

Utilizing Appropriate Technology for Development Cooperation with Africa

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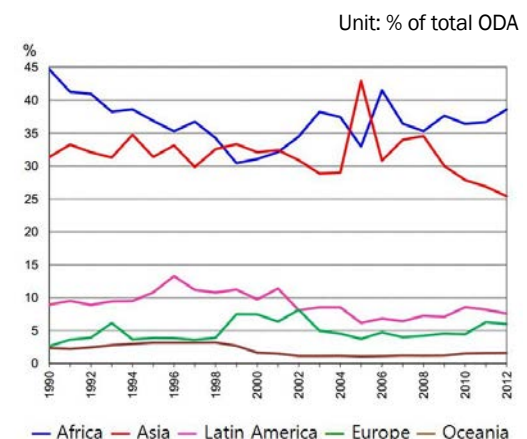
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Development Conditions in Africa

Since decolonization in the 1950s and 1960s Africa has received around 1.5 trillion USD in aid. Asia is a close second in the percentage of ODA received, but Africa has maintained first place for the most part since 1990, receiving between 30-45% of total net ODA. However, the effects of aid on poverty reduction remain opaque. While south and east Asia have grown double and fivefold in terms of GDP per capita, Africa has decreased by 0.2% each year.

Figure 1. Regional shares of total net ODA



Source: OECD.

Africa's poor performance comes as a result of the dynamics of a range of intrinsic and extrinsic factors. For example, some have argued that democracy is not the pre-requisite for economic growth but rather that economic growth leads to democracy. However, the absence of transparent institutions, leadership and animosity towards privatization and the market economy have been pointed out as practices of bad governance that hinders economic growth in general. Barriers to universal primary education have also been recognized as a challenge for Africa's development. Much effort has been taken to improve access to education but reality remains somber as the number of children out of school has in fact increased around 5% between 2008 and 2010. The natural environment for agricultural activities also provides hostile conditions to development as much of Africa lies in the tropical climate. This increases the likelihood of diseases and deters agricultural productivity growth. Moreover, international aid and finance organizations have often been accused of disregarding the uniqueness of Africa's culture and political systems in providing economic prescriptions. Such factors have maintained Africa's underdevelopment despite considerable sums of aid especially for agriculture, energy and access to clean water and sanitation, areas that are most critical to the livelihood of Africans.

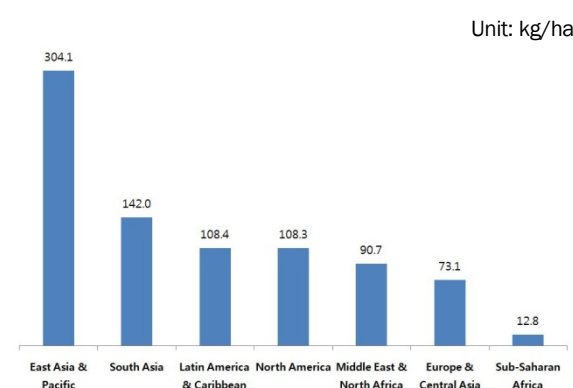
Agriculture

Agriculture is an integral part of Africa's economic development. The agricultural sector accounts for 30-40% of Africa's GDP and employs 65-70% of the continent's population. However, production remains low and food security is at high risk. Climate challenge is a great risk factor in agricultural development. Rainfall is scarce in the Sahel while in other areas rainfall is concentrated only during the wet season. Yet much of Africa still remains

dependent on rain-fed agriculture. Women and children walk several kilometers per day to collect water for crops which, during the dry season, barely covers enough for drinking water. Moreover, 80% of rainwater evaporates or is lost due to soil runoff.

Little interest and knowledge in soil management has led to the depletion of nutrients. This requires the use of chemical fertilizers that are too costly for an average farmer in the rural areas. The price of urea, diammonium phosphate (DAP) and potash (MOP) fertilizers averaged between 200-500 USD per ton in the past 10 years, reaching its highest in 2008 at over 800 USD whereas GDP per capita was 1692.5 USD in 2012. Purchasing fertilizers is also difficult due to challenges in accessing market price information and poor transportation infrastructure. As a result, the average use of fertilizer per hectare in Nigeria is 6kg while that of China equals 550kg and Indonesia 180kg.

Figure 2. Regional consumption of fertilizers



Note: 2002-2010 average.

Source: World Bank Database.

Post-harvest loss (PHL) which is most severe in the stages of harvesting, drying and storing, is also a major problem. Due to the absence of adequate repositories, crops are naturally dried in the sun. This increases exposure to rain, pests and dirt. In eastern and southern Africa

alone, post-harvest losses amount to 1.6 billion USD among 11 billion USD of total production.

Energy

Africa faces a huge energy crisis in terms of both production and access. Reasons behind the energy crisis vary across different countries. In Nigeria, inadequate production is due to the deterioration of power plants. Increasing investment to modernize production facilities is difficult as it would add to the already high service charges. On the other hand, Mozambique has abundant renewable energy sources including hydro, wind, and solar energy. It is also rich in traditional sources of energy such as coal and natural gas. However, only 13% of the population has access to electricity while 65% of the power production is exported to South Africa and Zimbabwe. This is mainly because establishing domestic power distribution and transmission networks are too costly. Rural areas are especially at risk as the costs of installation and transmission increase sharply because of low population density over a wide area of land. Consequently, only 2% of the rural population has electricity connection. Barriers to sustainable energy supply also cause environmental challenges because households use biomass for cooking and heating as an alternative, leading to deforestation and production of nitrogen oxides harmful to human health. Projections of high population growth add to the energy burden.

Water and Sanitation

Africa also faces clean water and sanitation problems. According to WHO and UNICEF, 92% of the global population will be able to drink clean water by 2015. Yet, 334 million people in Sub-Saharan Africa still do not have access to clean water and 70% of the population uses unhygienic cleaning facilities. As a result, 0.5 million die of diarrhea-related dis-

eases every year. Approximately 11.3 billion USD of investment is required every year to tackle this problem.

Although much effort has been made to construct public water supplies and sewage treatment plants in urban areas, supply is limited because of the fast influx of people. Rapid urbanization has degraded access to clean water and sanitation systems, especially in slums. Much of the existing systems have also deteriorated. Around 60% of the waste water disposal plants in South Africa are malfunctioning due to the lack of maintenance. As with the case of energy, urban population growth poses a great challenge to the clean water and sanitation problem.

In rural areas, low population density hinders economically feasible construction of public water and sewage treatment systems. The government of Burkina Faso undertook a national program to improve water facilities and saw tangible results, but still a quarter of the population in rural areas is excluded from its benefit. Likewise, the gap between urban and rural areas is still large in other countries. In Madagascar, 78% of the urban population has access to clean water while this figure falls to a mere 35% in rural areas. In the Democratic Republic of Congo the gap widens to 79% and 29% respectively. Awareness of hygiene and public health has improved but is far from sufficient. On average, around 70% of the population in sub-Saharan Africa does not have access to public health facilities. Mozambique displays a high rate of 44% in urban areas while in Tanzania the rate drops to 25%. The numbers are significantly lower in rural areas: Mozambique 11%, Tanzania 7%.

Manufacturing as a Growing Opportunity for Development

To achieve sustainable economic develop-

ment, Africa recognizes the need for economic transformation. With the genetic improvement of crops and development of localized farming machinery, excess labor in the agricultural sector is expected to migrate to other sectors. However, options are yet few in Africa. Although the service sector has grown rapidly, much of it is still based in the informal sector. Growth of the manufacturing sector will build new markets for domestic labor and foreign investment. Ethiopia has been successful in nurturing the manufacturing sector. With the largest number of livestock in Africa, Ethiopia has potential for developing the leather and shoe manufacturing sector. Also, with favorable climatic conditions and a long history of cultivation, Ethiopia demonstrates vibrant cotton production. Cheap labor, preferential trade arrangements with western markets and aggressive support from the government through the 'Growth and Transformation Plan (GTP)' also encourage growth of the manufacturing sector in Ethiopia. However, with the leather and textile industries taking up only 2.8% and 0.7% of total exports the lack of skills and technology is pinpointed as the major challenge in supporting the growth of the manufacturing sector.

Appropriate Technology and Its Implications for Africa

Appropriate technology was first introduced by Ernst Friedrich Schumacher in the 1970s. Discussion on the application of appropriate technology for economic development evolved during the 1980s as demand for practical skills and technologies grew in developing countries. As a result, both the private and public sectors actively invested in the development and application of appropriate technology. However, the attempt was donor-centered rather than user-centered, which led

to the development of technologies that ignored the culture, social values or purchasing power of locals.

Appropriate technology for advanced countries would mean technologies that make daily activities more convenient. However for Africa, appropriate technology would mean technologies that solve basic needs such as heat for cooking and heating, water for drinking and farming, or storage facilities that protect crops from disease and pests. Donor-centered development of appropriate technology in Africa led to the implementation of inappropriate technologies. For example, farming tools and machinery provided as ODA to Africa in the past were complex in design while also difficult to maintain as spare parts were unavailable in Africa. Dams and other facilities built by donor countries also ceded functioning after some years because of the shortage of skilled labor in maintenance. Consequently, appropriate technology failed to be mainstreamed as a development aid tool.

Recently, appropriate technology research has taken a more user-centered approach, taking into consideration the socio-cultural and natural environments of the local market. It also seeks cost-effectiveness by utilizing local resources in the making of such technologies.

Examples of Appropriate Technology in Use

Agriculture

Appropriate technology development has been most active in the agricultural sector because farming is the main source of income for the majority of the population. In response to the difficulties of accessing transparent information related to agricultural inputs, USAID used SMS for tracking the movement

of fertilizers. By connecting delivery trucks with warehouses through an automatic SMS documentation system, farmers are notified of the estimated time of arrival, truck registration number and amount of fertilizers that are to be delivered. This prevents loss and theft as well as increasing the time efficiency of farmers who must travel several kilometers to reach a market. USAID also increased crop productivity in Namibia by applying the ‘mulching (covering)’ technique which enabled soil temperature adjustment, prevented soil loss during the rainy season and preserved moisture. Namibia was able to increase millet production 5.6 times per acre as a result. MIT and Kick Start have developed cheap farming tools that are easy to use. MIT built the ‘portable corn sheller’ that enables farmers to collect corn kernels from stalks without having to carry heavy cornstalks to the fixed-type corn shellers that are expensive and easily cause injury. Kick Start’s ‘Money Maker Max’ and ‘Money Maker Hip Pump’ are irrigation pumps that are manually operated by foot. The light weight and durability of these pumps make them easy to use in rural areas where there is no electricity. Kick Start has sold 240 thousand pumps so far.

Energy

Recognizing the need to secure sustainable energy for poverty eradication, GIZ developed two energy-efficient stoves in Africa where the use of biomass is prevalent. In Kenya, 68% of the population relies on biomass as the primary source of energy. However, the use of wood, manure, agricultural byproducts and other sources of biomass increases the likelihood of respiratory diseases and also leads to deforestation. GIZ produced the ‘Jiko Kisasa’ and ‘Roket stove’ that are made from ceramic to prevent heat loss. They are portable and locally made. More than 4,000 locals are employed in the production of the stoves. D-Lab

of MIT also produces environment-friendly coal from agricultural waste such as cornstalks, banana leaves, coconut shells, cassava powder and so on. The technology carbonizes such byproducts, squeezes the sugar and bakes the bagasse in an oil drum to make the coal. It reduces environmental damage by reusing by-products and is also very cheap. Practical Action developed the ‘Zeer pot refrigerator’ that stores food for a long time without the need for electricity. This refrigerator uses thermodynamics by inserting sand or soil between the inner pot and outer pot. The pots are cheap and easy to make and has created employment opportunities in pottery. The technology is widely used in Cameroon, Chad, Ethiopia, and Nigeria.

Water and Sanitation

Water-borne diseases are frequent in Africa. Solar sterilization and chlorination are the usual options for purifying water, but Practical Action has developed filters to achieve this goal. The ‘Bio-sand water filter’ uses gravel and sand to slowly filter clean water in a plastic bottle. The materials are easy to obtain and cheap to assemble. The ‘lifestraw’ is another example of an appropriate technology. It is a simple straw that can filter 1,000 liters of water, removing bacteria and parasites such as salmonella and guinea worm from contaminated water. It comes in various sizes according to the needs of communities.

BOP and CSR Approaches to the Application of Appropriate Technology in Korea’s Development Cooperation Policy

Korea views appropriate technology as an important means for development cooperation.

Like other donor countries, private companies as well as government agencies, universities and NGOs have initiated research and development into appropriate technology development. However, rather than the technology becoming an end in itself, creating markets and encouraging economic activities are ways to enhance the effectiveness of appropriate technology.

Table 1. Areas of appropriate technology developed in Korea

Area	Appropriate technology
AGRICULTURE	
Organic fertilizer production	· Environment friendly recycling of agricultural by-products (ex. Coffee)
Small-scale irrigation	· Gravity and solar-powered irrigation systems · Renewable energy pumping systems · Rainwater management
PHL management	· Post-harvest repository
Livestock	· Manure composting · Disease prevention
Crop improvement	· Breeding and cultivation · Prevention of insect afflicted damage
ENERGY	
Power generation	· Bio-energy (ex. Sugar cane charcoal) · Solar energy generation and efficiency management · Wind energy monitoring and evaluation system
Power transmission	· Transmission automation · Smart-grid systems
WATER AND SANITATION	
Rainwater management	· Rainwater collection tanks · Rainwater purifiers · Ram-pumps

Water treatment	· Element technology · Substance monitoring and purification
SMALL-SCALE MANUFACTURING	
Textile industry	· Waste material recycling · Heating tents
Leather industry	· Leather coating and dyeing

The Bottom of the Pyramid (BOP) model views the lowest income class as a potential market rather than mere recipients of aid. The BOP model attempts to develop products and services that eradicate poverty, improve livelihoods and create new revenue. The BOP market is gaining attention with the recent stagnation of existing consumer markets in developed countries.

Africa's potential for developing the BOP market is promising. Africa ranks second in terms of size, with approximately 12.3% (490 million) of the global BOP population residing in Africa. In the case of Nigeria alone more than 40% (72 million) of the population lives below the poverty line. Their GDP per capita is expected to grow by 4.7% in 2015 while the number of emerging consumers is expected to grow to 35 million households (160 million people). Growth in the youth population will expand the consumer base as they are expected to be more economically active than previous generations.

The two most important factors to consider when entering the BOP market in Africa are price and product localization. Even though the purchasing power of Africans is increasing, much of the population, especially in rural areas, consists of low income communities. For example, around 70% of Nigerians still live on less than 1.25 USD a day. They are unable to afford the 'lifestraw' which costs 6 USD. Therefore, the 'lifestraw' is bought and dis-

tributed by international aid organizations for free in rural areas.

In regard to product localization there are some distinct constraints in Africa that need to be considered. For example, literacy rates are low in Africa. Literacy rates in 12 countries including Ethiopia, Mali, Niger, and Côte d'Ivoire are still below 50%. Therefore, products need to be easy to install and use. Moreover, distribution channels are mostly informal and difficult to penetrate. More than 70% of consumers in Nigeria, Ghana and Ethiopia use informal channels such as street vendors to purchase goods. Cooperating with large distribution companies that already exist is an option. Shoprite and PEP are large South African distribution companies that have entered both urban and rural markets in Botswana, Lesotho, Zambia, Mozambique, Angola, Malawi and other neighboring countries.

Corporate Social Responsibility (CSR) is also an effective means in building an economic partnership based on trust, for it emphasizes sustainable development through the creation of social capital. Recently, the concept of CSR has changed from 'charity' to 'self-sustainability'. In the past, companies built schools, wells and provided food subsidies. Nowadays, companies are seeking social innovation by using appropriate technology in CSR activities. Smaller companies such as Architecture and Vision, and Wagner & Co, as well as large companies such as Nestlé and Philips have incorporated appropriate technology into CSR activities. Schneider Electric has developed and distributed lighting systems using solar power. The corporation analyzed the demands of different community sizes and developed three different power generating systems. As a result, 1.8 million households gained access to light. In addition, they provided maintenance training to locals so that power could be sustainably generated. They

also offered training programs for start-ups using solar energy to encourage market formation. Architecture and Vision, an architecture design company, designed and built 'Warka Water' in Ethiopia. 'Warka Water' differs from existing water purifiers in that it takes advantage of the temperature gap between day and night to collect clean water. It collects at least 30-40 liters of clean water per day. Korean companies have also developed appropriate technologies for CSR purposes. Samsung Electronics and MYSC used old mobile phones to build solar-powered mobile beam projectors that do not require electricity. This added a new cultural dimension to the rural village life.

Korea has accumulated advanced industrial technology through its economic transition from an aid recipient country to a donor country. Seizing the opportunity to create new markets and cultures by utilizing these skills in addition to policy recommendations will enhance the development effectiveness of Korea's development cooperation policies. In response to the demands of changing development needs in Africa BOP and CSR approaches will be effective in creating jobs, supporting local markets and facilitating the consumption of local materials and work-force.

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