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Full Length Research Paper

Rethinking development and sustainability of African economy: The roles of science education

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It is an understatement that of all the continents in the world Africa is seriously lagging behind in the area of development and sustainability. Trend studies of vital indices revealed a slow pace of development, which portends a great danger for the continent coupled with it being bedeviled by political instability. This study offers a rethink of these situations and the roles science education could play in fostering the much-needed development in Africa. The areas of focus are food security, energy supply, institutional infrastructures, education, health and environmental conscious designs. Conclusions are drawn and recommendations made on the ways forward.

Key words: African economy, sustainable development, science education.

INTRODUCTION

The sustainable economic development paradigm acknowledges that if development must be sustained, the environment needs to be protected. It must achieve sustainable activity that meets the needs of the current generation (intragenerational equity) without depleting the future supply of resources from future generation (intergenerational equity). Since the Rio Earth Summit in 1992, numerous environmental and developmental plans have been undertaken by various African countries and a number of studies have been conducted by the African Development Bank. Nonetheless, because of lack of adequate financial resources and major economic stress exacerbated by structural adjustment programmes, much has not been achieved. These and other problems of increased population, illiteracy and bad governance have made the sub-Saharan African region to lag behind in almost every sector. Plagued with worsening energy and food crisis, health and environmental problems, the region has not fared well. Science and technology has answer to human problems and it is the belief of this study that this twin concept has a vital role to play if properly appropriated and applied to African situations.

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The paper takes an overview of these problems before discussing the intervention strategies through science and technology.

OVERVIEW OF DEVELOPMENT IN AFRICA AND COMPARATIVE ANALYSIS

Energy crisis

With the world oil prices approaching $75 a barrel, economies across Africa are grinding to a halt under the burden of soaring energy costs (Schultz, 2007b). High oil prices slam the door on prospect for economic development in poor countries. The impact of this is not immediately felt among rural dwellers to which substantial parts (747 millions, Schutz, 2007b) of the entire population belongs. This is because this large number still uses firewood and dung to cook their meals. They neither own vehicles or motorcycles to fill with gas nor do they take shared taxis. These several millions (more than 80% of Africa's population) (Nieuwoudt, 2008) of people do not have access to electricity. This means that human development suffers, as schools, hospitals, businesses, industries and computer networking all rely on electricity.

In most African nations, there are not just frequent blackouts in towns and cities, budgetary allocation

desperately needed in the health and education sectors are being spent on reducing oil and electricity costs. For example, Senegal spends about the same amount (roughly 8.5% of its gross domestic product, GDP) on health and education combined as it does importing oil. Its West African neighbours are even worse. Those African countries not afflicted by the 'curse of oil' such as Nigeria, Gabon, Sudan, Algeria and Libya are plagued by the cost of rising global oil prices, debt burden and internal crisis like in Niger Delta States of Nigeria. The World Bank estimates that poverty has increased as much as 6% in some parts of the world due to hike in oil prices in recent years. The most vulnerable are the debt-burdened countries, particularly in Africa, which rely on fuel import to stimulate their economy. According to a news report by the World Bank, 'Global Economics Prospects: Managing the Next Waves of Globalization, 2007' (Nieuwoudt, 2008), the world population is expected to rise from 6.5 billions to eight billions by 2030. This translates into an annual growth rate of 60-million people. More than 97% of this growth will take place in developing countries. The mathematics is simple. This means that more people will demand more fuel resources. Until drastic efforts are made to develop the tools to diversify energy supplies away from conventional fossil fuels, the destabilizing effect of high oil prices will continue to undermine development efforts in Africa.

Food security

Ensuring food security, the basic right of people to food they need, is one of the greatest challenges facing the world community. Of the 86 countries that are listed as low–income and food–deficient, 46 are in Africa (SD Dimensions, 1998). The right to food was recognized in article 25 of the Universal Human Rights Declaration (1948) adopted by the United Nations six decades ago. Everyone has the right to a standard of living adequate for the health and well being of himself and family, including food. This inalienable right was further entrenched by various agenda of actions and inter-national resolutions among others (Dauda, 2008). For instance, the right to food is included in the International Covenant on Economic, Social and Cultural Rights which was adopted by the UN General Assembly in 1966 and came into force in 1976. A total of 156 countries including Nigeria have ratified the declaration to date. The right was elaborated in 1999 with the General Comment 12 by the United Nations Committee on Economic, Social and Cultural Rights, which oversees the implementation of the covenant. It states that the right adequate food is realized "when every man, woman and child, alone or in communities with others, has the physical and economic access at all times to adequate or means for its procurement" (Dauda, 2008). This right was further reaffirmed by the Rome Declaration on World Food Security on 13th November, 1996. A commitment was made to reduce by half, the number of undernourished people by 2015, and the Millennium Development Goal, to reduce by half the proportion of people afflicted by extreme poverty and hunger by 2015.

In spite of these commitments, food crisis gets to an alarming rate in Africa. Foods needs vary dramatically from region to region and among countries within the regions of the world. This means that approaches to food security have to be tailored to each situation. In Africa, population growth, poverty and agricultural production capabilities are crucial factors when considering food security. Although, global population rates are slowing down in sub Saharan Africa, populations are expanding by about 3% a year, enough to double the number of people in one generation (SD Dimension, 1998) . Food production continues to grow more slowly than population. In contrast to every other region of the world, per capital food production has declined since the 1970s. It is estimated that 40% of the total population of sub Saharan Africa goes hungry, and that the figure will increase to 60% by the year 2015. Apart from population increase and slow production, poverty is another chronic cause of hunger. There are many people who go hungry in food surplus areas, people who lack adequate income to purchase or produce enough food for themselves and their families. Ironically, food insecurity is most severe in rural Africa where farming and herding are still the main means of livelihood. Ninety percent of Africans living in poverty are rural dwellers (SD Dimension, 1998; Mason, 2006).

Factors that contribute to poverty in Africa include:

1. Unfavourable terms of international trade: Large external debts burdens.
2. Political instability and civil wars and inadequate public investment in agricultural research, training and infrastructure.

These have directly and indirectly contributed to decline in food production. Getting food to eat is one thing, eating the right food is another. Malnutrition is a common phenomenon in Africa. This, as reported by Nwaniki (2003), has devastating effects on the population. It increases mortality and morbidly rates, diminishes the cognitive abilities of children and lowers their educational attainment, reduces labour productivity and reduces the quality of life of all affected. It is not just enough to embark on a short term production, a long term dietary diversification and biofortification must be planned.

Environmental degradation

The term 'environment' refers to the aggregate of external conditions and influences affecting the life and development of organisms (Fadamiro, 1995). It consists

of abiotic and biotic components (including man) interacting with one another (Ero, 1997). The interactions also include the dominance of some species over the others. Man modifies the interaction in order to satisfy his needs and aspirations. He achieves this with the use of natural endowments like the possession of pentadactyl limbs to handle tools to work, reasoning faculty, and the ability to communicate and keep records and technology (problem solving ability) at his disposal. The possession of these abilities or capabilities makes some authors to refer to man as a high and intelligent animal (NISP-National Industrial Symbiosis Programme). However, in the process of controlling the environment to get what he wants, man has failed to take into consideration the issues of 'environmental accounting' (Enahoro and Ehi-Ebewele, 2008) and 'sustainable environmental development' (Olaolu, 2008). His activities do not only impact negatively on the environment, they have also rendered it unable to support and sustain him and the generations after him. If there is any part of the world that sustainability, accountability and transparency has been compromised, all the more is Africa in general and Nigeria in particular. The environmental commons like atmosphere and water are the most affected by human activities. The consequences are evident and are reported. They include health hazard, environmental de-gradation (Onuoha, 2008), loss of biodiversity (Enahoro and Ehi Ebewele, 2008), abuse of global commons (Oyeshola, 2008), conflict de-escalation (Onasoga-Molake, 2008), violence and hostage taken (Eseduwo, 2008), militarization (Bot, 2008), poverty among others. These are done in spite of the various treaties and commitments like 'California Clean Air Act of 1997', 'Montreal protocol' and 'Kyoto Protocol of 2004' held to protect and enhance the human environment. Since there exists strong relationship between environment and economic development, deterioration of environment and natural resources have consequences on economic development.

Education

Education in Africa is at a crossroads today. There is an urgent need for a coherent policy response. Obtaining results will require a shared basis for action within each country and between a country and its development partners. There are many ways of measuring a nation's commitment to education: several indicators are funding, quality and standard, literacy levels, number of out-of-school children and teacher-student ratio. However, the overall determinant is funding, not just the amount that is contained in the budget but what actually goes to financing education. Depending on what side of the divide the pendulum is swinging, positive or negative, these all have grave implications for a nation's economic development.

A look at a few of these factors will reveal the level of commitment in Africa. First to consider is the public education expenditure in world regions (Table 1). Table 1 show that governments of the world invested the equivalent of PPPS 2.5 trillion in education in 2004. This figure represents 4.4% of global GDP in PPPS (GDP = Gross Domestic Product; PPPS = Purchasing Power Parity. PPPS gives a better reflection of the real value of educational investment made by governments and families. PPPS are rates of currency conversion which eliminate differences in price levels among countries. This means that a given sum of money when converted into US dollars in PPP rates will buy the same basket of goods and services in all countries). Governments of North America and Western Europe invested the highest shares of national resources in education, 5.6% of the regional GDP. The region is followed by Arab States (4.9%) and sub-Saharan Africa (4.5%). The regions of Latin America and the Caribbean as well as Central and Eastern Europe are close to the world average, with 4.4 and 4.2%, respectively. Figures of the last four columns are more revealing and more realistic; sub-Saharan Africa came third from the rear, beating only the Arab States narrowly and Central Asia.

Secondly, primary school enrolment, teaching staff variables, survival rates from the first grade to the last, transition rate from primary to secondary schools in world regions including sub-Saharan Africa (Table 2 and Figure 1) were considered.

From Table 2, it can be seen that the sub-Saharan African region is at the bottom of the ladder in:

1. Average enrolment of 70 (70% of primary school age in school), with some countries like Mali having as low as 40; Congo 44; and Seychelles as high as 99; South Africa (87); Ghana (69) and Nigeria (68%), respectively.
2. Pupil/teacher ratio of 45, although, it has the highest number of teachers
3. Survival rate to last grade. This is an indication of high number of drop out from primary one to six.
4. Transition rate from primary to secondary is an indication of high number of drop outs from primary to secondary school.

The last point is further illustrated by the figure below where only 13% of children that enrolls for primary education complete senior secondary school. According to Ilemobade (2008), only 7% have access to university education.

Health

The concerns about health have driven international cooperation forward with huge success being made in medicine and technology. There are several ambitious initiatives meant at eradicating transmissible diseases

Table 1. Public education expenditure in PPPS and as a percentage of GDP per regions of the world (2004).

Region	Countries	Educational expenditure					
		As % of GDP		PPPS (in billions)		% of Regional total	
		Total	Primary level	Total	Primary level	Total	Primary level
Arab States	20	4.9	1.7	77.8	27.0	3.2	3.6
Central and E. Europe	20	4.2	1.1	164.0	41.2	6.7	5.6
Central Asia	9	2.8	0.6	7.7	1.8	0.3	0.2
E. Asia and Pacific	34	2.8	1.0	441.7	149.8	17.9	20.2
Lat Am and Caribbean	41	4.4	1.6	186.5	68.8	7.6	9.3
N, Am and W. Europe	29	5.6	1.5	1,355.6	372.3	55.1	50.2
S. and W, Asia	9	3.6	1.2	169.1	54.6	6.9	7.4
Sub-Saharan Africa	45	4.5	2.1	59.9	27.9	7.4	3.8
World	207	4.4	1.3	2,462.2	743.1	100.0	100.0

Source: Global Education Digest 2007 - Comparing education statistics across the world.

Table 2. Primary education: Enrolment, teaching staff, progression/completion and transition (2005).

Region	Average and Range	Enrolment rate	Teaching staff	Pupil/ Teacher ratio	Survival rate to last grade	Transition rate from primary - secondary
Arab States	Average	83	1,802,311	22	88	86
	Range	33 - 97			70 - 99	71 - 100
Central–En Europe	Average	91	1,248,904	18	96	98
	Range	83 - 96			90 - 100	92 - 100
Central Asia	Average	90	290,108	21	94	99
	Range	79 - 98			75 - 99	97 - 100
E Asia and the Pacific	Average	94	9,758,681	20	81	85
	Range	84 - 100			57 - 99	53 - 100
L America and Carribn	Average	95	2,971,428	23	82	91
	Range	81 - 99			62 - 98	81 - 100
N America and W Euro	Average	95	3,681,197	14	98	97
	Range	80 - 99			82 - 100	73 - 100
S and W Asia	Average	86	…	…	75	84
	Range	68 - 97			65 - 88	69 - 97
Sub-Sahara Africa	Average	70	2,461,370	45	64	64
	Range	40 - 99			25 - 99	33 - 95

Source: Derived from Global Education Digest 2007 - Comparing education statistics across the world.

with the hope that these diseases may one day disappear. According to World health organization, (WHO) one-third of the global disease burden is accounted for by transmissible diseases (Fust, 2005). In many parts of world, infectious diseases and not only HIV/AIDS, are leading to a dramatic decline in health and standard of living. Transmissible diseases are the principal cause of premature death. “Killer diseases” are generating a veritable roll call of victims: more than one million deaths per year due to malaria; 1.4 million deaths

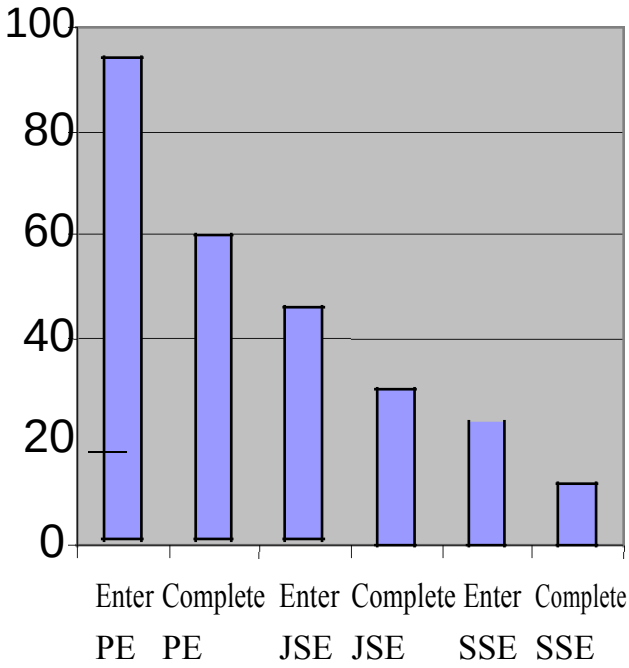

Figure 1. Survival rate on entering primary education and completing secondary.

as a result of childhood diseases; 1.5 million from tuberculosis; and 8.5 million new tuberculosis infections. HIV/AIDS is killing several millions of people in a year. On top of all these figures, this whole development is unfolding within a context where resistance to treatment is reducing the options available for controlling disease.

How does Africa fare in all these? African population was put at 738 million people, 11% of the world total (Kaiser Global Health Reporting Organization, 2006). Ninety percent of malaria cases and 60% of global HIV occur in the continent. Apart from this, a look at two data (Tables 3 and 4) one estimate of maternal mortality and the other infant mortality rate will reveal more health problems. It can be seen from the table that women in less developed region face high risks of dying during pregnancy and child birth. In regions where obstetric care is scarce and fertility rates are high, the life time risk of maternal death is as much as 150 times that of maternal death in more developed regions. From Table 4, it can be seen that the sub-Saharan Africa has the highest rate of infant mortality. The investment in malaria control by governments of the world regions in Figure 2 shows that African continent is among the least subscribers.

Science and technology: The way forward

Before channeling the way forward, there is need to look at the analytical framework, a candid compilation and appraisal of Africa's internal strengths and weaknesses and its internal opportunities and threats (World Bank, 2002). These revelations provide a food for thought in the process of building strong economic development (Tables 5 and 6). In spite of these internal weaknesses and external threats, the continent still possesses vital ingredients and potentials for growth and development.

The strengths and opportunities are there. They maybe good enough in proposing sound economic goals for Africa in the areas of wealth creation, achieving not just development but sustainability and actively participating in the world economy and political system.

In the area of energy production, Africa has vast, latent potential for wind and solar power generation. Recent studies showed that strong potential for wind power generation is not only in coastal South Africa, Morocco and Madagascar, but also in Kenya and Ethiopia. Geothermal activities along the several water falls in East and West Africa could produce several megawatts of electricity. Biofuel is another sector where the continent could rival major global producers and play a central role in meeting the soaring demand for ethanol in Europe, United States and China. According to Schultz (2007a), African's arable lands are well-suited to a range of energy crops, especially in the tropical climate zones around the equator that enjoy optimal rains and a long growing season. Conventional feedstock crops like sugar cane, maize and soy, as well as new oilseed crops are already being grown and converted into biofuels and with science and technology, this can be achieved with minimal efforts.

Maintaining healthy and balanced environment for productivity hinges on not only sound education, but also

Table 3. Estimate of maternal mortality in world region.

Region and Country	Maternal mortality ratio	Total fertility rate	Life time risk of maternal death
World total	430	2.9	1 in 60
More developed region***	27	1.6	1 in 1,800
Less developed region	480	3.3	1 in 48
Africa	870	5.6	1 in 16
Eastern Africa	1,060	6.0	1 in 12
Middle Africa	950	6.5	1 in 14
Northern Africa	340	4.0	1 in 55
Southern Africa	260	3.5	1 in 75
Western Africa	1,020	6.4	1 in 12
Asia***	390	2.8	1 in 65
Eastern Asia	95	1.8	1 in 410
South-Central Asia	560	3.6	1 in 35
South-Eastern Asia	440	2.9	1 in 55
Western Asia	320	4.0	1 in 55
Eastern Europe	62	1.3	1 in 730
Latin America and Caribbean	190	3.0	1 in 130
Caribbean	400	2.8	1 in 75
Central America	140	3.4	1 in 170
South America	200	2.8	1 in 140
Oceania***	680	2.4	1 in 26

Source: Population reports: Why family planning matters (information and knowledge for optimal health).

Table 4. Infant and under-five mortality, 1999 - 2001.

Region and Country	Infant	Age 0-5
Sub-Saharan Africa		
Burkina Faso	105	219
Ethiopia	97	166
Gabon	57	89
Guinea	98	177
Malawi	104	189
Mali	113	229
Rwanda	107	196
Tanzania	99	147
Uganda	88	152
Zimbabwe	65	102
Asia and Pacific		
Bangladesh	66	94
Cambodia	95	125
India	68	95
Nepel	64	91
Eastern Europe and Central Asia		
Armenia	36	39
Georgia	43	46
Kazakhstan	62	71
Romania	30	32

Table 4. Contd.

Ukraine	14	14
Latin America and Caribbean		
Columbia	21	25
Ecuador	36	39
Guatemala	40	59
Haiti	43	119
Peru	43	60
Near East or North Africa		
Egypt	44	54
Mauritania	74	116

Source: Demographic and health surveys.

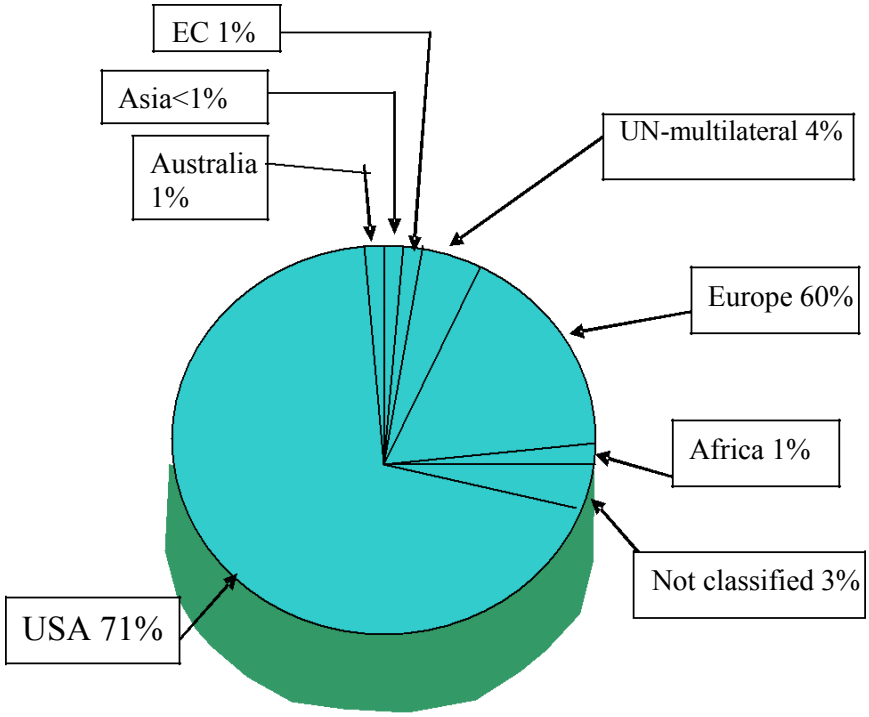

Figure 2. Government Investment on malaria control by region in 2004. Total is US $323 million. Source: Global Forum for Health Research.

on literate society. The Education for All (EFA) and Education for Sustainability (EFS) campaigns become more imperative and indispensable. Loening (2005) asserts that a better-educated labour force has a positive and significant impact on economic growth. Being educated makes a citizenry to get near being scientific literate and more scientific minded. Scientific mindedness does not only involve the development of science and technological skills needed for daily problem solving, but the acquisition of appropriate scientific attitudes needed for harmonious living with others and environment. It is also an important ingredient for good governance and participatory democracy.

CONCLUSION AND RECOMMENDATIONS

Development, generally speaking, is trying to get a country in a position to fully participate in a globalizing world. The world is essentially driven by technology, medicine and health, clean air and water, transportation, communication, sanitation, management use and

Table 5. Africa's internal strengths and weaknesses

Strengths	Weaknesses
Rich complex of minerals, oil and gas deposit.	Weak domestic market.
Varieties of flora and fauna	Lack of highly skilled labour.
Unspoiled natural habitat (rain forest).	Weak states.
Minimal emission and effluents	Lack of long-term policies and Implementation of programmers.
Paleontological and archaeological sites (cradle of human kind).	Price distortions.
	Lack of advanced information and communications technology.
Open uninhabited spaces	Lack of capital.
Rich cultures and creative community.	Unfavorable terms of trade.
Cheap labour and raw materials.	Poor purchasing power.
Richness of agriculture.	Lack of conflict prevention and management.
	Poor health services (HIV/AIDS, malaria).
	Class and gender inequity.
	Poor infrastructure.
	Non- participatory governance, undemocratically elected leaders, lack of transparent legal and regulatory framework.
	Inadequacy in research and development.
	Political instability.
	Heavy external debt.
	Persistence balance of payments deficits.

Table 6. Africa's external strengths and weaknesses

Opportunities	Threats
Becoming the architects of their own sustained uplifting growth (Regain their self confidence).	Competition with the newly industrializing countries (NICs).
	Dependence on external agencies and markets.
Integration of nation al system of production	Internal upheavals and border conflicts.
Value chain in manufacturing and service sector.	Bilateral and multilateral aid may be based on insurmountable conditionality.
Ready to acquire modern knowledge and skills.	
Natural and diversified work force to be harnessed.	Heavy subsidy on primary products from US or European countries.

conservation of natural resources (Neureiter, 2002). All are based intimately on science and technology and research and development. It is obvious that to become part of that world, there must be science and technology elements in the development process. For sustainability, there must be capacity building and investment in the training of the next generation. The African continent possesses the strength, opportunities and potentials for growth in terms of unspoiled natural habitat, human population and raw materials for industrial productions.

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