tanya-settlements. While these initiatives aim to serve excluded groups such as disabled individuals, seniors, and school children, they fall short in providing a comprehensive solution for transport exclusion. This analysis

highlights issues related to accessibility, funding constraints, conflicts between service providers and citizens, legal frameworks, and lack of public awareness, all of which hinder the effectiveness of these programs in promoting inclusive and sustainable transportation in disadvantaged areas.

Falubusz and Magyar Falu Program primarily focus on specific groups, leaving out a significant portion of the population within tanya-settlements. The services fail to satisfy the general transportation needs of residents, forcing them into car ownership or reliance on inefficient, sporadic means of transport. While these programs provide vehicles, the operational costs are not covered. This financial burden often falls on cash-strapped municipalities, limiting the regularity of services. The irregular schedules create inconvenience and unpredictability for residents, diminishing the programs' effectiveness in providing reliable mobility solutions. Budgetary constraints create a conflict between service providers striving to reduce costs and citizens with unmet transportation needs [24]. This conflict hampers the development of a sustainable, widely accessible transportation system within tanya-settlements.

Municipalities dictate the legal framework for these programs, giving service operators significant power in determining the necessity of vehicle usage. This places passengers, especially those from marginalized backgrounds, in a disadvantaged position, making it challenging to advocate for their transportation requirements effectively. One of the critical issues lies in the lack of publicly accessible information regarding the rules and regulations governing the Magyar Falu Program and Falubusz. This low awareness reduces program utilization, as residents are unaware of the services available to them, further exacerbating transport exclusion.

4. CARPOOLING

Carpooling, also known as ride-sharing, can be defined as the shared use of a vehicle by a driver and passenger [25]. Carpooling can be seen as a system that connects passengers with drivers through automated processes [26]. Recognizing the importance of sustainable and cost-effective transportation options, carpooling initiatives allow residents to share rides, reducing the strain on individual resources and contributing to a more environmentally friendly transportation landscape [27]. These initiatives offer an opportunity to address transport exclusion and promote community engagement.

Carpooling has gained popularity as an effective means of reducing transportation costs, alleviating traffic congestion, and promoting more sustainable travel options. Commuters form carpooling groups with colleagues or neighbors who share similar routes, allowing them to save money on fuel and reduce the number of vehicles on the road [28]. Carpooling is also utilized for long-distance travel between cities or regions. This approach enables travelers to share the costs and make use of available space in private vehicles allowing access to mobility on the feeder lines [29].

Various ridesharing platforms and mobile apps have emerged in Hungary to facilitate carpooling. These platforms connect drivers with available seats to passengers seeking rides along the same routes [30]. Examples include BlaBlaCar and Oszkár. BlaBlaCar is one of the most prominent carpooling platforms in Hungary. It connects drivers traveling between cities with passengers looking for rides. Users can specify their departure and arrival points, travel dates, and preferences for carpooling partners. But there were no offers of ride available for Békés Megye. Oszkár is a Hungarian ridesharing platform that connects drivers and passengers for both local and long-distance trips. It offers a variety of options, including ridesharing, bike-sharing, and parcel delivery services. Although service is used to serve all the trips its major user profile is the commuter and driver commuting on long distances, from 500 verified inquires none of them were made in the distance shorter than 10km and from the settlements smaller than town. In addition to dedicated carpooling platforms, many people connected to Békés Megye join Facebook group *Fbook Telekocsi Békéscsaba*. A phenomenon of connecting of popularity feasibility and accessibility made a social media platform one of the most popular marketplace for the mobility services^[31]. It was analyzed where after analysis of the 70 offers none of them was made in the distance shorter than 10km and from the settlements smaller than town.

The popularity of informal carpooling services was not studied in the context of Békés Megye, but according to the literature the existence of transport exclusion phenomenon influences changes in passengers' mobility strategies [32]. One of them could be the increase in the share of individual transportation in the overall number of trips. Another solution might be overcoming mobility constraints through organizing or utilizing informal transport services [33]. The choice of strategy is influenced, among other factors, by the existence of social bonds based on existing contacts and social trust regarding family members and people from the immediate surroundings [32]. The choice of strategy is also related to the cultural conditions of a given community concerning the driver-passenger relationship, impacting:

- Trust,
- Willingness to use informal solutions,
- Safety during the journey [34].

1. Economic Benefits:

- Cost Savings for Participants:

Carpooling practices result in significant cost savings for participants. By sharing the expenses of fuel, maintenance, and tolls, individuals and families can reduce their transportation costs [35], which is particularly beneficial for low-income households.

- Reduced Congestion and Infrastructure Costs:

Carpooling reduces the number of vehicles on the road, leading to decreased traffic congestion on road infrastructure. This translates into cost savings for local governments, as they spend less on road maintenance and repairs.

- Environmental Cost Reduction:

Carpooling initiatives contribute to a reduction in vehicle emissions and air pollution. This leads to health benefits, including lower healthcare costs associated with respiratory illnesses.

- Employment Opportunities:

Improved access to transportation through carpooling can enhance employment opportunities for residents in underserved areas. This can result in increased tax revenue and a more vibrant local economy.

2. Social Benefits:

- Enhanced Mobility and Access:

Carpooling practices significantly enhance mobility and access to essential services [36]. Residents who were previously excluded from accessing healthcare facilities, education, and employment due to transportation barriers can now participate fully in these activities.

- Reduced Social Isolation:

Carpooling initiatives reduce social isolation, particularly among elderly residents who may have limited mobility [37]. They can remain connected to their communities and engage in social activities, leading to improved mental and emotional well-being [38].

- Community Building:

Carpooling fosters a sense of community by encouraging residents to collaborate and share resources. It promotes social interactions, trust, and a sense of belonging among participants.

The implementation of carpooling initiatives in Tanya settlements within Békés Megye holds immense potential for fostering sustainable mobility. By reducing environmental impact, enhancing social connections, providing economic benefits, and addressing challenges through targeted interventions, carpooling can pave the way for a more sustainable future in rural transportation systems in tanya-settlements.

5. CARPOOLING SOLUTION TAILORED FOR TANYAS IN BÉKÉS MEGYE

The potential models for organizing mobility in Tanya-settlements within Békés Megye through carpooling services encompass diverse solutions, each tailored to address specific challenges and opportunities.

DEMAND-RESPONSIVE TRANSPORT (DRT)

The potential model of organizing mobility for Tanya-settlements in Békés Megye through Demand-Responsive Transport (DRT) offers a promising solution to address the unique challenges faced by these communities. By extending the existing Falubusz and Magyar Falu Program, this approach ensures that transport services are universally accessible. DRT operates on a flexible schedule, responding to the specific demands of passengers, making it highly adaptable to the irregular commuting patterns often found in rural areas. This flexibility enhances the overall convenience of the service, catering to the diverse needs of tanya-settlements residents.

Organizing DRT through the budget responsible for the general transport (Volánbusz) is crucial aspect of its viability. Organizer of the regional transport can allow its integration by managing its integration and allocating funds for services. This financial support outside of the municipal budget may allow to focus of the operator on delivering the mobility promoting social equity and inclusivity.

From an economic standpoint, investing in DRT generates a range of benefits. It stimulates the local economy by:

- enhancing mobility,
- enabling residents to access employment opportunities,
- educational institutions, and healthcare facilities.

This increased mobility fosters economic activities within the tanya-settlements, contributing to the growth of local businesses and services. Moreover, DRT has environmental advantages. By reducing the number of individual vehicles on the road, it curtails carbon emissions and minimizes the ecological footprint of transportation in these settlements. This aligns with broader environmental goals, promoting sustainable practices within the region.

In conclusion, the implementation of Demand-Responsive Transport, as an extension of Falubusz and the Magyar Falu Program, stands as a comprehensive and inclusive solution for tanya-settlements in Békés Megye. Its financial accessibility, economic stimulation, environmental sustainability, and social cohesiveness make it a model worth considering transforming the mobility landscape of these unique rural communities.

INSTITUTIONALIZED CARPOOLING INTEGRATED WITHIN PUBLIC TRANSPORT SYSTEM

The prospective model for organizing mobility in tanya-settlements within Békés Megye may focus on the integration of institutionalized carpooling into the existing public transport framework. This approach relies on non-professional drivers who are already commuting for their daily activities, such as work or school. By using these existing travel patterns, the model maximizes the utilization of private vehicles, thereby optimizing resources and reducing the overall environmental impact.

In this system, community members are encouraged to become part-time drivers for the public transport network. These individuals, often residents of the same tanya-settlements, driver (volunteer or paid by the local government as it is done within the Magyar Falu Program) to provide ridesharing services to their neighbors. They operate on predetermined routes and schedules, ensuring that the service is reliable and consistent.

From an economic perspective, this model is utilizing existing private vehicles, therefore significant investments in new transport infrastructure or vehicle fleets are minimized. The costs associated with expanding the public transport network are substantially reduced. Additionally, local governments can provide incentives or subsidies to these community drivers, motivating their participation and ensuring the sustainability of the service. These incentives can come in various forms, such as reduced fuel costs, vehicle maintenance subsidies, or financial incentives.

Socially, this model promotes a sense of community and mutual support. Residents become active participants in enhancing the mobility options within their settlements, fostering a strong sense of belonging and shared responsibility. The elderly, disabled individuals, or those without access to private vehicles benefit significantly from this service. It provides them with a reliable means of transportation, reducing social exclusion and ensuring equal access to essential services, education, and employment opportunities.

Moreover, integrating institutionalized carpooling within the public transport system enhances the overall efficiency of transportation in tanya-settlements. The model supplements existing bus or train services, extending the coverage of public transport to even the most remote areas as it may be a schedule integrated within bus and rail networks.

RIDESOURCING

The other model for organizing mobility in tanya-settlements within Békés Megye may be ridesourcing, offering a flexible and digitalized solution to the mobility challenges faced by these settlements. Ridesourcing refers to a transport service where private individuals use their own vehicles to offer rides to others, facilitated through digital platforms or mobile applications. This model harnesses the power of technology and community collaboration to enhance transportation accessibility and address the unique needs of tanya-settlements.

In this system, residents of tanya-settlements can connect with nearby drivers through a mobile application specifically designed for ridesourcing. Through the app, passengers can request rides, specifying their pick-up and drop-off points within the settlement or to nearby towns or public transport hubs. Simultaneously, local drivers who are willing to offer rides can indicate their availability and routes through the same platform. The key advantages of ridesourcing in tanya-settlements include flexibility, cost-effectiveness, and community engagement. Unlike fixed public transport schedules, ridesourcing allows residents to request rides on-demand, catering to their specific needs and schedules. Moreover, ridesourcing leverages the existing private vehicle pool within the community. Residents who own cars can become part-time drivers, offering rides to their

Carpooling and transport exclusion in Békés Megye: enhancing transport ...

neighbors. From an economic perspective, ridesourcing minimizes the need for significant investments in public transport infrastructure. It operates on a peer-to-peer basis, reducing administrative costs associated with managing a fleet of vehicles. Additionally, ridesourcing platforms can integrate payment systems.

To evaluate the opportunities and limitations of the presented models the five criteria for evaluating different carpooling models in tanya-settlements were used. Criteria were grounded in the multidimensional nature of transportation systems and their impact on communities:

1. **Costs:** Cost is a pivotal factor for both service providers and users. It determines the financial viability of the system and the affordability for passengers, directly affecting its accessibility and popularity. Affordability ensures that a transportation solution is inclusive, catering to a wider demographic and addressing socio-economic disparities in the community.
2. **Reliability:** Reliability ensures that the service is consistent and dependable, crucial for daily commuting, especially for work and education. Unreliable services can disrupt daily routines, impacting on people's employment, education, and overall quality of life.
3. **Ease to Find Drivers:** Availability of drivers influences the convenience of the service. Easy access to drivers (supply) is vital for the system's utilization and overall effectiveness. Difficulty in finding drivers can lead to underutilization of the system, defeating the purpose of enhancing mobility options.
4. **Accessibility:** Accessibility refers to the reach of the service, ensuring that it covers various areas, especially remote or less connected regions. A lack of accessibility can isolate certain communities, limiting their opportunities, social interactions, and access to essential services.
5. **Adaptation to Special Mobility Needs:** Inclusivity is vital, ensuring that individuals with special mobility needs are accommodated, promoting equity in transportation access. Neglecting special mobility needs can create a segregated transport system, excluding a significant portion of the population from essential services.

By evaluating carpooling models based on these criteria, a comprehensive understanding of their effectiveness and potential shortcomings can be gained. This knowledge is essential for policymakers, local authorities, and community leaders to make informed decisions, ensuring that the chosen transportation solution is not only efficient and cost-effective but also socially inclusive, environmentally friendly, and sustainable in the long run. Below there is an evaluation of the three models based on the criteria mentioned above.

1. Costs:

Demand-Responsive Transport: Costly, requiring purchase of vehicles, hiring of drivers, and covering the operation costs. It may operate free of charge for the passengers.

Institutionalized Carpooling within Public Transport: Cost-effective due to utilizing existing transport infrastructure and non-professional drivers. Can be served on the basis of voluntary service or remuneration of costs or payment.

Ridesourcing-based Carpooling: Variable costs, influenced by market dynamics are potentially higher for passengers but can be competitive for short distances. Service is paid by for the passengers.

2. Reliability:

Demand-Responsive Transport: Reliability depends on municipal funding stability; consistent funding ensures regular services.

Institutionalized Carpooling within Public Transport: Dependent on the success of drivers' participation in the incentive. Drivers may exchange with each other but in situation of lack of supply the service may be not served.

Ridesourcing-based Carpooling: Reliability influenced by driver availability and demand, can be less predictable during peak hours. In situations where the driver would have to travel long distances to give a ride, may consider it as not worth it, even if paid.

3. Ease to Find Drivers:

DRT: Drivers are part of organized programs, ensuring availability but may have limited flexibility in schedules.

Institutionalized Carpooling within Public Transport: Utilizes non-professional drivers already commuting, if successful in recruitment of drivers, it will ensure a consistent pool of drivers.

Ridesourcing-based Carpooling: Easy to find drivers through digital platforms, offering flexibility but might face scarcity in tanya-settlements, which may consequence on the long waiting time or limited availability.

4. Accessibility:

DRT: Widely accessible if funded adequately, ensuring coverage for remote areas, the system organizer is deciding on the scale and range of the service.

Institutionalized Carpooling within Public Transport: Accessible only for the passengers whose transport needs are compatible with the schedules and destinations of the drivers.

Ridesourcing-based Carpooling: Accessible through smartphone apps, might exclude those without smartphones or internet access. The accessibility may drop during the peak hours and days of high demand for ridesourcing services.

5. Adaptation to Special Mobility Needs:

DRT Extension: Adapted to special mobility needs by providing proper vehicles with the framework of Falubusz.

Institutionalized Carpooling within Public Transport: Public transport infrastructure may need retrofitting for accessibility; might face challenges for passengers with special mobility needs.

Ridesourcing-based Carpooling: Limited adaptation might not be suitable for passengers with special mobility needs without specialized services.

CONCLUSIONS

The research on transport exclusion in Békés Megye's tanya-settlements showed the critical importance of reevaluating existing mobility paradigms on mobility for the specific settlement types. Transport exclusion has profound consequences as a barrier to economic participation, limits access to essential services, and it fosters social isolation. Analysis of the challenges for mobility in tanya-settlements shows that the outdated industrial economy-driven approach to mobility is insufficient to meet the diverse needs of tanya-type settlements residents.

In response to these challenges, this study advocates the consideration for further study of three innovative carpooling models for tanya-settlements:

1. Demand-Responsive Transport: as an extension of the Falubusz and Magyar Falu Program, offers an inclusive approach. By making services universally available and financing them through municipal budgets, it eliminates financial barriers. This approach ensures mobility for all residents, fostering economic activities and community engagement.
2. Institutionalized Carpooling within Public Transport System: Integrating carpooling within the existing public transport system by employing non-professional drivers, such as those commuting to work or school, represents a community-centric solution. It optimizes existing resources within the community, promoting cost-effectiveness and sustainability. This approach not only enhances mobility but also strengthens social ties within the community.
3. Ridesourcing-based Carpooling: Leveraging digital platforms for ridesourcing introduces flexibility and convenience. By connecting local drivers with passengers through digital means, this model facilitates on-demand shared transportation. This approach aligns with contemporary digital trends, enhancing accessibility and convenience for tanya-settlement residents.

In conclusion, the adoption of innovative carpooling models offers a possible transformative pathway toward mitigating transport exclusion in tanya-settlements. Beyond mobility, these models empower residents, ensuring their active participation in economic, social, and cultural spheres. It is imperative for local authorities and policymakers to prioritize these models, ensuring the holistic development of rural communities. By fostering enhanced mobility, these initiatives not only bridge the existing gaps but also pave the way for inclusive, sustainable, and vibrant tanya-settlements in Békés Megye.

In evaluating the carpooling models based on various critical criteria, a comprehensive perspective emerges. Institutionalized Carpooling within Public Transport offers a financially viable solution, ensuring affordability for passengers and the feasibility of implementation for municipalities. For reliability Demand-responsive transport, as an extension of Falubusz and Magyar Falu Program, offers a most stable and professional service, additionally, integration within an established system enhances dependability, ensuring consistent service for passengers. When it comes to the ease of finding drivers, carpooling is based on ridesourcing excels. Utilizing ridesourcing platforms makes it convenient for both drivers and passengers to connect, ensuring the availability of rides. In terms of accessibility, demand-responsive transport extended through existing public transport infrastructure is best suited for ensuring connectivity even in remote settlements but only if the proper funding is secured. Regarding the adaptation to special mobility needs, the demand-responsive transport, extended through Falubusz and Magyar Falu Program, is best suited for ensuring by providing the

vehicles adapted for serving all passengers. Lastly, for sustainability, carpooling based on ridesourcing, especially is likely the most eco-conscious option as it limits the number of unnecessary fares and using the seats in the vehicles most efficiently.

Considering these aspects, there has to be a deeper study on which of the models is most suitable for tanya-settlements or a hybrid approach integrating institutionalized carpooling within the public transport system, along with demand-responsive transport and ridesourcing platforms, emerges as the most comprehensive solution is possible for providing a flexible, inclusive, and environmentally friendly transportation system for tanya-settlements in Békés Megye.

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