Chapter 3

Transport Modes and the Green Economy

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Abstract This chapter provides empirical evidence regarding the various transport modes and the green economy in the Limpopo Province of South Africa. Issues pertaining to green transport, strategies for implementation and any challenges associated with the transition towards green transport are grounded on empirical research conducted in the province. In South Africa, transitioning to a green economy is envisioned as a vital means to respond to critical development challenges that the country is facing and will continue to face in the near future. Many of these challenges are intertwined and they range from high levels of unemployment, poverty and inequality, to energy, security and climate change. The transition to a greener economy is articulated in the national development policy through a series of frameworks, strategies, policies and Acts which all enshrine sustainability or the notion of making the South African economy greener (Department of Environment Affairs (2016)). However, the implementation of green transport in general and particularly in the Limpopo province, is still in the infancy stage.

Keywords Transport modes · Green economy · Implementation strategies · Transitions towards green transport

3.1 Background

3.1.1 *Transition to Green Transport*

In South Africa, green transport is a very complex enterprise, mainly because the transition towards it, presents a mix of challenges and opportunities. In terms of challenges, South Africa is at a crossroads, because while it has developed effective policies, which are in line with international trends, placing the country on a

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J. O. Odiyo et al. (eds.), *Green Economy in the Transport Sector*,
https://doi.org/10.1007/978-3-030-86178-0_3

low carbon trajectory, there is still a great need to overcome socio-economic challenges such as poverty and unemployment (Mahadea & Simson 2010). Through the development of frameworks, policies and Acts, South Africa aspires to be a sustainable, economically prosperous and self-reliant nation that safeguards its democracy by meeting the fundamental human needs of its people and implementing global collaboration (Department of Environmental Affairs and Tourism 2008). Currently, this aspiration seems to be far-fetched, and the challenges are not being addressed except the maintenance of current transport systems that directly contribute to GHGs. On the other hand, transition to green transport is likely to afford us the opportunity to engage communities in meaningful and non-academic discourse in order to harness common green transport skills and job opportunities which will allow us to integrate them in the general value chain for the advancement of an eco-friendly, low carbon and energy efficient transport sector (RSA 2003; Cetinkaya et al. 2011).

3.1.2 The Concept of Green Transport and Its Contribution to Green Economy

In simple terms, green transport means any kind of transportation practice or vehicle that is eco-friendly which also has minimal negative impacts on the immediate environment. It is sometimes referred to as sustainable transport and has the main aim of minimizing the adverse impact of transport on the environment while addressing current and future transport demands based on the principles of sustainable development. Green transport, therefore, requires that socio-economic growth targets are met in a way that guarantees greater safety to citizens and commuters alike (Limpopo Green Economy Plan 2013). Such targets should also harmonise with the natural, social or economic environment (DEAT 2008). In addition, green transport intends to reduce the adverse impact of carbon emissions and the effects of transport infrastructure on the immediate environment. This is argued to be achieved through reducing private car dependence in favour of public and non-motorised transport as well as using a low impact design and materials for transport infrastructure (DBSA 2011).

However, the artificially enforced separation between places of work and shopping and places of residence (Davies 2015) makes road transport, the primary source of CO₂ emissions in South Africa, unavoidable. The heavy reliance of various sectors (energy, transport, mining, industrial, commercial and agricultural) on road-based transport, in order to move people and freight, contributes both to a quicker deterioration of road infrastructure and higher levels of greenhouse gas emissions. The pressures on transport and its associated infrastructure to develop the economy are enormous and the increasing resources consumed to develop the transport sector will negatively impact the environment in the long-term (Pearce et al. 1989).

3.1.3 Legislative and Policy Instruments

The following are South Africa's legislative and policy instruments which all have a bearing on green transport:

- National Land Transport Act (2009);
- National Environmental Management Act (1998);
- Energy Efficiency Strategy (2005);
- White Paper on National Transport Policy (1996);
- National Climate Change Response White Paper (2011); and
- National Development Plan (2011).

These legislative instruments aim to ensure sustainable road transport with minimal impact on the environment by managing it in a sustainable manner. Other objectives provided for in the legislations are to:

- Make public transport affordable, safe, reliable and accessible as an alternative to private modes of transport;
- Reduce traffic congestion and carbon emissions;
- Promote non-motorised transport by providing safe infrastructure for its use;
- Ensure the use of environmentally-friendly materials in road construction and maintenance;
- Ensure that spatial and route planning enhances green transport initiatives; and
- Promote sustainable partnerships for better integration of various modes of transport.

3.2 Study Aim and Specific Objectives

The aim of this study was to explore fundamental issues pertaining to green transport modes in rural areas of the Limpopo Province. The specific objectives were to: determine dominant types and characteristics of green transport modes; identify resources, infrastructure, skills and enhancement plans needed for green transport support; examine the perceptions of the public (commuters) and stakeholders pertaining to green transport modes; identify the challenges as well as the strategies to support effective implementation of GT modes; and identify and examine the level of green skills development for particular transport modes.

Table 3.1 Study’s sampling frame and size

Province	District	Municipality	No of commuters
Limpopo	Vhembe	Thulamela	10
		Makhado	7
		Musina	8
	Mopane	Greater Giyani	10
	Capricorn	Polokwane	10
	Waterberg	Mokopane	10
		Total (N)	55

3.3 Research Methodology

3.3.1 Study Location

The study location is comprised of selected districts in the Limpopo Province, namely: the Vhembe, Mopani, Capricorn and Waterberg districts (Table 3.1). This is home to predominantly rural communities that often distance themselves from urban areas. In the Waterberg district, communities that were interviewed were situated along the main transport route to town and they were living in rural development programme (RDP) houses probably due to proximity to towns.

3.3.2 Research Design

The research design adopted for this study was a case study coupled with grounded theory which allowed us to investigate transport modes from the points of view of commuters and main stakeholders in the transport sector. This design also provided us with a framework for understanding green transport within a particular social and institutional context. It has also allowed us to form our own impressions and reactions, as researchers, about green transport issues which then presented an opportunity to develop a theoretical account of the general features of GT modes in the province and ground the account in empirical observations/data.

3.3.3 Sampling Approach

Considering the difficulties which would be faced when attempting to interview all travellers and drivers in transit, 55 commuters using public and private transport modes in four districts were randomly sampled for a questionnaire interview. Purposive sampling of the main transport stakeholders (from all the districts in Limpopo)

was adopted and these stakeholders were invited to a workshop organised for this study.

3.3.4 Data Collection and Analysis

Questionnaires and the cluster analysis technique were used to collect and analyse data. Questionnaires were distributed to 55 respondents (mainly consumers) who elicited empirical evidence on transport mode preferences; rationale behind these preferences; current utilisation of available green transport modes; general readiness with the shift to green transport economy; and the use of IT to reduce business trips. Cluster analysis as a technique was used to group similar observations into a number of clusters based on the observed values of several variables for each individual. It is an exploratory data analysis tool for organizing observed data or cases into two or more groups. Stakeholder engagement in the form of a workshop and interviews elicited data on the use ratio of motorised and non-motorised transport; technology, innovation and skills transfer in green transport; policy implications and directions about green transport; roles and responsibilities as well as challenges associated with green transport. The emphasis was placed on strategies/enhancement initiatives, green technology and challenges associated with the transition to green transport. Collected data were then captured into SPSS for analysis.

3.4 Results and Discussion

3.4.1 General Modal Split

The results of the study are organised as shown in Fig. 3.1. Modal split represents the percentage of travellers using a particular mode of transport to and from work. Green or sustainable transport reduces the impact on the environment with respect to carbon emissions and the effects of transport infrastructure on the immediate environment. Empirical data from the Limpopo Province, especially in the Mopane (63%) and Waterberg (40%) districts, showed that the respondents interviewed regarded Taxi's as the preferred form of transport (Fig. 3.2) when compared to other forms. More importantly, the overall use of Taxi's and single occupant cars was greater in all selected districts as compared to walking, cycling, the use of buses and car sharing/pooling. However, walking is the preferred mode in Mopane (38%), followed by the Capricorn (33%) and Waterberg (20%) districts. The district in Limpopo (excluding Sekhukhune) which walked the least was the Vhembe district which together with Waterberg used "bakkies" to commute to work and school. This is regarded by Bradshaw as the top priority and most ecologically friendly mode of transport (Fig. 3.3). Pedestrian mode requires one to prefer to walk to school, to

Fig. 3.1 Organisation of research findings: survey and stakeholder engagement

Fig. 3.2 Percentage (%) travelers using a particular mode of transport

Fig. 3.3 Green transportation hierarchy, based on *eco-friendliness* (Source: Bradshaw (2014))

work and to shops, because walking does not emit any greenhouse gas (Hass-Klau 1993). It is also free and a good form of exercise for the body. The main impediments in rural areas are long distances from home to work, due to the artificial separation of the two sectors.

3.4.2 Factors Influencing Modal Choice

Respondents were asked to provide reasons as to why they preferred a particular mode of transport. Of the four districts visited, Mopane recorded the highest use of single occupant vehicles (88%), followed by the Waterberg district (40%). In terms of carpooling, Capricorn and Waterberg showed the highest figure compared to the Vhembe district. The concept of carpooling (multi occupant vehicle) seemed non-existent in the Mopane district. This is a favorable mode of green transportation, where groups of people, can use one vehicle, when heading in similar directions on a regular basis. It is a more economical and eco-friendly option, especially if all rotational vehicles are insured and well serviced. Cost, income, comfort, driving license ownership, time and reliability are perceived as factors influencing transport modal choice (Chee & Fernandez 2013; Wibowo and Chalermpong 2010). Most respondents (54%) attributed their choice of a single occupant car to *reliability* (Box 3.1). Taxi's, though not perceived as cheap and reliable, were chosen by the majority (50%) due to *time effectiveness*. Similarly, walking was regarded as cheap and quick, especially for shorter *distances*. Respondents have not selected income, comfort and driving license ownership as factors which have influenced their transport modal choice. However, the lack of an alternative was perceived as the most important rationale for the choice of a bus as a mode of transportation (Fig. 3.4).

Fig. 3.4 Consumers preferred mode of transport

Box 3.1 Perceived factors influencing transport modal choice in Limpopo

○ Car: Cost (Cheap) (22%); Time (Quick) (27%); Reliability (54%);
○ Taxi: Cost (Cheap) (33%); Time (Quick) (50%); Reliability (46%)
○ Bus: Lack of Alternative (33%);
○ Walking: Cost (Cheap) (44%); Time (Quick) (44%)

3.4.3 Utilisation of Eco-Friendly Transport Modes

The study has used various indicators to assess the use of eco-friendly modes of transport amongst consumers. Such indicators included the use of public transportation; bicycle ownership and use; car sharing/pooling; use of IT to reduce business trips and the concept of working from home.

Use of Public Transport

Public transport is regarded as the third greenest mode according to Bradshaw's (2014) green transportation hierarchy (Fig. 3.3). Regardless, most respondents (51%)

do not use public transport when going to work compared to 47% who used it due to the lack of an alternative. The difference between the commuters who used public transport to work and those who did not is not of statistical significance at ($p = 0.01$). However, this finding is consistent with a study by Alvinsyah Soehodho and Nainggolan (2005) who argued that most commuters, especially men, prefer to drive to work instead of using public transport due to the lack of comfort. Perceptions of mode attributes are significant in determining the likelihood of a modal shift from private to public transport (Nurdden et al. 2007; Satiennam et al. 2011). According to Nor Ghani et al. (2007) preferences for comfort and convenience significantly increase the likelihood of choosing to drive over using a bus service. Though it is much more comfortable and convenient to drive one's own private vehicle to the office or market every day, it is required of responsible world citizens to opt for green transportation modes that are easily accessible to everyone. 18% of people who use public transport have employer subsidised tickets. Perhaps, lack of employer subsidy is an issue of concern, especially for those who use taxis to and from work.

Bicycle Ownership and Use

Using bicycles to commute to work is another great mode of green transportation. It is faster than walking, has a low cost and is a form of healthy exercise. The buying and maintenance costs of a bicycle are only a fraction of that required for car. In many cities though, cycling has received very little attention from transport planners over the years and it has been a marginalised mode of transport. Motorised modes of transport often take up much more space in cities and within transport planning (Koglin and Rye 2014). In the Limpopo province, bicycle ownership data obtained were sparse and time series varied considerably in length from one district to another. To find similarities in ownership across geographical regions, clustering presented itself as an effective pattern recognition tool. The questionnaire survey indicated that 66% of respondents in urban areas owned bicycles but they did not necessarily use them to travel to work. This is in comparison with 34% in rural areas who said they used them to go to work. More than 30% of the urban commuters showed interest in purchasing discounted tax-free bicycles for exercising and for bicycle competitions but not to ride them to work. Despite, this geographic variation in bicycle ownership among the five districts of Limpopo, we were able to identify two distinct districts (i.e. Vhembe and Makhado) in which riding bicycles to work is perceived as a sign of 'poverty and the onset of mid-life crisis'. In these two districts, cycling is also hampered by a lack of appropriate bicycle lanes and a generally negative attitude by motorists towards cyclist which may impose an accident risk to cyclists (de Hartog et al. 2010). It cannot be assumed though, that simply by developing a "walkable" (or "cyclable") environment, public health goals will be achieved; the relationships are more complex than this (Andrews et al. 2012).

Despite the health benefits associated with cycling and walking, few people use bicycles to get to work. This trend is different from that of the USA and Scandinavian countries where bicycle ownership is high and regarded as a sustainable mode of transport, especially by workers and students. In South Africa, the government at all levels with the help of public health experts, health and transport geographers

(Davison & Curl 2014), and other stakeholders, can harness and mobilize cyclists as change agents by developing policies that support bicycle education, infrastructure, and a culture of safety for all road users. As highlighted by Rind et al. (2013) and Andrews et al. (2012), attention should be paid to inequality, both in the built environment in terms of its ability to facilitate walking and cycling as well as active travel behaviour, which may or may not be related to the environment.

Car Sharing/Pooling

Globally, the growth of car-sharing services as a new and more sustainable way of transportation is shifting the private mobility from ownership to service use (Ferrero et al. 2018; Thamizh Arasan & Vedagiri 2011). The basic idea of car-sharing is quite simple: you share the usage of a vehicle fleet by members for trip making on a per trip basis which is an option often motivated by economic reasons. In the Limpopo province, 4.3% of motorists usually drove with three or more people to work showing little evidence of car sharing. More than twenty percent (23%) of commuters used single occupant vehicles to make business trips outside the province. This practice was often considered by employees as a safety precaution in order to avoid significant loss in the case of an accident. According to Chee and Fernandez (2013), the possession of a driving license and regular access to a private vehicle are both significant factors in influencing the choice of transport mode. These factors contribute towards the tendency to use single occupant vehicle. Other barriers to the adoption of car sharing services in Limpopo, include: long distances to cover, lack of comfort, distrust and fear of liability in the case of an accident.

Use of ICT to Reduce Business Trips

Combating carbon emissions to advance a low carbon trajectory is an urgent task for us all. ICT can have a positive impact on the reduction of CO₂ emissions while making businesses more efficient. A survey in the Limpopo province, indicated that the state of green technology, in the form of Skype, face time and video-conferencing to reduce business trips, is in infancy stages. About 35% of respondents were unaware of these facilities compared to 30% who were aware of these facilities. All in all, 23% did not have the required skills. The spatial variation is insignificant and negligible. The only difference is that most urban respondents were aware of these facilities but were not using them regularly in order to reduce business trips. The use of tele-conferencing in some businesses was motivated by the cutting of costs rather than environmental considerations (Rasagam 1999).

The Concept of Working from Home

Work from home is a concept where the employee can do his or her job from home. Work from home gives a flexible working hour to the employee as well as the job for the employer is done with ease. In South Africa, working from home is often perceived as informal and self-employment. 30% of respondents who work in the corporate world or formal sector would be interested in working from home if their companies or government could approve and advance such initiatives. However, 28%

of the respondents who are self-employed were already working from home as a cost saving initiative.

3.4.4 General Public Interest Toward Green Transport Modes

There is a general lack of interest in cycling, walking, car sharing, IT use for business trips and the use of public transport. This could be attributed to the *type of business; distance to work; lack of dedicated lanes, cost and lack of general awareness on IT uses for business meetings*. Empirical evidence from Limpopo suggests a general lack of readiness with regards to a shift towards green transportation. In Limpopo, this shift is constrained by longer distances to be covered to work, under-developed pedestrians/cyclists' lanes and overcrowded public modes of transport. In South Africa, especially in Limpopo and other remote rural areas, most of these public modes of transportation are not fuel-efficient and still use high Sulphur diesel (500 ppm) that contributes to GHGs. Hence, most people in Limpopo still resort to private transportation to commute to and from work.

3.4.5 Enhancement Initiatives, Green Technology Development and Challenges

In a workshop organised for stakeholder engagement in the Limpopo Province, participants from various transport chambers were asked to identify green transport enhancement initiatives, green skills and challenges associated with the transition to green transport in Limpopo.

Enhancement Initiatives on Green Transport

Various commissions identified the following initiatives to advance transition to green transportation:

- Need to make all modes of transport (motorised and non-motorised) green in the long run:
 - Buses, motorcycles, taxi's, walking, skating and donkey carts for rural transport;
 - Promote non-motorised transportation and prioritise mass public transportation with the identification of hotspot (high volumes) zones;
- Partial banning of small vehicles in highly congested areas during peak hours.

Green Technology Development for Green Transport

Commissions at the Limpopo Stakeholder Workshop have pinpointed the fact that each transport mode has different green technology skill requirements and that there is need to harness green transport common technology and integrate it into the general transport value chain. The specific common area identified in green transport was the energy sector which requires the identification of mechanisms and knowledge in dealing with various energy components in terms of various transport modes, transport infrastructure and technology required for maintenance of such transport modes (Winston 1991).

- Green Technology for Car/Bus/Bicycles/Motorbikes:
 - Fuel – transition from Lead to Unleaded (already existing); From high sulphur (500 ppm) to less sulphur (50 or 10 ppm) (already existing).
 - Battery—electric cars and motorbikes while also providing adequate charging points/stations and/or high capacity batteries.
 - Solar—solar car (effective if hydro-electricity is generated); solar powered bicycles/motorbikes;
 - Bio-gas—provide adequate pump services; effective utilisation of waste in landfills;
 - Bicycles—Using Chinese bamboo or waste instead of metals for bicycle frames, especially for non-racing bicycles, could be problematic and dangerous for mountain biking.
 - Bio-diesel—provide adequate pump services; take extra care of the environment; do not utilise staple food crops for bio-diesel production since this will impact food security negatively.
 - Hybrid cars—reduce cost and improve reselling value.
- Green Transport Infrastructure:
 - Bus stops – solar lighting could be introduced.
 - Traffic lights/Street lighting—solar lighting adequate.
 - Introduction of daylight devices for automating the switching off and on of lights in order to save power.

The development of green transport technology in Limpopo is still at an infant stage. The situation is relatively similar in most developing economies (Marchán & Viscidi 2015).

Challenges Associated with Green Transport in Limpopo

With regard to challenges associated with the transition to green transport, stakeholders in Limpopo identified the following:

- Poor Investment in energy efficient public transport, including rail;
- Green transport is perceived as another Taxi re-capitalisation programme;
- Lack of mobility alternatives for short distances;
- Poor rail, taxi and bus linkage system;

- No specific effective policy for green transport although a green economy strategy exists;
- Role identification poor, responsibilities fluid and co-ordination lacking at all three tiers of government with respect to green transport;
- Job losses, and people would have no skills for new green jobs created; and
- Lack of integration of green transport skills in the general value chain.

These are consistent with green transport challenges in more developing and emerging economies in Africa and Latin America (Caia et al. 2011; Maia et al. 2011; Mxolisi 2006; UNEP 2008, 2011).

3.5 Summary of the Major Findings

- The use of private cars is typical in most districts of the Limpopo province; although walking is predominant for shorter distances;
- Lack of alternative cheaper modes of transport to cover long distances due to apartheid spatial planning;
- Subsidisation of green transport and green initiatives by employers not available;
- There is a general lack of interest in cycling and walking to and from work.
- Rudimentary use of IT (Skype, tele and video-conferencing, face time, etc.) to reduce business trips;
- Very little evidence of car sharing or car-pooling.
- Solar lighting at bus stops and robots not administered.

3.6 Policy Recommendation for Sustainable Implementation of Green Transport

- *Short to medium term recommendations include:*
 - Developing green transport awareness and sensitisation programmes.
 - Enhancing access to green affordable public transport.
- *Other policy recommendations include:*
 - Incorporating green transport in relevant policy making processes;
 - Conducting monthly audits for the utilisation of green transportation;
 - Training more local green transport professionals;
 - Making all modes of transportation green;
 - Harnessing common green skills;
 - Integrating job creation and poverty alleviation in green transport into the general value chain.

3.7 Conclusion

The term “*green transport*” has often been used as a greenwash marketing technique for products which are not proven to make a positive contribution to environmental sustainability. Nevertheless, there is consensus that transport is a major contributor of greenhouse gases and hence, the primary target for reducing CO₂ emissions. Green transport emphasises the need to walk and the use of multi-occupant vehicles as the modes that should receive top priority since they are beneficial for the environment. Hence, it is asserted that the environmental impacts of transport can be reduced by improving the walking and cycling environment in towns and cities, and by enhancing the role of public transport, especially electric rail and fuel-efficient public buses and taxis. In South Africa, the problems regarding the balancing act of socio-economic objectives with environmental objectives may render some of the green transport initiatives ineffective. This is clearly supported by empirical evidence from the Limpopo Province. Nevertheless, some consumers and transport stakeholders in Limpopo have supported green transport initiatives and have reckoned that such initiatives are likely to alleviate poverty and unemployment in the long-term if green skills are harnessed and transport technology is adopted to support green transport initiatives in rural provinces in South Africa.

Acknowledgements Thanks to commuters in the Limpopo province, stakeholders who attended the Stakeholder Workshop in Limpopo (14–15 July 2016) and my research assistants (Ms. Gundo Mulaudzi and Ms. Shylet Anesu Nyamwanza) who interviewed commuters in the Vhembe, Mopane, Capricorn and Waterberg districts of the Limpopo Province. The final gratitude goes to the Transport Education and Training Authority (TETA) for funding the project.

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