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SCIENCE, TECHNOLOGY AND DEVELOPMENT: THE CONTRIBUTIONS OF GHANAIAN UNIVERSITIES RE-EXAMINED

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Science, Technology and Development: The Contributions of Ghanaian Universities Re-examined

Synopsis:

This paper examines the scientific and technological contributions of Ghanaian universities to the development of the Ghanaian society and its people, since their inception in the 1960s. It argues that the Universities have failed to contribute adequately to the scientific and technological development needs of the country due to several constricting factors, including the nature of the science and technology curricula, lack of a national government science and technology policy, ill-equipped and obsolete scientific and technological laboratories, and inadequate funding. The paper suggests the need to re-examine the nature, objectives and relevance of the science and technology programs in the country's universities to national development, in light of the pressures of the new global economy, as well as the fast changing socio-economic needs of the current and future Ghanaian society and its people.

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Introduction

This paper examines the scientific and technological contributions of Ghanaian Universities to the development of the Ghanaian society and its people, since their inception in the 1960s. It argues that the Universities have failed to contribute adequately to the scientific and technological development needs of the country due to several constricting factors. These factors include the nature of the science and technology curricula, lack of a national government science and technology policy, ill-equipped and obsolete scientific and technological laboratories, dearth of experienced and qualified scientific research faculty due to acute brain drain, inadequate funding, poorly trained secondary school science graduates entering the Universities, and the inelastic nature of the Ghanaian economy to absorb and utilize the skills and knowledge of the science and technology graduates from the Universities. The paper suggests the need to re-examine the nature, objectives and relevance of the science and technology programs in the country's Universities to national development, in light of the pressures of the new global economy as well as the fast changing socio-economic needs of the current and future Ghanaian society and its people.

Universities and National Development – Theoretical Paradigms

Ghanaian Universities, as independent and autonomous institutions of higher learning, have only been in existence since the 1960s due to the lack of development of such education by the British during the colonial period. University education therefore became a top priority on the development agenda of the newly-elected Ghanaian government at independence in 1957.

The urgency to develop university education in the immediate years of independence was based in part, on redressing the colonial neglect of the development of formal education in general, especially university education in the country (Altbach & Umakoshi, 2004; Agbodeka, 1998) but more so, it was based on the suppositions of the prevailing development theories of the 1960s, particularly the Modernization and the Human Capital theories, which argued that a strong correlation existed between higher education and national development (Leys, 1996; Todaro, 1985). While the Modernization pundits contended that Africa's underdevelopment was the result of its endogenous barriers to change, and which temporarily hindered the continent's inevitable transition from underdevelopment to development, the Human Capital proponents added that the problem included a lack of adequate numbers of highly qualified educated personnel with the requisite knowledge and skills fundamental to initiate growth hence there was the need for investment in higher education, particularly science and technology to remedy the situation (Schultz, 2004; 1961; Harbison & Myers, 1964). The university at this time therefore, was perceived as key to the socio-economic development of all nations, particularly those of the newly independent societies of

Africa, through its scientific research and the development and transfer of technology into the local economies for the improvement of the quality of life.

Like most African countries Ghana attained its independence in 1957 with just a handful of local post-secondary graduates, underscoring the magnitude of the seriousness of the manpower problem that faced the country at the time. The problem across Africa as a whole therefore, was staggering, as confirmed by the World Bank:

At independence less than a quarter of professional civil service posts were held by Africans; most trade and industry throughout the continent was foreign-owned; only three percent of high school-age students received a secondary education. Zaire (now DRC) for example, reached independence without a single national engineer, lawyer, or doctor. With all its copper wealth, Zambia had only 100 university graduates and a thousand secondary school graduates. In 1961, the University of East Africa (serving Kenya, Tanzania, and Uganda) turned out a total of 99 graduates for a combined population area of 23 million (World Bank, 1991: 45).

Thus starting from scratch African universities – including those of Ghana - experienced unprecedented academic expansion, with a record 9 percent per annum increase (more than the developed countries) in the number of scientists and have made giant strides at building national research systems (Teferra, 2003; Gaillard & Waast, 1993). According to Teferra, the total number of African universities rose from just six in 1960 to about 300 by 2003, with four to five million students by 2003. In Ghana, Nkrumah's government established three universities - the University of Ghana (formerly University College of Ghana), the University of Cape Coast, and the Kwame Nkrumah University of Science and Technology (KNUST) in Kumasi, with two more added since the 1990s being the University of Education at Winneba (UEW) and the University for Development Studies (UDS) in Tamale (Effah, 2003; Agbodeka, 1998).

In their apparent attempt to “save” Africa from “reinventing the wheel” and thus cut down cost and speed up its development, Western economists and development

experts suggested that Western nations embarked on massive infusions of foreign capital, high-level technology and expertise into the African economy to build an industrial production base to facilitate economic expansion in the various African states. Western development experts and the international development Banks, including the World Bank, therefore encouraged African governments to invest more in education, especially in higher education than any other sectors of their economies to produce the required human resources, particularly the scientific and technological personnel needed for their nation's socio-economic development (Leys, 1996; Todaro, 1985). This development strategy however, failed to examine the magnitude of the prevailing underdevelopment problems caused by the European colonial enterprise on the continent and the depth of the dependency foundation it had laid regarding the knowledge, development and application of Western education, especially science and technology in Africa. More importantly, the assumption that mere infusions of imported high-level technology and expertise was the remedy for the African economy not only failed to consider the contextual and implementation problems involved, but it also prevented Africans from developing their local and indigenous technologies to form the foundations of their industrial bases to avoid future dependency on external assistance in this area, as well as the opportunity to develop at their own pace.

African universities – including Ghanaian Universities - were charged not only to produce the required manpower needs of their countries (Altbach & Umakoshi, 2004) but also to collaborate with industry to turn knowledge into usable products or commodities, develop and transfer technology into the local economy, and transform raw material into marketable and export goods to assist with national development. The universities

therefore, were founded on the basis of their scientific and technological relevance to the needs of the society and the economic well being of the people. The vision was for these institutions of higher learning to undertake creative and curiosity research to provide for the formal educational needs of future workers, to transfer technology to industry and business, provide advanced knowledge to agricultural and mechanical industries, and to update the skills of the workforce (Pappas & Eckart, 1997; Ryan & Helm, 1997). But such task also required adequate inputs and support from the newly-elected African governments, including the Ghanaian government, if the universities were to succeed in fulfilling their mandated tasks. This support, as will be shown later in this article has not been forthcoming in the case of Ghana. More importantly, African governments failed to consider the size, nature and capability of their economies in regards to the creation of adequate number of jobs each year, particularly for the science and technology graduates in order for the society to benefit from their acquired knowledge and skills – a miscalculation which has resulted in the underemployment and unemployment of majority of these graduates, particularly in Ghana.

Thus after half a century of producing hundreds of science and technology graduates through these universities, with billions of dollars invested in their development, it is still evident today, that Ghana's dependence on the importation and consumption of Western technology and scientific expertise for its development needs continues to increase rather than decrease, underscoring the fact that Ghanaian Universities have failed in their mission to provide the required scientific and technological needs for the country's development. This situation has been made worse by the emergence of the new global economy since the 1990s, dictated by rapid

advancements in science and technology for information production, processing, storage, dissemination and application for national development.

Rationales Behind the Failure of Ghanaian Universities in the Development of Science and Technology

Several conferences on the importance of science and technology to national development have been held by African leaders since the 1960s, with solemn pledges from participating member countries to increase their budget allocations to the development of this sector. One such significant conference was the Lagos Plan of Action for Economic Development for the period 1980-2000. The Lagos Plan specifically emphasized:

The importance of scientific and technical skills and know-how in modern development cannot be overemphasized. It is in this area that Member States are over-dependent on imported technical and scientific manpower. It is therefore very cardinal and in accord with the principles of self-reliance that Member States should give special priority to the development of scientific and technical manpower at all levels, including the training of science and technical teachers and instructors... (Browne & Cummings, 1985: 88).

Despite the various pronouncements and the urgency of the situation, none of these promises have been kept, in part, due to the socio-economic problems confronting many African countries, including Ghana, since the mid-1970s.

The failure of Ghanaian Universities to produce the scientific and technological requirements for national development therefore has been due to several reasons. Effah (2003) ascribes this problem to several reasons including the lack of clearly defined educational and research priorities at both the national and institutional levels, the increasing involvement of academic staff in undergraduate teaching due to enrolment increase, and a lack of opportunities for sabbatical leave for faculty, difficulties

experienced in attending conferences and seminars overseas, with financial support being the major obstacle (Effah 2003: 345). Similarly, Teferra (2003) assigns the failure to a shift in educational policy and economic hardships which have confronted African countries since the late 1970s and 80s, resulting in a steady decline of both external and domestic funding resources for universities thus affecting university inputs for teaching and learning, and research particularly in science. The Association of African Universities confirms this predicament:

The effects of the economic crisis were severely felt in the educational systems of African countries. Specifically government grants to universities in Africa came under strong pressure as the levels of funding could not match in real terms the requirements of critical inputs – equipment, books and journals, and maintenance of existing faculties – to sustain acceptable standards of instruction, research and service (AAU, 1991:1)

The shift in educational policy was largely due to World Bank studies conducted in the 1970s and 80s by George Psacharopoulos whose reports ruled in favor of primary education funding over higher education based on the premise of social rate-of-return and fairness in resource allocation in education (Woodhall, 2003; Psacharopoulos, 1980a; 1980b; World Bank, 1988).

However, in the case of Ghana, Amoako (2004) argues that if successive Ghanaian governments have not shown much interest in funding scientific research in the Universities, it may be because they have not been convinced by the Universities of its functionality in national development. While this assertion may be true to some extent, it is equally true that since independence, and despite the many prevailing constricting socio-economic problems, successive Ghanaian governments have rather preferred to rely on imported Western scientific and technological resources and expertise than on supporting and funding their own universities in this area, since they deem imported

scientific and technological products and personnel as “more advanced and of better quality and skills than those of their own countries.” This attitude is one of the many lingering colonial legacies which continue to put down the validity and significance of African knowledge and skills. And yet as observed in the developed nations, scientific and technological research is important to national development. According to Effah (2003), Canadian Universities add nearly CN\$15.5 billion each year from research to the Canadian economy generating approximately 150,000 jobs (Association of Universities and Colleges of Canada, 1998, cited in Effah, 2003: 345).

It must be recalled that the mission of Ghanaian Universities has remained the same: teaching, research, and public service (Ajayi et al, 1996). However, it is also evident that in terms of research the output by the Universities has been seriously deficient, since their inception in the 1960s partly due to reasons mentioned above but also including the lack of resources and well-equipped research laboratories, and cutbacks in government funding in recent times. Indeed the overall scientific and technological research performance of Ghanaian Universities in the past 40 years has been negligible hence the research output and generation of new knowledge have lagged far behind the training accomplishments of the Universities (Agbodeka, 1998; Ajayi, Goma & Johnson, 1996; Saint, 1993). In 2000 the government allocated only \$1,392,499 to the ten research institutions of the University of Ghana for their research operations, while the Kwame Nkrumah University of Science and Technology (KNUST) received just \$291,375 for its eight research institutions and the University of Cape Coast received \$102,104 for its three research institutions (Effah, 2003). During the same period the research allowance given to faculty members at the KNUST increased from \$92.40 to

\$338.81 per year. This level of funding is acutely inadequate to produce any significant research output or maintain adequate laboratory resources required for serious scientific and technological research in the country's Universities.

Inadequate funding has been a greater part of the problem regarding the inability of Ghanaian Universities to achieve their objectives in science and technology (Woodhall, 2004). For example, according to Mills (2004) the Ghanaian government's annual expenditure on research and development (R & D) is 0.06% of its GNP (Mills, 2004). However, Eisemon and Davis (1993) emphasize that universities everywhere are among the most important scientific institutions accounting for significant proportion of national research expenditures, as well as production of mainstream research in agriculture, health sciences, engineering, and other fields. Universities are the locus of technological and scientific training, and represent a large proportion of national research capacity in both applied and fundamental scientific fields. But as Teferra notes: "For scientific endeavors to be sustainable and productive, the development of national research capacity – meaning institutional and organizational changes for a modern scientific system – is a prerequisite and requires long-term investments and careful nurturing" (2003: 30-31). This requirement has been seriously lacking in Ghana.

Instead of encouraging serious scientific and technological research in Ghanaian Universities successive governments have relied on quick consultancy reports and options produced by imported expensive foreign experts, who also rely heavily on local scientists for their data and information collection for the government. According to Edoho (1997), African governments host about 100,000 foreign scientific and technological consultants per year and as observed by Professor Andam, former Vice

Chancellor of KNUST, this policy costs a total of about \$4 billion per year in tied aid to Africa (Ramphele, 2004) which also reduces the funding allocated to African universities by their various governments. Most of the scientific and technological research funding of Ghanaian Universities therefore, currently depend on foreign aid. However, Teferra (2003) warns that such funding also is tied to the techno-economic interests of the donors with whom the African power structure continues to have ties – mainly of the ex-colonial rulers. This means that donors will mainly fund projects that serve their own interests – not African interests – thus a loss to the local economy and the people.

In terms of scientific conferences, symposia, workshops, panel discussions and conventions, Teferra (2003) strongly emphasizes their significance as the major means of scientific communication among scientists of the world, particularly of universities around the world. He notes that papers presented at such conferences are current, specific in scope and can be the first public disclosure of scientific information. Thus many important scientific and technological developments are first made known at such conferences or events, but almost all of such meetings do occur in the developed countries, since “organizing international scientific conferences in Africa is considered hazardous” (Teferra, 2003: 130) generally due to infrastructural and certain logistics problems prevailing in African universities and their countries. Again, he notes that most African scientists work in poor academic environments that cannot provide the basic infrastructure to undertake research let alone pay for expensive travel to attend major scientific meetings (Teferra, 2003: 36). Gaillard and Waast confirm this problem:

To honor an invitation to go abroad commits the scientist to hurdling a veritable obstacle course: exit visas, foreign currency, depleted travel budgets, the administration’s hint of suspicion that the trip is for pleasure, or an unjustified privilege for a senior civil servant (Gaillard & Waast, 1993: 43).

Ghanaian scientists therefore have to wait until conference papers are published before they can obtain copies and even this depends upon their University library's capacity to purchase or trace such articles. According to Teferra (2003), exposure to current information is crucial to scientific endeavor and yet remains highly limited in Africa, where the resources are extremely meager. On the other hand, the importance of scientific research has become the hallmark of almost all universities in the new global academic community and Daxner (1999) confirms this: "The university of the future will be largely defined by its research or there will be no university" (1999: 59). These problems have combined to underline the poor research output of Ghanaian Universities where currently, several of the science departments have very few or no usable equipment in their laboratories, while the few that have anything at all still in them use the outdated equipment installed in the 1960s. It should be obvious to the current and future governments of the country that science and technology professors cannot conduct research to advance at the knowledge frontier without adequately furnished laboratories, decent salary and other incentives against soaring inflationary trends in the Ghanaian economy.

The inelastic and deteriorating nature of the Ghanaian economy- like other African economies – has also prevented the economy from absorbing and utilizing the knowledge and skills of the science and technology graduates produced by the Universities in terms of employment, resulting in acute brain drain of high-level manpower trained by the country's Universities. At a recent induction ceremony for over 1,000 newly qualified medical and dental practitioners in Accra, Dr. Addo Kufour, the former Minister for Defence observed that about 2,800 doctors left Ghana between 1969

and 2006, in addition to a large number of pharmacists, laboratory technicians and other health professionals (ghanaweb.com, March 30, 2007). And yet he states that it costs the country approximately \$80,000 to train one doctor from primary school to the university level. According to the ILO (1992) an estimated 60% of Ghanaian medical doctors trained in the early 1980s are now working in Europe, North America and elsewhere. In 1998 alone about 120 doctors left the country while between 600 and 700 Ghanaian physicians were reported practicing in the US alone, representing 50% of the total population of doctors in the country.

Furthermore, since January 2002 the Ghanaian government has been fighting European governments, particularly Great Britain against the recruitment of qualified Ghanaian nurses to staff European hospitals, which practice continues to render hospitals in Ghana acutely understaffed of qualified nurses. According to the Minister for Defence, 11,000 nurses have left Ghana since 1996. On the local scene, and what has been termed “brain hemorrhage” the acute economic conditions have lured several scientific and technological, as well as other qualified university professionals into the public and private sectors where the remunerations are more attractive than those at the universities. According to a recent study conducted at the country’s Media, Energy and Revenue Collection Departments it was observed that the salaries at these establishments far exceeded those of the country’s Universities (Effah, 2003). Others, including university science and technology professors have found their way into the country’s political domain where they currently hold ministerial level portfolios for very attractive salaries and fringe benefits, but where their knowledge and skills in science and technology are

not being used for the practical improvement of the society and the people, while their absence further worsens the teaching and research abilities of the Universities.

This exodus from the Ghanaian Universities has been largely due to the prevailing professional frustrations, including ill-equipped laboratories and poor salaries facing many science and technology professors in the Universities. For example, in 2006 the monthly salary of Assistant Professors at the KNUST was equivalent to US\$360.00, Associate Professors US\$480.00 while full Professors earned US\$720.00. As politicians however, they not only earn higher salaries but also receive several additional fringe benefits including free fuel and free government cars for travel plus living allowance and housing. This public sector lure therefore, has severely affected the teaching and learning of science and technology at the Universities. At the pre-university level it has been reported that several science teachers, particularly from the Senior High Schools (SHS) have left the country for positions in Southern Africa including Swaziland, Lesotho, South Africa, Botswana - and even Nigeria where they are better paid for their expertise and professional services as well as being provided with the necessary resources for their work. And yet these professionals were all trained with the Ghanaian taxpayer's contributions, underscoring the great loss of human capital both to the people and to the society as a whole.

The result of the brain drain has not only been the loss of qualified scientists and technologists for the secondary schools and the Universities but more so, has led to the production of more social science graduates than science and technology graduates, since most university students have lost confidence in choosing science as their major when it comes to effective teaching and learning and also job security due to problems in the

economy, following graduation. This condition thus forms a major part of the many problems affecting the inability of the Universities to produce enough scientific and technological manpower which is basic for progress in research and in the general utilization of science and technology in national development.

As stated earlier, the problem of brain drain at the country's Universities continues to increase at an alarming rate due to the harsh economic conditions facing the highly trained and experienced scientific and technological professors as well as the Universities, and the inability of the government to solve the problem. However, it appears that this issue has become a continental phenomenon, for in 1995 the UNDP reported that about one-third of Africa's professionals, including scientists and technologists had moved to Europe. Again, according to the *West Africa Magazine*, during the period 1987-91 alone, Africa lost an estimated 60,000 middle and high-level professionals to brain drain (*West Africa*, May 4-10, 1992: 749). Currently, about 40% of Africa's top professionals including scientists and technologists are residing in the rich countries of Europe and North America due to the reasons given above – an issue which continues to frustrate the development of African societies. The lack of the Ghanaian government's intervention in solving the problem therefore, will continue to increase the scientific and technological development problems of the country's Universities and schools which in turn will increase the hiatus and depth of the country's dependency on the importation of Western scientists and technologists, using hard earned foreign aid loans and which will further hurt the already declining economy.

Another constraint affecting the development of science and technology in Ghanaian Universities has been the fact that the science and technology curriculum

suffers from serious lack of critical reforms reflecting current and future realities and needs of the society and the academic world, due to the stranglehold of inherited traditions from their colonial past. Thus whereas the curricula of British Universities, for example, have evolved considerably during the last fifty years to meet the changing needs of the British society, the curricula of Ghanaian Universities have remained practically unchanged. For instance, there are insufficient number of African -oriented courses on science and technology, and indigenous technologies in the curriculum geared towards the study of the Ghanaian society, including traditional medicine and healing techniques, tropical diseases, agriculture and indigenous technologies. For the most part, it has been observed that it is rather Western scholars, scientists and technologists from Western universities and research institutions that come to show interest in researching African topics at Ghanaian Universities, instead of Ghanaian scholars some of whom deem such topics unimportant and non-academic, particularly indigenous technologies of the informal sector of the economy. Sadly, the Universities are unwilling to work with the informal sector of the economy to help in developing this sector industries and skills which are local and indigenous to the economy and the people and thus are more likely to provide direct help to the society. The informal sector has always been considered by the Universities as “below their standards” hence they would not have anything to do with it, concerning research and development of new technologies. And yet the informal industrial estate sector is where most of the technologies used by most Ghanaian households and small businesses have been developed – not at the Universities.

The unchanging nature of the university curricula, especially in science and technology thus prevents the introduction of new and more pragmatic courses capable of

realistically transforming the Ghanaian society. This situation is the result of the dilemma confronting the Universities as they try to create their own academic traditions (Altbach, 2003) while at the same time they struggle to fit into the “accepted standards” prescribed by Western universities, in terms of quality and the ever elusive concern over the lowering of “standards.” The science and technology curricula of Ghanaian Universities therefore continues to be geared more towards Western academic requirements and examinations than on local needs, particularly regarding their use of local resources, technologies and expertise. Above all, Ghanaian Universities continue to award general degrees in science and technology, and engineering instead of specialized degrees relevant to national and community development and to the new global economy.

On the other hand, it should also be acknowledged that Ghanaian Universities have contributed immensely towards producing manpower for the country’s industries, including the Volta River Authority (VRA) which manages the Akosombo Dam for electricity production, the Public Works Department (PWD), the Ghana Water and Sewerage Corporation (GWSC), and the Tema Oil Refinery (TOR). However, in terms of actually impacting the communities in regards to inventing new technologies or improving on existing local ones, as well as creating new products for public use, and developing new scientific methods to enhance the quality of life of the people, the Universities have failed in these areas. For example, one can easily argue that the KNUST, as a scientific and technological University, has not practically or significantly affected the technological development of Kumasi, its immediate community, in any meaningful way better than the popular Kumasi informal sector engineering estate nicknamed the “Suame Magazine” where almost all of the equipment such as grain

milling machines, palm nut crackers, and many other necessary household and other small business and local industrial technologies for public usage have been invented by school drop-outs and high school graduates, whose educational levels do not rank those of the KNUST graduates and professors alike.

In terms of pedagogy, there appears to be too much concentration on the teaching and learning of scientific theory for passing university examinations than on the practical application and adaptation of the knowledge gained in the economy as a whole. This problem is due to the lack of well-equipped laboratories and experienced scientific and technological personnel engaged in cutting edge research experiments, to assist students to acquire the practical skills of specialization and understanding of the scientific processes of inventions. According to Colclough (1989), resource starvation at the secondary school level leads to less qualified university students, which contributes to declining performance and internal inefficiency within the universities. Teshome Wagaw (1990) adds that the low level accomplishment in science education at the universities lies with the secondary school systems in Africa. He argues that since the foundations of the skills and attitudes that may lead students to choose these fields are laid in the grade schools, and since most of these schools are destitute of sufficient facilities, equipment, and qualified teachers the goal of preparing enough engineers, technicians and other technological specialists remains elusive. This conclusion is supported by Manuel Zymelman (1990) who states that secondary schools are consequently failing to supply adequately trained candidates to higher education institutions and to foster positive attitudes towards modernization in general. It appears that this problem is found not only in Ghana but across Sub-Saharan Africa where many universities, in efforts at solving the

problem, have added special pre-university remedial courses for in-coming secondary school candidates (SADC, 1991).

The problem of poor accomplishment in the development and transfer of science and technology into the local economy by Ghanaian Universities therefore, is partly due to inadequate scientific preparation and poor training resources and facilities both at the university and high school levels, as well as enrolment increases against rapidly declining resources available to the Universities. The focus on scientific and technological theory is thus prominent and prevalent both at the pre-university and university levels of the Ghanaian education system, where the emphasis of science is merely the verification of experiments. That is, known scientific laws and theories, and laboratory experiments are memorized and reproduced during examinations, with students lacking the practical understanding and application of these theories and laws (Azubuike, 1997). It is a system of rote memorization and regurgitation of facts without critical analysis and local testing for relevance and adaptation. The teacher simply leads students to master the contents of the textbooks and to reproduce them verbatim during set examinations. For example, students memorize even step-by-step examples of technical drawings of either tables, chairs, doors, and any other frames provided in the textbooks and correctly reproduce them during examinations – without the slightest practical understanding of what they have memorized, due to the lack of technical workshops at the school site for students to acquire the practical knowledge and experience involved.

Thus the performance and scientific knowledge of students is greatly measured by their ability to re-tell the teacher what he or she has already told them during the course of the academic year, and the slightest deviation from this style of teaching and learning

method means failure for the student in the final examinations, since most of the science teachers equally lack laboratory research experience and skills because they also went through the same system and style of teaching and learning. This cyclical problem of teacher and student production in the Ghanaian educational system therefore, is only capable of producing science and technology graduates well grounded in theory than in the application of theory for social change. The result is that the significance of such graduates to national and community development is hardly realized both by the people as well as the society as a whole.

Ghanaian university science students therefore acquire a heavy dose of theoretical content, while in practice they lack the skills of creativity, experiment, analysis, adaptation, inquiry, critical thinking, research and practical application of theory. To them, science exists only in textbooks, while laboratories are built for content reproduction (Azubuike, 1997: 413). In this routine atmosphere of teaching and rote memorization technique of learning, students develop the impression that the work of the scientist is confined to the office desk, while the relevant and significant problems within the society are not investigated. Science, as both university and pre-university Ghanaian students perceive it is that it is a discipline completely divorced from the society and the needs of the people including technological inventions, having no connection whatsoever for practical application except for examinations and the nursing and medical professions. Ironically, science and technology students are perceived by their peers as the most capable, knowledgeable and useful students because they study the most “difficult’ and “important” subjects of the curriculum.

The lack of a clear government national policy on science and technology has also been another problem facing Ghanaian Universities. Like other African countries where the central government plays a crucial role in formulating national policies, the organizational composition of the bureaucracy and the level of expertise are lacking (Teferra, 2003). The critical role of leadership in governmental organizations for the development of science and technology has been emphasized, but Forje (1993) rather sees African governments as the fundamental problem of science and technology in Africa due to their lack of support and inadequate funding of these programs. The result has been that Africa remains far behind the rest of the world in generating, organizing, disseminating, and consuming scientific knowledge (Teferra, 2003: 31).

Since independence, successive Ghanaian governments have been more interested in fighting university autonomy and administration through political and military confrontations than supporting their actual growth and relevance, in terms of formulating and implementing effective and useful national policies on science and technology for the Universities. This has been evident particularly with the various military regimes – especially the regime of Flt. Lt. Jerry Rawlings, which seized power in December 1981 and stayed in power until 2000. These confrontations have included governmental decrees closing down the Universities indefinitely, sending military personnel to use deadly force to quell down peaceful student demonstrations against unjust government interference with university policies, and cuts in governmental funding as a form of punishment or retaliation for criticisms against the ruling government. The result has always been the disruption of teaching and learning and university activities, particularly research which greatly affects the scientific and technological programs. In some cases

such interferences have resulted in soldiers causing extensive damage to University property including residence hall electrical fixtures, bathroom equipment and classroom facilities. Such damages take much longer time to be repaired or replaced, if at all, and which also severely affects teaching and learning. Indeed these political tensions between the Universities and the government also have greatly contributed to the acute brain drain problem facing the Universities and the country as a whole, because during such clashes with the military some academics at the Universities are either severely beaten up while their wives and daughters are raped or they are chased out of the country. However, since 2000 this condition has ceased under the civilian elected government. On the other hand, this change has not translated into adequate financial support from the government for the development of the science and technology programs at the Universities, partly due to the current financial crisis facing the country as well as the lack of government interest in funding this area of education.

The emergence of the new global economy driven by rapid scientific and technological advancements coming from the industrialized nations including the US, Britain, France, Japan and Germany appears to have not only increased Ghana's dependency on the importations of Western scientific and technological expertise and resources but it also seriously threatens the country's monoculture economy based chiefly on cocoa exports, as a result of the major scientific and technological innovations, including the uses of biotechnology. First, it is evident that any feeble attempts by Ghanaian Universities to develop or depend on their own scientific and technological skills have been seriously overwhelmed and undermined by new scientific and technological inventions of the rich countries. For instance, the use of cell phones is now

quite common within the Ghanaian society but it is also evident that Ghanaian scientists - who also use these phones – did not produce this technology thus deepening the country's dependency on the importation of Western technology.

In terms of biotechnology it is certain that this new scientific and technological breakthrough seriously threatens the monoculture economy of Ghana - and those of other African countries - due to the uses of this scientific process to create raw material substitutes in the laboratories of the universities and research institutions of the rich countries. For instance, Cornell University, as well as the Nestle and Hershey Companies have produced low-quality cocoa butter in their laboratories through biotechnology creating a real threat to Ghanaian cocoa exports in the very near future. This is one area where Ghanaian Universities are badly needed to find ways to combat such economic threats coming from the global economy, through serious scientific and technological research and development – but they can only undertake this exercise with adequate governmental support and funding.

The endless possibilities offered by biotechnology to bypass the use of raw materials for substitutes in Western societies pose a grave challenge to the Ghanaian economy, which depends primarily on the export of raw materials. For, as what constitutes national wealth shifts from natural resource endowments toward the acquisition, manipulation, and application of knowledge and information through science and technology, the demand for natural resources, raw materials, and cheap labor will all decline thereby intensifying the marginalization of the Ghanaian economy within the new global economy. This condition is bound to deepen Ghana's dependency on the importation of Western scientific and technological creations for its socio-economic

development, which in turn will increase the decline of its economy and the general poverty of the people, since it will have to pay for such imports with foreign loans. But it is also evident that national development is impossible at this time without the renaissance and active involvement of Ghanaian Universities, particularly in the scientific and technological areas.

Conclusion

The goal underlying the establishment of expensive universities in Ghana following independence in 1957, to aid in the production of highly qualified scientists, technologists and engineers for national development purposes has since not been achieved. Instead, Ghanaian Universities continue to decline in terms of their practical relevance to the Ghanaian society and its people, particularly in the development and transfer of new technologies for adaptation and application in the economy.

The role of Ghanaian Universities in national development must now be redefined if their relevance is ever to be realized based on the rapidly changing needs of the people, and the new skills and knowledge required by the local and the global economies. There is an urgent need therefore, to reorient the science and technology curriculum to focus more on research and application and adaptability than on examinations and mastery of theory, for theory alone is not enough for the practical development of the Ghanaian economy. The Universities must become scientific and technological problem-solvers knowing that it is the Ghanaian society with its vast rural populations that need to be developed, by helping them to multiply their agricultural production, finding new industrial uses for primary products, new solutions drawing on traditional healing

methods, and the use of the principles of biotechnology in solving some of the many socio-economic and agricultural problems facing the country. As institutions of higher learning, they should research the country's informal sector technologies and to assist with their development, since this sector of the economy has rather emerged as the major source of technology production for the needs of small businesses and industry, and households of the Ghanaian society. Similarly, the Ghanaian government must assist with the funding of the development of science and the transfer and adaptation of technology into the local economy. It also needs to collaborate with the Universities to produce a national science and technology policy framework to guide the Universities in their efforts to harness the powers of science and technology for national development, as well as satisfy both current and future socio-economic needs of the people and the pressures engendered by globalization.

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