1. Issues and Realities

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The Role of Science and Technology

Science and technology, and science and technology education, play an important role in the development of a country's economy, environment and social relations. African countries recognise this role and many have committed considerable resources to the development of their science and technology, and educational systems. In the early 1960s, immediately after independence, most African countries promoted capacity building in science and technology by sending scholars for training in universities in industrialised countries, while offering science and technology as subjects in their primary and secondary schools. Some invested heavily in the development of infrastructure such as national laboratories, and university and school science departments.

Despite such investment, the countries of sub-Saharan Africa continue to rely on the agrarian and extractive sectors and, in some cases, tourism. The agrarian sector largely consists of subsistence farmers and pastoralists who often cannot produce sufficient excess to meet both national needs and provide exports of cash crops such as coffee, tea and horticultural products. Tourism is dependent on adequate infrastructures and stability, which itself depends on good governance. The extractive sector mines and exports resources such as chrome (97 per cent of world stocks) and platinum (50 per cent of world stocks), without adding value by processing them into manufactured and secondary products. UNECA estimates that Africa contributes only 2 per cent of the world's industrial output. Most of the world's 97 least developed countries are in Africa.

Facing Realities

In much of sub-Saharan Africa, to borrow from the Chinese saying, people live in interesting times. Many countries, for example Sierra Leone, Somalia and the Sudan are ravaged by civil war, while others are scourged by HIV. Some countries suffer from long-established, increasingly despotic leaderships. Others are riddled with corruption, and the international press features violence and crime throughout the continent. Lest we despair as science

educators that there is little we can do in the path of what appears to be the horsemen of the apocalypse, we should look at other changes taking place. Uganda and Ghana, both countries that have experienced extraordinary hardships during the past, are for the most part peaceful, economically thriving and, just as important, full of hope for the future. In Nigeria, which has been plundered for some 30 years, there are signs that a more democratic, less corrupt era may emerge. A newly democratic South Africa is contributing to the development of the region with increasing confidence, despite the legacy of its troubled past. It is against this varied and complex background that we consider the role of science and technology, and science and technology education.

Despite its wealth and diversity of resources, Makhurane and Kahn (1998) report a UNECA estimate that '... Africa's contribution to the world's industrial output is only 2 per cent'. It has been estimated that the rich countries of the world together account for about three-quarters of global product, though their residents add up to only a fifth of all humans. Most countries of sub-Saharan Africa continue to earn foreign exchange through exporting cash crops and minerals or from tourism. Debt repayment on loans plunge many further into debt since their debts are larger than their meagre foreign exchange earnings. In some ways, the peoples of Africa are fortunate in having economies based on subsistence level farming, pastoralism and thriving informal sectors where a bewildering variety of goods and services are sold. Rural communities in Africa can survive, though as Cheru, quoted by Naidoo and Savage (1998), states, 'In 1981, according to the World Bank, 29 of the 36 countries with the lowest Gross National Product (GDP) were in Africa. Seventy out of every 100 Africans are either destitute or on the verge of poverty'.

In most countries of sub-Saharan Africa, the manufacturing and industrial sectors, usually dominated by an in-country, multinational presence, account for at most 20–30 per cent of GDP. South Africa is the only industrialised country in sub-Saharan Africa, but this has been achieved at a price. To power the mines and factories, black Africans were driven from the land and deprived of their means of survival. There is little or no subsistence level farming in the country. Ironically, this has contributed to a higher wage structure than in other parts of the continent where bachelor wages are paid, since it is assumed there is a wife back home on the farm to feed the children. Apartheid also ensured that the South African workforce had few skills. The combination of relatively high wages and a low level of skills resulted in a situation that suited the small white elite, but which has left the new South Africa uncompetitive in world markets.

Despite high levels of investment in education – in Kenya some 40 per cent of the recurrent government budget goes to education and some estimate that rural households spend over 75 per cent of their cash incomes on schooling – weak local currencies and bad governance render even these sacrifices inadequate. The peoples of rural Africa do survive despite central government and most of Africa is rural. However, most, especially the young, have higher aspirations. People have hopes that their children will live past the age of five and that they themselves will find healing when they are sick. People, especially women, hope for less drudgery. They hope for good sources of water closer to home and for energy that they can switch on rather than having to walk miles for firewood. Parents invest heavily in schooling hoping for better lives for their children who will look after them when they are old. In short, people in Africa hope for development and know that development only comes with good governance.

Numerous theories are used to explain this underdevelopment of Africa, including a lack of science and technology infrastructures. We argue that much science and technology, and science and technology education, is irrelevant or dysfunctional to developmental needs in Africa, and that this failing can be ascribed to a lack of understanding of what and whose science and technology system has been introduced and promoted. The first assumption made when science and technology was 'introduced' to Africa was that no science and technology was practised, and that the knowledge base and tools for science and technology had to be imported and transplanted. Most African scientists were trained in developed countries with rich resource infrastructures for research that focused largely on fundamental problems within the scientific disciplines. As a result many could not continue their research in Africa, while most could not contextualise their research within the continent's development needs. Within the industrial sector, little scientific research is conducted in Africa because most industries are multinationals that conduct research in the parent companies located in the mother country. Thus, the development and practice of science and technology is the state's responsibility, and is largely confined to education and training. Over the past decades, economic decline has contributed to a deterioration of government infrastructures for science and technology, promoting a flight of many of the best African scientists to developed countries. Furthermore, training of scientists at school and university levels is based on irrelevant curricula that are decontextualised from societal problems and indigenous informal and formal sector science and technology practices. Such science is alien to African society, an alienation that is further promoted by rote learning that does not embed science and technology in everyday practice and culture. Thus science and technology are seen as alien, Western

bodies of facts that must be memorised and that have no bearing on the improvement of the everyday existence of African people.

For such reasons, we argue, science and technology have not realised their full potential for improving the quality of life for most people in Africa, though they have contributed, for example, to reducing the incidence of infectious disease, improving agricultural production and have led to better communication and transportation. However, these and other benefits have been better capitalised on in developed countries and will continue to contribute to an accelerated pace of development, hence widening the gap between rich and poor countries. Indeed, developed countries have launched major programmes on 'Science for All' to popularise science in their countries. They have recognised that scientific and technological literacy is a major precondition for continued modernisation, wealth generation and the development of a democratic society. They argue that a science and technology culture addresses the need for innovation and problem solving, acquisition of transferable skills, a capacity to think and act rationally in response to new experiences and to appreciate new technological developments, as well as the ethical issues involved in active participation in modern democracies. This renewed interest in science and technology in developed countries recognises the role of the local community, state and private sectors in promoting, developing and sustaining a science and technology culture, as well as the comparative edge it gives in the global economy.

Although science and technology, and science and technology education, have so far failed African countries, we emphasise that this has been a science and technology that stresses memorising rather than problem solving. African countries must also, therefore, recognise the need to promote, develop and sustain a culturally sympathetic problem-solving science and technology culture if they are to narrow the gap between them and the industrialised countries. Otherwise Africa will continue to be a site for cheap labour and raw materials, a market for imported products and dependent on foreign technology and aid on dictated terms. African countries must reform policy, engage in programme development, reorganise institutions and reallocate resources to develop science and technology systems. However, such reform must be promoted with a sensitivity that learns from past failures, recognises the existing resource base and takes into account the developmental needs of the continent. This book will, therefore, re-examine and revisit:

- Why science and technology should be popularised;
- What and whose science and technology systems should be introduced and promoted;

- How science and technology should be implemented and practised.

Although science and technology, and science and technology education, have failed in most parts of sub-Saharan Africa, there are pockets of excellence that have made an impact on improving the quality of life in some communities. We need to learn from these pockets to widen their implementation throughout the continent. To help do so therefore, we will present analytical case studies of selected successful pockets.

Room for Cautious Optimism

Good governance has been lacking in most of Africa where civil war, tribalism, nepotism and corruption on an unimaginable scale have been the rule. Yet we tend to forget the recentness and fragility of the economic vigour and democracy of the industrialised world. *Dark Continent* by Mark Mazower is not about Africa, but Europe. Mazower reminds us that if Europe stood for civilisation, in 1945 civilisation ground to a bloody halt. How different are the Hitlers, Mussolinis, Stalins and Milosevics from the Amins, Bokassas and Mobutus of this world? How different was the economic collapse of Germany between the Great War and the emergence of the Third Reich, to that of Ghana or Tanzania? We forget so quickly that the economic recovery in Europe after 1945 was due as much to a mix of state intervention and social services as to market-force capitalism. We forget the centrality of US assistance to Europe in the form of the Marshall Plan, or to Taiwan and South Korea in the Orient. A mere 50 years on and we feel gloomy about Africa! An Africa whose starting point was so different, thanks to slavery, colonialism and economic exploitation. The USA still bears scars from the period of its history when its economy depended on that dehumanising brutality. Is it any wonder that countries such as Zaire remain haunted by King Leopold's Ghost?

In *Why the American Century?* (1999), Olivier Zunz, Professor of History at the University of Virginia, emphasises the role of mass consumption in America's economic success in the twentieth century. Unlike in Europe, Zunz argues, university academics created a vast 'institutional matrix of inquiry'. Business financed research, graduate programmes manned industry, social scientists worked with advertisers and intellectuals stressed the importance of material abundance to promoting equity. Africa, the last to pass the peak, saw its rate of population growth decline just before 1990, but is still the fastest growing continent and potential market (Morrison and Tsipis, 1998). Development and national responsibility grow together, since only with economic development can networks emerge based on class rather than tribal loyalties. Arguably, countries such as Kenya maintain some form of stability only because of a

significant urban middle class that transcends tribe, and has more in common with each other than with their relatives in the village. In many countries, rural subsistence farming communities are rapidly becoming enriched with a new resource, namely retired, experienced, well educated and skillful people. The very breakdown of central government is pushing local communities to better marshal their own resources to improve schooling, health and the local economy. On a macroeconomic scale, South African manufactured goods, services and investment are spreading throughout a continent that is one of the few large remaining potential markets. Over the last decade, pressures from within and without are, in some countries of sub-Saharan Africa, providing cautious optimism for a better twenty-first century. We see reason for hope.