chapter 17

Commentaries on Infrastructure

Sudhir Wanmali and Francis S. Idachaba

SUDHIR WANMALI

Although important to both planning and performance, infrastructure is not easy to define and is difficult to relate to agricultural development in an integrated manner. It is rarely recognized in the current literature that sectoral allocations, distribution systems, indigenous technical knowledge, and social systems are all integral parts of infrastructure. Its effectiveness and efficiency can be understood only by interdisciplinary analyses.

Research in India has shown that government investment in local infrastructures is an important determinant of the type and location of complementary infrastructures provided by the private sector. For example, government investment in irrigation, roads, and service facilities such as marketing, storage, processing, banking, credit, and the provision of agricultural inputs was followed by private investment in similar sectors of the rural economy (Wanmali 1981, 1983a, 1983b, 1984, 1985). Unfortunately, until recently government planning for development in most developing countries has favored establishing industrial units in urban centers without adequate consideration of the service infrastructures required for a dynamic agriculture. This has led not only to differences in farmers' access to publicly controlled service facilities but also to distortions in the type and location of services offered by the private sector.

Even where attempts by the government sector to provide certain services appear to have made distribution of goods and services more accessible to the rural population, important inefficiencies have arisen. Recognition of differences in consumer behavior by different types of households has not been adequately recognized. Some goods and services are required much more

frequently than others (Wanmali 1985). Also, the potential of the private and traditional sectors to better provide goods and services has not been accorded due consideration (Wanmali 1981).

Numerous researchers, including Lipton in this volume, have noted that the central physical grid infrastructure (CPGI) of transport, communications, power, water, and storage has been of little help in the development of agriculture in sub-Saharan Africa, particularly in relation to the benefits from alternate uses of these funds to promote farming. The consensus appears to be that sub-Saharan countries need to shift resources toward smallholder cultivation through study of local climate, environment, farmers' values and perceptions, indigenous technical knowledge, and provision of rural education and health services. It is believed that infrastructure has usually been inappropriately designed because it typically is viewed solely in CPGI terms. The main argument of this commentary is that investment in CPGI is not the best indicator of the impact of infrastructure on agricultural and rural development. Other kinds of infrastructure are at least as important. These typically require resource allocations that go far beyond study of smallholder systems and provision of human and social services.

For planning purposes, local knowledge of climate, physiography, soils, water, vegetation, population, and other aspects of environment needs to be collected, stored, and analyzed before planning agricultural development in a region. (A region is considered here as a national subunit rather than as a grouping of nations.) This should be done by national institutions in collaboration with regional and local institutions. These institutions are responsible for various forms of data collection and analysis, such as surveys of topography, plants, geology, underground water, soils, land use, climate, and population. In the absence of such a data base, the process of planning for agricultural development would not only be weak but also faulty; hence the great importance of further work in this area. This information is utilized by agricultural research, extension, and teaching systems. Together, these institutions form an important part of infrastructure and is termed centrally provided institutional infrastructure (CPII).

Also necessary for the development of agriculture are such services as postage, registration, money orders, radio licenses, telegraph, and telephone; cooperative societies, cooperative banks, land development banks, commercial banks, agricultural refinance organizations, and insurance companies; bus and train services and goods transport; veterinary dispensaries and hospitals; seeds, fertilizer, pesticides, and agricultural implements and machinery; and marketing facilities for food grains, cash crops, meat, dairy, and poultry products.

Distribution of these services could be provided by the government or jointly by government and the private sector. Such distribution systems have strong local, regional, and national links. For example, as Blackie points out,

the Grain Marketing Board in Zimbabwe is responsible for procurement of food grains from farmers at depots for which the areas of operation are delineated by the government. Let this type of infrastructural development be called a centrally provided soft infrastructure (CPSI).

Given the structure of African economies, it would be reasonable to expect that in ministerial and departmental budgets, CPII and CPSI allocations are likely to be substantial. However, there is insufficient evidence in current literature on infrastructure to determine the levels and importance of CPII and CPSI in sub-Saharan Africa and on their role in facilitating development of agriculture. Also needed are details of budget allocations for CPII and CPSI within the ministries of agriculture, rural development, irrigation, local government, health and education, transport, communications, and industries. To consider only CPGI is to overlook other major components of infrastructural investment.

For example, in Zimbabwe elements of all infrastructures are included in the budgetary allocations of the government departments and ministries. For present purposes, Zimbabwean infrastructural development is categorized into CPGI, CPII, and CPSI. The country's 1979–84 budget allocations in these categories is shown below:

Infrastructure	Thousands of Z$	Percent of budget
CPGI	792,483	43.79
CPII	483,172	24.21
CPSI	578,856	32.00

CPGI includes development of power, telecommunications, water supply, roads, and railways. CPII includes development of geological surveys, meteorological surveys, and training in technical and educational fields. CPSI includes development of marketing, roads, agricultural finance, input distribution, agricultural extension, veterinary services, minor irrigation, and other agriculture-related rural development. These allocations do not capture all elements of infrastructure. But the table makes it apparent that CPGI is only a part of the total.

This pattern appears to repeat itself at the regional level in Manicaland Province, where just above 70 percent of the proposed investment funds are designed for CPII and CPSI (table 17.1). Although this is a welcome shift from investment predominantly in CPGI, it still does not give sufficient information about the patterns of physical access to a CPSI type of infrastructure. It is also worth bearing in mind that the tables do not give any details at all (since these are unavailable) of the multiplier effects of this government investment on that of the private sector.

CPGI not only partially indicates the impact of infrastructure on agricultural

and rural development but also indirectly influences development of the agricultural and rural sectors. This influence should be judged in conjunction with the patterns of investment in CPII and CPSI. However, sub-Saharan African countries have made little attempt to integrate these infrastructures spatially and temporally while analyzing their agricultural development. In this regard, it is important to avoid confusing sectoral allocation and national-level investment with regional and local impact. Allocation of resources to certain infrastructures does not automatically mean easy access to them at any level. For example, expenditure for the establishment and operation of collection depots of the Grain Marketing Board in Zimbabwe does not necessarily insure that these are equally accessible to all farmers. They may be inaccessible or even nonexistent in many of the smallholder farming areas.

Analysis of CPGI provides few clues as to why the actions of governments seem to make no sense economically, particularly with regard to the development of infrastructural facilities. Lipton, for example, argues that the countries of the Southern African Development Coordination Conference (SADCC) are spending valuable and scarce resources on roads, railways, power, and communications, which are likely to help the Republic of South Africa. This argument is not adequately developed. It would be useful to know if these developments are pan-African in nature or if they simply strengthen the colonial routes to the Republic of South Africa. If they are the latter, they need to be reviewed carefully. The crucial point is that, for the newly independent SADCC countries, CPGI-type development *now* could lead to greater interaction, consultation, and trade with each other *in the future*. When that happens, all roads in southern Africa need not lead to the Cape, as they do now. It would then be possible for the SADCC countries to focus more clearly on the development of their respective CPII and CPSI. This is, perhaps, what the SADCC countries have been attempting to do in the early years of their independence.

Table 17.1 Budget allocation for infrastructural development in Manicaland Province, Zimbabwe, 1984–89 (thousands of Z $)

	Type of infrastructure			
District	CPGI	CPII	CPSI	Total
Buhera	720	0	948	1,668
Chitepo	0	0	469	469
Gazaland	200	150	500	850
Mabvazuva	156	0	1,001	1,157
Maungwe	540	0	1,091	1,631
Mutare	195	0	676	871
Nyanga	0	20	162	182
Total	811	170	4,847	6,828
Percent	26.41	2.49	71.10	100

Sources: Zimbabwe 1983a, 1983b, 1983c.

Thus, infrastructure is an important element of planning agricultural development. Whereas there have been some excellent studies on infrastructure, unfortunately these have been limited to CPGI—and then only to analyses of the economic aspects. An integrated interdisciplinary view of infrastructural development is still lacking in the sub-Saharan African development literature. An attempt is made below to provide an outline of a contribution in this vein.

The respective roles of various infrastructures in the process of planning for agricultural development in Zimbabwe can only be adequately identified if data on sectoral allocations for CPGI, CPII, and CPSI are obtained. Further, this would permit the government to improve its analysis of the overall pattern of service provision through its own investment and through its policies toward the private sector. The purpose of a regional analysis is to explain the role that differing populations, settlement patterns, traditional systems, and levels of other sectoral developments play, if any, in influencing the final form of CPSI and its delivery system. On the basis of such an analysis, gaps in the provision of CPSI could be identified and proposals made to reduce them.

Although it is true that adequate and appropriate geographical access to goods and services is crucial if increases in agricultural productivity are to translate into successful rural development, it must also be borne in mind that increases in productivity themselves do not take place unless there is also adequate provision of infrastructural facilities and services. Thus it is essential in the Zimbabwean context to help improve access to CPSI through greater articulation of the settlement systems of the districts. In the present context, articulation means the description and analysis of existing infrastructures and, based on these, prescriptions for removing bottlenecks in their provision. Although such studies are not available for Zimbabwe, an articulation of the settlement system based on regional analyses has been found useful in improving overall access to various rural services in other parts of the Third World (Wanmali 1981, 1983a, 1983b, 1984, 1985). These studies show that the use of some of the soft infrastructure services was positively influenced by income but negatively by distance. These services, which could be categorized as agricultural support and retail food and personal services, showed a tendency for lower frequency of use by households with increasing distance of the services from the households (Wanmali 1985).

It is felt that only by analyzing all three types of infrastructure is it possible to offer adequate explanations of their effects on agricultural development. In doing so, however, it is important to realize that long-term economic gains can be achieved only with simultaneous investment locally in CPGI, CPII, and CPSI. More research needs to be done in Zimbabwe and other parts of the Third World on the economic and geographical aspects of infrastructure provision and use at the regional and household levels, using primary field data, before governments can expect to identify the options available for the planning of national agricultural development.

Where will this lead? Purely from the point of view of physical access to infrastructures, it can be hypothesized that once the latter are made available at shorter distances than before, the savings on both costs and time would be retained locally and, indeed, could be used more fruitfully. These savings could strengthen production systems and demand linkages of various types. Besides, investments in infrastructure by the government do tend to have both regional and local multiplier effects in the private sector. The overall impact would be felt in the area of production and consumption, both regionally as well as at the household level. There is, of course, a time scale over which the above scenario will unfold, but it will be possible to determine its span once the program (and not merely projects) of infrastructural development is agreed upon.

FRANCIS S. IDACHABA

Many African governments and their advisers have tended to concentrate on the generation and supply of new technologies and appropriate pricing and economic incentives, almost to the total neglect of rural infrastructures.

If we view infrastructures as different types of capital capable of yielding services or future income (Fisher 1927), infrastructures can be classified in three ways: physical infrastructures, such as roads, irrigation and flood control facilities, and ferries and bridges; social infrastructures, such as health and education; and institutional infrastructures, such as farmers' cooperatives and rural institutions. This approach facilitates analysis in terms of assessing demand for and supply of infrastructures and setting decision criteria for priority investment in different types of infrastructures. It also has merit in emphasizing that infrastructural investment—even in health and human capital—is a factor of production in agriculture (Welch 1970; Everson and Kislev 1975).

Four key issues need to be addressed. First, what are the contributions of infrastructures to agricultural growth and development? Second, what are the sources of demand and supply? In particular, what is the optimal division of infrastructure supply between the private and public sectors and among the various tiers of government? Third, what criteria should guide public investments in rural infrastructures and what is the optimal sequence of these investments? Fourth, what is the empirical evidence on present rural infrastructures?

Contribution to Growth

Rural roads constitute perhaps the most important single factor for transforming rural sub-Saharan Africa. A decentralized, widely dispersed, and diffuse smallholder production system requires a widely dispersed network of rural feeder roads. Linked with national trunk systems, these roads would ensure more efficient evacuation of farm produce and delivery of farm inputs. Other benefits

include savings in energy and time, reduction in vehicle operating costs, improved agricultural production efficiency from greater regional specialization, and enhanced national social cohesion, to mention a few.

The development, maintenance, and management of small-scale and medium-scale irrigation facilities are the keys to national food security and sustained national food self-reliance through the alleviation of the devastating consequences of drought. (Although large-scale irrigation infrastructures have engineering appeal and technical grandeur, and policymakers in country after country prefer them to smaller projects, they are excessively demanding of funds and management skills and they benefit only a small fraction of total farming families and arable land.)

Social infrastructures—education and health in particular—have absorbed colossal amounts of public resources in sub-Saharan Africa and can be classified as intensive investments in human capital. The Nigerian experience with social infrastructures is the built-in "recurrent expenditure trap," by which staff salaries and other recurring costs of social capital come to absorb the largest share of national budgets. In a country like Nigeria, where primary school teachers' salaries alone cost about $1 billion a year, free primary education nationwide is at least as capital intensive as a major road program and not necessarily more productive.

Demand and Supply

The prevailing supply side approaches have resulted in wide rural-urban disparities in per capita infrastructures. Those rural infrastructures constructed by state and national governments deteriorated rapidly, since no system for maintaining these roads developed at the grassroots level. Evidently, rural communities failed to attach importance to these infrastructures.

A demand side approach would involve local communities first in drawing up priorities for rural infrastructure and second in planning a program for maintaining them. The optimal division of responsibilities among tiers of government is (1) national concentration on those infrastructures with significant divergence between private and social returns (such as transportation trunk lines that cut across agroecological zones, agricultural research, institution building, human capital accumulation) and (2) local concentration on those infrastructures that directly benefit their catchment areas (rural roads and applied on-farm adaptive research).

Criteria for Public Investment

Farmers will invest in infrastructures up to the point where the present value of expected returns equals costs at the margin. However, little or nothing is known about realized rates of return on investments in infrastructures in rural areas or

how they relate to private returns on similar investments in urban areas.

Given the lack of knowledge about the financial returns to private investment, the inadequacy of private investment in certain types of rural infrastructures, and the severe budget constraints of African governments, criteria to guide public investment in rural infrastructures are required. How should a planner allocate funds between rural feeder roads and a network of farm service centers? How should project management allocate a year's budget between infrastructures and agriculture proper?

More work is needed on criteria for optimal allocative sequences that can be used as a basis for preparing projects. Such criteria would include not only expected contributions to agricultural production but also complementary relationships among infrastructures as a guide to their sequencing. In the World Bank-assisted Funtua agricultural development project in Nigeria, for example, the first 10 farm service centers were located along existing roads while other roads were being built.

Evidence on Present Rural Infrastructure

As a general rule, available evidence on the spatial distribution of rural infrastructures is not sufficiently disaggregated to be very useful for public sector, agricultural development programing (Idachaba 1980a). Yet we can be sure that there is far too little infrastructural investment. Furthermore, the infrastructure available is extremely variable over locations. Recent surveys in Nigeria, for example, reveal gross inadequacies in per capita supplies of rural infrastructure and great regional imbalances. As shown in table 17.2, rural road densities range from only 10 meters per square kilometer in Borno State to 519 meters per square kilometer in Lagos State. When existing rural roads are adjusted for seasonality, the highest density is less than half of the recommended norm of 110 meters per square kilometer (Idachaba 1980a). Within each state, there are gross disparities in feeder road density. Computed coefficients of variation range from 33 percent in Sokoto State to 142 percent in Imo State.

Distribution of federally funded agroinput supply centers shows the average walking radius of a center ranges from 11 kilometers in Imo State to 35 kilometers in Borno State, excluding the unrepresentative and more densely serviced area in which there are agricultural development projects assisted by the World Bank. Population per hospital bed ranges from 3,924 in Oyo State to 5,548 in Sokoto State, while the population per doctor ranges from 12,384 in Oyo State to 84,035 in Borno State. Accessibility of hospitals ranges from 10 kilometers walking radius in Lagos State to 56 kms in Borno State.

There are also great disparities within states in the distribution of infrastructure. Kwara State has the greatest disparity in hospital facilities, with a coefficient of variation of 125 percent. The walking radius to a hospital ranges from 14 kilometers in Oyan local government area to 96 kilometers in Borgu

Table 17.2 Road densities by states in Nigeria, 1978–80

State	Road densities (meters per square kilometer)					Coefficient of variation of mean road densities across local government areas (percent)			
	Federal	State	LGA[a]	Total	Median	Federal	State	LGA[a]	Total
Anambra	50	82	47	179	111	89	215	129	138
Bauchi	22	12	60	95	405	76	76	83	79
Bendel	41	92	195	328	600	69	63	121	88
Benue	27	24	65	111	436	49	78	60	47
Borno	25	9	10	45	253	95	85	45	61
Cross River	48	96	227	371	579	41	59	91	78
Gongola	25	13	54	94	522	54	67	99	89
Imo	70	94	202	366	222	280	210	116	142
Kaduna	25	18	27	70	330	39	84	70	35
Kano	28	37	93	158	306	47	335	50	122
Kwara	31	18	38	88	322	61	104	111	86
Lagos	79	111	519	709	220	54	56	152	118
Niger	32	20	78	130	760	167	138	89	111
Ogun	48	55	393	496	842	79	63	60	54
Ondo	48	130	183	357	305	84	40	86	58
Oyo	25	20	168	215	222	95	84	134	104
Plateau	32	40	64	138	500	55	32	61	39
Rivers	21	30	n.a.	51	96	158	86	···	98
Sokoto	22	11	31	63	291	55	93	63	33

Source: Idachaba et al. 1981, vol. I.
[a]Local Government Area

Table 17.3 Selected rural infrastructures in Borno State, Nigeria, 1979–80

Local government area	Rural road density	Walking radius (kilometers) To agroservice center	To primary school	To secondary school	To post office or postal agency	To hospital	Population per doctor
Askira-Uba	25	28	3	20	28	28	61,770
Bade	12	40	4	28	28	40	69,672
Bama	8	44	4	31	26	44	105,513
Biu	12	52	3	23	37	52	125,855
Damaturu	7	58	...	41	29		
Damboa	12	52	5	52	52		
Fika	17	35	3	20	8	35	65,691
Fune	14	41	5	41			
Geidam	8		6	53	53	53	317,591
Gujba	9	44	7	44	31		
Gwoza	20	29	4	29	10	21	47,193
Kaga	6	53	7	38	53		
Konduga	10	51	5	51	51		
Kukawa	6	67	7	67	20		
Maiduguri[a]	18		1	7	5	8	6,296
Monguno	11	35	4	25	16		
Ngala	7	41	4	41	41		
Nguru	...	48	4	34	28	48	105,748
Total	10	48	4	33	22	56	84,035

Source: Idachaba et al. 1981, vols. 1 and 2.
Note: Borno State has the largest land area of all 19 states, constituting 12.62 percent of Nigeria's total area. Blank cells indicate that no facility is available.
[a]Maiduguri contains the state capital.

Table 17.4 Selected rural infrastructures in Lagos State, Nigeria, 1979–80

Local government area	Walking radius (kilometers) To agroservice center	To primary school	To secondary school	To post office or postal agency	To hospital	Population per doctor
Badagry	14	1.4	5.3	2.6	14	60,448
Epe	22	6.5	7.1	7.4	22	...
Ikeja	10	1.4	3.0	1.8	10	4,031
Ikorodu	9	2.0	5.6	6.3		
Lagos Island		0.5	1.9	1.2	3	11,081
Lagos Mainland		0.5	1.2	0.6	4	41,974
Mushin		0.6	1.5	1.0		
Somolu		0.8	1.5	2.3		
Total	15	1.3	3.7	1.6	12	30,614

Source: Idachaba et al. 1981, vols. 1 and 2.

Note: Lagos State has the smallest land area, constituting only 0.004 percent of Nigeria's total. It also contains Nigeria's federal capital, Lagos. Blank cells indicate that no facility is available.

local government area. Bendel State has the least disparity, with a coefficient of variation of 45 percent. Tables 17.3 and 17.4 present distributions of selected infrastructures in Nigeria's largest and most remote state (Borno) and smallest and most accessible state (Lagos).

The Nigerian survey convincingly documents the deprivation of the rural sector relative to the urban sector in the provision of infrastructures. The local government area containing the state capital usually is the most favored. Infrastructural investment of the type and magnitude required for agricultural development has major wealth and income distribution consequences, both interpersonally and interregionally. Work is needed on the methodology for assessing such distributional impacts in both the short and long run.