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Tanzania: Agricultural Sector Overview

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Overview

The United Republic of Tanzania, most commonly referred to simply as Tanzania, is comprised primarily of poor, rural, smallholders whose livelihoods are reliant on agriculture. *Table 1* below provides general facts on geography, population, income, and the economy.

Table 1: Tanzania At-A-Glance

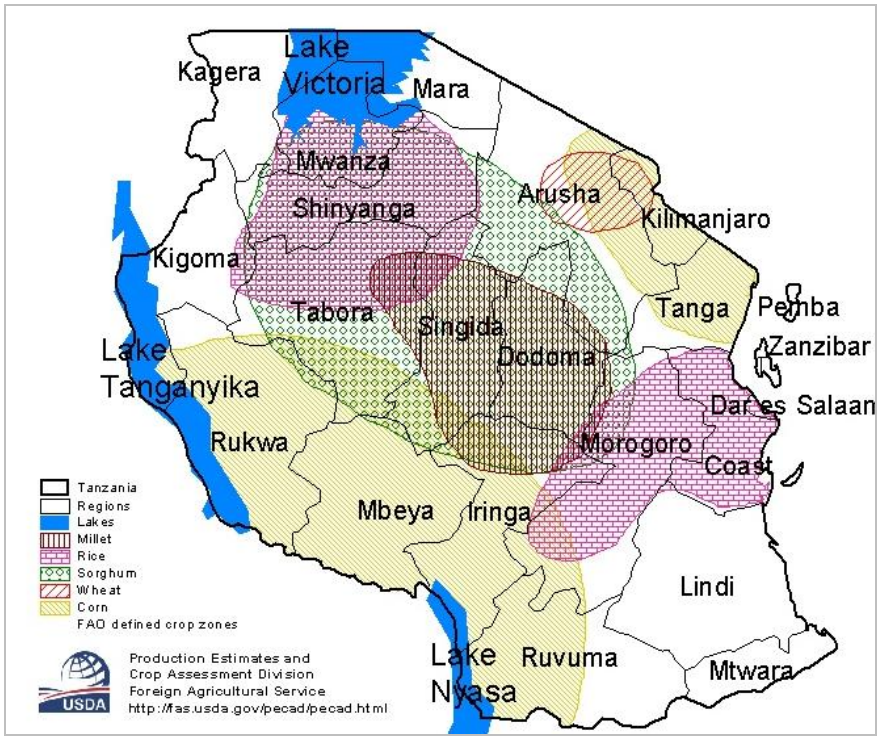
Geography	
Total Area	947,300 kilometers*
Land Area	885,800 kilometers*
Population	
Total Population (2008)	42 million*
Urban	25%*
Rural	75%*
Annual Population Growth Rate (2010)	2.032%*
Incomes	
Average Income per capita	$280**
Poverty Line	$0.65/person+
Population below	17 million+
Poverty Distribution (% of the poor)	
Urban	20%*
Rural	80%*
Economy	
GDP (2010 estimate)	$22.43 billion*
Exports	$3.8 billion*
Agricultural share of GDP	41.6%*
Average Annual GDP Growth Rate (1990-2003)	3.5%++
Average Annual Agricultural GDP Growth Rate (1996-2003)	4%++

*Sources: *CIA World Factbook; **Conforti & Sarris 2009, p 3; +Government of Tanzania 2006, p 4; ++Gordon 2008, p 97*

Structure of the Agricultural Sector

Tanzania's agriculture sector is extremely diverse. Crop production accounts for 55% of agricultural GDP, livestock for 30%, and natural resources for 15%.[1] The main export crops are sugar, coffee, cotton, tobacco, and tea. The most prevalent staple crops include maize, cassava, rice, sorghum, and millet. *Figure 1* provides a map of Tanzania and shows the geographic distribution of staple crops.

Figure 1. Staple Crop Production



Source: USDA 2003

Rural Livelihoods

Eighty percent of men in the labor force and 84% of women are employed in agriculture.[2] Ninety-eight percent of Tanzanian agricultural households are located in rural areas.[3] Of those rural households, 78% are male headed and 22% are female headed.[4] Rural household inhabitants are 46% under 14 and an additional 25% between the ages of 15 and 29.[5]

Farm Size

The majority of farms in Tanzania vary from less than one to three hectares,[6] with an average farm size of 2.4 hectares.[7] Farm size further varies across regions. For example, in the predominant tobacco area of Ruvuma, farms average 2.47 hectares while in the smallholder coffee region of Kilimanjaro, farm sizes average at 1.08 hectares. This is at least in part due to higher population density in Kilimanjaro, making land scarcer and more expensive than in Ruvuma.[8] Average farm size also varies depending on gender; men are more likely to have farms greater than one hectare while women are more likely to farm parcels less than 0.3 hectares.[9] The Government of Tanzania owns most large farms, greater than five hectares, which accounts for 16% of cultivated land.[10]

Agro-Ecology

The primary agro-ecological zones in Tanzania are the coastal plains, northern highlands, southern highlands, and central arid plains.[11] Tanzania's agro-ecosystem is characterized by dry land and extreme rainfall variability, which limits productivity and contributes to land degradation, leaving land scarcer in more populous regions. The vast majority of the poor population that derives its livelihood from agriculture is therefore vulnerable to weather-related and other shocks in the agricultural sector.[12]

Crop Production

The most common food and cash crops in Tanzania are maize, cassava, sweet potatoes, bananas, sorghum, and sugar cane.[13] Multiple factors influence the farmer's choice of crops, including: 1) physical factors, such as soil quality and water availability; 2) economic factors, such as marketability and seed prices; 3) personal preferences of the household; 4) crop profiles, including crop yield and pest resistance; and 5) resource availability such as machinery and fertilizer.[14]

Traditionally, over the last century, farming systems have been millet, cotton, sugarcane, and/or banana based. However, over the last few decades, systems have shifted due to increasing land pressure, and are now primarily cassava, maize, or mixed cassava-maize based systems.[15] Systems vary by region and mixed maize-pigeonpea systems are common in certain areas, particularly semi-arid regions, because of the deeper rooting and slower initial growth of the pigeonpea makes it more suitable for drier climates.[16]

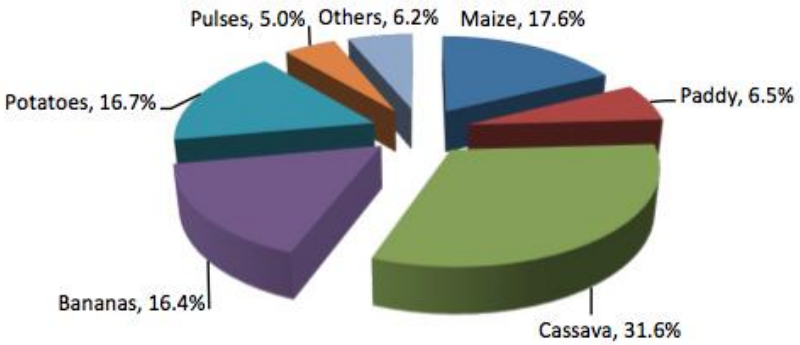
In the northern zones export crops include coffee, maize, and tea. In the southern zone coffee and tobacco are primary exports while in the southern highlands maize, tea, and coffee are predominant. In the western regions coffee and cotton are leading exports, however, 90% of the cotton is grown in the Lake Victoria region. The eastern region grows the remainder of the cotton.[17]

Staple Crops

Approximately 82% of Tanzanian farmers grow maize, 24% grow cassava, 16% grow rice, and 12% grow sorghum.[18] Of those farmers that grow maize, 85% are smallholders, 10% are medium farms, and the remaining 5% are large farms.[19] Rice farmers, on the other hand, are 94% smallholders and only 6% large farms.[20]

Sources vary on food production data, making reliability difficult to determine. Most studies, including one Ministry of Agriculture April 2008 document, report the dominant staple crop in Tanzania to be maize, accounting for 30% of agricultural GDP,[21] and the secondary crop to be cassava, accounting for 15% of national food production.[22] However, a November 2008 Ministry of

Figure 2: Food Crops Composition 1998-2008



Source: Ministry of Agriculture Nov 2008, p 14

Agriculture report cited cassava as overtaking maize as the dominant staple crop over the last decade, accounting for an average annual 31.6% of food production, and maize as secondary, accounting for only 17.6% of food production (*Figure 2* above).[23] FAOSTAT 2008 data also cites cassava as dominant, accounting for 25.7% of total crop production, with maize accounting for 14.2%.[24]

Maize production grew at an average annual rate of 2.4% between 1985-2000, which is slightly below the population growth rate.[25] The six main food crops combined have grown at an average of 3.5% per year.[26] Cassava is frequently cultivated on marginal, more distant fields, because of the low labor inputs required.[27] Rice is primarily grown in lowland rain fed areas (74%), although 20% is grown in upland rain fed areas and the remaining 6% is grown in irrigated lowlands.[28]

Consumption

Most staple crops are consumed at home, or traded informally. Only 31% of cassava is marketed, 42% of rice, 28% of maize, and 18% of sorghum.[29] While sorghum and millet are widely grown, they are predominantly staple crops with even less production taken to market than most staple crops (only 18% of sorghum). This is partly due to uncertain demand, which results in a thin, and unknown, market.[30]

Market Structure

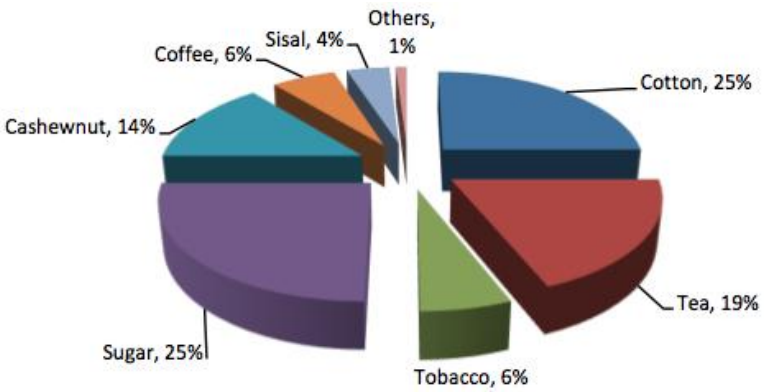
The market structure for staple crops is fairly informal and underdeveloped. One study found that 65% of Tanzanian farmers sell their produce out in front of their house, or at the farm gate. The main reason for this is distance from formal markets. Most rural farmers are an average of 3-6 kilometers away from the nearest village market and over 10 kilometers away from large markets. The same study found that while 6% of rich farmers are likely to sell their produce at markets five or more kilometers away, 0% of poor farmers do so. Forty-two percent of poor farmers said that their quantities of produce were too small to make it worthwhile to go to large markets, 27% lacked transportation, and 19% said local prices were sufficiently high.[31]

Export Crops

Export crops vary depending on the region. For example, in Kilimanjaro, two thirds of farmers grow coffee, while in Ruvuma only one third grow coffee. Coffee is primarily a smallholder crop, with 95% grown on farms averaging 1-2 hectares. The remaining 5% is grown on large estates.[32] Particular ethnic groups traditionally dominate cultivation of certain cash crops.[33] In Kilimanjaro, for example, coffee growers are predominantly Chagga, while in Ruvuma they are Matengo.[34]

According to Tanzania's Ministry of Agriculture, traditional export crops in Tanzania included cotton, coffee, tobacco, cashews, tea, pyrethrum, and sisal. However, other, more untraditional crops are increasing in popularity. These include, fruit and vegetables, cut flowers, cardamom, oil seeds, and fish products.[35] As traditional export crops, such as coffee, decline and new crops are becoming

Figure 3: Average Composition of Cash Crops Production



Source: Ministry of Agriculture Nov 2008, p. 17

more important, data on export crops is unclear. According to several sources, coffee was Tanzania's predominant export crop as of 2005, with earnings of somewhere between US$100 million and US$115 million per year,[36] and cotton is secondary with approximately US$90 million in export earnings.[37] However, according to FAOSTAT 2008 data and Tanzania's Ministry of Agriculture November 2008 report, cotton and sugar are the leading export crops (*Figure 3* above).[38]

In addition to the overall decline in coffee production, the market share of high quality Tanzanian coffee is also declining. In 1969 high quality coffee was 16% of Tanzania's market share and in 2000 high quality coffee had decreased to 1.6% of Tanzania's market share.[39] The market structure for cotton has become increasingly competitive since reforms in the 1990s, but seed supply, quality control, and seasonal credit problems remain.[40]

Livestock

According to the Tanzanian Ministry of Agriculture, 37% of households keep livestock.[41] See *Table 2* for exact figures of livestock owned by Tanzanian households in 2008. Of the 88.6 million hectares of agricultural land, approximately 60 million hectares are ideal rangeland for livestock grazing. However, only 40% of these rangelands are currently being used for livestock.[42]

Table 2: Livestock Owned by Households

Livestock	
Cattle	18 million
Goats	12.5 million
Sheep	3.5 million
Pigs	0.5 million
Poultry	31.3 million

Source: FAOSTAT 2008

Yield Levels and Agricultural Productivity

Coffee

While the area under coffee production doubled in the last two decades, yields remained stagnant. This stagnation has been attributed to decreased production on government run estates, aging trees, low inputs, increased diseases, and low returns to producers.[43] The trend in Kilimanjaro, one the main coffee producing regions, has been decreasing yields since the 1980s.[44]

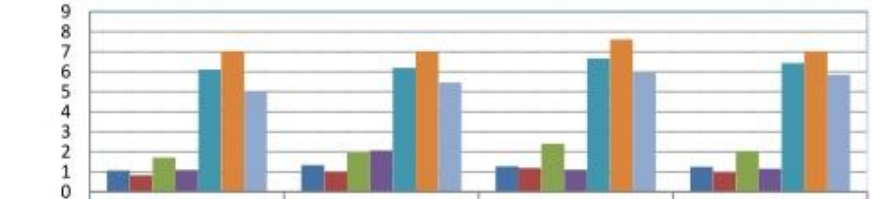
Staple Crop Yields

Figure 4: Five Year Moving Average of Maize Yields

Source: FAO Statistics

Yields for most food crops are difficult to measure since the majority is consumed in the household. Maize and rice yields are no exception.[45] However, estimates over the last 15 years maize yields have averaged 1.4 tonnes per hectare and experienced overall increases from 1997-2003 (*Figure 4*).[46] Rice yields increased from 450,000 tons of milled rice in 2000 to 800,000 tons in 2006.[47] In the 1990s rice was the fastest growing food crop with an average annual growth rate of 11%.[48] In the 1990s cassava had an average annual growth rate of 3.8% per year[49] and production increased from 1,698,000 tons in 2000 to 2,052,000 tons in 2005.[50] Mixed maize and pigeonpea systems yields increased when intercropped, and when fields were left fallow. Fertilizer and manure applications also increased maize and pigeonpea yields.[51] *Figure 5* below gives average yields in tons per hectare over the last several years and *Figure 6* provides FAOSTAT data from 2008.

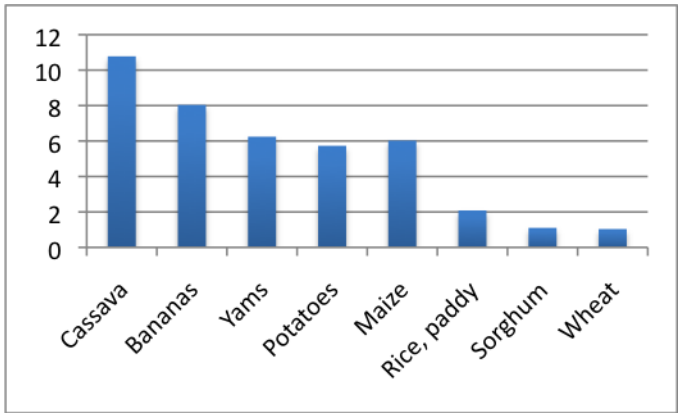
Figure 5: Productivity of Food Crops in Tons Per Hectare



	2004/05	2005/06	2006/07	2007/08
Maize	1.07	1.33	1.27	1.25
Sorghum	0.82	0.99	1.19	0.96
Paddy	1.71	1.95	2.4	2.03
Wheat	1.09	2.06	1.1	1.15
Cassava	6.11	6.2	6.67	6.44
Bananas	7.02	7.02	7.62	7.01
Potatoes	5.03	5.46	5.97	5.86

Source: Ministry of Agriculture Nov 2008, p 25

Figure 6: 2008 Productivity of Food Crops in Tons per Hectare



Source: FAOSTAT 2008

Yield Gaps

A variety of factors can contribute to yield gaps. Yield gaps are defined as the difference between yield potential and average farmers' yields over a given spatial or temporal scale.[52] One study found that 68% of smallholders attributed decreased yields in rice and maize to land resource deterioration, declining soil fertility, and increasing drought frequency; 59% attributed it to declining fertilizer consumption; and 39% to increasing variability in rainfall.[53] Yield gaps in rice are attributed to diseases and pests, poor inputs, insufficient water, poor soil quality, lack of fertilizers, and low yield seed varieties.[54]

Limited market demand also contributes to lower yields since farmers have little incentive to improve management practices. For example, in sorghum and pearl millet markets, the lack of surplus can lead to a lack in market demand, which prohibits farmers from investing in technologies that could increase production, which in turn could lead to a lack of surplus, resulting in a market cycle difficult to break out of.[55]

Tanzania's Ministry of Agriculture has highlighted factors that constrain potential for growth in the agriculture sector: arable land (only 25% of arable land is currently cultivated), availability of agriculture inputs and mechanization, more research and extension services, and irrigation.[56]

Agricultural Risks and Shocks

There are numerous challenges to agriculture in Tanzania, including limited access to support services (such as inputs, extension programs, technology, research, etc), dependence on rainfall, poor rural infrastructure (roads, communication, market access, etc), and limited access to financial capital and services.[57] Tanzanian farmers also have limited options for dealing with risks and shocks. Approximately three fourths of families use savings, 50-60% receive aid (predominantly from family), 25-30% generate additional income, reduce consumption, or change dietary patterns, and less than 7% borrow.[58]

Climate Change

In some cases, yield loss has been attributed to increasing temperatures. In a World Bank study on climate volatility in Tanzania, Ahmed et al. (2009) found that maize had a 12% yield loss per degree Celsius, rice showed a 17% yield loss, and sorghum a 7% yield loss over a six-month growing season.[59] In response to changing climates, agricultural households in Tanzania have extended and intensified crop cultivation, diversified their livelihoods, and migrated to new regions to gain access to land, markets, and employment.[60]

Crop Diseases and Pests

Crop diseases and pests present further challenges for crop cultivation. Increasing incidences of diseases and pests result in decreasing yields. Pests and diseases particularly constrain cassava cultivation. These include, Cassava Brown Streak Virus, Cassava Mosaic Disease, cassava mites, and mealy bugs.[61]

Other Risks

In the two main coffee growing regions of Tanzania, Kilimanjaro and Ruvuma, commodity price declines, human health issues, and drought were identified as major risk factors.[62] Cashew producing households have been more vulnerable to shocks than producers of coffee or tobacco.[63] Many Tanzanian farmers have used sweet potatoes as a risk management strategy because they are drought resistant and a high-energy food. However, sweet potatoes are not farmed more intensely because they are bulky, and therefore difficult to market.[64]

Available Resources

Smallholder success depends in part on availability of agricultural resources, including inputs, credit, and technologies as well as human resources, such as farmer groups and extension services.

Inputs

Since the agricultural reforms of the 1990s, government subsidies of fertilizers have been slowly removed.[65] Fertilizer use has declined as a result of both the removal of subsidies and decreasing crop prices.[66] However, in one study, falling fertilizer consumption was not significantly linked to changes in maize and grain supply.[67] See EPAR Brief # 75 (2009) *Political Economy of Fertilizer Policy in Tanzania* for more information.

Credit

In addition to lower subsidies, restricted credit access has also hindered smallholders from accessing inputs such as fertilizers and pesticides, particularly in the coffee and cotton sectors.[68] Credit markets in Tanzania are underdeveloped, and formal lending and credit are available primarily for the public sector.[69] Access to financial services, such as savings or cash deposits, is especially uncommon in rural Tanzania.[70] One study estimates that only 5% of farmers obtain credit from non-family sources.[71] Financial resources that are available in rural areas include: Savings and Credit Co-operative Societies (SACCOS), Savings and Credit Associations (SACAs), and informal sources of credit (family, friends, and moneylenders).[72]

Mobile Phones and Information Communication Technologies

Cellular phones are becoming an increasingly popular means for farmers to get advice on farming practices or emergency information from telecenter operators.[73] This is in part due to the low availability of other Information Communication Technologies (ICTs) such as Internet and data services and radio communications. As of 2010, there were only 72 Internet and other data application services available in Tanzania, resulting in low Internet use. Also as of 2010, there were 47 radio stations, but only 11 are community stations that cater to farmers' needs.[74] Radios are primarily used to communicate emergencies.[75] Marketing information on agricultural products and inputs is available in newspapers, on websites, and through SMS text messaging.[76]

A recent study suggested that ICTs can be especially important for populations that do not have access to extension services. For example, women only have access to 10% of extension services and are therefore likely more dependent on ICTs.[77] Limited funding is seen as a barrier to increasing the availability of ICTs, which in turn inhibits telecenters from providing sufficient agricultural information.[78]

Farmer Groups

In his study, Gordon (2008) found that farmer groups can improve access to technology, funding (such as savings and credit), crop processing and marketing (through commodities marketing groups), and livestock production (through involvement with dairy groups). Tanzania's largest farmer group network (MVIWATA) has approximately 1,000 groups in more than 80 districts.[79]

One study found that 56% of those in farmer groups improved their market situation through collective action. Of those that improved their market situation, 84% had at least one group activity and had access to a reliable water source. Groups with market improvement also averaged more than seven years of education while those without improvement averaged less than seven years of education. Sixty-five percent of previously existing groups, compared to 43% of new groups, were able to improve their market situation, suggesting that the more established groups are better off.[80]

Livestock

Livestock is considered a traditional store of wealth, especially in western regions of the country, because it can be easily liquidated and is a useful supplement in mixed farming systems.[81] It is seen as a reliable credit resource that is less susceptible to changing weather patterns than crops.

Irrigation

Irrigation systems are particularly useful in low rainfall areas, but only 1.8% of all cropped land in Tanzania is irrigated.[82] However, access to irrigation varies by region. For example, in Kilimanjaro 21% of households irrigate at least some of their fields, while in Ruvuma only 2.1% do so. However, this is consistent with the higher rainfall variability in Kilimanjaro.[83]

Land Tenure Policies and Reforms

According to Tanzania's land laws, all land is state property, and the president of the country is the trustee for that land.[84] Land is allocated in three primary ways, generally under terms of a 99-year lease. Seventy percent of land is designated as village land, and accommodates 80% of the population. Village land is demarcated into plots and certificates of rights of occupancy are distributed. Upper and lower bounds, set by a 2005 central government law, limit plot sizes.[85] The second form of land allocation is urban land, which accounts for 2% of land and accommodates 20% of the population.[86] The last form of land use is reserve land, which is defined as boundaries for conservation areas.[87] Reserve land represents 28% of all land.[88] One of the biggest controversies surrounding land rights is the issue of conflict between reserve land rights and land rights for pastoral and nomadic people.[89]

There are a variety of different forms of land tenure in Tanzania, including: customary rights, rights through allocation by village authorities, rented or borrowed land rights, land rights through commercial transactions, and open access land.[90] Increasing populations in certain areas are increasing pressure on arable land and pastures in those areas.[91] As a result of increasing demand and competition over land, there is a growing tendency to seek customary land rights as well as formal, legal land rights.[92] The disadvantage for smallholders to customary land rights is that the land must be used and there are restrictions on how long it can be left fallow. However, formally registering land rights is an expensive and time-consuming process that is prohibitive for many smallholders.[93] The tendency to seek both customary and legal land rights results in more complex negotiations, which create barriers for marginalized groups, such as women and pastoralists.[94] Due to the inaccessibility of legal land rights for the bulk of the population, elites have tended to benefit most from land reforms that replace traditional land institutions with formal institutions.[95]

Land tenure institutions in Tanzania are weak. Traditional land tenure systems in pastoral communities are communal and insufficient government policies result in insecure tenure, easy eviction, and expropriation.[96] Wildlife conservation and agricultural expansion further threaten pastoral land tenure.[97] Customary practices may also result in increasing fragmentation of landholdings. For example, in the Kilimanjaro region tradition dictates that a father is to split his land between his sons, resulting in smaller and smaller plots each generation, one factor contributing to decreasing coffee yields in that region.[98]

Agricultural Reforms and Policies

The Tanzanian government instituted a series of agricultural reforms in the 1980s-1990s that included market liberalization, removal of state monopolies, withdrawal of the government from production projects, and increased reliance on the private sector. However, reforms have been associated with declining access to inputs, decreasing output prices, and, particularly in remote areas, declining access to credit.[99]

According to critics, liberalization of Tanzania's export crops hasn't happened to the extent the government claims.[100] Overall, the agricultural sector has resisted reforms for export crop liberalization that began in the late 1980s. For example, the government has re-empowered export crop boards, government taxes limit

smallholders' disposable income, there are increasing policies and strategies that privilege the state (for example giving the central government power to act as initiator rather than facilitator in terms of foreign aid), and the government guarantees bank lending to certain co-operatives.[101] Despite these less than successful liberalization reforms, Tanzanian farmers have managed to produce sufficient staple crops to avoid famine in the period since liberalization.[102]

Tea Reforms of the 1980s and 1990s

Reforms in the tea market came before other export crop reforms and were largely successful,[103] in part because they were undertaken and owned by both the government and the sector as a whole.[104] In 1988 reforms instituted the privatization of two government-run tea estates and revived research efforts. Further reforms in 1994 created an agency to promote smallholder production, simplified the tax structure, and established the tea auction.[105]

From 1990-2004, tea production rose from 20,000 tons to 30,700 tons, a more than 50% increase in output.[106] However, problems persist. Tax structures are still too complex, the Tea Board continues to hold too much power relative to farmers, and trade policies need to be reformed. This results in tax evasion, corruption, and the ability of the government to refuse licenses on any grounds. [107]

Coffee Reforms of the 1990s

In the early 1990s, as part of the agricultural reforms, the Tanzanian government relinquished controls on coffee prices.[108] Since the reforms, some previously nationalized estates have been privatized, coffee is now marketed and processed primarily by the private sector, and the overall processing capacity has increased as a result.[109] After liberalization, farmers were paid cash on delivery and therefore received a higher proportion of export revenue. However, input credit disappeared as a result of the policy, the export volume of coffee failed to increase, the quality of coffee decreased (because farmers tend to get the same price regardless of quality), and declining world coffee prices decreased real producer prices.[110,111]

Despite the reforms, critics such as Baffes (2005) believe that the government is still too involved in the coffee market. Opponents of the government's policy argue that it has instituted complex taxes and intrusive licensing procedures, and that the continued power of the Coffee Board weakens private sector participation.[112]

Cotton Reforms of the 1990s

Cotton reforms began in 1989 when price controls were relaxed.[113] Major reform, however, began in 1994 with the Cotton Act of 1994, which allowed competition in both marketing and ginning of cotton.[114] This resulted in both increased ginning capacity and improved marketing structures.[115] However, while the producer's share of export prices increased, the input costs had also increased.[116] The most recent reforms came with the Cotton Industry Act of 2001, which officially gave responsibility for regulation of the cotton sector to the Tanzania Cotton Board.[117]

As with both the coffee and tea reforms, results of cotton reforms have been mixed and critics claim that the government remains overly involved in the sector. Opponents argue that taxation remains excessive, the sector is over-regulated by the Cotton Board,[118] and the data quality is unacceptable.[119] This has resulted in declining quality of the cotton.[120]

Agricultural Sector Development Programme

A more recent agricultural reform in Tanzania was the 2004 Agricultural Sector Development Programme (ASDP). The policy aimed to transition the agriculture sector from subsistence to export agriculture through the private sector, and achieve a sustained 5% growth rate in agriculture.[121] The ASDP included a variety of approaches: client and farmer empowerment; demand driven and market-led technology development; increased range of service providers and approaches to service provision; division of labor between local, district, and national governments; focus on economics, natural resource management, HIV/AIDS & malaria, and technical solutions; and increased accountability and transparency of processes.[122]

One of the ways in which the government of Tanzania hopes to achieve success is through the Local Government Reform Programme (LGRP). This policy aims at decentralizing procedures and improving delivery and quality of services to the public.[123]

Continued Impacts of Agriculture Reforms

Despite mixed results of agricultural policy reforms in Tanzania, reduced poverty from 1990-2003 can, at least in part, be attributed to the reforms. This reduction, however, has been unevenly spread across households. One study estimates that poverty reduction has been greater in male-headed households (10%) than female-headed households (3.5%), and greater in less educated households than more educated households. Distribution across regions has also been uneven with the Coast, Southern Highlands, and South Zone having seen poverty headcount fall by at least 10%.[124]

Reform policies that are believed to require additional review include the various crop boards and the government practices of intervening in food export markets.[125]

Conclusion

Tanzanian agriculture workers comprise 80% of the population and farm a wide variety of crops, ranging from staple crops such as maize, cassava, and rice, to export crops such as coffee, cotton, tobacco, tea, and sugar. Smallholders face increasing risks of climate change, pests, diseases, and land degradation among others. While they have some resources available to them, such as farmer groups and limited access to ICTs, they are also lacking in important resources such as credit and inputs. Tanzania's land tenure and agriculture policies have further complicated the lives of smallholders through increased taxes and administrative processes. Through the ASDP reform, however, the Government of Tanzania hopes to empower farmers and improve service delivery.

Literature Review Methodology This review was conducted using the University of Washington Libraries system and Google Scholar, as well as the websites of the Government of Tanzania, FAO, and World Bank. Search terms included the word Tanzania in combination with agriculture, agriculture/al sector, crop sector, smallholder, agricultural geography, agro-ecological zones, agro-ecosystems, land rights, farming systems, crop systems, yield gaps, subsistence crops, staple crops, export crops, crop yields, agricultural shocks, agricultural risks, government policies agriculture, agricultural resources, foreign aid, NGO distribution, aid distribution, NGO by district, and aid by district.

Please direct comments or questions about this research to Leigh Anderson, at eparx@u.washington.edu.

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