ASSESSING RURAL SERVICES, INFRASTRCUTURE AND THEIR IMPACT ON AGRICULTURAL PRODUCTION, MARKETING AND FOOD SECURITY IN TANZANIA [1]

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EXECUTIVE SUMMARY

The overall research objective is to identify policy and institutional reforms required to ensure effective provision of rural services for agricultural production. The specific objectives addressed by this discussion paper, however, are: (a) to assess the state of existing infrastructure and rural services in Tanzania and across its regions; (b) to identify relationships between rural services and infrastructure (RSIs) and smallholder farmers' agricultural production.

The analysis is based on secondary data. Using descriptive statistics and graphical analyses, the report attempts the following: characterizing rural services and infrastructure in Tanzania; delineating patterns of rural infrastructure and other rural services provision, showing differences across administrative regions; and, pointing to observed disparities of such services between rural and urban areas. Finally, using a Cob-Douglas production function, we show and compare the relationship between provision of rural services and infrastructure and food production, cash crop production, and aggregate agricultural production.

Tanzania's rural services and infrastructure are extremely poor and underdeveloped. At the regional level, the country compares unfavorably with both SADC and the East Africa sub-region. The government predominantly provides rural services and infrastructure in the country. Apparently, these are available in only few areas but used by larger and widely scattered populations. This translates to high transaction costs for rural producers. The underdeveloped infrastructure and rural services are ubiquitous; differences between administrative regions are small, except between urban and rural areas - the latter being significantly disadvantaged.

The empirical model revealed relationships between rural services, infrastructure and agricultural productivity; suggesting that investing in education, i.e. building quality human resource, correlates positively with increases in food crop(s) production, and addresses household level food availability in a more direct manner. Community development initiatives and cooperatives have impacts on agricultural productivity; however, in our case resources directed to socialist settlements and badly managed 'top-down' cooperatives led to negative effects on production, particularly for food crops. Investments in hard infrastructure: roads, irrigation, and in research and technology, influences more the more tradable, commercial agricultural products; we observed a positive and significant correlation with cash crops production.

Considering the multiple-cropping nature of smallholder growers, it is plausible to assume that gains from infrastructure development, and investments favoring cash crop development first, would ultimately spread to food production. The findings show that Tanzania is amongst countries in Sub-Saharan Africa that would benefit greatly from investments in rural services and infrastructure. The poor state of infrastructure and services calls for major investments across all categories. This poses a major challenge on any attempt to prioritize. Having noted improvements in budgetary allocation for agriculture and RS& I in 2000s, a key challenge for policy to resolve is how to raise resources to meet the required high levels of investments. It is also important to design policies that would provide incentives and attract private sector investments towards providing the rural services and infrastructure.

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1 INTRODUCTION AND BACKGROUND

Despite a rich endowment of natural resources, good climate and abundant land, Tanzania's agriculture performance is unsatisfactory. Agricultural productivity, rural incomes, food security and livelihoods did not respond to the 1980s reforms at levels expected earlier: Tanzania's agriculture GDP grew by only 3.5% from 1985 to 1990; and by 3.3% from 1990-1998, or on an average, by 3.3% over the entire period; barely above the population growth of 2.8% (FAO 2001; World Bank 2000, and 2001). The IMF (2003) estimates show agricultural GDP growth to be 5.5% in 2001, the highest recorded in two decades. It is evident that the 1980s reforms did not yield spectacular results.

Notwithstanding the current debate on the relationship between investment in infrastructure and agricultural productivity, the study joins in its premise, Gibson and Rozelle (2003), Fan et al. (1999), and Wanmali and Islam (1995), who have shown positive relationships between public investment and agricultural growth.

Remoteness due to under-provision of public services and infrastructure, whether spatial, physical or even social translates into high transaction costs of producing and marketing goods in rural areas, thus perpetuating poverty. Lack of infrastructure such as roads and railway automatically lead to high costs of travel and goods transportation. When combined with lack of tele-communication, it raises costs of getting information, including those crucial for linking producers and various categories of rural and urban traders. Poor infrastructure and services also raise search, screening, and contract enforcing costs. Under-served communities also suffer higher levels of risks and uncertainty in their production and marketing endeavors, and apparently, they tend to be

more risk averse, as a result of lack of growth. This study aims to contribute to the debate by studying the exact patterns of these relationships in Tanzania and suggests ways to ameliorate policies concerned with the provision of these services.

To do so we undertake two types of analysis: the first one identifies and describes the current status of infrastructure and rural services in terms of quality, access, and provision. We follow with an econometric model to test the relationship between levels of rural services and infrastructure: education enrollment, agricultural services - fertilizer, seed, extension, credit, and selected public expenditures on investment in infrastructure. We also analyze their effects on agricultural productivity, for both food, cash crops and aggregate values of the two.

Infrastructure, in this study, refers to physical structures such as roads, railways, electricity, water and agricultural establishments such as irrigation systems. Regarding services, we consider both "social" services: education, health and community development investments, and "productive" services such as input supply systems (High Yileding Variety Seed HYV and fertilizer), agriculture advisory services, and credit.

Section 2 characterizes rural services and infrastructure in Tanzania, drawing upon diverse sources of information including secondary data described in detail in **Appendix xx** and "gray" literature gathered from government offices. This section also compares the status of rural services and infrastructure in Tanzania with that of other Sub-Sahara Africa countries. Section 3 presents the budgetary processes and public funding of rural services and infrastructure in Tanzania. Section 4 reviews empirical models used to estimate relationships between RS&I and agricultural production. We then specify and

estimate a model for Tanzania. Section 5 summarizes the study findings, and presents a conclusion.

2 INFRASTRUCTURE AND RURAL SERVICES IN TANZANIA: A CHARACTERIZATION

This section gives an overview of RS&I in Tanzania with respect to availability, consumption, and provision and compares these findings with neighboring countries in the region.

We measure ***availability*** of RS&I by quantities and physical dimensions, e.g. kilometers of roads, road densities by administrative regions, lengths of railways lines or numbers of schools and health centers per location and for the whole country; *C**onsumption*** captures "user rates" or "use rate", such as enrollment rates e.g. General Primary School and Secondary School Enrollment. Considering the paucity of information for several services, we proxy 'use rates' by measures of distance and time to service providing centers, such as dispensaries, hospitals, major roads, and to primary and secondary schools. We believe, the closer a service center, the more use rural dwellers would make of it. Finally, ***provision*** of services, is measured by public funding for rural services and infrastructure, particularly the annual recurrent expenditure on infrastructure and socio-economic services.

We discuss the effect that each category of rural service and infrastructure has on agricultural productivity, rural incomes and food security, establishing the basis for our regression analysis described in Section IV. Table 1 presents summary statistics of rural services and infrastructure in Tanzania, disaggregated by administrative regions. The

regional dis-aggregation allows us to contrast the northern regions of Arusha and Kilimanjaro, which has benefited from better public service provision and infrastructure than the southern regions of Morogoro and Iringa.

*2.1 **Transport Infrastructure: roads, railways and ports***

Tanzania's transportation network, a legacy of the colonial era, serves Tanzania's narrow bundle of raw material exports from hinterlands to ports, and has very limited inland interconnections. Failure to develop new networks is at the core of the roads and railway problems experienced to date.

Tanzania has four major road networks: The Tanzania-Zambia highway traversing Dar-es-salaam, Coast, Morogoro, Iringa and Mbeya regions; the central line, starting from Dar-es-salaam passing through Coast, Morogoro to Dodoma administrative regions; The North Eastern highway, connecting Dar-es-salaam, Tanga, Kilimanjaro and Arusha; and lastly, the Lake Zone network, connecting Mwanza and Mara regions (Figure 1). These highways link to trunk, rural and feeder roads in the hinterlands. Figure 1 also shows the low density of roads and railway lines and how the two serve the same corridors.

Although feeder roads are more important for connecting remote smallholder rural agricultural producers to markets and services, available data at national level focuses mainly on paved and unpaved trunk roads.[4] In summary, the country has a very low road density, estimated at below .05 km per sq km. There are 85,000 kms of road comprising: 10,300 highway and trunk roads, 24,700 regional roads, 20,000kms district

[4] Through these roads farmers carry head lots, use donkeys and other animals carts and ride bicycles to ferry agricultural inputs, outputs and consumer goods.

roads, 30,000kms of feeder roads and 20,000kms are of an unclassified category. Transportation is crucial for timely delivery of productive and consumption commodities. Rural roads, and in particular district and feeder roads, deliver goods and services required for agricultural production to remote areas. In Tanzania, rural roads are predominantly impassable during the rain season. Road density for unpaved roads ranges across regions from 0.01 km per sq km in Lindi to 0.07 km per sq km in Mwanza, while paved road density is below 0.011 km per sq km for most regions (Table 1). Rural roads, expressed in length, increased significantly between 1996 and 2000 (Appendix I Table 1). Table 2 illustrates the advantage of Arusha and Kilimanjaro who have village feeder road density of 0.08 and 0.09 km per Sq. km., respectively, higher than the Southern areas of Iringa and Morogor. The low road density and seasonal state of roads raise constraints to rural producers.[5] Many farmers in Tanzania live and produce far away from major roads, markets and to other socioeconomic service centers, and consequently smallholder agricultural producers must face high transaction costs, including high transport costs that raise prices of inputs, and impair further access to information and markets. Not only does production in rural Tanzania rely on inadequate information, but the use of technology and inputs is also low; leading to low productivity, low incomes, food insecurity and poverty.

Efforts to improve the road network have been initiated by the Ministry of Works, The Prime Ministers Office, and regional and local government. An autonomous government agency, Tanzania Roads Authority (TANROADS), was created to oversee the development of roads and the government was preparing a national roads' master

[5] The western road system, linking Kigoma to Rukwa, and the connection between Ruvuma in the south to Mtwara are impassable for long periods in a year.

plan when we were drafting this report. Whether such efforts will resolve the problem of maintaining the old-age network of roads that splits the economy between the advantaged and disadvantaged areas, and upgrade the quality of hinterland earth roads remain to be seen.

Tanzania's major railway line was built in 1914 and is only 2,580 km long. Though old, this railway serves the major cash crop production areas for cotton, sisal, tobacco and coffee. It connects the Dar-es-Salaam Port with the central and northern agricultural zones, and crosses the border to Kenya. The Tanzania-Zambia Railway Authority (TAZARA) owns the second railway line that extends from Dar-es-salaam southwards to Kapiri Mposhi in Zambia. The TAZARA line also links agricultural potential areas in the south, such as Kilombero in Morogoro - popular for sugar and paddy production, with the Dar-es-salaam port.

Tanzania has five seaports managed by the government owned Tanzanian Harbors Authority (THA): Dar-es-salaam, Mtwara, Tanga, Zanzibar, and Lindi. The Dar-es-Salaam port, in addition, handles cargo for four landlocked countries: Zambia, Burundi, Rwanda and Uganda. Tanga and Mtwara ports are grossly under-utilized due to the underdeveloped nature of the hinterlands they serve, as well as due to a poor road network in the region.

A major weakness of post-colonial investments has been to maintain the basic framework, instead of expanding the network beyond the one established in the 1940s, to remedy the deficient infrastructure. Naude and Krugell (2002) argue that this pattern of roads and railways results in a dual economic structure: one of "off-road" or "off-rail" areas, remote, limited by high transactions costs, lack of information, and which are

consequently underdeveloped; and the other of “on-the-road” or “on-rail” areas, well served by roads and railways, and connected to global markets allowing them to benefit from trade and prosper. In Tanzania, as in many SSA countries, the disadvantaged “off-road” economies harbor the majority of the rural poor population.

*2.2 **Energy: Electricity***

Energy, specifically electricity, is important for production and processing of both agricultural inputs and outputs. Electricity reduces drudgery at the community and household level. It can ease the workloads and hence release labor, particularly that of women, to more productive purposes. In Tanzania, women in remote rural areas spend significant amounts of time fetching and using firewood for household chores such as heating and lighting, walking between 1.5 to 10.4 km. (Table 1).

Tanzania has 543 MW. installed electrical capacity: 320 MW of hydro and 214 MW of thermal electricity. Nonetheless, only 15% of households nation wide are connected to the grid. About 50 percent of the regions use less than 20 Million KW per year, and a few, such as the Coast region, use as low as one million KWs per year (Table 1). Historically, we observe a rapid growth in electricity sales from 1980 to1995 in Morogoro and Kilimanjaro. This period saw heavy government and donor financed import substitution industrialization. Since, many plants, which were heavy electricity users in Arusha, Morogoro, and Kilimanjaro are now closed halting the growth in sales: Polyester manufacturers, Morogoro shoes, Morogoro leather goods, Morogoro Tanneries, Morogoro Ceramics and Kilimanjaro Breweries (Figure 2).

With respect to agriculture, the observed modest differences of electricity consumption across regions are not that relevant, but the bias against rural areas is. In Tanzania, urban areas enjoy most of the connections and include 'large users', such as manufacturing plants and industries; 'domestic consumers' who in aggregate constitute the second largest consumer group; and 'small industries'.

Not only is the network limited to urban areas, but high installation costs and tariff rates exclude low-income rural dwellers from using electricity.[6] Industrialization has been the major driver of government energy policy; as a result, rural areas have been neglected, because manufacturing plants tend to be in towns and cities. The high cost of electricity for rural dwellers and for low-income urban dwellers, has had many negative environmental effects, including non-sustainable harvesting of forests for wood fuel and charcoal making.

2.3 ***Water***

The total annual renewable fresh water available in Tanzania is 89 cubic kilometers. The per capita water availability in 1995 was 2,964 cubic-meters, this is expected to fall to 1,496 by 2025 (Gleick 1998, Population Action International 2004).[7] FAO 1995 estimates that agriculture accounts for 89% of water use in Tanzania; however, this must be for varied purposes because irrigation is currently limited to very few areas: mainly those with surface-water flowing by gravity. Although Tanzania has a potential for 1.5

[6] Tanzania's electricity tariffs are among the highest in Eastern and Southern Africa, currently selling at US cents 10 per KWh.

[7] Kenya has 30.2 and Uganda 66.0 cubic kilometers of fresh water available; and in 1995 reported per capita water availability of 636 cubic meters for Kenya, and 3759 cubic meters for Uganda.

million ha of irrigable land, only 150,000 ha are currently under irrigation, i.e. only 10% of the potential.

Access to water, both for irrigation and for domestic consumption, is important for productivity, health and sanitation. In rural areas, 41 percent of water is from surface water sources, followed by open well, 28 percent (Table 3). Fetching water consumes considerable amount of time of the more productive cohort of the rural population, women, (Table 1). Furthermore, it is now widely acknowledged that water borne diseases resulting from poor water quality are an impediment to human resource productivity in rural areas. It also limits underdeveloped crop irrigation and primary agricultural processing. The apparent rural-urban disparity in access to water, where the latter is privileged, points to the need for concerted efforts on rural water supply. Table 4 points out to the higher share of the population in northern areas who have access to water than in southern regions, and to the disparity between rural (Arusha and Morogoro) and urban areas (Kilimanjaro and Iringa).

The water sector in Tanzania was amongst the major recipients of former donors multibillion US$ investments in the 1970s and early 80s . Water was free for all during the socialist era, and this, somehow, led to poorly managed and collapsed piped water systems. There are many non-functioning taps and hand-pumped wells in Tanzania's villages. We have to ask ourselves: What went wrong? Is heavy investment alone enough?

2.4 ***Education and Health***

Education and health services are important for enhancing the quality and hence productivity of human capital. For a rural dweller, access to health and education services is the main constraint. Often, rural dwellers perceive poverty in terms of the distances they travel to various social services. Inaccessibility of services underpins their articulation of poverty. Secondary data from Table 1 and Appendix I Table 4, suggests that illiteracy, measured by the population age 15 with no education, is more prominent in regions where the distance to primary school is more than 2 kilometers from homesteads (for example Dodoma, Kagera, Shinyanga, and Tanga). Sahn et al. (2002), and Mason and Khandaker (1997) have shown statistically that access and quality of services enhance demand for health and education. In particular they have found that distance to school, the opportunity cost of enrolling a child to school, an increase in wages, all correlate negatively with child (particularly girls) school enrollment rates. [8]

Post-primary education in Tanzania is even less accessible than primary education. Only between 5 and 7 percent of students having completed primary school join secondary school (Word Bank 2001). Table 1 and Figure 3 show that distances to secondary schools are 10 to 20 times larger than to primary schools. Overall, in Tanzania, the attainment rates at secondary and higher education are amongst the lowest in sub-Saharan Africa. The share of Tanzania's population with at least some formal post-primary education has declined from 5% at independence to 3.2% in 1990. The Word

[8] A household may find it more rewarding to wholly deploy the child's labor into agriculture.

Bank (1999) argues that the Gross Enrolment Rate (GER) of 7% in secondary schools age children in Tanzania is the lowest in sub-Sahara Africa.[9]

The fall in GER rates as we move from primary to post primary education (Figure 4) is consistent with Mason and Kandakher's argument that the farther the distance to post-primary education schools from homesteads, relative to the distance to primary schools contributes to the declining GER as we move from primary to secondary education. However, there are other reasons for this pattern: the low post-primary enrollment capacity in the country (post-primary education has never been an underpinning goal); and the enhanced opportunity cost of attending school as the child grows (children between 14 and 15 reaching the age for secondary education also enter the critical age for joining the rural labor force). IMF (2003) reports that there are a total of 4.8 million children working in various economic sectors, including in the most hazardous types of work. In a single 2002 operation, the Child Labor Unit removed 4,000 children from such employment in Iringa, Mbeya, Singida, Morogoro and Ruvuma regions. Inadequate educational services, depicted by low densities of post-primary education centers, ultimately impair development of a resourceful human capacity. We concur with Akabyashi and Psacharopouluos (1999) who noted that areas, with low school density where children work long hours per day, suffer deterioration in the quality of human capital over time.

It is worth emphasizing that post- primary education enhances classroom codified knowledge and tacit knowledge. The latter is instrumental for unleashing the innovative potential in human capital, and manifested in better skills like entrepreneurship (for

[9] GER measures the number of children in enrolled as a percentage of the number of children in the age group that should be at school.

example better crop husbandry, agro-processing techniques and marketing skills). Poverty easily accedes to subsequent generations if parents are not educated. The low level of post-primary education, therefore, clutches Tanzania in a poverty cycle.

Health services are also crucial for households and community stability. Access to dispensaries and hospitals during peak agricultural periods (wet seasons) is important for maintaining labor productivity. During these times, households are prone to diseases and many rural dwellers are more likely to succumb to infections. The distance to a health center, therefore, becomes a critical determinant of the household's success or failure in that seasons' agricultural production. Table 1 shows that people have to walk between 2 and 6 km to a primary health center and between 10 and 35 km to a hospital. Time spent on such long distances translates to low productivity. In addition, rural dwellers often opt for alternative but inferior medicine when impaired by large distances to formal health centers. Hospitals are usually harder to access than health centers, mirroring the pattern of primary and secondary schools.

Irrespective of the quality of services received, people in Arusha and Kilimanjaro have greater access to education and health facilities. They, in general, walk shorter distances, sometime times half the distance that southerners have to walk to reach education and health centers (Table 5).

In view of the descriptive analysis presented above, we expect provision of education and health to correlate positively with agricultural production, income and poverty reduction.

2.5 Agricultural Services

Tanzania has a broad scope for agricultural diversification and a great potential to enhance production through agricultural intensification. The country has 945,090 km^2 of land and 40 million ha (i.e. 42%) is cultivatable; but only 16% (6.3 million ha.) are currently being cultivated. However, enhancing production, both intensively and extensively, requires a mix of agricultural services: irrigation, agricultural extension, finance and credit, inputs and output marketing services.

2.5.1 Irrigation and Tractor Use

One lesson that Africa and Tanzania can learn from Asia is the pivoting role irrigation can play in rural development. Wanmmali and Islam (1995) elucidate how irrigation, beyond facilitating intensified agricultural production, acted as a door for a whole range of other investments in rural India. A meager 10 percent of Tanzania irrigable potential is under irrigation (150,000 ha.). Of that total, 120,000 ha are under traditional irrigation systems engaging an estimated 100,000 small, low resource endowed farmers. Only 25,000 ha of land are under relatively large-scale irrigation.

Dismal performance of previous irrigation schemes hinders more investment in irrigation projects. Irrigation is a good example of a rural investment that requires a correct "optimal mix" of other rural services for it to yield desirable results. [10] Studies by JICA (2001), and Maganga et al. (1999) point to the need for human capacity strengthening, institutional development (e.g. water user associations), market information and intelligence, road infrastructure and extension services. An irrigation

[10] Optimal mixes are important because often we observe wastage of investments in rural economies simply because an initiative fell into conflict with, or was not supported by other necessary services.

investment that is short of the above package is likely to be inefficient, lack ownership rules, be non-sustainable and fail, particularly after withdrawal of donor funding and management support.

Seventy percent of Tanzania's cultivated land is ploughed manually by hoe. Draft animals are used mainly in the Southern Highlands and in Sukuma land (Mwanza and Shinyanga regions). ESA data indicates that tractor use and irrigation are prominent in Kilimanjaro and to a lesser extend in Morogoro, Arusha, and Iringa.[11] Farmers in Rukwa use no tractors but rank third in irrigation use. Kigoma, Singida and Coast regions barely use irrigation or tractors (Appendix I Table 6). Low levels of mechanization and the decline in the supply of farm tools in Tanzania is viewed as a serious problem (Isinika 1995).

2.5.2 Extension services

The government has remained the main provider of extension services, while it has withdrawn from agricultural input and output marketing after liberalization of these sectors, leaving it to the private sector to play a larger role. The major change took place in 1999, when services were decentralized, vesting more responsibilities to local governments at the district level. Tanzania is a large country, with many dispersed smallholder producers, rendering it extremely challenging to centralize extension services. The regional distribution shows that over 70 percent of farmers received extension services in Kilimanjaro, 60 percent in Morogoro, 55 percent in Arusha, and

[11] Some studies, such as World Bank 1994, put the percentage of farmers in Kilimanjaro who use tractors. higher (40% to 70%) than the ESA (31.4%).

below 50 in Iringa (Figure 5). In essence, the efficacy of extension services also depends on an optimal mix of other services.

Besides central and local government extension services, small farmers also receive agricultural advisory services from autonomous donor funded development projects and crop specific private companies e.g. Tobacco Processing Companies and religious establishments (Appendix I Table 7). Lessons point to the need for extension to be demand driven, relevant, and participatory, fully engaging the recipients. Furthermore, it ought to be packaged together with on farm research, product marketing and inputs supply. Because extension has remained a public domain, principally funded by the central government, our regression equation should point to the effects of recurrent expenditure on the agriculture sector on productivity.

2.5.3 Agricultural inputs supply services: fertilizer, seed and pesticides

Prior to 1986, agricultural policies reforms had put in place a pan-territorial pricing for inputs and outputs, heavy subsidies on fertilizer, parastatal agricultural marketing institutions and an in-built credit system in which loans, supplied in kind, were repaid by deducting from produce sales through crops single marketing channels. Subsidies - both explicit and implicit – embodied in the system, led to a rapid increase in the use of inputs, especially fertilizer, and particularly in remote areas. Analysts argue that the relatively remote southern regions benefited from the system. These policies required huge budgets for subsidies, incurred large losses due to inefficiencies in input distribution by parastatals, and actual costs to contend with poor rural infrastructure while delivering inputs. The heavy fiscal burden on the government that followed necessited reforms.

In the new millennium, Tanzania's agriculture is still characterized by low input use. By the year 2001, fertilizer use was estimated at 65-70 tons per year for the whole country. Pesticides imports have fallen by about 40% from the mid 1980s' level and the seed industry has stagnated at 5 to 7 tons per year, with major changes in suppliers. The National Sample Census of 1994/95 and a World Bank and GoT (2000) joint study, report that only 18 percent of Tanzanian farmers use pesticides, 27 percent use improved seed, and only 15 percent use chemical fertilizer. These very low rates vary disproportionally across crops and regions. For example, 70 percent of pesticides are for coffee and cotton crops alone. Input use is lowest in remote areas (FAO 2001), were smallholder producers do not grow major cash crops. FAO (2001) reports that fertilizer, chemicals and improved seed are largely unavailable in these areas. In areas where they are available, farmers who used to receive subsidized inputs from cooperatives and state channels, are reluctant to purchase them from commercial, profit oriented traders. Also in these areas, there is no functioning regulatory system capable of controlling unauthorized vendors and stockists from selling poor quality chemicals sold in unmarked packaging, often adulterated or past expiry dates.

2.5.4 Rural finance and agricultural credit

Tanzania's economy is reasonably monetized, particularly in urban areas, and although informal financing exists, it rarely serves the agricultural sector and tends to be inferior to formal financing (Temu and Hill 1994). Overall, however, the system is shallow, and financial institutions that provide a broad range of financial products or at least the two basic ones: credit and savings, are still heavily urban biased. The very few financial

institutions (banks) found in rural areas carry a legacy from the command economy system, and mainly cater to civil servants, i.e. salary earners (teachers, medical personnel, extension workers, police and the like). On the other hand, rural smallholder producers have a harder time accessing these financial institutions, and have to walk long distances to branches (on average between 13 and 77 km., Table 1), making these trips inconvenient to be included in small farmers' daily errands. The Kilimanjaro Cooperative Banks developed around farmer primary cooperative societies (Temu, 1999) is an example linking local, proximally located savings and credit societies to formal banks, hence enhancing access. The CRDB Bank also has a rural micro finance wing that aims at adopting best practice micro finance principles. However, the rest of Tanzania remains seriously underserved.

In Tanzania, what is commonly referred to as agricultural credit entails supply led loans packaged into agricultural inputs supplies. The single marketing chain linking primary cooperative societies, apex cooperatives, marketing boards and state owned banks, acted as a conduit for such loans. Agricultural credit packaged in this way has shrunk tremendously following the reforms of input delivery systems and the divestiture of state owned banks. Remnants of the "credit in kind" system are found where multinationals have taken over the single marketing channel, e.g. in the tobacco sub-sector, and these are few and small in scale. To date, commercial credit for various farm investments and for primary production purposes is relatively small (Figure 6).

Tanzania's statistics are therefore riddled with confusing aggregate data showing patterns of high loan disbursements to the agriculture sector on one hand, conflicting with primary data which shows that farmers use very little credit from financial institutions.

Does it matter whether farmers receive direct or indirect credit? Yes it does. The literature presents many examples of failures of supply led credit systems, a hindrance to further development of rural finance. Rural financing is an important stimulant for technology adoption, it mitigates challenges encountered by farmers who face seasonal cash fluctuations, and it allows to forego current consumption for future benefits. Rural finance and credit systems are expected to be statistically significant and positively correlated with improved technology use, such as fertilizer and high yielding varieties of seed.

2.5.5 Communication services

The telecommunications industry is underdeveloped. There are only four telephone mainlines for every 1000 people in Tanzania (Kenya 8, sub-Saharan Africa 16), and only four newspapers per 1000 people (Kenya 10, Uganda 3, and SSA 12). Tanzania counts twenty television sets per 100 people, compared to 25 in Kenya and 27 in Uganda. Fax machines per 100 people are “negligible” in Tanzania, 0.1 in Kenya and 0.2 in SSA (Table 6). It is not uncommon for people to walk more than 50 km., spending a day or more, to relay simple messages such as notices for meetings, announcements for a statesman’s visit, or important information on agricultural projects. Market information, and other important agricultural information e.g. early warnings, weather forecasts, rarely reach rural smallholder farmers in time; even where some form of institutional framework is in place.

In this section, we have attempted to present the status of rural services and infrastructure in Tanzania including socio-economic. Within the country, we have found that Northern regions are favored relative to Southern regions and that there exists an urban bias in the provision of services. Examining data from the World Development Report (2003) and World Development Indicators, we find that even by African standards Tanzania's rural services and infrastructure are extremely poor and underdeveloped (Table 6). Differences between regions are meager; and where observed, they are not consistent across all attributes or categories of services

3 PUBLIC FUNDING AND CURRENT POLICIES FOR RS&I IN TANZANIA

3.1 Fiscal Policy and Public Expenditure on Rural Services

Developing rural infrastructure and extending rural services in low-income countries entails substantial provision of public goods. We believe that it is not intermittent allocation of domestic and donor funds that matters in ensuring adequate provision of rural services and infrastructure, but sound fiscal policy, budgetary discipline, and sustained allocation of a correct balance of development and recurrent expenditure across augmenting sectors over an extended period.

Providing various forms of public funded rural services, such as village settlements, health centers, education facilities, agricultural extension, and facilitating agricultural input supplies, were core policies of socialist Tanzania between 1967 and 1985. Performance indicators such as distances to health centers and schools, primary school enrollment rates, life expectancy, anthropometrics measures and other health indicators were so encouraging that in the late 1970s, donor countries praised the country

for its commitment to providing rural services and for achievements in rural development (Bigsten and Danielson 2001). However, these assessments often overlooked the sustainability of these programs, which was hidden by the influx of aid, such as grants and concessional loans. Furthermore, these programs generally discouraged a weak private sector from providing such services.

Fiscal reforms and budgetary restraints pursued from 1986 to 1996 were aimed at correcting a faulty fiscal policy and entailed severe cuts in budget allocations to the provision of public services. Consequently, the established meager rural infrastructure dilapidated fast, school enrollment rates dropped, rural water pipes dried, primary health care centers suffered lack of drugs and a drop in personnel morale. Roads, particularly trunk and feeder roads lacked maintenance.

*3.2 **The Wrongs of Budgetary Restraints: Public funding for RS&I and Reforms***

Researchers, who have analyzed the consequences of reforms, have been critical of the across-the-board budgetary restraints, which often accompany reforms and liberalization (Kherallah et al. (2002), Gabre-Madhin (2003), Doward and Kydd 2003), and Farm-Africa et al. 2004). They view the under-provision, underdevelopment of rural services, institutions, and infrastructure as the core reasons why African economies have not realized benefits from reforms.

The economic characteristics of SSA countries, including Tanzania, call for major public investment in RS&I before any other development can take place. These economies are characterized by partially developed monetary economies, as illustrated by Tanzania's road and rail infrastructure development corridors; large share of the

population dependent on agriculture with a substantial subsistence component; low levels of commercialization and diversification of economic activities; risky agricultural production activities that easily succumb to lack of economic coordination, price fluctuations, natural shocks and economic opportunism (Dorward and Kydd 2003).

Analysts concur that the post independence policies of these countries harbored significant appreciation of this challenge, and implemented institutional fixes to address them. Yet, reforms and liberalization, which aim to redress government's role in commercial and business engagements, significantly curbed provision of rural services and investment in infrastructure, which had been identified as the determinants of the success of liberalized economies. Considering the characteristics of SSA, and of Tanzania's economy in particular, RSIs ought to attract high volumes of public funding; they are strategically the most important factors to reduce transaction costs and reduce risk of investing in the rural areas.

3.3 ***Post-Reforms: An Analysis of Public Expenditure and Sector Allocations***

Between 1996 and 2002, Tanzania restructured its revenue generation, taxation and public expenditure processes. The government formed the new Tanzania Revenue Authority, that focuses on the private sector as the key source of revenue, rather than parastatals (as was the case during socialism). The *Cash Budget System* that now operates as an expenditure control measure, and the Medium Term Expenditure (MTEF) Framework have enhanced fiscal discipline. The government also introduced annually conducted Public Expenditure Reviews (PER) that aim to ensure more realistic budget estimates. The Poverty Reduction Strategy Paper (PRSP) and its implementation

processes prioritizes budget allocation to ensure a pro-poor focus and has been supplemented by 21 other core government policies that determine rural infrastructure investments and services provision (Appendix I Table 9).[12]

These policies illustrate the government strong intentions and commitment but results will depend on implementation.

With a strict cash budget control, in the post reform period 1996-2002, recurrent expenditure have stagnated around 12 percent of GDP. Recurrent expenditure on social services, which is our area of interest, covering education, health, water, community development, youth and labor, roads and agriculture, increased from 3.5% to 4.5% of GDP during the same period (Appendix I Table 8(a)). So the trend of allocations to pro-poor investments is increasing, if modestly. Nonetheless, the development budget component remains a concern. Aid and external loans are the main sources of funds for the development component. They should be channeled through sector programs as budget support, and over time, replaced with local resources.

4 EMPIRICAL ANALYSIS

4.1 Empirical Literature Review

Table 7 summarizes recent studies relating rural services and infrastructure with agricultural productivity and rural welfare. Most of the studies cover South Asia, and particularly India, except for a couple on Sub-Saharan Africa. None of the studies analyze a broad range of rural services and infrastructure on agricultural productivity. The Malawi study singles out the impact of access to credit on the welfare of rural

[12] These policies are reviewed in details in Temu et. al. (2003) ***Rural Services and Their Impact On Agricultural Production, Marketing And Food Security In Tanzania: The Policy Context***. A Phase 1 Unpublished Research Progress Report.

households; and the one on Madagascar investigate the relationships between market access, agricultural prices, and infrastructure. With the exception of Antle (1982), and Diagne and Zeller (2000), most studies are at the national, provincial, or district level.[13] Binswanger and Khandker (1993) caution that one must understand the intra-causality of variables before concluding the cause-effect relationship between them. For example they assume that better agro-climatic conditions: soil, rainfall, and irrigation potential, may increase economic returns to private farm investment such as in tractors and other farm machinery. Enhanced profitability from these regions may induces farmers to lobby their governments for increased investment in other supportive infrastructure. As a spillover, other service providers may be encouraged to invest in these areas, such as financial institutions in response to enhanced demand for capital. Such private and public investment leads to lower costs of inputs and technology, higher adoption of technology by farmers, and ultimately increased productivity. Binswanger and Khanderker (1993) note that the sequence of investments to arrive at an optimal mix of services, will depend on socio, economic, and physical conditions of a locality .Each stage in the sequence induces and fosters additional investments.

*4.2 **The Conceptual Framework***

In this section, we present the underlying framework upon which we analyze Tanzania's data and estimate the effects of rural services on agricultural production. In this section wee use data on the physical availability of rural services and infrastructure as well as recurrent expenditure budgets to estimate the regression equations

[13] This list is in no way exhaustive. The point aimed at here is the general paucity of such studies for sub-Saharan Africa and that for those existing, none has addressed the the whole set of RSI variables.

In summary, provision of rural services and investment in infrastructures may influence increased agricultural production directly: Improved infrastructure reduces transaction costs for both agricultural inputs and outputs, while social infrastructure improves the quality of human capital through health and education. But agricultural output can be affected indirectly by all three types of services, agriculture services, public services, and infrastructure because they enable human resources to adopt new technology and crop husbandry practices (Figure 7). We observe, in this framework, that to enhance production requires a blend of hard, soft and technological infrastructure availed in a synergic and an augmenting manner.

In line with the work by Shengen and Hazell (1999) and the variables identified in the conceptual framework, we specify a production function:

$$Q = f(Inp, Tech, Know, Infr, Env, \mu) \quad (1)$$

Where

Q, = Agricultural output

Inp = Conventional inputs (land and labor).

Tech = Production technology (farmer's use of chemical fertilizer and improved seeds, specifically the high yielding variety (HYV).

Know = Farmers' technical knowledge (measured by formal education and government spending on the agriculture sector, covering both crops and livestock, which is a proxy for extension services)

Inf = Infrastructure (roads, electricity, water) [14]

Env = Environment and fixed factors (e.g. rainfall)

μ = Random disturbance term (e.g. pest and diseases).

We expect all variables to have a positive influence on agricultural production. Because we suspect endogeneity in variables denoting and facilitating the adoption of improved farming technology, such as the use of fertilizer and high yielding varieties (HYV) in the production function, we specify these factors as endogenous variables in equations (2) and (3). We then use their predicted values to estimate equation (1).

$$Tech(fert) = f(Know, Infr, Env, Cred) \quad (2)$$

$$Tech(hyv) = f(Know, Infr, Env, Cred) \quad (3)$$

Where,

Cred = Credit

Rainfall is the major agricultural risk in Tanzania and hence it enters the equation under Env. to delineate variability based on annual precipitation. Both excess rainfall (el-nino system) and droughts, are major factors behind food insecure years in Tanzania.

In this analysis, we estimate education (school enrolment) as a function of government spending in primary education. This equation, together with farm-technology adoption equations above, represents the indirect effect of government spending in education and agriculture sectors, on agricultural output.

[14] Note that annual public maintenance expenditure on Tanzania's unpaved roads makes great differences in access; and, when these vary from year to year, we expect observable effects on marketing of agricultural produce and inputs.

$$Know(educ) = f(edu\exp) \qquad (4)$$

4.3 ***Data for the Empirical Model***

Because of the lack of livestock sub-sector data, we limited our empirical model to food and cash crop production, which contribute an estimated 50% of the agricultural GDP while livestock contributes about 35%. Five major food crops are included in the analysis: maize, rice (paddy), sorghum, millet, and pulses (beans); and five export crops: coffee, tea, cotton, cashew and tobacco. Sisal, though one of the major export-crops, was excluded, because it is mainly grown by large-scale commercial farmers.

Regional indices for export and food crops are obtained by aggregating the value of production of the selected crops produced in that region We deflated all prices using the Tanzania consumer price index (CPI) which is the basis for estimating inflation in the country.

About 80% of Tanzanians are engaged in agriculture; we therefore use population data from national census results, as a proxy for agricultural labor. There is no time series data on actual farming labor in Tanzania. Although information available from cross-section surveys inspires us to use population data in this case, we fully acknowledge the potential shortfalls of this strong assumption.

Besides physical and sector based data summarized in Table 8, we used government expenditures to capture provision of services and infrastructure. (*Volume III of Estimates of Public Expenditure: Supply votes (Regional)* published annually by the Ministry of Finance). In general, public expenditure is divided into recurrent and

development components. The recurrent budget entails the day-to-day operational costs: civil servants salaries including those for teachers and doctors; extension services; transport sector services; communication, hospital medicine, school books, and maintenance of various public sector facilities. The development budget includes mainly major physical investments and particularly physical structures, such as office buildings, classrooms, warehouses and bridges. This study uses the actual recurrent expenditure data.[15] This data reflects more correctly the over-the-time variability and cumulative investment in public provision of services. Volume III of the public expenditure books contains budgetary allocations disaggregated by regions. Information obtained targeted rural services although it was not possible to disaggregate all variables into rural and urban components, except for roads and water. The sectors included in the analysis are agriculture, primary and adult education, health, rural roads, rural water, and, cooperatives, villages, and general community development - the last three combined. [16]

We met with the usual challenges associated with collecting time series data for large amount of variables. First, we did not take into account intercropping when considering cultivated land area, so the area of land cultivated may be overstated. Second, changes in government ministries and departments following reforms, resulted into inconsistencies across budget items and confusion on which office was responsible for what data. Some data series lack continuity or consistency with past format. Consequently, the period 1983-1992 provides the most complete set of variables.

[15] When actual estimates were missing, we filled the gaps using 'approved' estimates.

[16] Villages and cooperatives expenditures trace their roots to the 'villagization-ujamaa' era, and a buttress to the now strongly critiqued 'top-down' agricultural credit cooperatives. We maintain both components of health expenditure: curative and preventive services.

*4.4 **Functional form and estimation***

Following similar studies, a conventional Cobb-Douglass production function is used to estimate equation (1). The analysis includes three equations, one for food crops, the second for export crops and the last for total agricultural production – where we combine food and export crops. The food crops' equations capture the effect of rural services on direct food availability and domestic food security, whereas export crop equation captures the diverse sources of income, and hence enables us to compare how the two sub-sectors respond differently to investment in rural and public services. The Cobb-Douglass production function estimation calls for linearization, and hence log transformation of the variables.

The analysis includes 19 regions (see table 1) with the exclusion of Dar es Salaam, a region covering mainly the capital city. Dar-es-salaam has the least proportion of rural population and those engaged in primary agriculture production.

*4.5 **Results***

Tables 9 to 12 present estimated production function equations for food, cash and aggregate crops and, tables 13 and 14 present an analysis of factors affecting education and input use. The results indicate the importance of rural services and infrastructure in agricultural production – albeit with a few explainable counter-intuitive patterns.

Overall, the relationship between rural services and infrastructure is more apparent in the case of cash crops. The R-Square for the food crops' equation is relatively smaller than that for cash crops. In addition, seven independent variables are significant in the cash

crop equation while only four are in the food crops. We can explain this difference if we consider that under smallholder farming systems, farmers manage and make resource allocation decisions with both cash and food crops in mind. Delimiting the production function to food crops only, may be a reason for the observed lower coefficient of determination.

Food Crops. Four out of 12 independent variables in the food crop equation are statistically significant (Table 9). Land is positive and significant at 1% level; education and agricultural services (extension and research) are positive and significant at 5%; the institutional support coefficient (cooperatives, villagization and community development) is negative and significant at 5% (this last result is counter intuitive).

The pattern of variables' significances and the level of the R^2, is the same for the two technology based sub-equations: for fertilizer and improved seed (HYV seed) respectively. It should also be notable that the coefficients for the use of improved seed and fertilizer are not significant in both food production sub-equations. We observe later that this is not the case with the cash crop production function where technology variables are significant.

The strong significance of the land variables and the insignificance of improved seed and fertilizer variables, in the estimated equations, typify the production strategy used by smallholder food-crop producers in Tanzania and SSA region, toward extensive rather than intensive production. The negative sign in front of the community development and cooperatives coefficient seems challenging to justify. However, in Tanzania, expenditure on community development funded the ill-fated villagization

program and defunct top-down cooperatives. The government used the resources to relocate homesteads and establishing communal settlements ("ujamaa villages"); over 8,200 were registered and sustained for long periods. There is extensive literature on the negative effects of villagization and the disruption it had on production: inadequate planning, disincentives to work in communal farms, overly exerted pressure on land close to where settlements were formed, bad management of communal assets – all contributed to the demise of agricultural productivity (Osterfeld 1985). Note that this variable is insignificant in the cash crop function; the villagization program resettled less homesteads in established major cash crop producing areas such as those growing coffee. We also note that the period of study covered an era of major support of the 'top-down' cooperatives. These apparently behaved like semi-government organizations, whose losses and bad debts from financial institutions were paid by the government. Expenditure to community development and cooperatives was therefore counterproductive, which may largely explain the unexpected sign.[17]

Export Crops. The export-crop production equation (Table 10) shows relatively higher significance levels. All the variables that were significant in the food-crop production function are also significant in this equation, namely: land, education, expenditure on agriculture research and extension, and rural institutions – cooperatives and community development initiatives. Noteworthy, are those variables, which were statistically insignificant in the case of food-crop production, but which are significant in the case of cash crops, namely: technology (fertilizer), external environment (rainfall) and rural

[17] We, however, cannot rule out complex relationships between the expenditures and agriculture; not captured by the model.

roads. The results from the effects of rural roads and technology are not surprising, and consistent with our observations earlier regarding the dual nature of Tanzania's agriculture economy, inherited from the colonial era (Section III). We can add however a proposition to the effect that development strategy for food crops is radically different than that of cash crops. In the case of food crops, farmers may adopt an extensive strategy based on expanding cultivated land area, while in the case of cash crops, they may adopt an intensification strategy, by using modern inputs.

The sign in front of the environmental factor (rainfall), and its significance, are counterintuitive and pose a challenge to explain. However, because we have used precipitation to capture the environmental factor, years when rainfall levels were unusually high due the El Nino, suffered low crop production following the floods.

Considering that small producers, who are the majority in Tanzania, grow both, food and cash crops, any intensification strategy applied to cash crops, would have spillover effects on food crop production. For example, areas where tobacco, cotton, and coffee grow, the use of fertilizer in maize is a secondary benefit, or a spillover effects from fertilizer availed primarily for use in the cash crop. The aggregate agricultural production equations (Tables 11 and 12) support prior results and the explanations that we made above regarding the two types of crops.

Table 13 conforms to our earlier propositions, and we observe significant coefficients for the credit variable in the case of the use of fertilizer. In Section 3, we discussed the in-built or inter-locked credit, channeled through the marketing system. The large proportion of that credit is in kind, and in the form of fertilizer and seed. Nevertheless, the message in this case is important, for smallholder producers to adopt

intensive agricultural production methods, not only are the availability of the technologies important, as expressed by the significance agricultural research and extension variables, but also financial services are helpful in supporting the uptake of technology

Having established the importance of education in food and cash crop production functions, it is noteworthy to observe the positive and significant effect of investment in education, through public funding, on school enrolment rates (Table 14).

5 CONCLUSION AND POLICY RECOMMENDATIONS

*5.1 **Summary of Key findings***

Tanzania's rural services and infrastructure are extremely poor and underdeveloped, and their provision has remained the sole responsibility of the government, partly as a continuation of the socialist management during the early years. The status of services provision compares unfavorably with neighboring countries like Kenya and with SSA countries in general. The main problem is that services and infrastructure are only available in few areas but used by a larger, broadly scattered population and settlements. This translates into high transaction costs for rural, predominantly smallholder agricultural producers. The underdeveloped infrastructure and rural services are ubiquitous in the country, but differences between administrative regions are small, and those expected between the north and south are not borne by the evidence. However, such differences are noteworthy between urban and rural areas, the latter being significantly disadvantaged.

Eighty percent of the rural population depends on agriculture and poverty in Tanzania, as in may SSA countries, is a rural phenomena. Underdeveloped services and infrastructure in rural areas are believed to contribute to low-income levels and poverty. The estimated empirical model pointed to the existence of significant relationships between rural services, infrastructure and agricultural productivity. The results suggest that investing in education (building quality human capital) correlates positively with increases in food crop(s) production, and may therefore address, in a more direct way, household and community level food security. Developing rural institutions such as funding community development initiatives and cooperatives is important and impacts on agricultural productivity; however, the model shows that resources directed to socialist settlements and inadequately managed 'top-down' cooperatives leads to negative effects on agricultural productivity, specially in in the case of food corps One lesson to retain is that allocation of resources is not in itself adequate, it must accompanied by purposes, efficient management and use. Investments in hard infrastructure such as roads, irrigation, and technology influence relatively more market oriented or commercial agricultural production, and in our case, we observed a positive and significant correlation with cash crops production. Nonetheless, considering the nature of multiple cropping practices pursued by smallholder growers, it is plausible to assume that cash crop production gains from infrastructure development, will spillover to food crops' production.

The findings show that Tanzania would benefit greatly from investments in rural services and infrastructure, but with scarce resources, the government faces two big challenges: First, having noted positive trends in resource allocation and public

investments towards agriculture and towards pro poor investments in line with PRSP initiatives, how can the country continue to raise required resources to fulfill the demand. Second, what policies would provide incentives to attract private sector investments towards providing, and hence sharing the responsibility of extending rural services.

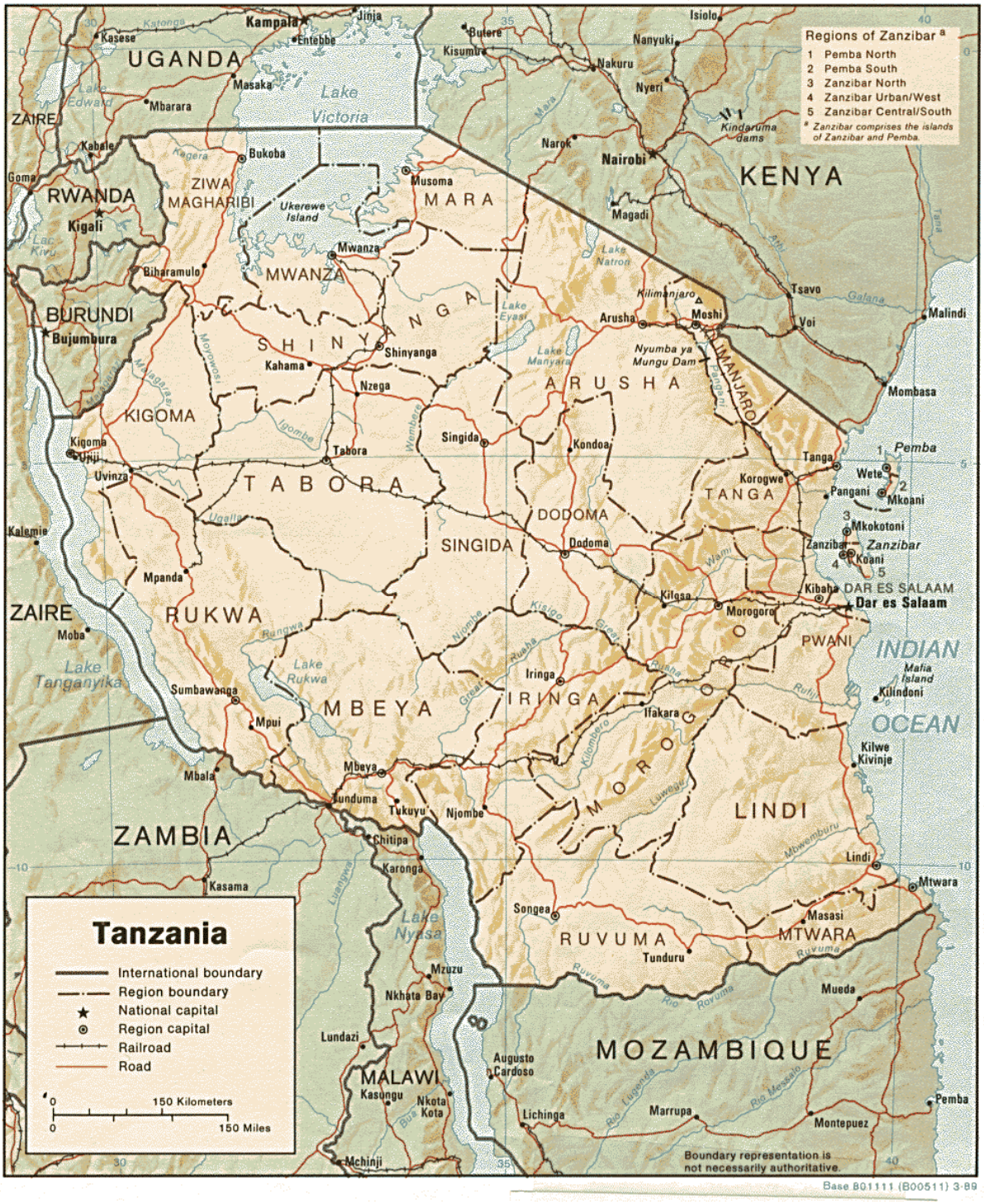
*5.2 **Policy Implications***

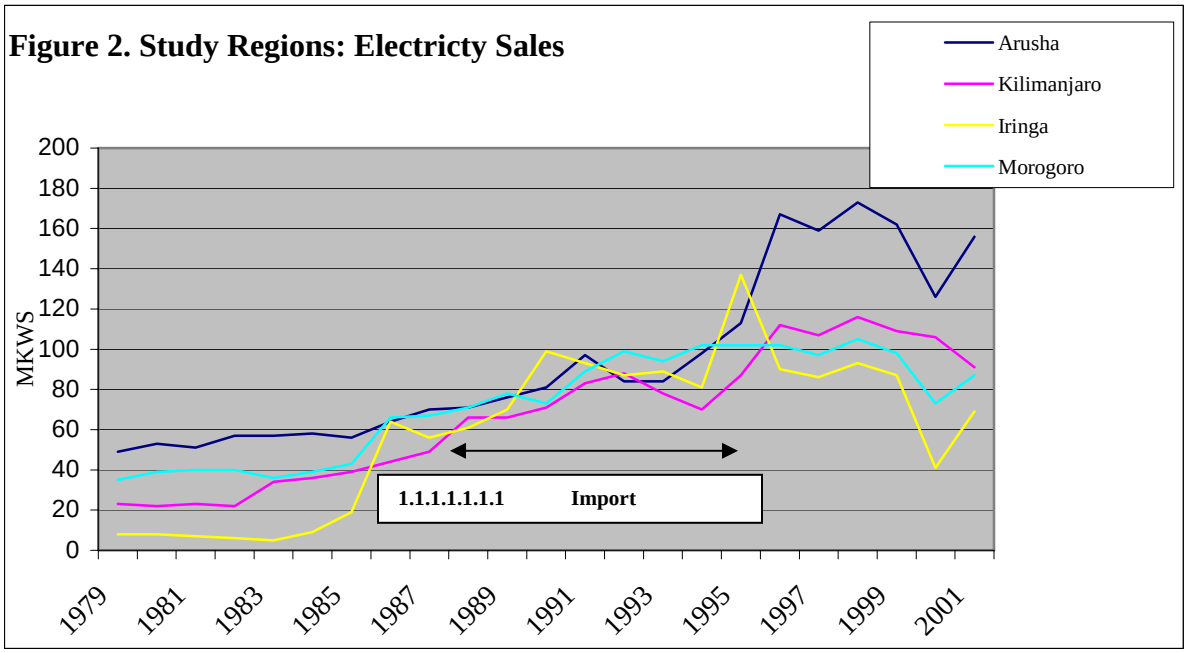
Tanzania ought to harness and tailor agriculture to re-invest into rural services and infrastructure. The smallholders, cultivating between 0.25 and 3 hectares, are not likely to be a driving force in generating savings and investments to achieve that goal. Considering the underutilized agricultural potentials of Tanzania, the best policy would be the one that deliberately pursues diversification of farm structures and encourages new, medium and relatively larger scale commercial, privately owned agricultural enterprises. Taking the advantages of the economies of scale, such investments are likely to contribute towards rural services and infrastructure, such as roads, health, and educational centers. The demonstration effects of the sisal and tea estates in Tanzania are prime examples of such impacts. Furthermore, medium and relatively large-scale private farms may be able to generate adequate savings for re-investments in rural services and infrastructure; and can co-exist with smallholder growers, and extend their benefits through out-grower type of schemes. This report has demonstrated that the problems are with overwhelming emphasis of the national policy agenda on very smallholder agriculture holdings, which often neglect the fact that there is potential for medium and larger scale enterprises that are better able of generate savings and investments in rural economy.

Regarding the hard physical infrastructure--especially roads, railway and ports—the report argues that it would be helpful for Tanzania to embark on deliberate policies and strategic investments in order to divert and expand the age-old transportation corridors established during the colonial period rule. This call for a 'business unusual' approach: that is, assessing Tanzania's production and trade potentials for domestic, regional and international markets, and designing infrastructure investments accordingly.

We concur with the recommendation made by an emerging school of thought, countering the 'across-the-board' withdrawal of the public sector in providing services, and more so through fiscal restraints built around structural adjustment strategies. Nonetheless, the issue may not be simply advocating for more budgetary allocations; what is required are a set of policies and deliberate strategies that will also encourage non-traditional investors, such as the rural private sector and community organizations, to invest more on rural services provision. The idea is simple: if a community grows and generates savings, it will be empowered, demand better services, and will be willing to pay for them. The role of the government, under such an environment, would be more of a facilitator of the growth process.

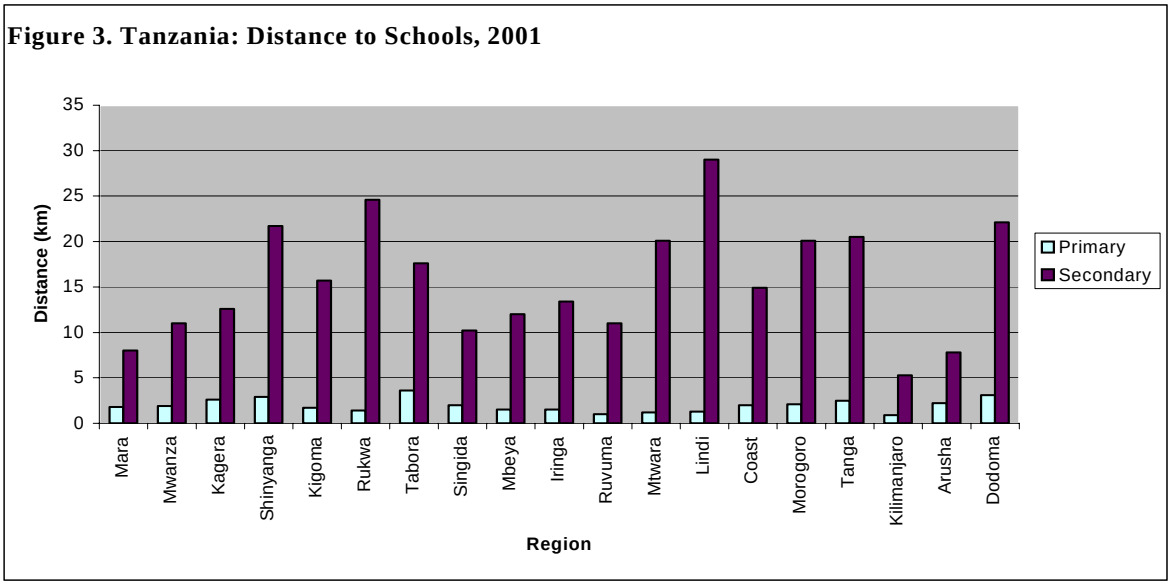
Figure 1: Map of Tanzania: Roads and Railway





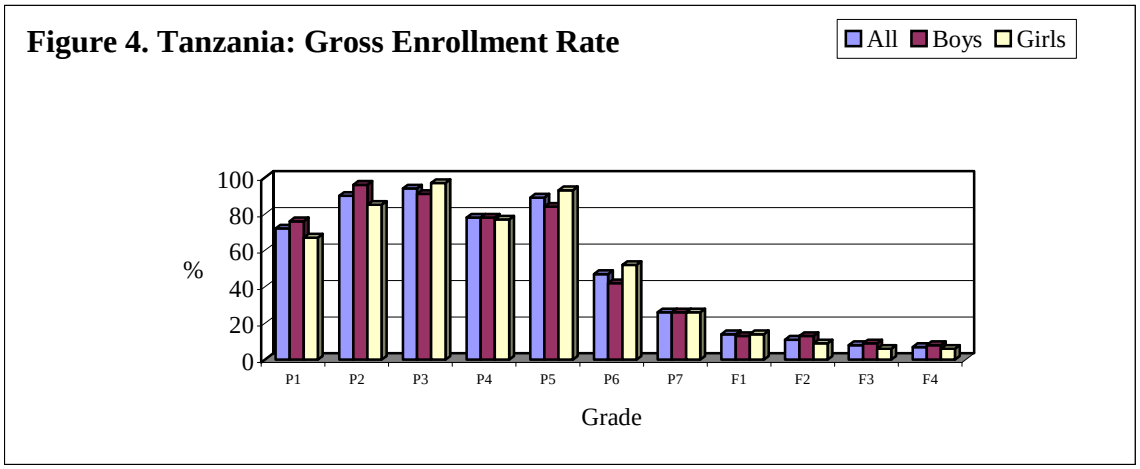
Source: Appendix 3.

Figure 3. Tanzania: Distance to Schools, 2001



Source: Table 1.

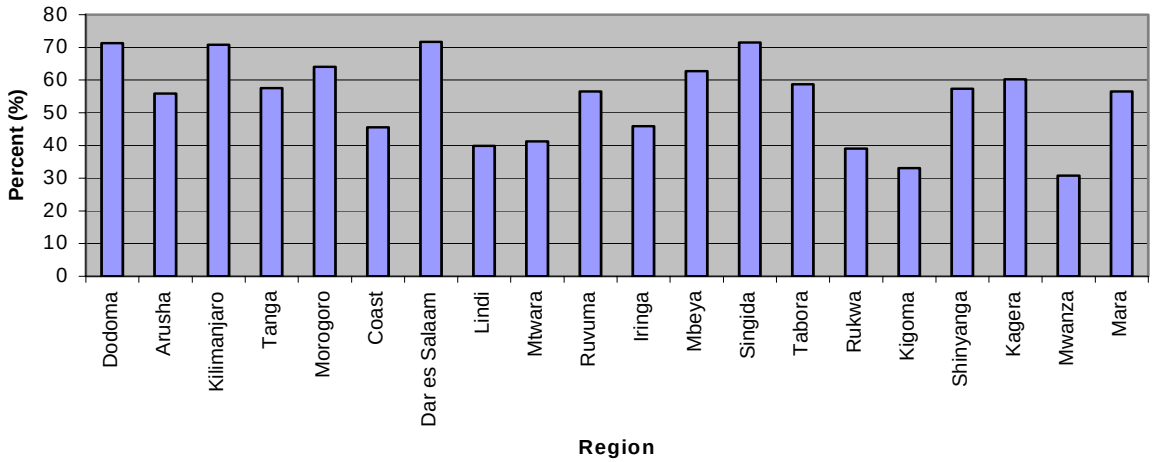
Figure 4. Tanzania: Gross Enrollment Rate



P=Primary, F=Secondary – form 1 to 4.

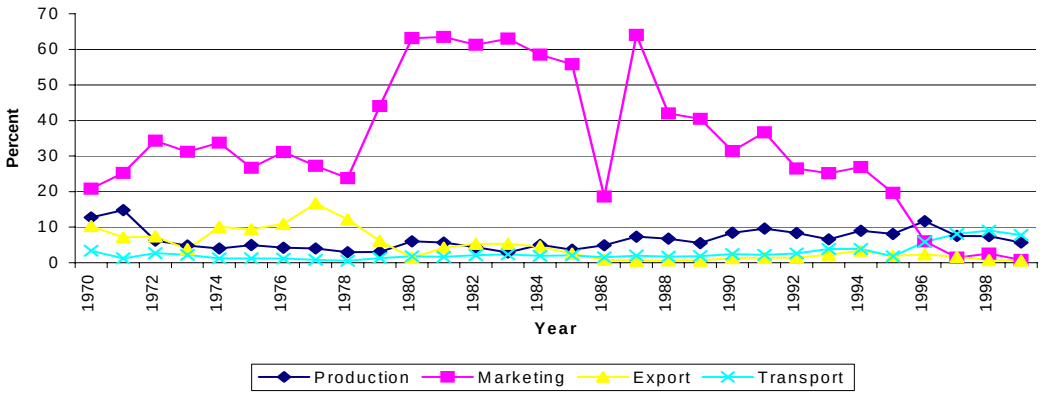
Source: Appendix I Table 5.

Figure 5. Farmers: Received Advice From Extension Agents



Source: URT (1995) ESA-94/95

Figure 6. Commercial Lending: Trends for Selected Sectors



BoT (2000).

Figure 7. Conceptual framework of the effects of rural services and infrastructure on agricultural production

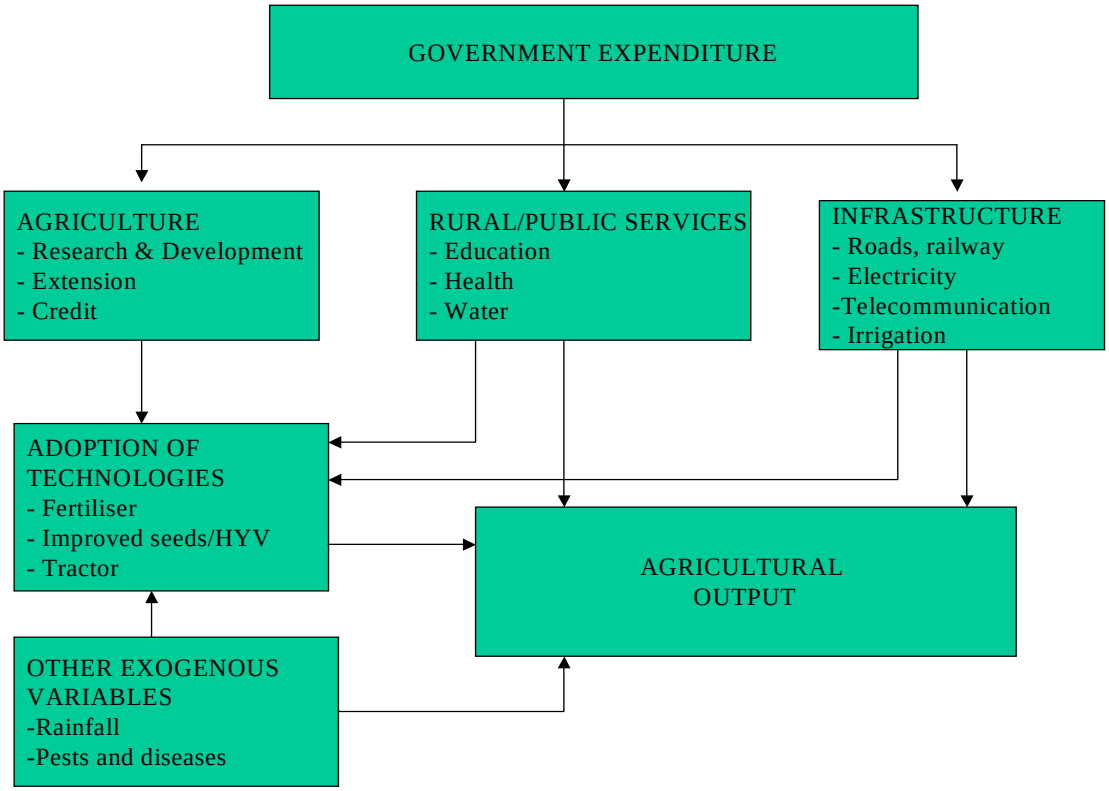


Table 1. Access: Mean Distances and Time to RSIs by Administrative Regions, 2000/01

Region	Shop (km)	Bank (km)	Primary School (km)	Secondary School (km)	Charcoal/ Firewood (km)	Health Center (km)	Hospital (km)	Drinking Water (mins)	Density Paved Rds Per SqKm	Density Unpaved Rds Per SqKm	Electricity Mean Sales 1990-01
Arusha	2.8	16.7	1.9	6.4	2.8	3.8	11.8	14.3	0.003	0.02	125
Coast	1	28.1	1.7	13.1	1.7	3	24.5	29.1	0.011	0.03	4
Dodoma	1.8	47.3	2.8	19.4	2.7	5.8	35.3	19.1	0.003	0.03	36
Iringa	0.9	36.1	1.5	12.7	3.6	4.8	18.9	10	0.009	0.02	88
Kagera	2.1	32.9	2.5	12	1.9	4.3	25.1	29.1	0.007	0.06	14
Kigoma	1.6	29.6	1.7	14.3	6.2	2.9	20.2	19.2	0.000	0.03	9
Kilimanjaro	0.2	12.9	0.9	5	1.5	1.9	9.5	9.1	0.009	0.03	93
Lindi	1.1	33.3	1.2	25.1	1.6	4.7	22.7	29.1	0.004	0.01	6
Mara	1.6	20.8	1.8	6.9	2.9	4.2	13.4	29	0.009	0.04	18
Mbeya	3.9	23.6	1.3	8.7	1.9	2.6	20.7	9.4	0.006	0.03	69
Morogoro	2.3	52	1.7	16	2.8	3.7	24	14.4	0.006	0.01	93
Mtwara	0.6	31.5	1.1	16.6	3.2	4.7	19.2	29.3	0.007	0.05	16
Mwanza	1.3	36.2	1.7	9.4	1.9	4.1	30.1	14.9	0.007	0.07	65
Rukwa	2.6	76.7	1.3	21.3	5	4.1	66	9.3	0.000	0.03	8
Ruvuma	0.8	25.8	0.9	9.2	2	3.6	21	9.9	0.003	0.03	10
Shinyanga	2.7	34.8	2.7	20.5	4.2	5.9	18.9	19.3	0.004	0.02	39
Singida	1.6	24	1.9	9.5	10.4	3.4	12.8	29.1	0.000	0.03	10
Tabora	2.1	25.1	3	15	2.5	4.7	13.7	19.3	0.000	0.02	27
Tanga	1.8	37.8	2.3	18.8	3.2	5.3	29	14.1	0.011	0.04	115

Source: Household Budget Survey, 2000/01, National Bureau of Statistics, The United Republic of Tanzania; The Economic Survey (Several Issues), The Planning Commission, United Republic of Tanzania, various years.

Table 2. Village feeder roads: Lengths (km) and Density (km/Sq km.)

	Village Feeder Roads	Area	Total roads Density
Arusha	6,494	82,306	0.08
Arumeru district	674	2,896	0.23
Kilimanjaro	3,003	32,407	0.09
Hai district	194	2,168	0.09
Iringa	2,599	56,864	0.05
Iringa Rural district	908	24,458	0.04
Morogoro	1,423	70,799	0.02
Kilosa district	470	14,918	0.03

Source**:** Regional Engineers' Offices Unpublished reports - Feeder roads**.**

Table 3. Tanzania: Household Water Sources by Residence (%)

Source	**Dar**	**Other Towns**	**Rural**	**Aggregate**
Private	50	29	2	11
Water vendor	3	0	0	0
Truck vendor	0	0	0	0
Neighbor	33	17	1	7
Public tap	9	26	20	21
Hand pump	1	10	9	9
Open well	4	11	28	22
Surface water	1	7	41	30
Other	0	0	0	0
Total	100	100	100	100

Source: WB (2001).

Table 4. Study Area: Water Access Indicators

Region	% Population who have access to water	Minutes to Drinking Water Collection point
Arusha	35	14
Kilimanjaro	60	9
Morogoro	28	14
Iringa	55	10

Source: WB (1999).

Table 5. Study Area: Access to Education and Health Centers

	Distance to school (Kms)		**Distance to health center (Kms)**	
	Primary	***Secondary***	***Primary***	***Secondary***
Arusha	1.9	6.4	3.8	11.8
Kilimanjaro	0.9	5.0	1.9	9.5
Morogoro	1.7	16.0	3.7	24.0
Iringa	1.5	12.7	4.8	18.9

Source: Appendix 4.

Table 6: Comparison with Kenya and SSA countries

Infrastructure and Rural Services	Tanzania	Kenya	SSA
Paved roads (%)	4	14	16
Electricity consumption (kw hours per capita)	59	126	439
Telephone (per 1000 people)	4	16	16
Newspaper (per 1000 people)	4	10	12
Television sets (per 100 people)	20	25	
Fax machines (per 100 people)	neg	0.1	0.2
Access to safe water	35	53	52
Secondary GER (%)	5	24	27

Source: World Development Report (2003)

Table 7. A Survey of Studies on Rural Services and Agricultural Productivity

Author	Analysis	Model	Data	Dependent Variable	Independent Variables
Antle, 1982.	Infrastructure, human capital, and rice productivity.	A Cobb-Douglas production function.	Farm level data in India.	Rice output.	Land, labor, variable inputs: fertilizer, seeds and pesticide; education, extension, transport, technology: high yielding variety, irrigation, and rainfall.
Antle, 1983.	Infrastructure and agricultural productivity.	An Aggregate Cobb-Douglass production function.	A Cross country data set from least developed countries.	Aggregate agricultural output.	Land, labor, livestock, fertilizer, education, infrastructure.
Binswanger, 1989.	Agricultural production, output, and government policies including rural infrastructure and services provision.	A Supply function.	Aggregate crop output and investment in agriculture. Cross country and India data.	Aggregate crop output.	Technology, investment in roads, markets, irrigation, infrastructure, education, health, research, extension, fertilizer.
Fulginiti and Perrin, 1990.	Government policies in Argentine's agriculture.	A Multi-input, multi-product trans-log profit function.	Aggregate output and input data in Argentine.	Aggregate output.	Labor, capital, fertilizer, seeds, chemicals, and prices of other crops
Binswanger and Khandker and Rosenzweig, 1993.	Infrastructure, financial institutions, and agricultural output.	An Aggregate crop output and input demand models.	District level, time series data for India.	District level crop output.	Crop price, input price, urban wage, interest rate, road, canal irrigation, rural electrification, commercial bank, primary school, rainfall, soil quality
Diagne and Zeller, 2001.	Access to credit, agricultural income, and welfare.	Choice-based equations for credit limits, credit demand and outcomes, with truncated and censored dependent variables.	Household and farm level data for Malawi.	Household welfare: agricultural income, food security, and nutrition.	Access to credit: formal and informal, crop prices.
Minten, 1999.	Infrastructure, market access, and agricultural prices.	A Modified co-integration method.	Farm survey and time series price data for Madagascar.	Market price.	Price in other markets, market access, road quality and distance.
Zhang and Fan, 2001.	Public infrastructure on agricultural productivity.	A Generalized Method of Moment-GMM method.	Provincial pooled time series data on road density for rural India.	Total factor productivity.	Road, rainfall, high yielding varieties.

Table 8. Data sources and description

Variables	Source	Description
Q	Basic data: Agriculture Sector Bulletins	Value of Agricultural Output: Food and cash crop production
Prices	Ministry of Cooperatives and Marketing database Bank of Tanzania and Quaterly Economic Review Bulletin	• Regional prices are the mean of all market prices in the regions. • Value of exports based on countrywide annual average of producer prices
Inp	Basic data: Agriculture Sector Bulletins	Physical inputs: (i) Land: area planted to selected crops (ii) Labor: agriculture population data
Tech	Basic data: Agriculture Sector Bulletins	Improved technologies: fertilizer and seeds sales
Cred		Agricultural credit: Value of loans issued by the CRDB Bank.
Env	Tanzania Meteorological Agency	Environment: Annual precipitation in millimeters
Know	UNHS socio-economic module	Farmer's know how : Government expenditure in education
Infr	Economic Survey	Infrastructure (i) Electricity annual sales in KwHr

Table 9. Food Crops Production Function

Independent	With Fertilizer			With HYV Seed		
Variables	**Coefficients**	**t-ratio**	**Sign**	**Coefficients**	**t-ratio**	**Sign**
(Constant)	9.38	3.68		9.41	3.71	**
Land	0.63	7.47	**	0.63	7.47	**
Labor	-0.38	-1.42		-0.39	-1.41	
Fertilizer	0.025	0.42				
Seeds (HYV)				0.036	0.41	
Education	0.63	2.38	*	0.63	2.39	*
Rainfall	0.058	0.44		0.058	0.41	
Electricity	-0.043	-0.043		-0.024	-0.476	
Public Expenditure						
Agriculture	0.23	2.58	*	0.23	2.58	*
Curative services	-0.02	-0.17		-0.02	-0.17	
Preventive services	0.056	0.96		0.56	0.96	
Rural water	-0.051	0.61		0.05	0.60	
Coops and community dev.	-0.34	-2.89	*	-0.34	-2.88	*
Rural roads	-0.073	-1.2		-0.07	-1.2	
Adj. R-square	0.421			0.421		
N	190			171		

*Significant at 5% level
**Significant at 1% level

Table 10. Export Crops Production Function[18]

Independent Variables	Coefficient	t-value	Sign
Constant	14.09	3.64	**
Land	0.55	7.30	**
Labor	-0.76	-1.90	*
Fertilizer	0.39	3.97	**
Rainfall	-1.65	-8.11	**
Electricity	0.18	2.10	
Education	0.85	2.01	*
Public expenditure			
Rural roads	0.25	2.68	*
Agriculture	-0.24	-1.75	*
Curative services	-0.06	-0.33	
Preventive services	0.02	0.21	
Rural water	0.05	0.36	
Coops and community dev.	0.18	0.96	
Adjusted R-square	0.601		
N	170		

*Significant at 5% probability level
**Significant at 1% probability level

Table 11. Aggregate Food and Export Crops Production Function

Independent variables	Coefficient	t-ratio	Sign
(Constant)	10.53	4.28	**
Land	0.60	6.64	**
Labor	-0.33	-1.29	
Fertilizer	0.05	0.78	
Rainfall	-0.05	-0.40	
Electricity	0.00	0.08	
Education	0.45	1.72	*
Public expenditure			
Rural roads	-0.04	-0.66	
Agriculture	0.15	1.79	*
Rural water	0.09	1.05	
Coops and community dev.	-0.27	-2.37	*
Curative services	-0.06	-0.50	
Preventive services	0.04	0.75	

*Significant at 5% level
**Significant at 1% level

[18] 4 regions were excluded (Dodoma and Rukwa do not have export crops while Mtwara and Lindi do not have information on cashew crop area).

Table 12: Total Agricultural Production Equations for HYV and fertilizer

Independent Variables	With Fertilizer			With HYV Seed		
	Coefficient	t-value	Significance	Coefficient	t-value	Significance
Constant	10.38	4.30	**	10.42	4.35	**
Land	0.61	7.15	**	0.61	7.15	**
Labor	-0.41	-1.64		-0.41	-1.64	
Fertilizer	0.03	0.59				
Seed				0.05	0.59	
Rainfall	-0.03	-0.27		-0.03	-0.27	
Electricity	0.02	0.51		0.02	0.51	
Education	0.61	2.41	*	0.61	2.41	*
Public expenditure						
Rural roads	-0.05	-0.81		-0.05	-0.81	
Agriculture	0.20	2.43	*	0.20	2.43	*
Rural water	0.06	0.73		0.06	0.73	
Coops and community dev.	-0.34	-3.00	*	-0.34	-3.00	*
Curative services	-0.04	-0.40		-0.04	-0.40	
Preventive services	0.06	1.05		0.06	1.05	
Adjusted R-square	0.439			0.439		
N	190			170		

*Significant at 5% probability level
**Significant at 1% probability level

Table 13. Farm Technology Adoption Equations

	Fertilizer Use			HYV Seed use		
Independent Variables	**Coefficients**	**t-ratio**	**Significance**	**Coefficients**	**t-ratio**	**Significance**
(Constant)	-8.39	-2.2		-11.35	-2.87	*
Education	0.977	2.034	*	0.045	0.095	
Rainfall	0.392	1.17		0.045	0.19	
Electricity	-0.02	-0.017		0.503	4.12	**
Credit	0.52	5.58	**	0.33	3.69	**
Public Expenditure						
Agriculture	-0.097	-0.6		0.49	2.99	**
Rural roads	0.67	4.5	**	0.497	2.99	**
Adj. R-square	0.338			0.416		
N	190			171		

*Significant at 5% level
**Significant at 1% level

Table 14. Effect of Public Expenditure on Education (School enrollment)

Independent Variables	**Estimates**		
	Coefficients	t-ratio	Significance
(Constant)	0.624	4.129	**
$EducExp_{t-1}$	0.811	17.671	**
Adj. R-square	0.623		
N	190		

*Significant at 5% level
**Significant at 1% level

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APPENDIX I. SUPLEMENTARY TABLES

Appendix I Table 1: Road Network By Region (By Length in Kilometres)

REGION	Up to 1996				Up to 2000				Total Roads 2000	
	Trunk roads		Rural roads		Trunk roads		Rural roads			
	Paved	Unpaved	Paved	Unpaved	Paved	Unpaved	Paved	Unpaved	Paved	Unpaved
Arusha	223	223.3	0	1153	266	280	10	1228	276	1508
Coast	278	56	0	774.7	349	58	0	796	349	854
Dodoma	146.5	421.7	5	691.3	133	425	5	699	138	1124
Iringa	479	514.8	0	1182.2	477	413	25	988	502	1401
Kagera	112	395.8	0	1016.7	214	391	0	1515	214	1515
Kigoma	240.5	51	64.7	553.6	5	465	0	595	5	1060
Kilimanjaro	0	469.6	0	635.3	240	151	66	630	306	781
Lindi	198.2	246.8	0	565.3	233	230	0	728	233	958
Mara	200	136.5	0	656.5	169	159	0	678	169	837
Mbeya	351	276	0	1291.9	364	293	0	1540	364	1833
Morogoro	421	141.4	0	1013.5	418	142	0	736	418	878
Mtwara	127	88	8.9	623.1	108	102	12	763	120	865
Mwanza	135	135.3	0	1247.6	130	279	0	1084	130	1363
Rukwa	0	941.7	0	1370.8	10	825	0	1268	10	2093
Ruvuma	166	547	0	717.4	177	505	3	1371	180	1876
Shinyanga	209.8	130.1	0	964.1	199	155	0	948	199	1103
Singida	3.5	606.8	0	863.4	8	600	0	979	8	1579
Tabora	0	669.5	0	1100.3	5	641	6	1060	11	1701
Tanga	298	0	12	1029.4	267	57	32	1044	299	1101
Total	**3589**	**6051**	**91**	**17450**	**3772**	**6171**	**159**	**32291**	**3931**	**38462**

Source: Ministry of Works, The United Republic of Tanzania – Unpublished Reports.

Appendix I Table 2: Tanzania Transport Corridors

Corridor	Length (Km)	Region	Population catchment	Volume Agriculture output million TAS (tons)	Output other sector million TAS	Daily traffic
TANZAM	1324 (P=81%) (G=19%)	Coast, Morogoro, Iringa, Mbeya, DSM	3.8 (14.9%)	1287700 (11.6%)	9001.9 (16.6%)	123-7900
NORTH EAST	950 (P=78%) (G=22%)	Coast, Tanga, Kilimanjaro Arusha	3.8 (14.9%)	1022500 (9.3%)	14405.8 (26.5%)	102-1526
SOUTHERN COASTAL	508 (P=35%) (G=65%)	Coast, Lindi	1(3.9%)	301500 (2.7%)	772.7 (1.4%)	100-7000
CENTRAL	1584 (P=39%) (G=61%)	Morogoro, Dodoma, Singida Tabora, Shinyanga, Mwanza, Kagera	6.3(24.7%)	2763600 (2.7%)	1431516 (26.4%)	114-208
LAKE CIRCUIT	1019 (P=22%) (G=78%)	Kagera, Mwanza, Mara	2.4 (9.4%)	985900 (9%)	3496.2 (6.4%)	46-458
SOUTHERN	1326 (P=37%) (G=63%)	Ruvuma, Mtwara, Iringa, Lindi	1.4 (5.4%)	1238800 (11.2%)	1942.2 (3.5%)	45-338
GREAT NORTH	1024 (P=21%) (G=79%)	Arusha, Dodoma, Iringa	2.6 (10.2%)	1211400 (11%)	7485.0 (13.8%)	20-2714
WESTERN	1286 (P=0%) (G=49%) (E=51%)	Kigoma, Rukwa, Mbeya	2.4 (9.4%)	1024400	1310.3	21-144
MIDWEST	1201 (P=3.2%) (G=9.7%)	Rukwa, Mbeya, Tabora	1.8 (7%)	1208400 (11%)	3496.2 (2.6%)	11-96
TANZANIA MAINLAND	102222 (100%)		22.5 (9.4%)	11044200 (100%)	54178.7 (100%)	46-458

Source: Mabere (1995).

Appendix I Table 3: Electricity Sales (Million kilowatt hours)

Region	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Arusha	49	53	51	57	57	58	56	64	70	71	76	81	97	84	84	98	113	167	159	173	162	126	156
Coast	1	1	1	1	1	1	1	1	1	1	1	1		1	7	2	5	6	6	6	6	1	1
Dodoma	10	10	9	11	10	11	15	14	18	23	22	24	33	36	36	36	39	39	37	40	37	40	39
Iringa	8	8	7	6	5	9	19	64	56	61	70	99	93	87	89	81	137	90	86	93	87	41	69
Kagera	3	4	3	4	3	3	5	4	4	5	6	6	8	11	11	12	19	18	17	17	16	16	18
Kigoma	3	3	3	4	3	4	4	5	4	7	7	7	7	9	10	10	9	9	9	9	8	7	10
Kilimanjaro	23	22	23	22	34	36	39	44	49	66	66	71	83	88	78	70	87	112	107	116	109	106	91
Lindi	1	1	1	1	1	2	2	2	3	4	5	5	6	7	4	5	5	5	5	6	6	5	9
Mara	3	9	13	14	16	13	9	12	8	6	12	12	15	21	20	18	17	18	17	20	19	18	24
Mbeya	10	10	12	14	19	26	26	30	31	35	62	85	50	55	60	60	77	69	66	71	67	86	81
Morogoro	35	39	40	40	36	39	43	66	67	71	78	73	89	99	94	102	102	102	97	105	98	73	87
Mtwara	4	5	4	5	4	5	5	6	5	7	7	6	10	13	12	14	19	16	15	16	15	21	29
Mwanza	49	42	54	30	29	31	38	32	30	30	42	45	49	58	58	63	58	74	71	77	72	82	78
Rukwa			1	0	1	1	2	2	3	4	4	4	6	7	10	7	9	10	10	10	9	8	8
Ruvuma	2	2	2	2	2	2	2	2	4	5	6	7	9	12	10	10	17	11	10	11	10	9	9
Shinyanga	4	4	4	5	5	6	6	7	6	8	9	10	46	61	51	35	31	41	39	43	40	38	36
Singida	1	2	1	1	1	2	2	3	3	6	6	7	6	9	10	13	12	10	10	10	9	11	12
Tabora	7	6	4	4	5	9	9	11	10	11	13	14	19	19	19	16	24	22	21	23	22	72	49
Tanga	68	76	88	77	70	70	69	86	82	95	96	107	129	88	112	110	118	133	127	138	129	89	101
Total	**282**	**295**	**319**	**297**	**303**	**329**	**352**	**452**	**453**	**516**	**588**	**583**	**755**	**765**	**775**	**762**	**898**	**952**	**909**	**984**	**921**	**849**	**1888**

Source: URT - The Economic Survey, The Planning Commission, United Republic of Tanzania, various years

Appendix I Table 4: Comparative Basic Economic Indicators across Administrative Regions

Region	Area Sq.Km	Popul. Mill	GDP/Capita TSh (1$=1000Tsh)	Agric/Liv As main Activity%	Per Capita Consumption Expend TSh	Below Food Poverty%	Below Basic needs Poverty%	BMI Women	Age 15 With No Education
Arusha	82,306	2.1	277,367	52	8750	28.1	42.8	2216.0	24
Coast	32,407	0.9	180,579	72	9922	29.7	48.2	2248.5	42
Dodoma	41,311	1.7	154,772	75	7587	13.9	36.3	2110.1	33
Iringa	56,864	1.7	247,323	71	10765	10.6	30.1	2195.5	17
Kagera	29,388	1.9	149,829	85	8456	18.2	29.3	2254.5	26
Kigoma	37,037	1.2	154,549	84	6384	21.7	38.5	2261.6	29
Kilimanjaro	32,407	2.0	152,004	60	10580	11.4	31.9	2277.1	13
Lindi	66,046	0.9	184,215	78	8263	36.1	56.9	2207.1	48
Mara	19,566	1.4	182,428	80	7612	37.6	45.8	2354.2	26
Mbeya	60,350	2.2	201,583	71	11548	9.2	23.2	2326.6	19
Morogoro	70,799	1.8	205,334	77	8253	15.1	32.1	2183.5	31
Mtwara	16,707	1.1	263,901	77	11712	17	39.4	2114.2	30
Mwanza	19,592	2.6	222,755	79	7716	30.1	48.3	2423.8	29
Rukwa	68,635	1.1	220,761	84	6204	11.9	31.8	2221.9	33
Ruvuma	63,498	1.2	206,646	88	8592	29	43.6	2176.0	16
Shinyanga	50,781	2.6	285,053	71	7273	23.4	44.1	2222.4	42
Singida	49,341	1.1	183,077	64	6372	29.1	57.7	2214.2	29
Tabora	76,151	1.4	183,496	76	9590	8.7	27.4	2263.7	33
Tanga	26,808	1.8	191,125	70	8802	11.6	37.9	2125.8	33

Source: HHBS (2000/01)

Appendix I Table 5. Tanzania: School Enrolment Patterns

	Gross Enrollment Rate %		
Grade	**All**	**Boys**	**Girls**
Primary 1	72	76	67
Primary 2	90	96	85
Primary 3	94	91	97
Primary 4	78	78	77
Primary 5	89	84	93
Primary 6	47	42	52
Primary 7	26	26	26
Form 1	14	13	14
Form 2	11	13	9
Form 3	8	9	6
Form 4	7	8	6

Form 1 to 4, is secondary education.
Source WB (1990)

Appendix I Table 6. Irrigation and Tractor use Patterns (%)

	Irrigated crops	**Used tractor**
Dodoma	.2	5.4
Arusha	7.4	9.7
Kilimanjaro	21.6	31.4
Tanga	3.5	.7
Morogoro	2.4	16.0
Coast		.3
Lindi	.9	4.2
Mtwara		2.9
Ruvuma		.7
Iringa	4.9	5.1
Mbeya	.5	6.8
Singida	.8	.3
Tabora	2.2	1.2
Rukwa	5.3	
Kigoma	1.1	.2
Shinyanga	.3	2.1
Kagera	1.3	.7
Mwanza	3.6	
Mara	.5	1.5
Mean	3.1	5.0

Source: URT (1994/95) – ESA.

Appendix I Table 7. Autonomous extension services: Donors, NGOs and religious establishment

Region	Description
IRINGA	
HIMA (Hifadhi ya Mazingira - Iringa):	An environment project emphasizing sustainable agricultural production, land management and utilization. DANIDA funds it.
CONCERN	An Irish International NGO that supports agricultural production in rural areas in Iringa region.
PRIDE	An international NGO providing rural credit to small businesses.
CEFA	Provides social services in Iringa region, mainly water, agriculture and health.
SHDDP	Supports smallholder dairy production in the region.
RBM-SIIP	Supports construction of irrigation structures in Luganga, Malangali and Nyamahana villages.
ASPS	Supports seed production and irrigation in the region.
ISWCP	Supports utilization of indigenous knowledge on soil and water conservation in selected villages of Ismani, Mazombe, Kilolo and Kiponzelo divisions.
SOFRAIP	A pilot project on soil and water conservation in Mkungugu and Malinzanga villages.
MEMA	Involved in environmental conservation in some districts in the region.
MOROGORO	
UMADEP:	Uluguru Mountains Agricultural Development Program.
FAO-	Special Program for Food Security
EZCORE	Ulanga Ireland Aid support
DANIDA	Under Agricultural Sector Program Support (ASPS)
DANIDA	Under Private Agricultural Sector Support (PASS)
SOFRAIP	A pilot project on soil and water conservation.
MEMA	Involved in environmental conservation in some districts in the region.

Appendix I Table 8(a): Public Expenditure by Sectors as % of GDP

Composition of public expenditure % GDP							
Financial Year	1996	1997	1998	1999	2000	2001	2002
Recurrent expenditure	12.5	13.5	13.1	12.8	12.8	13.6	12
Debt service	3.7	5	4.9	3.8	4.2	3.4	2.8
Supply votes	8.8	8.5	8.3	9	8.6	10.1	9.3
Recurrent central	6.5	6.2	6	6.9	6.3	7.4	6.8
Recurrent regions	2.3	2.3	2.3	2.1	2.3	2.7	2.5
Development expenditure	0.5	0.9	1.6	1.8	1.5	2.1	0.4
Total Expenditure	13	14.4	14.7	14.6	14.3	15.7	12.4
Social sector recurrent expenditures % GDP							
Education	0.3	0.3	0.4	0.3	0.3	0.4	0.4
Health	0.3	0.4	0.5	0.6	0.5	0.5	0.5
Water	0	0	0	0.1	0	0.1	0.1
Science, technology	0.5	0.5	0.4	0.5	0.4	0.6	0.6
Regions	2.3	2.3	2.3	2.1	2.3	2.7	2.5
Total services	3.5	3.5	3.6	3.7	3.6	4.4	4.5
Sector development expenditures % GDP							
Administration	0.1	0.4	0.4	0	0.3	0.4	1.6
Defense and security	0	0	0	0	0	0	0
Social services	0.2	0.2	0.4	0.9	0.5	0.8	1.5
Economic services	0.1	0.2	0.6	0.7	0.6	0.6	0.2
Productive services	0.1	0	0.2	0.2	0.2	0.2	0.2
Total	0.5	0.9	1.6	1.8	1.5	2.1	3.5

URT (2002).

Appendix I Table 8(b): Recurrent Funds: Sector Expenditure and percentage of Total

Sector	1995/96	2001/2002
Administration	16.7	21.1
Defense and security	19.2	14.9
Social services	28.5	33.3
Economic Services	1.6	6.8
Productive sector	4.1	2.7
Consolidated fund	29.9	21.2
	100.0	100.0

Social: Education, water, Health, Comm. Development, Labor, Teacher, Higher Education
Source (URT 2002).

Appendix I Table 9: Important Government Policies Affecting Rural Services Provision

1. Agricultural and Livestock Policy of 1997
2. Agricultural Sector Development Strategy of 2001
3. Community Development Policy 1996
4. Cooperative Development Policy of 1997
5. Education Sector Reform and Development Programme 1999
6. Energy Policy of Tanzania of 1992
7. Health Sector Reform 1994 – and updates
8. National Employment Policy
9. National Environmental Policy of 1997
10. National Eradication Strategy – NPES 1998
11. National Food and Nutrition Policy for Tanzania of 1992
12. National Land Act and Village Land Act of 1999
13. National Land Policy of 1997
14. National Micro-Finance Policy May, 2002
15. National Telecommunication Policy of 1997
16. Poverty Reduction Strategy Paper of 2000
17. Road Sector Development Programme 1997
18. Rural Development Policy of 2001
19. Rural Development Strategy of 2001
20. Rural Water Policy 1997
21. Strategic and Action Plan for Public Service Reform Programme (1998-2003)
22. Sustainable Industrial Development Policy (SIDP) of 1996

APPENDIX II: DATA NOTES

IFPRI designed this study to cover a broad range of rural services. The set of rural services and infrastructure covered in this study are also very heterogeneous. Services range from 'goods' comprising of inputs like fertilizer to 'services' exemplified by agricultural advice, commonly dubbed 'extension'. Infrastructure transcends from the 'soft' type such as information, to 'hard' or 'physical' infrastructure, namely: roads, railways, and harbors. An additional dimension is that cutting across from 'social' services: education and health, to "economic" services encompassing utilities such as water and electricity. Units of measurements for the diverse set of variables differ considerably, and no single database in Tanzania stores all such information. The ways through which the services affect agricultural production, rural incomes, and hence poverty, differ considerably and hence implications for observed patterns of investments may vary for each category of service or infrastructure. This has been the key challenge in undertaking the study.

For the characterization section, we collected and analyzed the following type of secondary data:

i) National data: These are time series statistics from statistical abstracts, economic surveys and from the National Bureau of Statistics (NBS) database. The NBS disaggregates some of this data by administrative regions.

ii) Market prices: The Market Information Service Department, formally the Marketing Development Bureau (MDB) of the Ministry of Agriculture and Food Security collects this information.

iii) The Household Budget Survey: Conducted by the NBS

iv) Demographics and Health Survey: Conducted by the NBS.

v) Both the 1991/92 and The 2000/01 Household Budget Survey data sets are used.

vi) Agricultural Surveys: Conducted by the Statistics Unit of the Ministry of Agriculture in collaboration with NBS.

vii) Secondary "gray data", collected from headquarters of selected study regions is used fill gaps and present the grassroots information that is not available from secondary sources, or not revealed by national level secondary data.

All nation-wide surveys, i.e. The Household Budget Survey, the Demographic and Health Survey, and the Agricultural Surveys base their data collection on the National Master Sample (NMS) framework. Analysts can therefore disaggregate data sets based on the NMS into regional, district and village levels. This allows us to contrast and identify whether some areas, regions, are particularly disadvantaged. There is a perception in Tanzania that areas towards the south are relatively disadvantaged and underserved. We use Arusha and Kilimnjaro from the north, and compare them with Iringa and Morogoro in the south, for deeper insights, across all categories of RS&I.

Because of the diverse sources of data, we experienced many gaps and differing times of data collection; the paper therefore also draws significantly upon past studies done to analyze infrastructure and rural services – especially central studies of the agriculture and social services sectors by the World Bank. Notably, none of the reviewed documents covered all services. The data used for the econometric model is a select of indices that have long enough time trends; it includes additional sets, e.g. sector budgets, not used in

the characterization section. We present details of the data used for estimating the empirical model in section 4, preceding the econometric model.