Can South African road authorities satisfy constitutionally protected basic access needs without sacrificing economic growth?

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Abstract — **This paper combines economic theory with GIS application to assess whether South African road authorities can satisfy constitutionally protected basic access needs without sacrificing economic growth. The trade-off between access to basic services for all citizens and economic growth is investigated, with particular attention to issues of constitutional obligations, quality of life, and the fundamental role of economic growth in poverty reduction. Based on Rawls's Theory of Justice and game theory arguments presented by Binmore, lexicographical priority is assigned to basic access roads. Following the definition of basic access roads and an investigation of the national demand profile, the extent of the potential basic access road network is estimated using primary and secondary schools as a proxy for service centres.**

Keywords — roads; road network; prioritisation; classification; basic access; rural roads; game theory; Rawls; Binmore; GIS.

I. INTRODUCTION

South African road authorities are constitutionally obliged to provide all citizens with at least a minimum level of access to basic services. This raises the concern that if this obligation were taken fully seriously as a basis for prioritizing road maintenance and upgrading projects, insufficient funds might remain available in roads budgets for pavement infrastructure improvements necessary to support economic growth targets.

It seems not only constitutionally unviable but also morally impermissible that roads prioritization might ignore basic access demands. But forswearing promotion of growth through transport infrastructure seems equally unacceptable, given that growth is the fundamental necessary condition for sustainable reduction in the rate of poverty. Might we thus face a Hobson's choice in trying to arrive at a consistent policy for determining which roads to maintain and improve? The paper explores the extent to which this potential dilemma really arises for contemporary South African transport authorities.

The initial goal when exploring this potential dilemma is to provide a rational justification, based on philosophical arguments that are consistent with economic logic, for the lexicographical prioritization of basic access roads. Although policy planners sometimes take this conclusion for granted, some may question whether it is really appropriate that basic access demands should normatively precede the mandate placed on road authorities to support economic growth. To ensure a common point of departure, the logic of this position is explained.

We go on to demonstrate that the demand for basic access roads does not claim so much of the available road budget that practical economic considerations never get any purchase. This outcome is important to allay fears that the principles of justice embodied in the South African constitution are incompatible with the resource allocation required to support South Africa's economic growth.

To reach this finding, basic access roads are defined and linked to a clear set of identifiable characteristics. These characteristics are used to determine a regional demand profile. We also provide a brief analysis of the migration statistics for all of the relevant provinces and municipalities, which allows authorities to account for the impact of changes in the pattern of demand on the supply of basic access roads and maintenance decisions.

The final objective is to estimate the extent of the potential basic access road network, and show that this can be accommodated within existing budget parameters. This is achieved by layering demographic data, the GPS coordinates of basic service facilities, and road network maps in a GIS software package. The GIS exercise identifies instances where the travel distance exceeds the prescribed norms and standards. These cases are then cross-referenced with the characteristics of basic access roads to determine the extent of the network. It is estimated that South Africa's total potential basic access road network would be optimized at 61 741 kilometres, which roughly corresponds to 8.2 per cent of the total road network.

II. BASIC ACCESS NEEDS VERSUS ECONOMIC GROWTH

By law, all South African citizens are equally entitled to the privileges enshrined in the Bill of Rights (1996). The Bill of Rights establishes a set of non-negotiable basic entitlements that the white paper on national transport policy (1996) mandates the road network to support. Of chief importance are Sections 27 and 29, which specifically state that everyone has the right to have access to health care services and basic education, respectively.

The argument for prioritization of support for basic access is rooted not only in constitutional jurisprudence, but also in moral philosophy. Rawls, Sen (2009) and Peffer (2008) all argue that the primary good for a person, liberty, is based on the ability of a person to convert basic material endowments into good living and opportunities to pursue their objectives. People are severely disadvantaged in this respect if they lack adequate access to basic amenities and essential services. Indeed, in the absence of a minimal threshold of such access, a life might not be worth living at all. Thus a society that failed to allow some citizens to reach this threshold would effectively sacrifice those people – perhaps, if their needs competed unavoidably with prerequisites for economic growth, for the sake of the more fortunate remainder of society. A moral philosophy that licences such trade-offs is a variant of utilitarianism.

The three philosophers cited above reject utilitarianism. Peffer (2008: 4) contrasts it with the demands of what he calls the *Basic Rights Principle*, according to which: "everyone is to be guaranteed the standard range of resources needed for becoming and remaining a normally functioning human being and citizen, including standard – at least basic – health care (and assistance) and basic education, as well as adequate nutrition, potable water, minimally decent shelter and a liveable environment." This position does not require equality of welfare or capability, but that citizens are entitled to the most extensive basic rights compatible with similar rights for others. In South Africa, this minimum level of access is based on department guidelines and access norms and standards.

The importance of economic growth must also be considered in a deep normative context. Because governments borrow against future growth, excessive spending on basic access roads that choked off growth would erode the ability of the state to borrow. The amount of redistributive tax revenue that government is able to collect also progressively falls if growth stalls. Economic growth is therefore essential if government is to maintain the fiscal capacity to sustain and grow expenditure on key public services that target the least well-off.

According to Rodrik (2007), "historically nothing has worked better than economic growth in enabling societies to improve the life chances of their members, including those at the very bottom." Research that compares the experiences of a wide range of developing countries finds consistently strong evidence to support Rodrik's assertion that rapid and sustained growth is the single most important way to reduce poverty. A typical estimate from cross-country studies is that a 10 per cent increase in a developing country's average income reduces the poverty rate by 20 to 30 per cent (DFID, 2008: 3). Roemer and Gugetty (1997) regressed the growth of income for the poorest 20 per cent and the poorest 40 per cent of the total population of 26 developing countries against the GDP growth of these countries and obtained a similar, although more conservative, result.

The level of economic growth in question, however, must be around the 5 to 6 per cent targeted by the National Development Plan (NDP). Given annual population growth of about 1.5 per cent and the fact that government currently funds expenditure through debt, economic growth significantly less than the NDP target would mean that per capita wealth is falling, or at best staying constant, and government would be unable to cover its debt service costs.

Given the obvious importance of both basic access needs and economic growth, we face a challenge in thinking about how to prioritize among roads that serve one but not the other. We follow widespread precedent by turning first to Rawls's *Theory of Justice*. The next section traces Rawls's argument through to its conclusion that fair social contracts maximize the welfare of the least well-off. Supplementary arguments, which draw on game theory, are also given to support the use of a Rawlsian framework. Some readers, especially those primarily concerned with practical issues, may wish to skip this discussion if they are satisfied that prioritization of the interests of the poorest citizens can be defended by both philosophical and economic arguments that are complementary to one another and similar in their conclusions.

III. Lexicographical order of priorities

Our approach takes it as given that basic rights are non-negotiable. This is precisely what makes them 'rights'. This does not spare us the need to justify the specific Rawlsian understanding of the role of rights in selecting allocation principles, or the need for a framework that reconciles their prioritization with the urgent demand for support of economic growth.

The Rawlsian normative framework puts basic rights and the welfare of the least well-off first in a lexicographical order of provisioning priorities. A lexicographical ordering stipulates a set of priorities to be addressed in order of descending importance, where the first priority must be fully satisfied or no longer applicable before the second priority can be addressed, and so on.

The least well-off are defined as the most disadvantaged members of society, who in this case lack adequate access to the set of basic services that satisfy their fundamental human rights. To put their interests first would mean that basic access roads are made the top priority. In contrast, well-off members of society enjoy access to all basic services. Given that well-off citizens already enjoy access to basic services, their interest is in higher economic growth. Of course, the poor share this interest, and still more urgently. But the Rawlsian normative framework assumes that all lives must be made worth living before we ask how to make any of them better.

Rawls (1971) formulated a conception of justice intended to regulate the basic structure of society. The objective was to find principles for achieving balance between the competing claims of citizens and establishing a fair social contract that would be accepted by all. The theory of justice developed by Rawls begins with two principles:

1) Each person is to have an equal right to the most extensive basic liberty compatible with a similar liberty for others.

2) Social and economic inequalities are to be arranged so that they are both (a) to the greatest benefit of the least advantaged and (b) attached to offices and positions open to all under conditions of fair equality of opportunity.

The first principle is referred to as the Liberty Principle, and puts liberty of conscience, the political liberty to vote and run for office, freedom from arbitrary arrest, and the freedom of speech, assembly and personal property first in the order of priorities. Rawls (1971: 3) argues that in a just society basic liberties are not subject to bargaining; not even the welfare of society as a whole can over-ride the loss of freedom for some.

We are concerned with the first part of the second principle, called the Difference Principle, which demands that the welfare of the least well-off be maximised. The associated maximin criterion gives precedence to the welfare of the least well-off over the welfare of everybody else. While utilitarians are willing to let the poor get poorer if this makes the rich sufficiently richer, Rawlsian analysis tolerates no such sacrificial lambs.

Rawls makes use of the following thought experiment to defend the maximin principle: Imagine that the citizens of a society meet to plan a new social contract. Now imagine that a veil of ignorance is imposed, which hides from each person his or her particular, contingent place in society so that each person has equal cause to fear that they might become the victim of any injustice built into the final deal. Under these conditions, Rawls argues that each citizen would vote for a fair social contract that maximized the welfare of the least well-off. Although the conclusion that an egalitarian baseline is intuitive in the circumstances of the original position, the reasoning has been subject to criticism, particularly from economists.

A first basis for contestation pertains to the assumption that all members of society have the same 'rational' preferences, and will therefore vote the same way if they are unaware of their particular material circumstances. This idea is problematic as it removes the point of bargaining. A stable social contract is one that members of society would collectively choose not because everyone has identical preferences – which they do not – but rather because it is in their self-interest to do so given the existence of a range of different preferences. It is this self-interest that will bind citizens to whatever they agreed upon behind the veil of ignorance once it is lifted.

Rawls also assumes that all rational people are risk averse. Under the assumption that people are risk averse it is not sensible for anyone to take the risk of supporting a social contract that neglects disadvantaged citizens, lest they turn out to the be among the least well-off once the veil of ignorance is lifted. Rationality, however, entails no particular attitude toward risk. An individual who consistently prefers to accept risk is just as rational as someone who consistently seeks to minimize it.

The economist Ken Binmore (1994, 1998) agrees with the picture Rawls paints of the nature of a just society, but finds that the arguments with which he defends his position fly in the face of sound economic logic. Binmore therefore turns to game theory, in which bargaining outcomes are only internally stable if they establish a self-enforcing Nash equilibrium[1], to establish the considerations that would govern rational bargaining if citizens were to jointly choose a social contract.

[1] A Nash equilibrium is a set of demands such that no one has incentive to change their own demand given the demands of others.

Binmore (1998: 423) models bargaining over social contracts using an indefinitely repeated game, referred to as the Game of Morals. Essentially, the Game of Morals allows all players the option to renege on whatever social contract was decided. If this option is exercised, players again go behind the veil of ignorance to negotiate what social contract should be operated in the future.

Without an outside benevolent dictator to enforce an agreement, a contingent social contract that assigns substantive advantage to one player is untenable since nothing prevents the disadvantaged party from refusing to honour the deal. In Binmore's idealization of this reality, all a bargainer has to do to exercise his option to renege on the social contract is insist on returning to the original position. In real life the dissatisfied inflict social costs on others in society through a range of more complicated forms of resistance.

Should citizens vote to improve the welfare of the relatively well-off, in this case by choosing to prioritise growth-orientated roads over basic access roads, clear winners and losers would be revealed once the veil of ignorance were lifted. The winners would be the well-off citizens who already had access to basic services and could thus enjoy the benefits from economic growth. The least well-off would remain isolated from basic services, and in the face of this barely acceptable quality of life marginalised from any economic benefits.

To reach a stable equilibrium, players must recognise that they need to make do with choosing from a feasible set of outcomes that do not incentivize some parties to reject a social contract and provoke a level of social strife that is more costly than the incentives needed to keep them at the bargaining table. This feasible set of outcomes is referred to as a security strategy because it jointly yields the largest expected payoff.

Binmore shows through analysis of this bargaining game that the only social contract that satisfies the requirement for an equilibrium in security strategies is one that maximizes the welfare of the least well-off. In line with the arguments of Rawls and Sen the new social contract will typically not, and need not, establish a situation of equality. It is only necessary that the least well-off player receives sufficient compensation to ensure it is not in his or her interest to reject the agreement.

The effect of Rawls's appeal to the maximin criterion is therefore obtained here by abandoning altogether Rawls's claim that we have a natural duty to honour hypothetical deals reached in the original position. Players in the original position are not assumed to be absurdly cautious or to all have identical risk preferences. They confine their attention to the set of potentially stable agreements, where the welfare of the least well-off is maximized, because payoffs outside this set do not establish a Nash equilibrium and are therefore unavailable without a benevolent dictator to enforce the agreement. Since benevolent dictators are extremely rare and never reliable even when they briefly come along, a soundly organized society will avoid social contracts that rely on them.

The constitutional principle that basic rights – which, where roads are concerned, are represented in basic rights of access – is thus supported by economic reasoning that, although highly idealized and abstract, is ultimately rooted in the practical

necessities of maintenance of political stability and legitimacy. South African road authorities should therefore operate a project prioritization policy that does not strand poor citizens without access to basic services.

IV. Definition of Basic Access Roads

Access norms and standards are legal documents, drawn up by the relevant departments to stipulate accepted travel times or walking distances to reach essential public services. The Access Norms for the Department of Basic Education are uniform across urban and rural public ordinary schools, but do not include special schools (Government Gazette 33283, 2010). Every public primary and secondary school is required to have a feeder zone with a radius of 5 kilometres. The unofficial target set by the Department of Health is that 90 per cent of the population served by primary, mobile, and satellite clinics must also be within a 5-kilometre radius of at least one of these facilities (CSIR, 2012: 50). Basic access roads provide households that fall outside these feeder zones with the means for effective access to basic education and health care facilities.

Without the option of walking or alternative access routes, households are reliant on authorities to ensure these roads are maintained and remain open. The demand elasticity for basic access roads under varying economic conditions is thus zero. Regardless of cyclical fluctuations in the economy, children must attend school and people who require medical attention need to access healthcare facilities.

The next characteristic of basic access roads we consider, which is linked to traffic volume and length criteria, is that they should serve only one function: to provide communities with their constitutionally protected access to healthcare and basic education facilities. As a result not all of the roads required by households to reach schools and clinics are classified as basic access roads. Traffic volumes should be low, typically less than 50 vehicles per day. Traffic volumes in excess of 50 vehicles per day are an indication of additional activity, such as the transfer of freight. Similarly, basic access roads should be shorter than 3 kilometres in distance as longer roads tend to be associated with a range of other users.

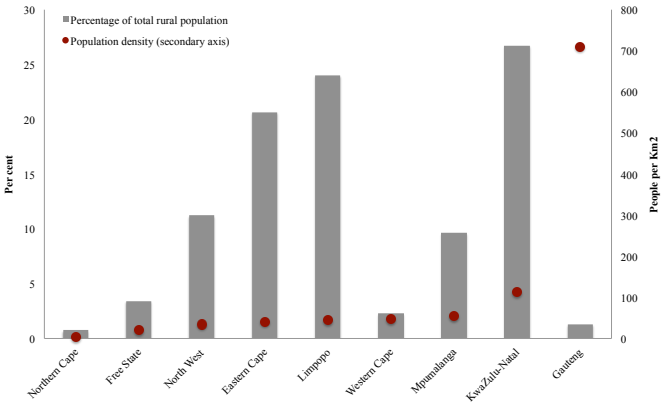
The demand for basic access roads is therefore only present in rural areas, defined as sparsely populated regions that contain 5000 people or less in villages and scattered and dispersed settlements. Schools and clinics that serve urban areas, and even peri-urban areas, are often in relatively close proximity – relative, that is, to the generally deplorable spatial inequities inherited from the apartheid regime - to the intended beneficiaries. Where this is not the case, economically motivated urban road networks typically present a variety of alternative routes. The lower population densities in rural areas, however, mean that it is often impossible to include all beneficiaries within the catchment areas of service facilities or to connect households to these facilities via roads that have additional justification. McLaren, Ardington, and Leibbrandt (2013) confirm this point using the National Income Dynamics Study Wave 3 data. They find that while almost all urban households are within 5 kilometres of the nearest clinic, and none are further than 10 kilometres, around 10 per cent of rural households are more than 10 kilometres from the nearest clinic.

The final characteristic of basic access roads is that their justification for their prioritization stems from the specific needs of lower income households. Although distance poses barriers to low income and affluent rural households alike, the later – who are often wealthy farmers – have the ability to privately fund the maintenance of their own access roads. But lower income households, who comprise the majority of the isolated rural population, are completely reliant on the state to maintain basic access roads.

V. Demand for Basic Access Roads

Following from the definition, the first indicator of demand for basic access roads is the presence of rural communities. At the time of the 2011 Census approximately 38 per cent of the national population lived in rural areas. Fig. 1 details the provincial distribution of South Africa's rural population. As shown, more than 70 per cent of the total rural population is located in the former homeland provinces of the Eastern Cape, KwaZulu-Natal, and Limpopo. Significant portions of the rural population also live in the North West and Mpumalanga. Although the remaining provinces make up a smaller share of the total rural population, the presence of rural communities in all nine provinces signals the widespread nature of potential demand for basic access roads.

Fig. 1. Distribution and density of South Africa's rural population, 2011



Source: Statistics South Africa, 2011.

Population density is another indicator of potential demand for basic access roads. Lower population densities, in the absence of more facilities, result in longer travel distances to access government services and therefore increase the demand for basic access roads. The Northern Cape's low population density of less than 3 people per kilometre, as shown in Fig. 1, signals the potential of high demand for basic access roads in the province. The population densities in the Free State, North West, Eastern Cape, Limpopo and the Western Cape all hover around the national average of 44 people per kilometre. These figures, unlike the very high population density in Gauteng and to a lesser extent KwaZulu-Natal, do not exclude the existence of potential demand for basic access roads in these provinces as they are still low by international standards – according to the United Nations World Population Prospects (2004) South Africa is only the 169th most densely populated country.

As mentioned, demand for basic access roads also depends on the number and distribution of schools and clinics within the specific regions. Fig. 2 illustrates the national distribution of all primary, secondary, and combined schools. The diameter of each point reflects the stipulated 5-kilometre catchment zone. From this, it is evident that the low population density in the Northern Cape is paired with a sparse coverage of facilities. In addition, the noticeably low facility coverage in parts of other provinces with low population densities - Free State, North West, Eastern Cape, Limpopo, Western Cape, Mpumalanga - are also likely to give rise to transport pressures and therefore an increased demand for basic access roads in these regions. Again, Gauteng and KwaZulu-Natal present a reduced demand for basic access roads on account of the high number and even distribution of service facilities.

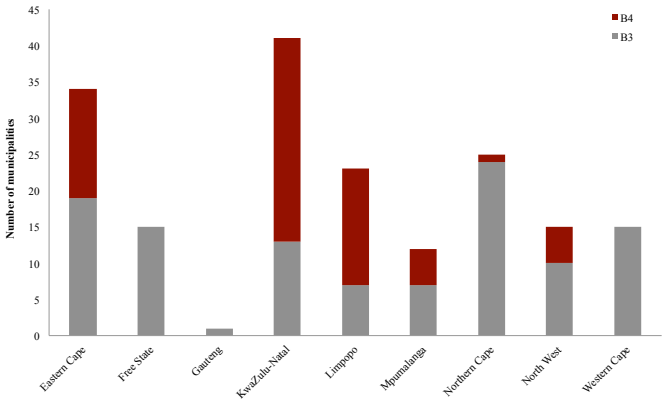
Fig. 2. Distribution of education facilities, 2015

Source: Department of Basic Education, 2015.

Because government takes the view that the separation of rural areas from cities and towns imposes artificial political and administrative boundaries between areas that are otherwise functionally integrated, the Constitution (Republic of South Africa, 1996) and Municipal Structures Act (Republic of South Africa, 1998) do not distinguish between rural and urban municipalities. Instead, rural municipalities are included in the demarcation of category B (B3 and B4) municipalities.

B3 municipalities feature several small towns, commercial farming areas, and dispersed settlements. According to the 2001 Census (Statistics South Africa, 2001), 52 per cent of the population within these municipalities reside in the various small towns and therefore enjoy effective access to basic education and healthcare facilities. The 29 per cent of residents who stay in the commercial farming areas and the 10 per cent of residents who stay in dispersed settlements on tribal land, however, are often isolated and require access to basic services through road connections. Fig. 3 illustrates the provincial distribution of the 111 B3 municipalities. The highest numbers of B3 municipalities occur in the Eastern and Northern Cape. With the exception of Gauteng, where the demand for basic access roads is expected to be low, there is a fairly even distribution of B3 municipalities in the remaining provinces.

Fig. 3. B3 and B4 municipalities

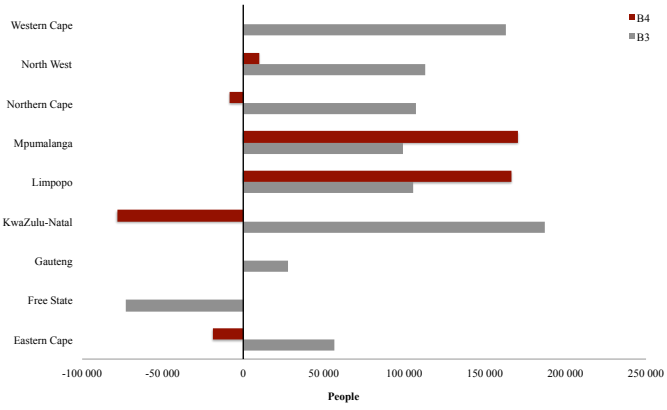


Source: Statistics South Africa, 2011.

B4 municipalities are classified as mostly rural and are dominated by scattered villages. At most these municipalities include only one or two small towns. The 2001 Census (Statistics South Africa, 2001) estimated that approximately 83 per cent of households within B4 municipalities live in tribal settlements, with an additional 7 per cent staying on farms and in small towns respectively. As shown in Fig. 3, the majority of B4 municipalities are concentrated in the former homeland regions of KwaZulu-Natal, Eastern Cape, and Limpopo. The few remaining incidences of mostly rural municipalities are in Mpumalanga, the North West, and the Northern Cape.

Population changes within the B3 and B4 municipalities give an indication of elicited future demand. Between 2001 and 2011, B3 and B4 municipalities in the Eastern Cape and Limpopo experienced net out-migration of 2,4 percent and 2,6 percent, respectively (Statistics South Africa, 2011). Over the same period 17 500 people left the Free State, 13 500 left KwaZulu-Natal, and 5 000 left the Northern Cape. Most of these migrants settled in the Western Cape and Gauteng, which both experienced significant in-migration over the period. There was also significant rural-urban migration within the provinces that is not recorded in the net migration data.

Fig. 4. Population changes in B3 and B4 municipalities, 2001 - 2011



Source: Statistics South Africa, 2011.

Fig. 4 shows the overall change in the population between 2001 and 2011 for all of the B3 and B4 municipalities grouped

by province. The effect of out-migration and rural-urban migration within the provinces has important implications for basic access roads. If the demand for basic access roads falls, this affects road maintenance and upgrading requirements. In order for the demand for basic access roads to at least remain constant, the birth rates for a specific rural area need to keep pace with the associated death rate, urbanisation rate, and out-migration rate combined. With the exception of B3 municipalities in the Free State and B4 municipalities in the Eastern Cape, Northern Cape, and KwaZulu-Natal, high birth rates have meant that all of the B3 and B4 municipalities have in fact experienced population growth.

VI. Extent of Basic Access Roads

It is important to check that basic access roads, if assigned lexicographical priority as per the normative framework discussed earlier, will not entirely or predominantly consume the available road budget before the demands of economic growth are attended to. Were we to discover such extreme budgetary implications from attention to justice, the resulting implied dilemma would be a cruel one: on the one hand we would be obliged to support funding of the basic access roads, but at the cost of starving the country of infrastructure resources required for the economic growth that is in turn necessary if South Africa is to reduce poverty and improve the life prospects of the poor.

In order to determine the extent of the required basic access road network, access issues must first be identified. To do this it is necessary to know where people are in relation to service centres. In the absence of healthcare data the GPS coordinates for all education institutions, analysed into primary and secondary schools to account for differences in number of facilities and distribution, are used to capture service centres. This information was combined with population data at the enumeration area level, enumeration areas being the lowest levels at which data were collected during the 2011 Census. The results are presented in the form of a heatmap in Fig. 5 and detailed in Table I.

Fig. 5. Heatmap showing the distance to basic services by enumeration area

Source: Own calculations.

Table I: Access distance to primary and secondary schools by province

	Enumeration Area Centre-Point to Primary Schools (kms)			
	Mean Distance	Max Distance	Max (99 Percentile)	Max (95 Percentile)
Eastern Cape	1,4	49,4	9,5	3,1
Free State	1,7	32,5	16,1	7,5
Gauteng	0,9	14,0	4,9	2,3
KwaZulu-Natal	1,3	16,3	5,5	3,4
Limpopo	1,6	50,3	15,2	5,6
Mpumalanga	1,5	61,2	10,6	5,1
Northern Cape	8,1	101,1	63,3	41,2
North West	1,8	50,7	13,6	6,3
Western Cape	1,5	67,1	20,7	5,5

	Enumeration Area Centre-Point to Secondary Schools (kms)			
	Mean Distance	Max Distance	Max (99 Percentile)	Max (95 Percentile)
Eastern Cape	1,9	65,6	15,1	4,3
Free State	2,6	37,9	23,4	13,4
Gauteng	1,2	19,2	7,0	2,9
KwaZulu-Natal	1,8	29,2	8,3	5,2
Limpopo	2,3	55,7	21,3	8,0
Mpumalanga	2,2	61,8	17,9	9,2
Northern Cape	11,5	122,1	73,3	52,5
North West	3,0	69,5	20,3	10,9
Western Cape	2,5	74,1	30,3	12,9

Source: Own calculations.

The findings presented in Fig. 5 and Table I are based on the assumption that people access the facility nearest to their place of residence. It is important to note that the existence of more primary than secondary schools leads to further travel distances for high school students. In line with the regional demand profile outlined in Section V, access conditions can be seen to vary across provinces. While distance is a significant constraint to access in most provinces, there is visibly less pressure on road authorities in Gauteng and KwaZulu-Natal to provide basic access roads.

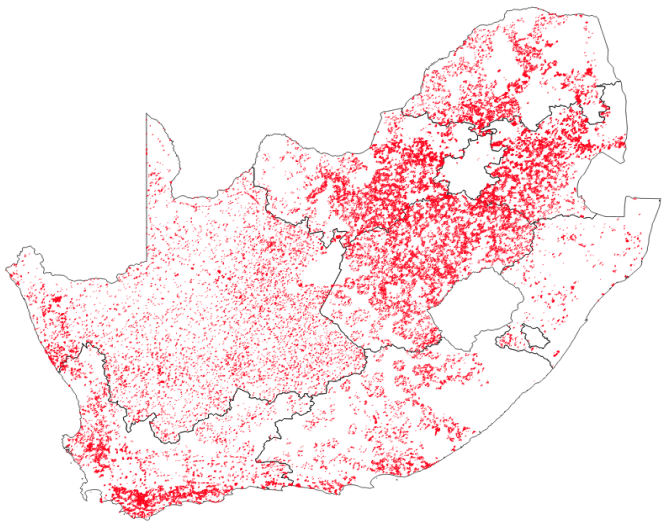
The next step is to include all roads that lie between the furthest students and the education facilities they must access. An outer perimeter, in the form of a buffer zone, is set for each school according to the distance within which 99 per cent of students in that province are from the nearest primary and secondary school. The details of the specific buffer zones are recorded in Table I. All roads that fall outside these perimeter buffer zones are removed from the analysis. All roads within 5-kilometres of each school, which is the prescribed maximum walking distance, are also removed from the analysis.

The remaining roads are controlled according to distance. In line with the given definition, only those less than 3 kilometres in length are kept in the analysis. To further ensure that all multi-functional roads are excluded, data cleaning was done to remove all arterial roads, highway on-ramps and off-ramps, main roads, secondary roads, streets, lanes, and avenues. It is not possible, however, to fully account for multi-functional roads without traffic count data. Given that this information is not available in South Africa, the estimated potential basic access road network is likely to be considerably larger than the actual basic access road network. This fact must be kept in mind when interpreting the results.

Fig. 6 depicts the resultant potential basic access road network, as well as the length of the network per province. The process outlined above was followed to control the approximate 750 000 kilometres of roads in South Africa for the characteristics of basic access roads. As suspected, Gauteng and KwaZulu-Natal have a relatively low incidence of demand

for basic access roads. Demand is higher and fairly evenly distributed across the remaining provinces. Fig. 7 depicts the same potential basic access road network, but adds all other roads in order to contextualize the results.

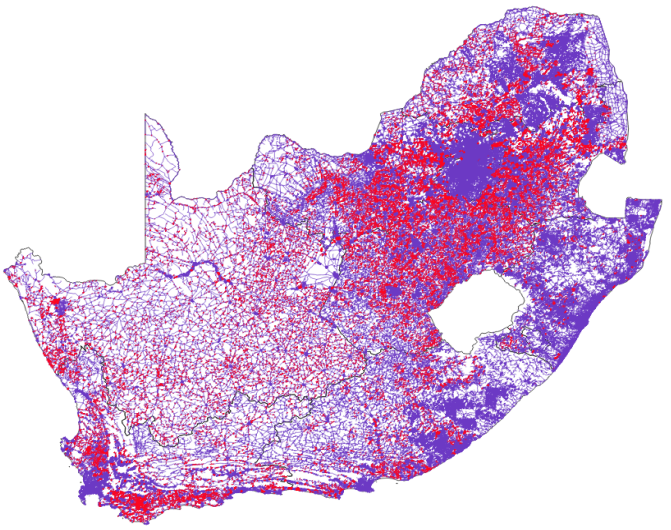
Fig. 6. Potential basic access road network



GAU	KZN	EC	LIM	WC	MP	NW	NC	FS	**Total**
123 km	784 km	4 836 km	7 054 km	7 385 km	7 421 km	10 394 km	11 754 km	12 440 km	**61 741 km**

Source: Own calculations.

Fig. 7. Potential basic access road network (red) compared to total network



Source: Own calculations.

In total, the optimized potential basic access road network is estimated to be 61 741 kilometres. It is important to stress again that this value is a maximum estimate, and likely includes several instances of multi-functional roads. Even still, this corresponds to only 8.2 per cent of the total road network.

VII. Conclusion

One might worry, in advance of research, that South Africa faces a paralyzing problem, an unthinkable trade-off between basic rights and economic growth. This turns out not to be the case, as much of the demand for basic access can be addressed through multi-functional roads. The remainder of the demand, although significant, is manageable within the current budgetary constraints. Engineers, policy makers, and citizens who fear that taking fully seriously the constitutional obligation to provide basic access roads would consume the entire road budget need not leave this consideration to lawyers and activists, and can incorporate it within a unified prioritization framework that is otherwise driven by economic principles.

Acknowledgements

We would like to thank the Southern African Bitumen Association for their financial and technical assistance with the research.

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