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COUNTRIES- THE GAMBIA IN PERSPECTIVE

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ABSTRACT

This survey seeks to identify important factors relevant to higher education and public research systems, establish the context in which the topic is reviewed, and generate and gain new insights. It further seeks to gain understanding of the organization and structure of higher education and research in developing countries and explain the relevance of higher education and research/innovation challenges to the competitiveness of a developing country like the Gambia. The survey raised research questions of how policy can be used to shape national science and technology base and what contextual and motivational factors support scientific effectiveness. It further provides the insight that the Gambia in pursuit of strategic development goals, must necessarily invest heavily in research and development, wisely choose its research governance model and structures, preferably scientific committee structures, and prioritize the development of its scientific and technological base.

KEYWORDS: Higher education, research, policy, governance, innovation

1. INTRODUCTION

Research generally makes invaluable contribution to a society's economic, social and environmental goals. This survey cannot view the research system in isolation from its critical linkages with education, innovation and a nation's policies and aspirations. Formal higher education, particularly universities have over the years increased in importance as centres for creating and transmitting knowledge and the mainstay of efforts all over the world to strengthen national economies, generate innovations, and support and improve quality of lives of peoples. However, institutions of higher learning and scholarship face daunting global challenges some of which include the challenge of finding solutions to global problems of climate change, HIV/AIDS, and natural disasters such as earthquakes, volcanic eruptions, tsunamis, etc. The public research system is though narrower than the national research system which includes business actors, research and technology organizations as well as a wide range of stakeholders who contribute, fund, support, work in, or make use of research. In other words, national research systems become broader than sectoral and sub-sectoral systems such as the national agricultural research system, the national health research system and so on. The environment in which research systems are situated are highly diverse, ranging from large federal-state systems with considerable capacity in strategic research, to small systems with a handful of research stations carrying out mostly adaptive research such as those found in some parts of low-income African countries. These systems are found within the broader national innovation system, implying the existence of pluralist research systems as each is located in specific sector and performing different types of research. An innovation system refers to a system of organizations within an economic system directly involved in the creation, diffusion and use of scientific and technological knowledge, as well as in the coordination and support of these processes (Dantas, 2005)

However, following on the heels of purposes of a review listed by Hart, (1998), this survey seeks to identify important factors relevant to higher education and public research systems, establish the context in which the topic is reviewed, and generate and gain new insights. It further seeks to gain understanding of the organization and structure of higher education and research in developing countries and explain the relevance of higher education and research or innovation challenges to the competitiveness of a developing country like the Gambia. The survey examined research and innovation systems from a global perspective in section 2 and the organization of public science in the

developing world in section 3. Section 4 reviewed literature on higher education and public sector research in the Gambia while sub sections 4.1-4 examined government-based agricultural research in the Gambia, higher education and research in the Gambia, health research sector in the Gambia, and context of developing health research system in the Gambia respectively. The survey ends with a conclusion.

2. RESEARCH AND INNOVATION SYSTEMS

According to Arnold and Bell (2001:292), bedrock principles for developing innovation systems include:

1. Innovation is essentially the result of an interactive process between many actors, including companies, universities, research institutes, NGOs as well as users. Individual organizations rarely possess all the knowledge necessary for the whole process of innovation. As a result, they need to combine scientific, design, engineering and operational knowledge from different sources.
2. Innovation does not follow a linear path that begins with research, moves through the processes of development, design and engineering, and production, and ends with the successful introduction of new products and processes – what development practitioners call the TOT (transfer of technology) approach. Rather, it tends to involve continuous feedback loops between the different stages of development.
3. The innovation systems framework can be applied to different levels of the economy, depending on whether one is trying to analyze (or promote) innovation at a supranational, regional national, local or sector level.
4. The innovation system framework brings together the elements of good practice required to foster innovation. In other words, it provides a coherent analytical tool for handling the disparate processes of knowledge creation, distribution and use, as well as the ways that these affect productivity, competitiveness, and economic and social development.

Multi-stakeholder partnership approach to research and innovation seeks to engage and build on partnerships across public, private and civil society organizations that contribute to innovation and its application; and enabling partners to work together to identify, develop, disseminate and use innovations (technologies, processes, products) within a specific institutional, societal, economic, legal and political context. Major aspects of this wider concept of research and innovation include the notion that context is central and there are multiple stakeholders with a variety of perspectives and functions whose interests need to be considered. Besides, the approach permits wider sources of innovation (including and involving a non-linear pattern of interaction and feedback between research, development and up-date of technology). The increasing emphasis and focus on pluralist research systems have meant the realization of the theoretical and practical relevance of the dynamic and evolving nature of the environment in which research takes place. Strategic response to challenges from all sectors and stakeholders connected with basic and/or industrial or applied research can only improve or remedy deficiencies in the public research system.

A public research system generally displays some basic characteristics. Some of these features may indicate a certain research and development funding intensity including mechanisms for funding both basic and applied research. Research funding may come from the government or its agencies, private business, Non-governmental organizations (NGOs), regional or international institutions. Most governments, as in European Union (EU) countries, using its research and innovation policies and regulations work towards shaping and adapting its public research system to deal with new social, economic and environmental challenges that they identified. For instance, according to European Commission, Report of ERA Expert Group, (2008), France traditionally funded public research through contract instruments between the state and research institutions (including universities and public research organizations). However, since 1999 successive French governments, in addition to direct funding, have tended to fund public research based on project (project funding as against institutional funding) no matter the researcher's institutional affiliation; and to modify the organization of public research system to meet new challenges.

A significant feature of a public research system would arise from the fact that research and knowledge production are activities developed within an organizational context. Consequently, this requires not only an inflow of human resource (researchers and other highly skilled workers). It also requires that public research policies recognize the dynamic and evolving nature of public research system and develop open and mutually beneficial interactions and learning among the principal stakeholders or research performers such as individual researchers, universities. In most European states, such policies are adaptive, though to a much lesser extent in developing countries. Other research performers may include research funders such as Research Councils, Business, sectoral Ministries, NGOs and beneficiaries of research such as Business, Government, and the Society. In other words, research and

knowledge production engaged in an ecosystem. While sharing similar starting points with system approaches to research and innovation, the ecology approach regards the research and innovation system as an ecosystem. This means bringing in the benefit of focusing on the "distribution and abundance of research performers and knowledge and their interactions with each other and the broader environment" (European Commission, Report of ERA Expert Group, 2008:23). Policy approaches that think of research and innovation system in this way can raise the quality of research by improving connectivity and communication between actors who perform, support and use research. The works of (Bowonder and Miyake 2000; Coombs and Georgehiou 2002; Dvir and Pasher 2004; Wulf 2007) reflect this growing tendency to apply the ecology analogy to knowledge production.

The traditional linkage between higher education and basic research further characterize a public research system. Though universities mainly conduct basic research, public research is organized around universities and public scientific /research organizations. Government interest and role in higher education and research vary significantly from one country to another. Modes of public funding for research and development also vary widely and reflect the institutional setting of countries' research system. According to OECD, Research and Development Database, (2010), the principal mode of Research and Development funding in Germany, Israel and New Zealand is institutional funding, which can help to ensure stable long term funding of research, while Belgium and Korea rely mainly on project funding to higher education. Such project funding includes national research and development contracts from line ministries. Alternatively, Governments may often contribute to national funding agencies such as Research Councils based on specific projects. A project-based funding can promote competition in the research system and may aim at some strategic areas. However, in developing countries the principal mode of public funding for higher education and research have remained largely institutional in the form of state contributions or subventions to universities and other research organizations, though in special circumstances there has been limited project based funding from non-profit international organizations particularly in selected fields of science such as agriculture and medical sciences.

However, the general belief is that a clearer public appreciation that research and the skills that research sustains are critical elements in addressing the economic, social and environmental problems facing a society must necessarily support investment in, and high-level attention to, research and innovation. It is further generally believed that public objectives of research can be achieved by creating a research-friendly ecology achieved through a series of coordinated actions encompassing research, innovation and the development of lead markets and/or regulatory and public service environments (Report of ERA Expert Group, 2008). While there is often a distinction between basic and applied research, varying reasons support the conduct of research at several levels, which include national, regional or sub-regional, and the global levels. The argument here is that support for research at each of these levels could come from quite different reasons. At the national level, support for basic research may seek to enhance the gains for society and economy through dissemination of results of research, flow of trained people, informal networking, problem solving and development of equipment (Salter and Martin, 2001). On the other hand, support for industrial/applied research may come from its potential to inform public policy as well as provide support for innovation and competitiveness. Beyond the nation state and perhaps involving a combination of states, support for basic research might seek to enhance collaboration and virtual common platform and approaches that would stimulate competition in research and achieve economies of scale and scope (e.g. opportunity to expand research competences and seek complementary skills, ERA Expert Group Report). On the other hand, applied research at this level can provide more chance of finding expert solutions to problems. Basic research is about experimental or theoretical work undertaken to acquire new knowledge of underlying foundation of a phenomenon and observable fact without any particular application or use in view. In contrast, conduct of applied research seeks to support innovation and competitiveness. Public support for research generally rests on the argument that the outcome of research (i.e. knowledge generated) often has the attributes of public good, being non-rival in use as multiple users can simultaneously benefit from the results. It is also non-exclusive as beneficiaries may include people who have not paid for it. Besides, most governments generally accept as their responsibility the development of basic capacity for research through training. Another reason for government intervention in research and development investment is the lack of knowledge of the outcome of research and uncertainty associated with research and innovation generally. ERA Expert Group report further identified challenges of coordination of research efforts, insufficient opportunities created by basic research, gaps in the innovation system or its risks of being stock with obsolete, as reasons for government involvement in and support for research. However, Salter and Martin (2001) argued that governments might support basic research within their borders because of its contribution to the economy and society. Universities and public research institutions carry out most basic research. Public support for research therefore becomes necessary as it makes invaluable contribution in developing new scientific and technological knowledge and human capital that can lead to innovation beneficial to society and economy. Such benefits accrue to society and the economy through knowledge flows achieved via open publications, flow of trained persons, informal networking, problem solving and developing new equipments and technologies. On the average, more than three-quarters of all basic research in the Organization for Economic Cooperation and Development area is conducted by universities and

public research organizations (OECD, Research and Development database, 2010). Evidence from this data source shows that university spending on R&D accounts for 0.40% of GDP in OECE area reflecting the growing importance of universities as providers of useful new knowledge and as trainers of researchers and other highly skilled workers on which knowledge-based economies rely. Globally, university basic research in most countries accounts for 40% to 70 % of all basic research in the country.

At the global level as in other levels, reasons for research support often arise from the concept of global public good. It is widely recognized that a broader approach to research may provide significant economies of scale, spillovers, and synergetic interactions. Many organizations and scholars now realize that a number of important economic and social problems go beyond national boundaries, and that a broader approach to research on these, which is often not possible within individual state's projects and resources, can achieve greater results. In this context, it would appear that there are greater promise, though greater danger, of international approach in providing global public goods. Global public good, defined in terms of outcome of research involving global benefits, results from response to global challenges. Science has the potential for improving the wherewithal of society and increasing the wealth nations (Kealey, 1996; Bacon, 2000; Henry, 2002). Besides, the social returns to research investment tend to exceed the private gains realized by the individual firm. Consequently, scientific and technical knowledge possesses a public goods dimension (Mowery and Rosenberg, 1989; Ruttan, 2001). Research programs in both public and private sectors may produce public goods that have social benefits, which is freely available to all and do not diminish by use. Public good is conventionally relevant and open for use in a given state. However, its relevance often goes beyond national confines to involve sub-regions, regions and even the global community. Research programs could address global problems, which generally include health and environmental hazards such as the scourge of HIV/AIDS, climate change, tsunami, the challenge of nuclear fusion, global insecurity arising from terrorist activities and threat of limited and large-scale wars.

However, in most states, universities have the traditional role for education but they also play critical role as principal performers in basic research providing human resources for research and innovation. Their relevance within the wider, global research and innovation ecology calls for the harmonization of research policy with education policy as well as encouraging the interface and collaborative links with industry particularly in the high tech sector. In addition to research and education missions of universities, Schoen, et al. (2006) identified eight dimensions of universities' third, if not global, mission of knowledge production and transfer which include human resources, intellectual property, spin offs, contract with industry, contract with public agencies, participation in policy making, engagement in social and cultural life and public understanding of science. Besides, in defining the unique mix of these three missions of universities, Larédo, (2007) argues that universities are influenced by historical conditions and their contexts and the functions, which they are able to perform, namely mass tertiary education, professional specialized higher education and research and academic training and research. These unique features of universities as centres of knowledge production, and the milieu in which they operate, dictate that empirical inquiry on search processes of knowledge production and invention must necessarily make use of the theoretical assumptions and framework of the stakeholder and ecology approaches to knowledge production. Insights from these approaches, which underscore context of research and innovation processes, multiple stakeholder involvement, policy approach that develops open and mutually beneficial interactions among research and innovation actors and synergy with the environment, could in fact direct data collection design based on consideration of data inputs from all relevant stakeholder sources as well as internal and external research and science environment.

3. THE ORGANIZATION OF PUBLIC SCIENCE IN THE DEVELOPING WORLD

The evident pitfalls of data collection appear to handicap the study of structure of research systems in developing countries. The collection of pieces of relevant information about the scientific world are rather scattered across different establishments, departments and sectors. Keepers of information often withheld much of such information, though they may not be aware of it. Some of the information quickly disappears as it only appears in reports and gray literature, with few copies and little attention given to it. One major setback in this regard is the lack of local offices or institutions responsible for collecting and archiving such data, reports and articles. Besides, the state of research in developing countries need standardized list of relevant information, to describe it accurately. In this context, CREST/IRD Project, (2009:61) recommended,

Up to date [2009], reliable and relevant information is perhaps the key prerequisite for the production of studies to characterize the status of science in the developing world and develop appropriate strategies and Reference Centres or Regional Observatories of science. The Observatories should not only confine themselves with the gathering and analysis of quantitative data and statistical indicators, but also with descriptors (that could be standardized) and relevant narratives

However, in spite of these limitations survey of literature appears to suggest discernible patterns in the structure of scientific world in developing countries. Nevertheless, two major periods seem to characterize the history of research and science and technology in developing countries. These periods include research under the colonial influence and the other under independence. Colonial and other powers influenced specific scientific organization and governance, which varied across countries. Modern science in most developing countries surfaced in the colonial period. In 1923 in Burkina Faso modern science developed with the creation of the experimental station for agronomic research in Saria (CREST/IRD Country review template Project, 2009) and in Cameroon in 1939 with the creation of the Société d'Etudes Camerounaises (SECAM). According to this project report, another experimental station was the Institute of Scientific Research in Cameroon (IRCAM) created in December 1949 placed under the control of the Overseas Scientific Research Institute (ORSTOM), a French organization set up earlier on October 11, 1943. Colonial research in these regions, publicly funded and administratively supervised from the metropolis, focused mainly on agriculture, medical and social sciences fields. However, the idea that research could play a pivotal role in national development began under colonial research. Independence was accompanied by wide spread desire in developing countries to take over control of public research. In the Cameroon political independence saw the establishment of a national Scientific Research and Applied Studies and Survey Council (CRSAEE) in 1962 and the National Office of Scientific and Technical research (ONAREST) replaced later on May 2, 1965. The General Delegation further replaced this body for Scientific and Technical Research (DGRST) in 1979. These changes progressively increased the responsibilities of the institutions for research and triggered increases in the number of national researchers, which rose from 152 to 400 within the period 1980 to 1987 while the number of expatriate researchers remained unchanged (CREST/IRD Country review template Project, 2009). These and similar associations in the regions originated many scientific journals that also have ceased publication for lack of funding. A majority of these journals disappeared after the first two issues, though foreign institutions supported those, which are running well. However, in recent years, some regional and transnational scientific associations and journals are beginning to have stronger funding foothold. One such transnational scientific association is the Association for Public Administration and Management (APAM) based in Nairobi Kenya. In Cote d'Ivoire, the three major research and development performers are the national University, the Centre National de Recherche Agronomique and the National Polytechnic Institute Houphouët Boigny each, having evolved in different ways and experimenting with new ways of linking research and teaching with research and development. Cocody University, the oldest and major university of the country, has 13 research and training units, 12 research centres and institutes, 2 autonomous research centres and one school/faculty. The University attempted to integrate research centres with training units. However, its organization and management of research makes the university unique in that some research institutes employ full time researchers while a scientific commission supervises research activities in each unit. In addition, the Centre Universitaire de Recherche Appliquée en Télédétection is integrated with the geosciences and mining resources unit. In this context, CREST/IRD Project Report (2009:27) further stated:

The academic community wants to keep a clear distinction between the different types of structures, especially concerning budget allocation. Indeed, this integration is seen as the first step towards a merging of the structures designed to compensate for lack of human resources. Abobo Adjam University is experimenting with a new type of recruitment. Academic staff more or less belongs to civil service but signs a contract with the university

In Cote d'Ivoire, the National Centre for Agronomic Research was created in 1998 after the merging of agronomic research institutes: the Institute des Forêts (forestry), the Institute des Savanes (savannah areas) and the Centre Ivoirien de Recherche Technologique. The centre introduced a novel policy of privatization of research as its management revised the Centre to assume a private status and a mixed capital base-40% public and 60% privately funded. These narratives on Cote d'Ivoire reveal that the objective of policy of privatization of research was to allow the institute to operate according to global market forces and engage researchers on contract with the institute rather than the State. Researchers sign a contract with the Institute, which in line with the general policy, is to run according to the laws of economics. The policy design is to adapt the process to the global market and to reinforce the relationship with private partners and development. Nevertheless, these narratives on Burkina Faso, Cameroon, and Cote d'Ivoire disclose a common trend in the structure of scientific world in developing countries.

Generally also lack of research funds and the inevitable support for research from external sources further characterize public research in developing countries. Much of the internal funding for public sector research in the region seem to come in the form of institutional funding as research grants, public subventions or budgetary allocations. Most project-based funding on the other hand come from external sources, particularly Non-governmental organizations, the World Bank, and other donor and funding institutions and these were mainly bilateral programs in agriculture and medical sciences. On this background, Pound and Adolph (2005) argued that in some parts of the developing world during the 1960s and 1970s most technical expatriate researchers whose major roles were on-the-job training for national researchers filled cooperation research positions particularly in the agricultural sector.

According to the authors, this period produced "a cadre of national researchers technically equipped but operating largely with a conventional research approach" (p.1). During this research project era, expatriate researchers operated as project managers and specialist researchers with their national counterparts. The era ended with a shift towards capacity building as well as emphasis on higher degree training and bilateral program based funding. The British Council "shifted from granting scholarships competitively or through sectors to linking higher degree training scholarships to projects. A number of these projects (at least in the agricultural and health sectors) were development projects with a research component" (Pound and Adolph, 2005:1). Cameroonian research for instance, benefited from important state support until the middle of the 1980s. CREST/IRD Project Report, (2009:31) further stated:

In 1974 Cameroon was one of African States that invested most in research and this was not only possible due to oil revenue but also because of state involvement in the establishment of a scientific elite. Agricultural research, which constituted one of the most dynamic sectors, flourished with the aid of public funds. The Institute de Recherche Agricole and the Institute de Recherche Zoologique et Vétérinaire were the two principal institutions for agricultural research in Cameroon.

According to International Foundation for Science (2003), in developing countries the late 1990s and early 2000s witnessed increasing disillusionment with research among international donors and national governments. Levels of donor and government investments declined considerably and fewer scholarships were available to developing country researchers. Pardey and Beintema (2002) found that by the late 1990s, after a period of rapid expansion in budgets of National agricultural research systems, a slowdown in spending on research had become a worldwide phenomenon. Latin America, Sub-Saharan Africa, and the countries of the former Soviet Union felt the most severe effects. The least affected were the Asian National Agricultural Research System. Many developing nations experienced brain drain within the period as experienced researchers left due to poor in-country conditions and were not replaced thereby creating doubts about the capacity of national research to play leading role in poverty alleviation. Using quantitative indicators, Pardey and Beintema, (2001, 2006) described recent developments in agricultural research in developing countries in the following terms:

- The private sector accounts for an estimated six percent of research resources invested in developing countries compared to just over 50 percent in industrialized countries. Much of this research is located in Latin America and Asia where it is concentrated in a few large countries, such as Brazil, Mexico, Argentina, and India. With the addition of private sector investments, the gap in research intensities (total public and private investment) between industrialized countries (about 5% of Agricultural Gross Domestic Product) and developing countries (0.7%) is even wider.
- Well over 100,000 agricultural scientists (full-time equivalents) are working in the public sector National Agricultural Research Systems (NARSs) of the developing world compared with about 60,000 in industrialized countries. In general, the number of scientists has expanded faster than budgets, resulting in a squeeze in operating budgets and reduced real salaries.
- There is wide diversity across countries in the size and maturity of NARSs. China and India have the largest research systems in the world, with tens of thousands of scientists, and account for over one-half of developing country research capacity, but perhaps three quarters of NARSs in developing countries employ fewer than 20 researchers.
- The quality of scientific work force as measured by the proportion of scientists with postgraduate degrees has increased sharply in all regions, and especially in Sub-Saharan Africa.
- Studies consistently show high returns to investments in agricultural research in developing countries, averaging over 40%. (See Alston et al. 2000).

In addition, results of recent analysis by the ASTI, (2012) on Asian countries suggest that investment in agricultural research and development consistently provides higher returns than other public investments, both in terms of economic payoffs and poverty reduction. In particular by 2009 returns in Brazil and China outpaced those of the rest of the developing countries; though in Africa south of the Sahara much-needed salary increases and the rehabilitation of infrastructure and equipment after years of neglect gulped most of these funds (Beintema and Stads 2011) as in some cases increases in agricultural investment did not translate into more research. However, much of the public investment allocations in research and development in the developing world generally go to the national agricultural research system and the assumption is that this investment has produced unprecedented results in agricultural productivity over the past two decades. A further belief is that agricultural research and the national innovation systems have potential to stimulate further agricultural growth and poverty reduction in the developing world. Sustained investments in agricultural R&D could prove beneficial as a major contributor to growth by providing knowledge useful for adapting and disseminating technologies developed elsewhere and applying science towards

local needs. In recent years, investment in agricultural research appears to be expanding in Africa as evidenced by current increases in research and development budgets of the governments of Nigeria, Ghana and Kenya in 2011.

Research capacity is an important issue closely associated with the development of research and public science systems in the developing world. Research capacity and the state of science vary across the developing world, and even within countries. Capacity of research systems is often quite variable, depending on funding, incentive systems, and political support. Harris (2004) noted the existence of a wide range of scientific progress in developing countries. Some of these countries such as India, China, Thailand, Brazil, Mexico, Argentina and Chile are actually quite advanced in terms of scientific development, national budget for research and numerous PhD programs. Low-income countries on the other hand, such as Nicaragua, El Salvador, Ecuador, Bolivia, Haiti, Swaziland and most sub-Saharan African countries, often have none of these. A wide gap exists between the developed and developing countries in the area of research as well as development of research capacity. According to the Commission for Research Partnerships with Developing Countries (KPF, 2001), high-income countries invest about 85% of resources on research worldwide, India China and East Asia about 10%, and the rest of the world only about 4-5%. Most of the research resources in less developed countries are used by northern agencies (e.g. the Medical Research Council, UK) undertaking research in the south. The emigration of experienced national researchers to the North, the often-called brain drain phenomenon seems to account for the limited research capacity in developing countries. Other setbacks to the development of research capacity in the region include loss of staff through HIV/AIDS, low government research funding allocations, and a limited number of researchers. According to DFID, (2004), the effectiveness of researchers is further compromised by "unreliable finance, poorly paid and managed staff, weak and unreliable infrastructure, and sometimes a lack of security". Describing the state of brain drain in developing countries, Solimano, (2005) stated that some 70,000 highly qualified African scholars and experts leave their home countries every year to work abroad, often in more developed countries. It would appear that the problem of recruiting, retaining and motivating qualified staff in developing countries is especially acute in the public sector. Besides, external support for research in developing countries is often program tied.

In the context of research for development, research capacity is about the ability of individuals and institutions to conduct and use research in effective, efficient and sustainable manner in addressing local, national and regional priorities needs. It is the sum total of human, financial and institutional conditions for conducting research. The usual concept and practice in capacity development have tended to concentrate on development of individual knowledge and skills. However, recent literature on the subject appears to indicate a shift towards a broader multiple stakeholder partnership approach that targets all actors in the system, and the linkages between them, in order to enhance the performance of the system (Lusthaus, Anderson and Murphy, 1995; Horton et al. 2003). These linkages could be more important than the individual elements of the system. In this context, Velho (2002: 26) argued that "a national system of innovation made up of actors which are not particularly strong, but where the links between them are well developed, may operate more effectively (in terms of learning and in generating innovations) than another system in which one or other actor is strong, but the links between them are weak". This argument in literature underscores the significant contribution of communication and research collaborations to the process of knowledge production. Linkages especially external networks have potential to enhance research competences at both individual and organizational levels. According to DFID, (2004), sustainable capacity development of developing countries' research systems is critical for the adoption of evidence-based, innovative approaches, and the production and uptake of technologies and policies that will contribute to economic growth.

Besides, much like the shifting emphasis in governance of research institutions in most parts of Europe, there appears to be increasing demand for policy reforms in developing countries permitting shift from centralized to decentralized structures for steering research. Recent literature on public sector reforms, higher education and research appears to be characterized by new approaches and re-thinking in governance of research institutions. There appears to be a growing emphasis on a shift from the traditional centralized authority and power structures to their redistribution across various policy levels. New approaches to governance warranted new institutional arrangements for coordinating public sector activities (Kooiman, 2000). Leišytė (2007:17) observed that in many countries coordination of organizational operations has changed "from a classical form of state dominated regulation in parallel with professional self governance to forms in which various actors at various policy levels govern the system". In the new governance model, described as "multi level, multi actor governance" (Van Kersbergen and van Waarden, 2001), coordination occurs through interactions at various policy levels as many of the actors tend to influence policy agenda setting, policy development and determination, policy implementation and evaluation (De Boer, Enders and Schimank, 2007). In most parts of continental Europe, public sector policies have tended to shape governance of higher education and research. Shifts in policy reforms in these countries have produced changes in governance forms, in patterns of interaction among authority structures and roles at various policy levels. In most parts of Europe, and to a lesser extent in developing countries, various forms of multi-level governance are replacing state centric/state bureaucracy in the governance of higher education and research. The post-2000 period in Europe

witnessed reforms in the governance of research institutions including universities, which introduced more competitive and performance oriented modes of coordination and greater autonomy to universities. The reforms included managerial executive leadership structures at the institutional level. Policy makers in most parts of Europe expect that executive leadership governance structures would promote higher quality education and more relevant research output. While monitoring of output is increasing, achievement of academic objectives by faculty appears to be increasing. In addition to incentive structures, performance based contracts with individual faculty members and department have lead to increased pressure to achieve in terms of output of doctorates, and publications, attracting third-party funding for research projects, etc.

In developing countries on the other hand there appears to be increasing demand for policy reforms allowing shifts in research governance from government to governance, from centralized to decentralized control and coordination of research efforts. There has been increasing demand for university autonomy and academic freedom and a shift from state centric to decentralized steering of research in most of West and Central African universities. Highlighting this trend, IDRC Report (2009:6) states,

As in most African countries south of the Sahara, the early 90s was marked by claims for more liberty resulting to what many observers qualified [as] the wind of freedom. It is in this context that the university centers of Buea and Ngaoundéré were transformed to fully fledged universities in 1992. Same as the universities of Yaoundé I, Yaoundé II, Douala, and Dschang were created on January 19, 1993.

There are various hierarchical levels in university research governance in Cameroon, Nigeria, the Gambia and a host of other public sector research institutions in West Africa. These hierarchies include faculty and departmental research committees, referees and special scientific committees, though without significant research steering autonomy. The state in most cases maintained a supervisory role and remained a dominant player in research policy arena.

In brief, it would appear that there is not much in literature on the effects of research governance models and structures in the context of developing countries. However, evaluation of studies on the state of university governance in West and Central Africa shows that the major stakes and challenges for research governance generally include,

Few established regional laboratories/research groups; limited number of well trained resident scientists committed to solving local health problem through well designed research projects; absence of heavy equipment even in some established laboratories (multiplex analyzer etc.); limited funding sources especially for poverty related disease research; poor awareness of ethical issues and arbitrary costing of projects. Others include poor completion rates for projects, compliance to contractual requirements for funded research, especially for institutional and higher education grants, and difficulties in tracking projects because of non-compliance to guidelines on submission and reporting. It further includes low level of reporting on research activities, heavy teaching loads, uncertainties in the rhythm of disbursement of funds for research (this is receiving the very close attention of the administration in the Gambia), inadequate laboratory space and lack of equipment; inadequate access to training for the conduct and management of research (IDRC , 2009:37).

Evidence from literature nevertheless shows that in developing countries, the research tradition of the former colonizers tends to influence public research systems. With few exceptions such as India, public science systems in most of these regions have seen very limited development. The agricultural and health research sectors appear to be more developed in terms of research capacity and funding, though few of the developing countries seem actually quite advanced with respect to scientific development. The quality of scientific work force remains very low in almost all regions. Lack of funds for research and support for research seem to hinder the development of most of the public science systems. Structures for steering research remain largely dependent on state funding and supervision, while 'brain drain' tends to limit research capacity. In some cases, poorly paid and managed staff, weak and unreliable infrastructure, and sometimes lack of job security appear to compromise the entire research process. These constraints and concerns present enormous challenges that confront governance of research institutions in developing countries. This state of organization and governance of the scientific world in developing countries however warrants further search for answers to problems that hinder scientific knowledge production.

4. HIGHER EDUCATION AND PUBLIC SECTOR RESEARCH IN THE GAMBIA

In recent years, the benefits of developing effective science and technology (S&T) and innovation systems seem to have informed the Gambia higher education and research policies. Report of the Gambia Round Table Conference, (2007:2), which produced A Higher Education Strategy Paper, 2007-2011 stated,

With higher education come new specialized knowledge and skills. In addition, with increased capacity come the ability to improve one's socio economic condition and contribute to the overall development of one's country. At the national level, it is understood that a well-educated and highly skilled labour force is a pre-requisite for economic growth and socio-economic development. In order to achieve the kind of socio-economic and technological progress envisaged in The Gambia Inc. _ Vision 2020, there is need to develop a critical mass of university -educated people who are able to apply the products of research, science and technology to increase the productive capacities of the country.

According to GOTG, (1996:39), the education sector is indeed expected to continue investing in training infrastructure to produce a continuing stream of technicians in order to cater for a diversification of economic and social activities. However, the Gambia has not yet developed an effective science and technology system, and the country "currently lacks a science, technology, and innovation policy to define national S&T objectives and priorities and to provide a policy framework to underpin socioeconomic development" (Stads and Manneh, 2010:3). Besides, innovation is still very rudimentary. Higher education and research nevertheless are becoming strategic instruments for developing core competencies, training in employability skills and for opening-up of opportunities for trainee-ships in research groups and in other working environments at doctoral/graduate and undergraduate levels (Blasi, 2005). Research, particularly those directed at producing tangible returns to the economy and society as well as innovation, provides suitable platform for generating development.

As centres for generating new knowledge and innovation, universities have globally tended to be the major recipients of new public and private funds devoted to development. In recent years, this consideration seems to focus the Gambia government's higher education policy as well a research and development investments towards research and capacity development. In this context, (Stads and Manneh, 2010:3) argued that the Gambia higher education policy recognizes,

the pervasive impact which science and technology can possibly have on national development, as well as the need to build capacity to increase competitiveness, participate in and partake of today's global knowledge economy, and—importantly—redress the effects of capacity losses over the past decade

On the issue of the extent to which research evidence informed policy development in the Gambia, studies by the Educational Research Network for West and Central Africa (ERNWACA) and the Gambia Economic and Social Development Research Institute (GESDRI), (GESDRI/ ERNWACA, 2006, 2007) argued that policy process does not sufficiently link research to policy development. This is because it is possible that global trends, structural adjustments, and international aid agencies (these agencies make policy reforms a condition for aid) determined established policies. Economic and social development planners need valid, reliable and relevant information, as do international agencies in confirming and re-enforcing their investment strategies. However, in the Gambia, the demand for such information far surpasses the existing capacity for accessing, retrieval, the organization, interpretation and overall use of complex research data. The Gambia evidently lacks capacity for research. The country lacks a critical mass of highly trained and competent Science and Technology (S&T) personnel and possesses limited S&T infrastructure and resources. There are no proper incentives and partnerships with the private sector (which in itself is underdeveloped) to engage in a more strategic and long-term development of the human resource base. The Gambia further makes very little investment in research and development (GOTG, 2006), and primary data are unavailable for concrete policy decisions.

In addition, the country has no formally articulated national science and technology policy. According to the Department of State for Basic and Secondary Education, (DoBSE, 2004:33), the Gambia education policy, in recognition of the rewarding but missing partnerships with private sector, envisages that "strategic and rewarding partnerships will be built with all stakeholders, including the private sector and donor organizations". The constraints arising from non-involvement of all stakeholders have tended to delay the development of a national science and technology system. However, in recent years, the government appears to have taken some concrete steps to deal with the challenges of developing policies and creating institutions that facilitate the generation of scientific knowledge

and its diffusion, expressed in the form of technological capabilities. Evidence of the government commitment to science and technology development includes the creation of the Directorate of Science, Communication, Information and Technology Education in 2001. Others are the creation of the Ministry for Communication, Infrastructure and Technology in 2001 as well as inauguration of the National Information and Communication Infrastructure (NICI) Policy and Plan developed for The Gambia. Most recently, another concrete step in support of science and technology is the creation of a new Ministry for Higher Education, Research Science and Technology in 2007. The new ministry consists of three directorates (higher education, research and planning, and science and technology). These directorates are responsible for policy development including the management and coordination of programs and activities to enhance socioeconomic development (MoHERST 2010). However, the fact remains that a national science and technology policy has not materialized. This has tended to drawback national development plans, and resulting in lack of a coordinated sense of direction. It has also meant that there are no formal platforms/guidelines to foster research and innovation in the country.

In the Gambia, building capacity is a national policy priority, and the major institutions responsible for this are the University of the Gambia, the Educational Research Network for West and Central Africa (ERNWACA) and the Gambia Economic and Social Development Research Institute (GESDRI). While university research dominates most of the basic research in the Gambia, the prominent sectors of research have generally remained in agriculture and health fields. In evaluating literature on public sector research in the Gambia, the following sub sections examined the major developments in agriculture, higher education, health/medical sciences and private sector research over the years.

4.1 GOVERNMENT-BASED AGRICULTURAL RESEARCH IN THE GAMBIA

Gambia is one of Africa's smallest countries. The country's economy relies heavily on agriculture. A study by Food and Agricultural Organization (FAO) of the United Nations (2004) reveals that in 2002, agriculture sector employed 80% of the Gambia's active population, mainly resource poor smallholders, and the sector accounted for 40% of the country's exports. The primary cash crop is groundnuts while rice and millet are the primary food crops. The logical consequence of this trend is that agricultural research and development remains the principal vehicle in the country's pursuit of food security and economic development. However, public agricultural research and development investment levels seem to have fluctuated over the last two decades. In 2008, the Gambia invested over 20 billion GM dalasis in this sector. Agricultural Research and Development capacity levels in the Gambia also declined since the turn of the millennium. According to (Stads and Manneh, 2010:1), in 2008 the country "employed 38 full-time equivalent (FTE) research staff compared with 42 in 2000". In 2001, nine agencies were engaged in agricultural research. These include six government agencies/units: the National Agricultural Research Institute (NARI), the Department of Livestock Services, the Department of Fisheries, the Department of Forestry, the Department of Water Resources, and the Food and Nutrition Unit of the Department of Agricultural Services. Among these are two higher education agencies: the Faculty of Science and Agriculture of the University of The Gambia, and the Gambia College School of Agriculture. The ninth agency is a private enterprise, the Gambia Horticultural Enterprise (Stads et al. 2004).

Established in 1993, the National Agricultural Research Institute (NARI) is the Gambia's principal agricultural research agency "accounting for two-thirds of public agricultural research and development staff and close to three-quarters of agricultural R&D expenditures in 2008" (Stads and Manneh, 2010:1). The Department of State for Agriculture administers NARI. The institute conducts adaptive research on crops, livestock, forestry, fisheries, and other natural resources to provide technological solutions to problems of farmers. Policy makers rely on its research to provide solutions that can sustainably increase agricultural productivity. Its research findings could further suggest measures to protect the environment and natural resource base (Stads, et al. 2004:2). At its inception, NARI took over the research activities of the former Department of Agricultural Research. However, according to World Bank Report, (1992) and FAO, (1993), the history of agricultural research began during colonial rule with research on groundnuts, the country's most important export crop. However, agricultural research activities expanded in 1965 when the country achieved independence. Research activities were diversified "but were generally conducted within the framework of development projects and did not incorporate appropriate coordination or oversight by the relevant ministries" (Stads et al, 2004:2). In 1977, the Department of Agriculture established the Agricultural Research Service, the country's first agricultural agency responsible for coordination and implementation of crop research. Three years later, the Department of Agricultural Research (DAR) established the National Agricultural Research Board. DAR was responsible for crop research, and the Department of Livestock Service (DLS) undertook livestock research, while the Department of Planning hosted social science research at this time. Supported by USAID, the government launched the Agricultural Research and Diversification Project in 1985. In 1993, the Project set up a national agricultural research board, which unified crop, livestock, forestry, and natural resources management

research. In the same year, the new and independent National Agricultural Research Institute (NARI) regrouped DAR and many of DLS research staff. NARI became an autonomous public agency supervised by the National Agricultural Board. The Board is responsible for overall policy guidance, research priority setting, and global as well as sectoral program resource allocation in line with the country's national development goals (World Bank Report, 2000).

In addition to research activities of the Gambia Agricultural Research Institute, five other agencies also engaged in agricultural research in 2001. The Department of Fisheries investigates improvements in fish processing methods and stock assessment, and employed four full time researchers in 2001. The Department of Water Resources, under the Ministry of Natural Resources and Environment, conducts limited water and soil research, and employed three full time researchers the same year. The Department of Forestry, under the Department of State for Fisheries and Natural Resources, conducts limited socioeconomic research. It employed three full time researchers in 2001. The Department of Livestock Services (DLS), under the Department of State for Agriculture (DOSA), carries out livestock research. The Food and Nutrition Unit of Department of Agricultural Services of the Agriculture Ministry, conducts post harvest research. Non-governmental agencies engaged in agricultural research include Action Aid, The Gambia, involved in poverty eradication programs and conducts limited agricultural research.

The higher education sector plays a limited role in agricultural research in the Gambia "accounting for an estimated share of 5% of total agricultural research and development staff in 2008" (Stads and Manneh, 2010:2). Most of the research activities in this sector are ad hoc in nature relating either to student activities (at the University of the Gambia and the Gambia College of Agriculture), or carried out jointly with the National Agricultural Research Institute or Université Cheikh Anta Diop in neighbouring Senegal. Identifying key trends in the agricultural sector since the year 2000, (Fatajo, and Kunjo, 2004:1) noted that agricultural research staff in the Gambia are less qualified compared with many African countries and that "involvement of the private sector in the Gambia agricultural R&D is minimal, which represents 2% of agricultural research staff and spending in 2001".

4.2 HIGHER EDUCATION AND RESEARCH IN THE GAMBIA

The Ministry of Higher Education, Research, Science and Technology is the government agency responsible for education policy in the Gambia. According to the Gambia Tertiary and Higher education policy, 2004-2015, tertiary education includes all post-secondary education programs in technical, teacher and university education as well as research. Currently, three institutions in the Gambia provide a variety of programs at post secondary level. These are the Gambia College providing programs in education, the Gambia Technical Training Institute in technical and vocational education, and the Management Development Institute in management studies. These institutions produce trained and skilled work force at middle level of services and industry. A major goal of the higher education policy is to evolve a tertiary and higher education system with the development of University of the Gambia at the apex. International donors/partners, which include the World Bank, the IDB, BADEA, the Saudi and Kuwaiti funds, OPEC, UNDP, and the Spanish and Taiwanese governments, support the development of tertiary and higher education sector in the Gambia. This policy seeks intervention in higher education in terms of support to the e-learning project at the University, the University Village Project, the Kanilai Institute, the Teachers Professional/Academic Development, the West African Examination Council and the Ministry of Higher Education, Research, Science and Technology's institutional capacity building (Today online, December 29, 2010).

Until recently, the University of the Gambia established in 1999 was the sole provider of university education in the Gambia. The Higher Education policy describes the University as a "fledgling institution" faced with the important challenge of putting together the necessary physical infrastructure and marshalling competent faculty strength (DoSE, 2004:43). The policy priority areas concerning university education include:

- 1.) encouraging The University of the Gambia (UTG) to offer graduate programs in faculties already established in co-operation with universities outside the country
- 2.) to encourage UTG to enter into collaborative arrangements with universities outside the country with a view to securing programs and materials in fields that are relevant to the country's immediate development needs
- 3.) to encourage the University to occupy a strategic position within the national development strategy, and
- 4.) Finalize the Higher Education Observatory Act, which involves the establishment of a system of accreditation and validation of qualifications awarded in the country that the University can only provide (DoBSE, 2004:43-44).

The university's research related objective is to "provide relevant, sustainable and high quality tertiary education and research to support socio-economic, scientific and technological advances and development, and promote excellence in the creation and dissemination of knowledge" (DoBSE, 2004:41). The Higher Education policy on research aims at

prioritizing the "establishment of research capacity and promotion of research in critical fields of development in the Gambia, mainly health, agriculture, basic sciences and human resource development". The policy proposed a higher education observatory and quality assurance council, which would serve as a tool for ensuring that investments in the tertiary education sector translate into institutional strategies that give explicit priority to improving the quality of teaching and research. For this purpose, the policy expects that the University of the Gambia and other tertiary institutions would develop and articulate appropriate strategies to achieve objectives that support research and development. However, suitable structures for steering research with strategic responsibilities are yet to materialize. Research activities at the University of the Gambia (UTG) as well as its research capacity are however beginning to take shape, though these and opportunities for doctorate training are still very limited. In working towards achieving the objectives of Gambia education policy, the University has opened up linkages with several external institutions aimed at promoting mutual academic and research benefits and consulting collaborations. These bilateral partnerships were achieved through Memoranda of Understanding. In pursuit of its bilateral partnership objectives, the University of the Gambia began exchange programs with St Mary's University, Canada and a number of other universities outside the country in 2005. Besides, a research and strategy committee existed at UTG up to 2009 as a major research steering body responsible for promoting research culture, environment and infrastructure of the university. The Committee supported the development of research staff involved in research projects. It supervised the competitive research funding through assessment of research proposals submitted to it by the academic staff requesting for grants. These assessments were based on explicit criteria. In spite of these policy provisions, this Committee became moribund after 2009.

Funding for research has remained a major setback to university research in the Gambia. The World Bank, in support of the government education policy (appraisal document, May 2006) gave a grant of approximately USD 8 million. According to the policy document, (DoBSE, 2004:46),

The Government will conduct strategic studies including those related to the creation of a competitive research fund... [Sic] the Competitive Research Fund will be managed by the UTG based on guidelines to be developed by the Department of State for Education. While the selection of research grantees is done by the UTG's Research and Strategy Committee, research proposals are to be approved by the University Council, and once approved funds are expected to be released by the Department of State for Education.

The competitive research fund has already received grants totalling three million dalasis, which is approximate US \$ 113,207 from the government. However, the Gambia government expenditure on Research and Development (R&D) is not lumped into one component but spread out using several nomenclatures such as field investigations, research fees, studies and surveys, environmental surveys, or simply research (Gambia National Budget, 2009). Based on these figures, it is evident that international donors, particularly, the World Bank remains the principal funders of university research in the Gambia. In addition to basic research, several consultancy projects have taken place at the University. These include projects sponsored or funded by IFAD, IDS, ECA, Action Aid, The Gambia, CEF, The Gambia, and Rural Finance and Community Initiatives Project by Department of State for Agriculture. The University of Gambia, School of Medicine also conducts research in health field and has established research cooperation in health related issues with the Ministry of Health units, the Internal Trypanotolerance Centre, and the Medical Research Council, the Gambia Unit. However, university research encounters several challenges. Research skills and capacity of faculty members remain largely under developed as most of them have qualifications below terminal degree (PhD). A greater number of the faculty serve as part-time lectures and for this reason cannot take part fully in academic and research activities in the University. Besides, research culture among serving full time academics is yet to take firm roots as very few actually engage themselves in research. Finally, technical incentives for conduct of research at UTG appear constraining because of inadequate research funding, limited research facilities, and time for research. Faculty members are often overloaded with teaching responsibilities and may engage in other income generating activities in order to supplement their rather meager incomes thereby leaving them with very limited time for active engagement in research. In addition, public and private sector support for research is minimal considering the very limited university share of the overall public research and development expenditure and nonexistent funding support from a fledgling private sector in the Gambia. Statutory allocations for research are fragmented appearing not as a lump sum but provided as research funds to various government departments where the funds remain largely underutilized. The evident non-collaborations between these departments (housing unused research funds) and the University faculty forestall the development of appropriate applied research and consultancy projects by faculty. In brief, it would appear that technical facilities for conduct of research at the University of The Gambia are inadequate. In this context, the thesis would seek to investigate how institutional condition for conduct of research and other motivational factors affect scientific knowledge production.

However, evidence from literature strongly suggest that poor management of research funding and overall

governance of research across research institutions in the Gambia, which is generally management centric, have not significantly contributed to research effectiveness of researchers and research teams (Ozor, 2013). The higher education and research policy depicts optimism in achieving national research and innovation objectives and places on the Higher Education and Research Directorate of the Education Ministry the responsibility for,

Co-ordination of all aspects of tertiary and higher education programs, facilities and resources, and promoting the culture of research the directorate will coordinate the review of strategic policy of all research activities to ensure that they are in accordance with the quality assurance system that are to be set up by tertiary and higher education institutions (DoBSE, 2004:46).

It is evident that these lofty policy ideas depart far from results on the ground. Between 2009 and 2010, publication counts for scientists across research institutions in the Gambia fell sharply with the apparent shift towards management centric form of research governance accompanied by lack of genuine management commitment to research and development and non-prioritization of research as well as very limited investment in research. Besides, the same period witnessed high labour turnover across research institutions in the Gambia as many scientists left their jobs for better offers in the sub region and overseas. The University of the Gambia in particular witnessed the exit of almost all its professors and core scholars. With apparent absence of a national research and science policy to harmonize and provide strategic focus to research and development initiatives, each research institution including the University maintained separate often inconsistent research policy and governance structures, which produced minimal results (Ozor, 2013).

4.3 HEALTH RESEARCH SECTOR IN THE GAMBIA

Building an effective health research system in the Gambia has remained a critical concern and focus of health research policy of the Gambia government. Palmer et al, (2009) observed that ministries of health in developing countries employ and implement deliberate and logical approaches toward building and strengthening national health research. These approaches include steps to develop a national health research policy and strategic plan, conduct a situational analysis of research in the country, set up a national health research agenda, establish research ethics and scientific committees, and build human and institutional capacity for health research management and conduct. These steps call for the development of a framework for health research policy, which is essential for the development of demand driven research or innovation systems in health and in science and technology more generally (Efron 2002; Rath 2005; Watson 2003; OECD 2003). Such policy framework is also necessary for an effective health priority setting as it provides the basic background and sets the necessary research agenda for choosing health research concerns. Without a defined national health research agenda, researchers and research funders are unable to align their work with the health and development needs of the country. According to (Ali, 2004; COHRED, 2007), in low income countries with limited funds for research, the absence of such policy framework can lead to donor rather than demand driven research agendas, as research efforts would produce little research to inform decision making in the health sector. Gambia has developed a national policy framework for health research with overriding goal of building research capacity. Assisted by Council on health research for development (COHRED), the country has also developed a national health research system (Arudo et al, 2008). Though the system is yet to be firmly rooted, it has discernible governance structures. In this context, the Gambia has a research program unit at the Directorate of Planning and Information at the Ministry of Health and Social Welfare, dealing with matters of research as part of Information Management and planning within the Ministry.

The Gambia as a developing country however faces a number of challenges in responding to the need for knowledge to improve decision-making and developing a functional national health research system. Some of these challenges include lack of legal and strategic frameworks for research and wise structures for steering research. Others include lack of coordination of research activities; inadequate participation of stakeholders in research, policy and implementation processes; lack of demand for research; low accessibility and use of research findings; and inadequate financial and human capacity (Kirigia and Wambebe, 2006; D'Souza and Sadana, 2006).

4.4 CONTEXT OF DEVELOPING HEALTH RESEARCH SYSTEM IN THE GAMBIA

The Gambia public health programs grapple with how best to achieve wider coverage in dealing with daunting health problems, which confront the country. There is a compelling need for research to inform policy in order to respond to the increasingly complex situation in the health sector. This is because of the high burden of communicable diseases, a rising number of cases of injuries from car accidents, limited health budgets and scarce human resource (Palmer et al., 2009). However, major health sector institutions in the Gambia including the Royal

Victoria Teaching Hospital, Banjul conduct health research, though these are usually small or limited studies to identify and address operational issues. Overall, using external resources, the Medical Research Council, The Gambia, a nongovernmental research institution, appears to conduct a major part of health research in the sector.

The Health Ministry began the process of developing a national health research system in the Gambia in 2002. The African Development Bank and the World Health Organization (WHO) supported the Ministry in the initial step of developing a health research policy aimed at promoting and coordinating health research relevant to the health needs of the population. Several other stakeholders including the academia, civil society organizations, and another development partner, UNICEF were involved in the process. As the process of developing a national health research policy unfolded, a number of initiatives were undertaken in the period from 2002 to 2008. These initiatives included the implementation of a national review of ethics in health research, the establishment of an Ethics Committee at the Royal Victoria Teaching Hospital, and a committee for research and publications at the University of The Gambia. However, despite advocacy efforts, the draft of the national health research policy failed to secure Cabinet approval principally for political reasons bordering on "concerns originating from perceived imbalances in research capacity between the public sector and the more highly capacitated non-government research institutions" (Palmer et al., 2009, http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2693112/#_ref-listid3723234). Though research activities have been going on in the country for several decades and sectoral research systems (agriculture, education and health) were developed, the fact remains that there has been no legal or political framework for a national science system. It is important to develop a legally based national science and technology policy integrated into an overall development policy agenda of government. It is also necessary to develop a national system of science governance and to formulate strategies for science, technology and innovation integrated into the national development plans and programs. Since genuine research, and in particular creative research and innovations require autonomy, individuality and freedom on the part of researchers, research teams, and governors of research, research institutions must wisely set up suitable governance model and structures, which provide for significant decision-taking autonomy at key hierarchical levels of governance. Overall, evidence from literature suggests the need for scholars to investigate further the determinants and hampering factors of scientific output.

It is also evidently clear from literature survey that there has neither not been any specific state policy in the area of higher education research, science and technology nor articulated national science and technology policy in the Gambia, except isolated references to science and research in national development documents such as the current Program on Accelerated Growth and Employment (PAGE), 2012. However, the Higher Education Ministry is currently developing a science and technology policy, which will drive science and research. Nevertheless, the fact remains that there is an urgent need to address the issue of developing a national research, science and technology policy in order to provide a national platform for harmonizing and coordinating the several hitherto discordant research and science policies and research activities of the various research organizations in the country including the University of the Gambia. A national research, science and technology policy could provide guidelines for developing institutional research strategic goals and a national research council, which oversees and regulates national science and research in line with national development goals. Besides, research is a serious enterprise that requires huge funding, and investments in research and development have proved rewarding for a nation pursuing strategic development goals. It is therefore necessary to improve institutional research funding, expand their funding sources, and introduce competitive research funds and partnerships with external stakeholders. At the institutional level, scientific structures for steering research could promote effective grant seeking, preparation of high quality research proposals, and diversification of competitive research funding as well as negotiation of research related contracts and consultancies.

Collaborative research exchanges and external linkages could generally improve research practices and expertise, save time and resources, expand sources of funding, the overall organization of research, and facilitate the coordination of research tasks. It is important to strengthen collaborations with industry, other local research institutions, and international research related organizations. In this context, this survey suggests the creation of scientific structures with responsibility for facilitating the establishment of partnerships with external stakeholders, the engagement of researchers with external organizations for the purpose of collaboration and encouragement of collegiality among staff. The Gambia needs not only to develop its scientific and technological base, but also must necessarily keep pace with scientific progress at both individual/researcher's and national levels. For this reason, the Gambia government, and indeed governments of developing countries, must be interested in enhancing the level of international collaboration through appropriate policies (Katz and Martin 1997; van Raan 2004). In addition, human capacity for research is very limited across research institutions in the Gambia. Thus, research institutions should urgently give high priority to development of staff capacity, aimed at developing research skills and expertise and ultimately improving research effectiveness and productivity of scientists. Carefully designed training programs, mentorships, attendance in seminars and scientific conferences are reasonable strategies for enhancing research

capacity at the micro/individual level. Meanwhile, there appears to be very limited empirical studies on science and innovations in the Gambia and its implications for development of the national science system.

5. CONCLUSION

In conclusion, this work evaluated studies on higher education and research and innovation systems from a global perspective and the organization of public science in the developing world. It further reviewed literature on higher education and public sector research in the Gambia and examined in particular government-based agricultural research, higher education and research, health research sector, and context of developing health research system in the Gambia. In this context, contemporary emphasis in literature is on multiple stakeholder partnership approach to research and innovation in a wider context. The underlying notion is that it is important to consider the interests of multiple stakeholders with a variety of perspectives and functions. It is widely recognized, at the public level at least, that a broader approach to research may provide significant economies of scale, knowledge spill over or diffusion, and synergetic interactions. Many organizations and researchers/scholars now realize that a number of important economic and social problems go beyond national boundaries, and that a broader approach to research, than is possible within individual state's projects and resources, can achieve greater results.

In addition, survey of literature on the structure of scientific world in developing countries show that support for research in the region come mainly from external sources. A greater part of the research and development investments in the developing world is located within the National Agricultural Research systems (NARS), and the assumption is that this investment has produced unprecedented results in agricultural productivity over the past two decades. Research capacity and the state of science vary across the region, and even within countries, capacity of research systems is often quite variable, depending on funding, incentive systems, and political support. Existing research suggests that some developing countries especially the middle income countries such as India, China, Thailand, Brazil, Mexico, Argentina and Chile, are actually quite advanced in terms of scientific development (Harris (2004). However, brain drain, low government research funding allocations, lack of critical mass of skilled and competent researchers, unreliable finance, poorly paid and managed staff, weak and unreliable infrastructures, and sometimes lack of security appear to weaken research capacity and outcome in developing countries. Moreover, recent literature on research governance tends to emphasize multi-level governance structures reflecting a shift from the more state centric (or government-centric) governance of research. A similar trend is found in developing countries as evidenced by increasing demand for university autonomy and academic freedom. There is evidence of a shift from state centric to decentralized steering of research in most of West and Central African universities. University research steering in Cameroon, Nigeria, the Gambia and a host of other public sector research institutions in West African reflect hierarchies of competences, though autonomous decision competence remained with institutional management. However, research policy literature in developing countries reveals very limited empirical studies on the effects of research governance on scientific knowledge production, and none using qualitative approaches.

Evidence from literature further demonstrates that the prominent sectors of research in the Gambia are agriculture and health. Apart from university research, which focuses mainly on basic research, there is virtually no evidence in literature of industrial research. Research evidence identifies major developments in agricultural research in the Gambia since year 2000. Compared with many African countries, agricultural research staffs in the Gambia are significantly less qualified. Further, the involvement of the private sector in the Gambia agricultural research and development is minimal, representing 2% of agricultural research staff and spending in 2001 (Stads, Fatajo and Kunjo, 2004). On the other hand, university research activities are beginning to take shape in a context where there are extensive linkages with external institutions as well as collaborative networks involving academics engaged in basic research. On the health sector, literature further reveals that, though the Gambia has developed a national health research system, the system is yet to be firmly rooted. The research program unit at the Directorate of Planning and Information manages and steers research done within the Health Ministry. However, the Medical Research Council, the Gambia unit dominates research activities in this sector. Overall, the state of organization and governance of the scientific world in developing countries including the Gambia warrants further search for answers to problems that hinder scientific knowledge production. Future studies could seek answers to research questions of how policy can be used to shape national science and technology base and what contextual and motivational factors support scientific effectiveness. Meanwhile, the Gambia in pursuit of strategic development goals, must necessarily invest heavily in research and development, wisely choose its research governance model and structures, preferably scientific committee structures, and prioritize the development of its scientific and technological base.

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