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NEW TRENDS OF RURAL TRANSPORT AND RURAL SUSTAINABILITY IN DEVELOPING COUNTRIES WITH EMPHASIS ON AFRICA

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Abstract

Rural road infrastructure remains a powerful tool for attainment of rural sustainability; rural sustainability planning should go hand in hand as urban sustainability because of their complementarity. And the neglect of rural transport is a bane to rural sustainability, which has brought dis-optimal use of rural resources hence low standard of living. The paper examined the trends in rural transport and rural sustainability in developing countries as a new way removing rural underdevelopment. The use of systematic literature review was adopted as methodology. The findings included rural roads are made of gravel or earth and mostly unsealed with low density and inadequate maintenance thus vulnerable to climate change effects. The roads are characterized by potholes, dust, lack of safety barriers, and lack of special lanes for intermediate means of transport. A symbiotic relationship and complementarity was established between urban and rural areas as necessary condition for rural sustainability that guaranty agricultural mechanization for bounty production and food self-sufficiency. The challenges to rural sustainability identified are deruralization, urban expansion, rural characteristics of low population density, and environmental degradation. It identified good connectivity as means for rural sustainability and rural transport can be improved through improved rural transport connectivity and use of right technologies for monitoring and management, building of storage facilities and adoption of demand responsive mobility. It thus recommended building of all-season rural road

EDITOR-IN-CHIEF
Prof. A.I. Mteiye [MALAWI]

infrastructure, regular rural road maintenance and intensive research on rural transport, and improved rural use of Information and Communication Technologies, and formulation of policy on agricultural land resource protection measures.

Introduction

The rural environment is predominantly for primary economic activities particularly agricultural production and extraction of resources in which the bulk of the produce and resources generated are consumed and utilized as input into secondary activities in the cities. This setting makes good connectivity and accessibility in terms of safe, reliable, and affordable transport services and durable transport infrastructure a priority in rural areas. This is pointing to the fact that any discourse of rural environment cannot be done in isolation of urban areas. And one basic and visible connection between them is rural transport infrastructure which to a large extent determines the prosperity of the rural areas on how well connected. Rural road infrastructure has the potential to bring about social and economic developments that can promote rural sustainability. The discourse of rural transport and rural sustainability is of paramount importance given the fact that approximately 68% of the world's rural population, still do not have all-season access to road networks (Limi, Ahmed, Anderson, Diehl, Maiyo, Peralta-Quiros, &. Rao, 2016).

Rural transport is thus inseparable from rural sustainability. It is a vital strategy for attaining sustainability for rural area. There is need to observe the principle of equity in the planning of both rural and urban transport because these components of human settlement complement each other. However, urban transport is given much more priority with little attention or neglect of rural transport. And the general submission in the literature is that good transport is a counter strategy against rural-urban drift, for reversing and drawing people back to farm for modern agriculture practices. In developing countries, motorized rural transport services and intermediate means of transport are generally run and maintained by private operators within the informal sector; and governments restrictive role in transport is the maintenance of road infrastructure, regulating against unsafe transport practices (with minimal enforcement) and taxing means of transport. The neglect and the non-proactive and laissez-faire approach of the government in carrying out its responsibility with respect to rural transport has resulted in unproductive consequence which is preventing millions of people from being more productive, from contributing to local economies and from having better qualities of life with deny access to income, health and education. This condition made many rural people to remain primarily subsistence farmers, with little impact on the regional economy (Starkey, 2007).

EDITOR-IN-CHIEF
Prof. A.I. Mteiye [MALAWI]

Rural settlement/environment is described as the growth engine of a country for food supply; and the rural populations are the custodians of the environment and ecosystems. Without any doubt road provision fits into the larger goals of rural development, with priorities on economic and social growth (O'Neill, 2011). The rural environment offers greater natural diversity, better contact with the natural environment, healthier places, cultural specificity, nurtured tradition, traditional values, and rich heritage than urban environment (Lekić, Gadžić, & Milovanović, 2018). And to really maximize the benefit of rural environment it needs to play sustainably with good transport. Therefore, the main goal of this paper is to examine rural transport, particularly the rural transport infrastructure and its essential for rural sustainability. The rest of the paper sheds light on some concepts; rural road characteristics, quality and challenges in Developing Countries; significance of rural road infrastructure; rural sustainability: Importance and Challenges; and nexus between rural transport and rural sustainability. The method adopted for the study is systematic literature review with focus on developing countries.

Conceptualisation

Concept of Rural Area

Jimoh (2004) pointed out that there are different ways for describing rural areas, among which is the use administrative centres as urban area while other settlements are regarded as rural as in some countries in South America; the use of functions in which settlements where people predominantly engaged in primary production are rural; and the use of population size of settlements and where relatively small number of people reside in dwelling places singly or in small group as in villages, hamlets are termed rural. A rural area is defined by OECD (1994) as a community with a population density of less than 150 individuals per km^2. US Department of Agriculture's Economic Research Service (2019) defined rural area as regions with fewer than 2,500 residents and a population density of less than 500 individuals per square mile.

The conditions in the rural areas in Nigeria are pathetic with bad roads, erratic power supply, and dearth of qualified manpower in the health and education sectors (Awojobi, 2014). Bryant and Granjon (2009) described sustainability of rural milieus based on four perspectives: the biophysical environment (rural areas and populations, open spaces, frame in which rural communities evolved which constitute the actual "rural" people); natural resources embedded in the biophysical environment (base for livelihoods in rural communities); rural milieus in close proximity to cities partial (resources for the well-being of urban milieus); and rural milieus (characterized by small communities, either concentrated into villages or dispersed, or both). The rural environment has a low-density built environment with more intensive presence of natural elements, it is, at the same

EDITOR-IN-CHIEF
Prof. A.I. Mteiye [MALAWI]

time, often connected to undeveloped infrastructure, limited mobility of inhabitants, and consequently to their isolation (Lekić1, Gadžić & Milovanović, 2018).

Rural area development is characterized by complex social phenomena, such as the lack of job opportunities, conditions of poverty, unequal development and health services coverage and quality (Roldan, Giraldo, & Santana, 2023). The rural areas are also more often characterized by out-migration, particularly of young people who leave to take advantage of greater educational and employment opportunities in the cities. This can erode entrepreneurial spirit and generally create dependency in relation to government support and subsidies, sapping the creative energies of the communities. The out-migration are common features of the homelands in South Africa, vast areas of Brazil, and many parts of rural India (Bryant & Granjon, 2009) which are usually based more on perceived differences in living standards and opportunities between rural and urban milieus and often create abject poverty, unorganized living in shanty towns at the edges of urban agglomerations (Bryant & Granjon, 2009).

Concept of Rural Roads

Rural roads are commonly planned, constructed and managed by the rural local governments in the areas under their jurisdiction and such include forest roads, canal roads, and village roads. They are described as low-volume rural roads (LVRR) carrying an Average Annual Daily Traffic (AADT) of 1000 vehicles per day or less, including both paved and unpaved roads (Faiz, Faiz, Wang & Bennet, 2012). Banjo et al. (2012) described rural roads as those connecting settlements of less than 2000 to 5000 inhabitants to each other or to higher classes of roads, market towns and urban centres (UNESCAP, 2019). In many rural areas, non-motorized transport modes include walking, cycling and riding animals, while human and animal traction and agricultural machinery such as tractors are commonly used to carry agricultural produce. Informal sector entrepreneurs provide services which include trucks, pick-ups, 'rural taxis', motorcycles, bicycles, and animal-drawn carts (UNCRD, 2015), and inland water transport systems for riverine communities (ESCAP, 2019).

Concepts of Infrastructure, Service and Nodes

Infrastructure represents physical access which in this respect includes tertiary roads, rural roads; trails, footpaths, small bridges, rural waterways, jetties and piers. It can also include feeder roads, secondary or link roads; provincial roads, some trunk/ primary roads; and some highways.

Services represent mobility inform of privately owned transport (including intermediate means of transport), local transport services, local buyers / brokers / suppliers. It can also

involve medium distance truck services, local transport services, local buyers / brokers/ suppliers, privately owned transport

Nodes represent sites of exchange and transfers such as local markets, local shops, local warehouses, local transport hubs, bus stops, IWT piers. It can also include urban wholesale markets, warehouses, transport hubs.

Concepts of Rural Transport and Connectivity

Rural transport infrastructure includes the rural road network, which generally refers to tertiary road network (i.e. all roads which do not fall under the secondary or primary road networks) such as paths, tracks and trails; and local bridges (UNESCAP,2019). Yap (2019) gave the alternative way for the provision of rural roads in the peri-urban areas to involve private real estate developers who do invest in roads connecting their new housing developments to primary roads, but those people living outside of these developments rely on the government, which often take much longer to build.

Connectivity is defined as the capacity for areas and people to be connected, either physically or non-physically, through transport or communication (UNCRD, 2017) and this could be measured for a place by the number of trips taking place to/from that place, access to rural roads, such as the use Rural Access Index (RAI). Rodrigue (2017) defined connectivity as the extent to which flows of passengers or freight from a node can reach other nodes either directly or indirectly. Rural Access Index is measured as the share of the rural population who live within 2 kilometers (typically equivalent to a walk of 20-25 minutes) of an all-season road as a proportion of the total rural population. An all-season road is defined as "a road that is motorable all year by the prevailing means of rural transport (often a pick-up or a truck, which does not have four-wheel-drive) (UNESCAP, 2019).

Concepts of Sustainability, Rural Development and Sustainable Rural Development

Sustainability encompasses preservation of livelihood through maintenance and enhancement of resource productivity on long-term basis with no adverse effect on the environment with in-built formidable resistance to stress and shocks. Livelihood refers to adequate stocks and flows of food and cash to meet basic needs (Chambers & Conway, 1991).

Tisdell (1988) coined development as the modification of the biosphere with the application of human, financial, living and non-living resources to satisfy human needs and improve the quality of life. Laah et al. (2013) thus defined rural development as the product of various quantitative and qualitative changes in the midst of a rural population with converging impacts, in time, indicating an increase in the standard of living and favourable changes in the way of life of the people concerned.

EDITOR-IN-CHIEF
Prof. A.I. Mteiye [MALAWI]

Sustainable rural development refers to the improvement in the quality of life of the rural people by developing capacities that promote community participation, health and education, food security, environmental protection and sustainable growth, thereby enabling community members to leave the cycle of poverty and achieve their full potential. It is concerned with the use of resources of rural communities to increase their standard of living optimally (Awojobi, 2014).

Rural Road Characteristics, Quality and Challenges in Developing Countries

The rural roads are often a lifeline for rural communities. The rural road networks in most of developing countries consist predominantly of roads of gravel or earth construction and much of the trunk road network also remains unsealed. For instance, only 7% of the entire classified road network is bituminized in Tanzania. The problem with gravel roads is that they often deteriorate rapidly, especially in the wet season, disrupting transport services and hinder access to other social benefits. The gravel roads are characterized by short road-life expectation due to erosion and wear, lack of drainage and watercourse crossings, damage to health and detriment to farming productivity from dust, and damage to road users and equipment from rough roads, gravel road deteriorated rapidly if not maintained timely (grading and regravelling), and funding for upgrading being a serious problem (O'Neill, 2011).

Further, the road quality constitutes a crucial limiting factor to rural transport, poor roads lead to long journey times, unreliable services, high operating costs, high fares, poor access to health (and consequently higher mortality), poor access to education (and consequently lower school attendance), low participation by rural people in the regional and national economy and increased isolation from markets and services (Starkey, 2007). It clear from foregoing that rural transport services are not constant, but vary greatly, with daily, weekly, monthly and annual fluctuations. The regular use of rural transport do occur during periodic markets (weekly, monthly), during holidays and festivals are period of major surges in traffic in the rural areas. Also, more traffic are experienced during harvest times which stimulate itinerant traders to visit rural areas such as cocoa harvest in Cameroon; whereas closed seasons can significantly reduce transport such as fish ban months in Zambia. Some roads are completely impassable during the rain seasons, bringing motorized traffic to a halt. The fluctuations in traffic affect rural people, who may adjust their travelling, produce sales and family visits accordingly (Starkey, 2007). And due to dispersed populations, longer distances and varying levels of demand, rural bus services can be challenging to operate commercially. There are more opportunities to walk, wheel and cycle safely (The Department for Transport, 2023). The usual practice in rural transport is Demand Responsive Transport (DRT) which is a form of shared mobility that allows users to specify their desired location, pick-up time and drop-off time, usually

nowadays through an online platform, app or phone service. These services are especially attractive in rural areas due to dispersed demand and fixed route services such as buses, can be difficult to operate commercially. DRT increases fixed-route bus services and connectivity to areas that might otherwise not benefit from a traditional, fixed-route service (The Department for Transport, 2023).

Furthermore, the rural transportation according to Henning-Smith et al. (2017) is faced by such challenges in US as infrastructure, geography, funding, accessibility, political support and public awareness and socio-demographics in order of significance. This is corroborated by Community Development Extension Educator (2020) that barriers to rural transportation are funding, low population numbers; longer travel distances and cultural challenges to adoption in rural areas including stoicism (personal pride or independence). The challenges faced by Africa's rural people in accessing distant services and markets are enormous due to poor provision and maintenance of road infrastructure plus poor transport service availability, unreliability, high fares, and safety issues because ownership of motorized vehicles and intermediate means of transport is often restricted to rural elites (Porter, 2016).

The density of road networks remains low in rural areas with inadequate maintenance (EXIM Bank, 2018). In rural communities in Africa, a road is often an essential lifeline linking isolated villages to economic opportunities and services and only one-third of rural population live within two kilometers of an all-season road in Africa, which is the lowest accessibility rate (Ako & Wanie, 2022);. Also, bad roads and inadequate fleets of vehicles are common features (Nwafor & Onya (2019) and 20% to 40% of agriculture produce in Africa is lost in transit causing food insecurity and price increase (Songwe, 2012). In addition, the neglect of rural road infrastructures has limited the level of agricultural activities of most farmers (Olorunfemi, 2018; Olorunfemi & Adenigbo, 2017) as well as inadequate number of transit vehicles, recklessness and highway robbery (Nwafor & Onya (2019). Obademi, Nwokobia and Onuh (2023) discovered that people in rural areas of Otukpo and Agatu LGA of Benue State in Nigeria do not have access to good roads, and the bad roads in those rural areas have hampered agricultural development. Also, Ako and Wanie (2022) observed that rural-urban roads in Maroua (Cameroon) are dilapidated and inadequate, making movement difficult especially during the rainy season affecting negatively different dimensions of food security.). For instance, improved road condition reduced the transport costs of bananas in Kenya by 14% (AFCAP, 2013) while poor road links recorded increase in transport costs in rural Tanzania (Seiber, 2009).

In developing countries, over 90% of the road network remains unpaved, mostly graveled and difficult bottleneck in maintaining them. Also, maintaining all-weather access in rural environment is more problematic as good gravel resources is depleting as traffic increases. Besides, rural roads are not well managed premise on huge problems led by

inadequate funding; and serious weakness in managing rain barriers which usually render some communities completely inaccessible for part of the year (Starkey, 2007). Starkey (2007) summarised the challenges to rural road transport as follows.

i. Inadequate infrastructure due to potholes, dusty roads, long grass obscuring vision, lack of safety barriers, lack of livestock fencing, inadequate signs, lack of traffic calming measures, and lack of special lanes for intermediate means of transport;
ii. Unsafe vehicles due to poor tyres, inadequate lights and reflectors (including carts), inadequate brakes (including bicycles);
iii. Unsafe loads due to high and unstable freight, passengers on top of vehicles, mixed passengers and freight, passengers crowding driver (rural taxis and motorcycles), overloaded boats;
iv. Unsafe behavior resulting from high speed, alcohol/drugs, wrong side of road (IMTs), inadequate attention (drivers, pedestrians), lack of safety measures (seat belts, crash helmets, life vests);
v. Vehicle overloading (with passengers and/or freight) looks dramatic; driver errors (high speed, drugs/alcohol and/or inadequate attention) are arguably more dangerous for rural people.
vi. Rural people seldom raise safety as a key issue, and
vii. Rural transport services are generally unreliable and unpredictable.

In some rural areas of developing countries with perennial experience of shortage in transport modes, the common practice is to use pick-ups or light trucks. Starkey (2007) reported that the truck operators ply regularly the rural routes, carrying freight and people, particularly common in areas with poor roads, where vehicles with low clearance may get stuck. Large trucks may carry as many as 100 people on top of a freight load. Despite the discomfort of standing in a truck, or sitting on sacks, some passengers prefer trucks to rural taxis.

Road maintenance is a critically issue if the maximum benefits of roads are to be realized; insufficient drainage left a large part of the feeder and rural road system unusable during the monsoon season (Faiz, 2012), poor maintenance render the road infrastructure vulnerable to climate change effects. Also, the rapid expansion of rural road networks in some countries make maintenance costs ballooning. The negative impacts of transport projects in rural areas include physically divided communities; increase in traffic accidents and fatalities; air pollution from increased traffic; run-off from roads polluting water bodies (Sheng, 1990); deforestation; transmission of diseases associated with increased traffic flows and truck drivers; Kuruppu and Ganepola (2005) added psychological and emotional effects from displacement and loss of livelihoods (ESCAP, 2019).

EDITOR-IN-CHIEF
Prof. A.I. Mteiye [MALAWI]

Significance of Rural Road Infrastructure

Rural transport is a lifeline for roughly 50% of the world's population. It facilitates people's access to jobs and markets; schools and health clinics; social events and religious gatherings, supports the movement of essential goods into rural areas, such as inputs to agricultural production, and movement of goods out of rural areas, such as food and forestry products to urban markets. It also facilitates the provision of services to rural residents, such as government officials, agricultural extension workers, teachers, and health workers to rural people and rural residents' access to services in nearby towns (UNESCAP, 2019).

Rural road infrastructure can influence increase in farm yields, decrease in production costs through its effect on access to fertilisers, mechanised equipment and high-yield seed varieties and open way for labour, agricultural extension workers and veterinary services to rural environment. It invariably makes attainment of rural sustainability easy and enhances, by its effect, food security, rise in profits for local producers and increase in their purchasing power, reduce post-harvest losses and transport costs to competitive input markets and remunerative output markets. It encourages the development of local markets like in Vietnam (Fan, Olofinbiyi, & Gemessa, 2015), small-scale businesses and farming as in India (Fan, Hazell, & Thorat, 2000), facilitate daily waged employees and migrant labourers mostly on bicycles (Asian Development Bank, 2002). In addition, the rural roads can influence the relative prices of factors of production, including different types of labour and fixed assets such as land. For example, Khandker, Bakht, and Koolwal (2009) show that in Bangladesh, investments in rural roads increased wages; while a study in India shown a shift of rural labour from agricultural to wage jobs which occurred in the villages closer to the cities (Asher & Novosad, 2016).

Rural Sustainability: Importance and Challenges

Rural sustainability can be defined as a continuous search for development strategies, which aims at a general improvement in the human condition, in maintaining and producing "healthy" rural communities in their economic, socio-cultural, political and environmental values. Rural sustainability, like urban sustainability, is a social construct which attainment process is dynamic in information, understanding and values evolving over time. It should be noted that the strategies for rural sustainability appropriate at a time and place may become inappropriate in the same place as other changes occurred; and strategies find appropriate in one place at a given time may be quite inappropriate in another place at the same time.. This further shows that sustainable development strategies must be socially and culturally acceptable and politically palatable in the short term. For rural sustainability to be attained substantial changes are required to achieve greater social equity (Bryant & Granjon, 2009).

EDITOR-IN-CHIEF
Prof. A.I. Mteiye [MALAWI]

Bryant and Granjon (2009) described rural sustainability as depended on synergetic relationship between urban and rural milieus and vice versa. They argued that key to achieving rural sustainability depends on the multi-functionality of rural areas' contribution in a substantial way to urban sustainability. This required appropriate local action and planning to achieve such significant local communities' participation. This means that many small towns and medium-sized urban areas are intimately tied to their surrounding rural environment with in terms of service provision. This demonstrates that complementarity between urban and rural areas must be sustained in achieving rural sustainability. Indeed, UN HABITAT (2017) coined it that urbanization is a driver for rural development, and effort has to be in strengthening "urban-rural linkages". Sustainable rural development involves a holistic approach for meeting the basic needs of rural populations through reliable public utilities combined with technical, socioeconomic, and environmental conditions to support regional economies and urban-rural linkages. It is a process aimed at creating favorable conditions for the economic, social and environmental development of rural areas, which ensures that the needs of the present generation are cared for without jeopardizing the ability of future generations from meeting their own needs. It protects and preserves the economic base of rural areas in its environmental and cultural heritage and ultimately enhances the life of the rural population.

Rural living provides unique opportunities to minimize energy needs, reduce carbon footprint and lower contributions to global climate change. In fact sustainable development is guided by five principles of conservation of the ecosystem or the environment; conservation of biodiversity of the planet; sustainable development of the society; conservation of human resources; and population control and management. In addition, Ako and Wanie (2022) submitted that sustainability entails mechanization of agriculture for bounty production that guarantees food self-sufficiency and prevents wasteful natural resources for present and future development without having detrimental effect on the environment or on the health of the population. For instance, the use of chemical fertilizers in a bid to increase productivity must not compromise the quality of food and livestock produced for the consumers in the city.

The main challenges to rural sustainability are examined here, with the leading challenge being deruralisation. Deruralisation is a process of rural depopulation, rural flight, or rural exodus, which represents the manifestation of migration of rural population. It is regarded as 'the new phase of globalization' (Czaika & Haas, 2014; Overbeek, 1995; Stalker, 2000). Kovács, (2009) opined that if deruralisation is not stopped, it can lead to the killing of rural area which implies 100% urban by the year 2152; which may lead to disappearance of a large part of cultural tradition in a monotone society of no identity (Kovács, 2009). Deruralisation will simultaneously occur with urbanisation, hence, rural

sustainability must be planned simultaneously with urban sustainability (Bryant & Granjon, 2009).

Another challenge to rural sustainability is uncontrolled non-farm residential development in farm areas (urban expansion) which has led to conflicts between farm and non-farm uses and in most cases displaces farming. Also, low density and widely dispersed populations characterize many remoter rural regions, isolation and lack of leadership in a stagnating socio-economic environment may be another difficult challenge for rural sustainability (Bryant & Granjon, 2009).

Rural sustainability may also suffer from desertification, deforestation, soil erosion, declining water tables, salinization, pollution, greenhouse gases and global warming, the ozone layer, irreversible use of the world's stock of non-renewable resources, and the use of sinks (e.g. the sea for carbondioxide) for pollution emissions (Chambers & Conway, 1991

Nexus between Rural Transport and Rural Sustainability

Rural transport and rural sustainability are inseparable because without good access sustainable rural environment will remain a mirage. Sasidharan (2019) identified the use of rural transport to achieve rural sustainability with such means as sustainable rural development through good connectivity and social cohesion promotion; promotion of commercial activities and accessibility to face out poverty, isolation and social exclusion; and food security through lower costs of farm inputs and lower transport costs for marketed outputs. European Commission (2023) also identified three priorities for rural development and rural sustainability in the EU these are environmental sustainability; social sustainability; and economic sustainability.

Importantly, investment in rural transport infrastructure will improve connectivity to link different network levels together; UNESCAP (2019) exemplified on how rural transport may be improved for rural sustainability to include, increase investment in rural transport connectivity, rural transport services and transport nodes; strengthen rural road asset management and monitoring through building of public sector capacity in GIS and use of GIS and Rural Access Index; and strengthen research on rural transport.

Rural sustainability according to Lekić, Gadžić, and Milovanović (2018) require proper management, planning and improvement of rural settlements through educational programmes, agricultural waste management, improvement of agricultural mechanisation, and exchange of knowledge and experiences in agricultural skills (United Nations, 1972); increased food production and food security, and developing and use of new technologies (United Nations, 1992); and involvement of various institutions, agencies, government and non-governmental organizations (Economic and Social Council, 1995); creation of policy to strengthen sustainable forms of agriculture through

industrial farming practices that protect biodiversity, increase soil fertility, and ensure safe and nutritious food for all (United Nations, 2012); facilitate contribution of rural businesses and social enterprise that increase job opportunities in rural areas (Steinerowski & Steinerowska-Streb, 2012; Steiner & Atterton, 2014, 2015); strengthen local leaders role in governmentality (Beer, 2014); strengthen community landownership for reconstructing rural development (McMorran, Scott, & Price, 2014); and enlightenment on gain of rural branding ; Swinney, Lang, & Runyan, 2012); identity and introduce method of coping with environmental threats (Messer, Shriver, & Adams, 2015); improve traditional farming systems and craftsmanship with resilient and adaptive socio-ecological system.

Also, viable for rural sustainability is non-motorised mechanism which according to Ako and Wanie (2022) includes construction of storage facilities for surpluses keep to maintain stable prices at time of deficit; and transformation of agricultural produce (create light processing industries). The adoption of new forms of mobility, such as demand responsive buses, shared cycle schemes; car clubs at rural rail stations and mobility hubs to increase connectivity and tackle social issues (The Department for Transport, 2023).

Conclusion

The study has brought to light that a symbiotic relationship and complementarity between urban and rural areas is identified as a necessary condition for rural sustainability that can guaranty agricultural mechanization for bounty production and food self-sufficiency. It shows that tackling the challenges of deruralization, urban expansion, rural low population density, and environmental degradation may go a long way in promoting rural sustainability. Also important for the attainment of rural sustainability is good connectivity, adoption of technologies for monitoring and managing rural roads, building of storage facilities and use of demand responsive mobility.

Recommendations

The integration of adequate rural transport to cover the rural environment is inevitable in the efforts at achieving rural sustainability; and from foregoing the following suggestions are put forward to facilitate the symbiotic relationship between rural transport and rural sustainability.

First, the rural roads should be made all-season road infrastructure with availability of transport services to support increase food security, allowing farmers to sell their produce to a larger market at competitive prices. They should be efficiently channel for goods and services supporting farming to reach farms at less cost; enhancing food distribution and lower transport costs via shorter journey times, lower fuel consumption rates and less vehicle wear and tear.

Second, road maintenance should be prioritized in rural areas with adequate attention to regular repair of damaged roads and adequate funding should be made available to position rural transport for sustainability in terms of rural economy and living.

Third, there is need to intensify research on how to innovatively convert the local materials to suitable, durable road construction materials and the engineers should design and built weather resisting roads in the rural environment with such materials. There should be Roads Boards for rural areas to maintain and monitor all existing sealed roads and simultaneously, responsible for upgrading of unsealed roads to sealed ones with better technical innovation.

Fourth, the complementarity between urban and rural areas should be strengthened and perfectly developed for solid foundation in rural sustainability planning. This can be a key to stem down the process of deruralisation. In addition, for sustainability of rural environment there should be improvements in Information and Communication Technologies (ICT) and mobile telephony enlightenment and utilization in rural areas to further remove the barriers in communication between rural areas and towns and cities. This can promote the exchange of goods and people, ideas, values, cultural practices both physically and virtually across multi-layered networks.

Fifth, a strong policy on agricultural land resource protection measures such as conservation should be instituted to protect agricultural land resources against encroachment and check to unplanned urban expansion. Also, agribusiness and other innovations to promote sustainable food value chains in connecting agricultural producers to global markets should be encouraged.

Sixth, to avert the negative effect on stok of renewable resources, strategy must be put in place to improve productivity of renewable resources like air and river water, soil, organic soil fertility and trees.

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EDITOR-IN-CHIEF
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