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Desafios e Perspetivas

بعث أفريقيا الغد في سياق التحولات المعولمة :

رهانات و آفاق

**Promoting Sustainability and Predicting Tipping Points in Africa:
Suggestion for a Collaborative Initiative via E-Clustering**

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Introduction

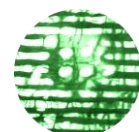
As the great African thinker and avid political activist Cheikh Anta Diop warned and made the clarion call to us about four decades ago,

The enormous progress of science and technology in the 20th century runs the risk of being turned against the development of Africa and black people in general. Science and technology will allow other states to reinforce their power and to be in a better position to continue their domination over the fragmented African states. I'm afraid that in this context, scientific progress, rather than acting in our favor, will work to our detriment, unless we create the social and political conditions for a rational exploitation and utilization of science and technology (quoted in Sertima and Williams, 1986:236).

Indeed, the preceding prophecy by Diop continues to unfold to this day. This paper is part and parcel of my ongoing humble effort to heed Diop's call.

To assert that African countries, like those on other continents, are quite ambitious when it comes to launching development projects is hardly a matter of dispute. The constant challenge, however, has been to ensure the sustainability of many of these projects. The logical question then is the following: How can African countries effectively address the challenge of sustainability? A corollary problem that hampers development in Africa is political instability. Why are some African political regimes suddenly changed, with no obvious trigger other than a slowly changing environment, while others that have the attributes of vulnerability thrive? How can this phenomenon be predicted, so that mechanisms can be put in place to facilitate a political system's stability? In this paper, I suggest two approaches mathematicians working with experts in other disciplines can employ to help address these perplexing challenges and questions. One is Mathematics of Sustainability—i.e. the mathematical modeling of the development and maintenance of “the conditions under which humans and nature can exist in productive harmony, that permit fulfilling the social, economic, and other requirements of present and future generations” (EPA, 2013). The other is Mathematics of Tipping Point—i.e. the mathematical modeling of “the moment when a system suddenly changes state, with no obvious trigger other than a slowly changing environment” (MAA, 2013).

Given the pluridisciplinarity (i.e. the systematic utilization of two or more disciplines or branches of learning to investigate a phenomenon, thereby in turn contributing to those disciplines) of the preceding approaches, it is therefore imperative for mathematicians to work with experts in other disciplines to systematically identify, measure, and analyze those variables and contexts that can yield answers to address the challenges of sustainability and tipping points in Africa. The major issue here then concerns how this collaboration can be accomplished. A

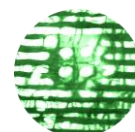


profitable answer is E-Clustering: i.e. the initiation of an economic cluster to network all participants in a value-added chain (Hansen, 2004a). Thus, the rest of this paper is divided into three major sections dealing with the aforementioned approaches and ends with a conclusion based on the discussion in those sections.

Mathematics of Sustainability

As I suggested earlier, the proposition that African countries, like those on other continents, are quite ambitious when it comes to launching development projects is tenable. The constant challenge, as I also state, however, has been to ensure the sustainability of many of these projects. The challenge prompted, to the best of my knowledge, two high-level meetings and two scholarly books to address it. The first meeting was convened by the United Nations on November 21, 2011 at which the organization's Deputy Secretary-General Asha-Rose Migiro emphasized the point that sustainable development is critical for addressing the economic, social and environmental challenges in Africa (United Nations News Centre, 2011). The second meeting was held in Cape Town, South Africa and brought together scientists and lawmakers from across Africa to discuss ways to promote sustainable development in Africa South of the Sahara (Voice of America, 2012). The first book titled *Sustainable Development in Africa* (2005) comprises papers from various contributors suggesting tools from various disciplines to examine factors limiting sustainable development in Africa and making recommendations. The second book, *Chemistry for Sustainable Development in Africa* (2013), entails a series of papers dealing with current chemical research in Africa focusing on environmental chemistry, renewable energies, health and human well-being, food and nutrition, and bioprospecting and commercial development. The major shortcoming with all of these efforts from an African-centered perspective is that they offer no encompassing or indigenous African scientific approach to address the challenge of sustainability in Africa. An answer to the challenge is Mathematics of Sustainability. Before discussing this aspect, it makes sense to first answer the following poignant question: What is all this talk about sustainability?

Each year, we use more and more natural resources to maintain our way of life. Some of these resources are renewable and will never run out while others are fading quickly. Natural gas is slowly fading and efforts are being made to harness other energy sources such as solar, wind and, of course, electricity. Houses are being powered by solar panels, cars by electricity, and businesses by wind. These efforts help to keep our environment safe while also giving us the energy we need to survive. These new sources of energy do not only help us personally and environmentally, but also economically. These new ventures generate new businesses, and they can be quite profitable as well. Governments, different organizations, and numerous corporations are making an effort to provide a sustainable way of life, making the concept of *sustainability*





quite significant right now in science. But, what exactly is sustainability? How do we use it? What purpose does it serve? According to the United States Environmental Protection Agency (EPA),

Sustainability is based on a simple principle: Everything that we need for our survival and well-being depends, either directly or indirectly, on our natural environment. Sustainability creates and maintains the conditions under which humans and nature can exist in productive harmony, that permit fulfilling the social, economic, and other requirements of present and future generations (EPA, 2013).

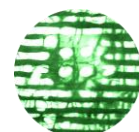
For North Carolina State University (NCSU), the “concept of sustainability centers on a balance of society, economy and environment for current and future health. Responsible resource management in all three areas ensures that future generations will have the resources to survive and thrive” (NCSU, 2013). The NCSU definition adds the economy, while the EPA definition just deals with society and nature living in harmony. Thus, the NCSU definition is more comprehensive by providing us a nexus among society, nature, and economy.

With the broader definition, the fields in which the concept of sustainability is being used can now be discussed. Just looking at the definition, it would seem that sustainability can be used in almost any field, since it deals with society, nature, and the economy. But for the sake of this essay, let us look at the available research. Steve Cohen, director of the Master of Public Administration program in Environmental Studies at Columbia University, has found that there has been much growth in the field of Environmental Studies. As he notes,

One of the most encouraging trends I’ve seen in recent years has been the growth of environmental studies programs in many American Universities. For the past decade I’ve directed an MPA program in Environmental Science and Policy at Columbia University’s School of International and Public Affairs and Earth Institute. Today over 500 graduates of that program are working as environmental professionals all over the world (Cohen, 2012).

Cohen would go on to discuss how the school later launched a program in sustainability Management and also how many other schools are developing sustainability programs.

Kate Galbraith wrote an article for the *New York Times* titled “Sustainability Field Blooms on Campus” (2009), describing how schools are ramping up their sustainability programs to meet the demand in society. Galbraith also discussed how many older individuals are going back to school for jobs in sustainability fields. As she put it,



Mr. Gressens's trajectory will sound familiar at educational institutions across the country, whose continuing education arms have seen influx of students interested in the relatively new field of sustainability. At Harvard's extension school, enrollment in environmental courses has soared by more than 70 percent in two years, according to the university, which has responded with new offerings in fast-changing fields like carbon neutrality and environmental economics (Galbraith, 2009).

Obviously, these institutions realize that this is a fast-growing market and are boosting their programs to meet the needs of society.

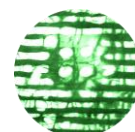
But still, what industries are using sustainability the most? This question leads to an article by Helen Coster in the *Forbes* magazine which listed the top 100 most sustainable companies. The list, which includes companies such as General Electric, H&M, Nokia, and Vodafone, shows that there exists a wide range of industries that use sustainability. With this concept's popularity and the growing threat of damage to our world, more industries and academic institutions are taking sustainability more seriously and really putting their thoughts and money behind how to become more sustainable. As Cohen states,

The challenges of global sustainability are also starting to influence higher education. The liberal arts have begun to reemphasize science, including earth sciences, ecology and environmental biology. The physics and finance of energy production and consumption are of obvious and increasing importance. My own academic field of organizational management is beginning to study the growing importance of the earth's resources in determining organizational effectiveness (Cohen, 2012).

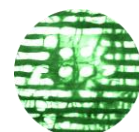
So sustainability is being used in almost every field now and everyone has a feeling of responsibility to society and the earth.

Along with the numerous fields in which sustainability is being used, it is also being employed to study different aspects of life. In essence, sustainability has an almost limitless potential for studying anything: the way we live, the way we do business, the way we go to school, and even the way we deal with other nations. Sustainability is used to study how we impact society, the environment, and the economy, which is mostly how we live in general. In short, sustainability allows us to study the aspects of the way we live our lives.

A number of mathematical models have been used or suggested for measuring sustainability. The following is an inventory of the works in the chronological order in which they were published:



- (a) Amir Abbas Rassafi and Manouchehr Vaziri (2003) use pairwise correlation to examine sustainability in 52 African countries.
- (b) The Global Community WebNet (2004) suggests the use of the Gross Environmental Sustainable Development Index (GESDI), which quantitatively describes quality indicators rather than merely measuring different variables by focusing on the interactions between four major quality systems: (1) people, (2) economic development, (3) environment, and (4) availability of resources.
- (c) Marion Hersh (2006) employs state space system representations, mental models, systems methodologies, optimization, mathematical decision making, multi-criteria problems, multi-criteria decision support methods, and fuzzy set operations to develop models for sustainable development.
- (d) System Analysis Decisions (2009) utilizes a gauging matrix mathematical model to measure sustainable development, which is characterized by two main constituents: (1) security of population (Isec) and (2) quality of their life (Iql). The generalized sustainable development measure is then presented by a quaternary (Q) with an imaginary scalar part $j(Isec)$, which describes the security of people, and a real vector part (Iqf), which describes quality of life in the space with three dimensions: (1) economic (Iec), (2) ecological (Ie), and (3) social-institutional (Is).
- (e) Jason Phillips (2010) applies ideas of coupled environment-human systems to develop a mathematical model of sustainable development.
- (f) Kalu A. Ugwa and A. Agwu (2012) tap difference equations, ordinary differential equations, partial differential equations, optimization modeling, simulation modeling, and function fitting data modeling to develop a mathematical tool for sustainable development in Nigeria.
- (g) George Assaf et al. (2013) suggest life cycle analysis (LCA) that is useful for comparing the impacts of different activities in order to make hard choices for creating a climate-friendly sustainable energy future.
- (h) Colin W. Clark (2013) implements the “logistic” model of population dynamics to measure sustainable resource management.

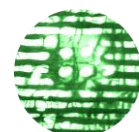


- (i) Charles R. Hadlock (2013) uses differential equations, probability statistics, simulation, evolutionary game theory, and network theory to show how human society can be sustained in a rapidly changing world.
- (j) Mark Alan Hughes and Elise Harrington (2013) show how the mathematics of Greenworks is comprised of baselines, absolute versus relative measurements, and interpolation.
- (k) David Kung (2013) employs numbers, statistics, and functions to demonstrate the connection between social justice and sustainability.
- (l) Fred S. Roberts (2013) calls for the utilization of statistical and algorithmic methods of data analysis, advanced computational tools, and new cryptographic tools to aid us in making management and policy decisions about the electric power grid.
- (m) The Sheward Partnership, LLC (2013) applies the LEED Rating System, which is the internationally-accepted benchmark for high performance green buildings, to calculate return on investment in sustainable design.

The problem with these models from an African-centered perspective is that a majority of them are not indigenous to the continent. The few that have their origins in Africa are not so identified, probably because the authors are oblivious to the fact.

Indeed, the notion of sustainability was quite present in the minds of classic Egyptians. In Egyptian Hieroglyphic, the word *sānkhu* represented the word “peasant,” “sustainer,” or “vivifier” (Budge, 1978:645), meaning to give or bring life to, animate, to make more lively, intense, or striking enliven (<http://www.thefreedictionary.com>). In fact, in the funerary texts of later periods (c. 300 BC), Isis, the goddess of motherhood, magic and fertility (380-362 BC), due to her great power, was considered the mourner, protector and sustainer of the deceased in the afterlife. Isis’ “protective and sustaining roles were extended to nobles and commoners and her power and appeal grew to the point that she eventually eclipsed Osiris (her brother and husband) himself and was venerated by virtually every ancient Egyptian” (<http://egyptian-gods.99k.org/isis.html>).

From Joyce Tyldesley, we also learn that Pharaoh Hatchepsut/Hatshepsut (throne name Maatkare, meaning Foremost of Noble Ladies, 1508-1458 BC), in her effort to ensure sustainability in ancient Egypt, launched a number of bold initiatives. First, Hatchepsut increased

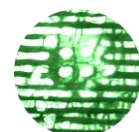


the demand for scribes which led to an expansion of the education system. Second, the Pharaoh poured a lot of money into the building of monuments to ensure that the past is resuscitated and her name lives on forever, which in turn benefited a lot of artists and sculptors (Tyldesley, 1996:39-40). Third, she launched theological and technological advances to make sure that “New Kingdom Egypt remained tied to Middle and Old Kingdom Egypt by an unparalleled continuity of language, religion and artistic/architectural convention, and by the idiosyncratic Egyptian view of the world, and the position of Egypt, her people and her gods within the world, which had remained basically unchanged for over a thousand years” (Tyldesley, 1996:5-6). Fourth, she dreaded uncontrolled chaos, which was by definition a *maat*-less period, and therefore did everything in her power to avoid it by engaging in many international trade and diplomatic ventures (Tyldesley, 1996:8-10). Fifth, she advocated for large number of offspring, especially for the royal family which was plagued by the dearth of children, with sons particularly being in short supply and single daughters being the norm (Tyldesley, 1996:73-74).

In terms of the Mathematics of Sustainability in Africa, Diop teaches us plenty. First, the geometric progression of ratio seven, commonly called the problem on “the inventory of *goods* contained in a house,” and the classical formula for the arithmetic progression, which I mentioned earlier, were invented in ancient Egypt. The mathematical series also invented included the following polygonal numbers (Diop, 1981/1991:270-272):

- (a) trigonal or triangular numbers whose ratio, or difference of terms, is equal to 1
- (b) tetragonal or square numbers such as 1, 4, 9, 16, 25, etc. whose difference in terms is 2, meaning that of the odd numbers 1, 3, 5, 7, 9, etc.
- (c) *gnomons*, or successive rectangular belts, that allow one to obtain all squares from one unit square from the arithmetic series of odd numbers
- (d) summing up of arithmetic progression: $S = \frac{N}{2}[2a + (n - 1)d]$ ⁴⁹

In sum, these are all the elements that led to the “discoveries” of Pythagoras’ theorem. This fact is echoed by Corinna Rossi when she points out that the first unambiguous evidence of the use of the theorem is a Demotic papyrus that dates back to the third century BC on which the numbers involved correspond to three triplets which might have been used as early as the Old Kingdom to construct some pyramids. Rossi observes that this truth is reflected in the insistence of the late Greek sources to link the 3-4-5 triangle to ancient Egypt (Rossi, 2007:64). She goes



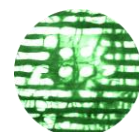
on to also cite the following most quoted passage from Plutarch's *De iside et Osiride* ("His and Osiris") to prove the point:

...the better and more divine nature consists of three elements—what is spiritually intelligible, the material and the element derived from these, which the Greeks call the cosmos. Plato is wont to call what is spiritually intelligible the form and the pattern of the father; and the material he calls the mother, the nurse, and the seat and place of creation, while the fruit of both he calls the offspring and creation. One might suppose that the Egyptians liken the nature of the universe especially to this supremely beautiful of the triangles which Plato also in the Republic seems to have used in devising his wedding figure. That triangle has a vertical of three units of length, a base of four, and an hypotenuse of five, which is equal, when squared, to the squares of the other two sides. The vertical should thus be likened to the male, the base to the female, and the hypotenuse to their offspring; and one should similarly view Osiris as the origin, Isis as the receptive element, and Horus as the perfect achievement. The number three is the first and perfect odd number; four is the square of the even number two; five is analogous partly to the father and partly to the mother, being made up of a triad and a dyad (Rossi, 2007:64).

Second, the following simple equations were invented by classic Egyptians (Diop, 1981/1991:272-274):

- (a) the abstract and symbolic notation of the unknown quantity by assimilating the privileged number 1 for X
- (b) the method of false supposition: A quantity (any) plus $\frac{1}{7}$ of it = 19; in modern algebraic form, A quantity X plus $\frac{1}{7}$ of it = 19; find X
- (c) the simple equation of a more complex form: $X + \frac{2x}{3} - \frac{1}{3}(x + \frac{2x}{3}) = 10$
- (d) the simple complex equation of $\frac{2}{3}$, plus $\frac{1}{10}$ of a number = 10; immediately the equation is written as follows: $(\frac{2}{3} + \frac{1}{10})X = 10$ $X = 13\frac{1}{23}$

Third, classic Egyptians invented the following quadratic equations (Diop, 1981/1991:273-274):



$$\begin{array}{l} \text{I} \quad \begin{cases} X^2 + Y^2 = 100 \\ 4X - 3Y = 0 \end{cases} \\ \text{II} \quad \begin{cases} X^2 + Y^2 = 400 \\ 4X - 3Y = 0 \end{cases} \end{array}$$

The explicit wording of this system of simultaneous equations for the quadratic problem is the following: How to divide 100 into pairs, so that the square root of one of them is $\frac{3}{4}$ that of the other. Stated in modern symbols, the equation reads as follows:

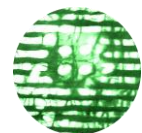
$$X^2 + Y^2 = 100 \rightarrow Y = \frac{3}{4}X \rightarrow X^2 + \frac{9}{16}X^2 = 100$$

Fourth, the balance of quantities (*pesou*) was the invention of classic Egyptians. An example is that if the *pesou* of a loaf of bread is 12, then it means that this loaf of bread contains $\frac{1}{12}$ of a bushel. Also, the sacred right-angled triangle shows that some mathematical proportions had a divine essence. Furthermore, a table found from 2000 BC to 600 AD has a division of the number 2 by the odd numbers from 3 to 101. The table $2/n$ has no error. Even more, the Egyptian notation of fractions of 2200 BC was as follows (Diop, 1981/1991:274):

$$\frac{1}{17} \text{ of a silver talent} = 352 + \frac{1}{2} + \frac{1}{17} + \frac{1}{34} + \frac{1}{52} \text{ drachmas}$$

Finally, in the area of arithmetic, the following three observations by Diop are poignant (1981/1991: 276:276):

- (1) The originality of Egyptian arithmetic is that it does not require any effort of memory. Multiplication and division are reduced to addition after a series of duplication. Only the multiplication by 2 needs to be known in order to easily carry out the most complex calculations.
- (2) Operations on the fractions generally deal with fractions whose numerators equal a unit; however, the Egyptians knew and used also the following complimentary fractions: $\frac{2}{3}$



(frequently used); $\frac{3}{4}$, $\frac{4}{5}$, $\frac{5}{6}$ (less frequently used). Owing to this fact, the Egyptians had made a table of factorization of the fractions of type $\frac{2}{n}$, including the fractions from $\frac{2}{5}$ to $\frac{2}{101}$.

- (3) By the third millennium onward, the Egyptians had already invented decimal notation and discovered or portended the zero. The proportional divisions were known. They knew how to rigorously extract the square root of any number, even fractional ones. All these are evident in the examples dealt with by the Egyptian scribe Ahmes in the *Berlin Papyrus*.

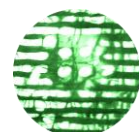
And even more interesting is that, as Diop demonstrates, many Egyptian mathematical terms have survived in the Wolof language (1981/1991:226-228).

It should also be noted here that other scientific areas utilized to promote sustainability in ancient Egypt included (a) Astronomy, encompassing the phases of the moon, the calendar, the orientation of the monuments, and the decans; (b) Medicine, (c) Chemistry, including the etymology of the word chemistry itself and the metallurgy of iron; and (d) Architecture, comprising the mathematical bases and the aesthetic canon of Egyptian art (for more on this, see Diop 1981/1991:278-307).

Mathematics of Tipping Point

As Brett Cherry (2011), the Rensselaer Polytechnic Institute (2011), and Christian Kuehn et al. (2013) assert, the recent political revolutions that took place in Tunisia and Egypt are characteristic of tipping points, as they could result in vast social changes throughout North Africa and the Middle East, and affecting the rest of the world in the process. This conjecture raises at least two related questions that I mentioned earlier: (1) Why are some African political regimes suddenly changed, with no obvious trigger other than a slowly changing environment, while others that have the attributes of vulnerability thrive? (2) How can this phenomenon be predicted, so that mechanisms can be put in place to facilitate a political system's stability? A solution to this dilemma, as I suggested earlier, is Mathematics of Tipping Point.

When thinking of society and everything that happens on a day-to-day basis, when do things break or change? It seems as if life moves at a constant pace, consistently keeping us in a loop. At some point it feels like one small event pushes us over the edge and leads us to a major change that breaks us from this loop. This happens every day in our personal lives, societies, businesses, schools and, especially, our environment. What I am hinting at here is *tipping point*. This relatively new scientific concept seems to be popping up everywhere. But, what exactly is



it? In my attempts to keep things simple, I will use a definition from dictionary.reference.com, which states that tipping point is “the point at which an issue, idea, product, etc. crosses a certain threshold and gains significant momentum, triggered by some minor factor or change; the point in a situation at which a minor development precipitates a crisis” (dictionary.reference.com). There is another definition of tipping point from the Mathematical Association of America (MAA), which states that

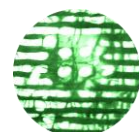
The term “tipping point” describes the moment when a system suddenly changes state, with no obvious trigger other than a slowly changing environment. Tipping points are difficult to predict and difficult to reverse. Examples range from capsizing boats to fishery collapse; they include financial market crashes, the poverty trap, melting polar ice caps, shifts in ecosystems, and mood changes (MAA, 2013).

Like the example I used earlier, tipping point is when a situation like your life has a major change from a minor event in it. Since I used very simple definitions, it is not hard to see how tipping point is used across multiple disciplines or how it is applied in studying numerous phenomena. Malcolm Gladwell wrote a book titled *The Tipping Point: How Little Things Can Make a Big Difference* (2002), and in this book he discusses how he uses tipping point to describe how events take or have taken place in history as follows:

The tipping point is the biography of an idea, and the idea is very simple. It is the best way to understand the emergence of fashion trends, the ebb and flow of crime waves, or, for that matter, the transformation of unknown books into bestsellers, or the rise of teenage smoking, or the phenomena of word of mouth, or any number of the other mysterious changes that mark everyday life is to think of them as epidemics. Ideas and products and messages and behaviors spread just like viruses do (Gladwell, 2002:3).

So Gladwell uses tipping point to examine all academic disciplines, making it a very useful concept for all fields of study. Gladwell also argues that no matter how different the disciplines may be, they can still be explained by using tipping point. For instance, Gladwell cites the rise of hush puppies and the fall of New York’s crime rate as examples:

The second distinguishing characteristic of these two examples is that in both cases little changes had big effects. All of the possible reasons for why New York’s crime rate dropped are changes that happened at the margin; they were incremental changes. The crack trade leveled off. The population got a little older. The police force got a little better. Yet the effect was so dramatic. So too with Hush Puppies. How many kids are we talking about who began wearing the shoes in downtown Manhattan? Twenty? Fifty? One Hundred—at the most? Yet their actions seem to have single handedly started and



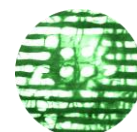
international fashion trend (Gladwell, 2002:3).

This truism has propelled me to come to the conclusion that indeed tipping point can be used in all fields. A profitable question then is the following: Since tipping point can be applied in all fields, how exactly is it being used? To examine how the methodology is being used, I look at the field of Ecology because the environment is a big issue these days and is receiving a lot of attention from scholars, policymakers, and activists. In the Ecology field today, numerous studies are being done to determine how much harm is being done to the environment and how we can reverse these effects and live a more sustainable life. Tipping point is used in these studies to determine what major change will occur from small occurrences. As Jeremy Hance points out,

Even climate change, which some scientists might consider the ultimate tipping point, does not fit the bill, according to the paper. Impacts from climate change, while global, will not be uniform and hence not a tipping point as such; Local and regional ecosystems vary considerably in their responses to climate change, and their regime shifts are therefore likely to vary considerably across the terrestrial biosphere; from a planetary perspective, this diversity in ecosystem responses creates an essentially gradual pattern of change, without any identifiable tipping points (Hance, 2013).

Scientists are using the methodology of tipping point to determine whether or not we will have a great change in our ecosystem. In an MAA article titled “Harnessing Math to Understand Tipping Points” (2013), Mary Lou Zeeman is reported to use mathematics to understand the Earth’s climate. According to the article, “Co-director of the Mathematics and Climate Research Network which connects researchers deploying mathematics to better understand Earth’s climate, Zeeman wants to empower those she teaches to seek solutions to today’s environmental ills” (MAA, 2013:17). Later in the article, Zeeman is noted to have given an example of how small events led to a much bigger change such as how the Earth moved out of its icy state millions of years ago as follows:

Coming back to a question posed earlier in the lecture, Zeeman explained how Earth emerged from the snowball state it evidently occupied 600 million years ago. While volcanoes spewed greenhouse gases into the atmosphere, the planet’s icy blanket prevented these gases from being removed via weathering of rocks or oceanic absorption of carbon. As greenhouse gases increased, the resilience of the stable snowball state decreased until, when it shrunk to nothing, the system tipped. A very hot Earth resulted: all the ice melted, rocks and oceans were exposed,



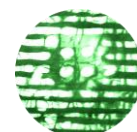
and all those mechanisms for drawing carbon out of the atmosphere [were]...accessible again (MAA, 2013:17).

This example shows how tipping point is used to explain how our world is habitable right now. If tipping point can be used in something as large and serious as climate change and even how our world survived the ice age, then it can be employed to explain relatively minor phenomena such as things that occur in our daily lives or small changes in business.

Indeed, tipping point can be utilized to explore and learn quite a lot about various physical and socioeconomic phenomena, especially the aspect of how things change. How we move from small events to major events and how these events change our lives are pertinent to tipping point. It is used to study changes in crime rates and fashion trends like Gladwell shows us, or in climate change such as Zeeman shows us. By using the Mathematics of tipping point and Sustainability together, we can find a better way to promote Africa's development. Also, by studying numerous fields across the board with these methodologies, we will have a better understanding of each other's disciplines, which will in turn give us a better understanding of each other's thoughts. The pace of our world is rapidly increasing with the advancement in technology. It is therefore imperative to have methodologies such as tipping point and sustainability to help us understand our world and how cataclysmic events come about.

To determine whether or not accurate mathematical representations of physical or socioeconomic systems display tipping point behavior, bifurcation analysis is employed. As I recount in my book titled *African Mathematics: From Bones to Computers* (2012:121-125), while mathematicians are generally consistent in defining the term "first order differential equation," this is not the case for the term "Bifurcation." Instead, they tend to view Bifurcation as a description of certain phenomena. A common perception is that a system undergoes a bifurcation if and only if the global behavior of the system, which depends on a parameter, changes when the parameter varies. Consequently, a general and a theoretical definition of Bifurcation can be delineated.

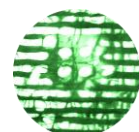
Bifurcation can be generally defined as a differential equation system that undergoes a qualitative change in its orbit structure, as one or more parameters of the dynamical system are changed. A Bifurcation is said to occur when a small smooth change made to the parameter values, or the Bifurcation parameters, of a system causes a sudden qualitative or topological change in its short-term dynamical behavior. Bifurcations result in both continuous systems, described as ordinary differential equations (ODEs), delay differential equations (DDEs), and partial differential equations (PDEs); and discrete systems, described by maps.



Theoretically, Bifurcations can be defined as the mathematical study of changes in the qualitative or topological structure of the integral curves of a vector field, or the solutions of a differential equation. Essentially, a Bifurcation is said to occur at a parameter value where a number of solutions changes. In essence, Bifurcation Theory examines structurally unstable dynamical systems. Dynamic stability refers to perturbations in the phase space—i.e. the stability of fixed points and limit cycles; and structural stability refers to perturbations in the function space—i.e. the topological stability of orbit structures.

Bifurcations have been typologized in two ways. One typology, which is less technical, identifies three types of Bifurcations: (1) Subtle Bifurcations, whereby an attractor changes type; (2) Catastrophic Bifurcations, whereby attractors appear out of, or disappear into, the blue; and (3) Explosive Bifurcations, whereby attractors drastically change size. The other typology, which is more technical, identifies two types of Bifurcations: (1) Local Bifurcations that take place through changes in the local stability properties of the equilibria (i.e. fixed points), periodic orbits, or other invariant sets as parameters cross through critical thresholds; and (2) Global Bifurcations that take place when larger invariant sets of a system collide with one another, or with equilibria of a system. These Bifurcations cannot be detected purely by a stability analysis of the equilibria. Since the second typology is predominantly employed in Mathematics, a bit more discussion of their characteristics is in order.

A Local Bifurcation emerges when a parameter change causes the stability of an equilibrium to change. In continuous systems, this corresponds to the real part of an eigenvalue of an equilibrium passing through zero; in discrete systems, this corresponds to a fixed point having a Floquet Multiplier (relating to the class of solutions to linear differential equations) with modulus equal to one. In both cases, the equilibrium is non-hyperbolic at the Bifurcation Point (more on this later). The topological changes in the phase portrait of the system can be confined to arbitrarily small neighborhoods of the bifurcating fixed points by moving the Bifurcation parameter close to the Bifurcation Point—thus, the name “local.”



Technically, the continuous dynamical system described by the ODE is considered as follows:

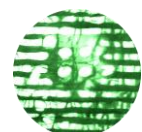
$$\dot{X} = f(x, \lambda) \quad f: \mathbb{R}^n \times \mathbb{R} \rightarrow \mathbb{R}^n$$

A Local Bifurcation emerges at (x_0, λ_0) , if the Jacobian Matrix df_{x_0, λ_0} has an eigenvalue with zero real part. If the eigenvalue is equal to zero, the Bifurcation is said to be a steady state Bifurcation; if the eigenvalue is non-zero, but purely imaginary, then it is said to be a Hopf Bifurcation (more on this later). For discrete dynamical systems, the following system is considered:

$$X_{n+1} = f(X_n, \lambda).$$

Consequently, a Local Bifurcation emerges at (x_0, λ_0) , if the Jacobian Matrix df_{x_0, λ_0} has an eigenvalue with modulus equal to one. If the eigenvalue is equal to one, the Bifurcation is either a Saddle-node—often called Fold Bifurcation when it appears in maps, Transcritical or Pitchfork Bifurcation. If the eigenvalue is equal to -1, it is a Period-doubling (or Flip) Bifurcation; otherwise, it is a Hopf Bifurcation. The following are examples of Local Bifurcations:

- (a) Hopf Bifurcation—a Bifurcation in which a fixed point of a dynamical system loses stability as a pair of complex conjugate eigenvalues of the linearization around the fixed point cross the imaginary axis of the complex plane.
- (b) Horse Saddle Bifurcation—a saddle point that is a minimax: i.e. a local minimum of maximum depending on the intersecting plane used.
- (c) Monkey Saddle Bifurcation—an example of an immersion, it is a surface defined by the equation to which it belongs to the class of saddle surface, and its name derives from the observation that a saddle for a monkey requires three depressions: two for the legs and one for the tail.
- (d) Neimark (Secondary Hopf) Bifurcation—a Bifurcation through which a system loses its stable period one operation.
- (e) Period-doubling (Flip) Bifurcation—a Bifurcation in which the system switches to a new behavior with twice the period of the original system.
- (f) Pitchfork Bifurcation—a generic Bifurcation in which a symmetric solution changes its stability; it occurs generically in systems with symmetry.



- (g) Saddle-node Bifurcation—a Bifurcation in which two fixed points of a dynamical system collide and annihilate each other.
- (h) Transcritical Bifurcation—a Bifurcation characterized by an equilibrium having an eigenvalue whose real part passes through zero.

A Global Bifurcation emerges when “larger” invariant sets, such as periodic orbits, collide with equilibria. Such a collision leads to changes in the topology of the trajectories in the phase space which cannot be confined to a small neighborhood, as is the case with Local Bifurcations. The changes in topology extend out to an arbitrarily large distance—hence, the name “global.” The following are examples of Global Bifurcations:

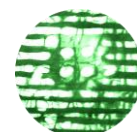
- (a) Blue Sky Catastrophe, when a limit cycle collides with a nonhyperbolic cycle.
- (b) Global Saddle (Fold) Bifurcation, when a system is expressed in polar coordinates.
- (c) Harmoclinic Bifurcation, when a limit cycle collides with a saddle point.
- (d) Heteroclinic Bifurcation, when a limit cycle collides with two or more saddle points.
- (e) Infinite-period Bifurcation, when a stable node and saddle point simultaneously occur on a limit cycle.

It should be noted that Global Bifurcations can also involve more complex sets such as chaotic attractors.

The codimension of a Bifurcation refers to the number of parameters which must be varied for the Bifurcation to emerge. This corresponds to the codimension of the parameter set for which the Bifurcation emerges within the full space of parameters. Saddle-node Bifurcations are the only generic Local Bifurcations which are really codimension-one; the others all have higher codimension. Nonetheless, Transcritical and Pitchfork Bifurcations are also often perceived to be codimension-one, because the normal forms can be written with only one parameter.

An example of a well-studied codimension-two Bifurcation is the Bogdanov-Takens bifurcation, which is characterized by the fact that for the particular parameter value the vector field has a singularity whose linearized field has a double zero eigenvalue, while the other eigenvalues have nonzero real part. The latter condition is imperative.

The Bifurcation Diagram is a very useful tool employed to illustrate Bifurcations. It helps to show the possible long-term values—equilibria or periodic orbits—of a system function of a



Bifurcation parameter in a dynamical system. It is normal practice to show stable solutions with a solid line and unstable solutions with a dotted line.

Named after their pioneer, Mitchell Feigenbaum, the Feigenbaum Constants are two mathematical constants used to express ratios in a Bifurcation Diagram. The first Feigenbaum Constant is expressed as follows:

$$\delta = 4.66920160910299067185320328\dots$$

where sequence A006890 in the On-line Encyclopedia of Integer Sequences (OEIS) is the limiting ratio of each bifurcation interval to the next, or between the diameters of successive circles on the real axis of the Mandelbrot set. While Feigenbaum originally related this number to the Period-doubling Bifurcations in the logistic map, he later showed it to hold for all one-dimensional maps with a single quadratic maximum. As a result of this generality, every chaotic system that corresponds to this description will bifurcate at the same rate. This Feigenbaum's constant is often employed to predict when chaos will arise in such systems even before it does. The second Feigenbaum Constant (sequence A006891 in the OEIS),

$$\alpha = 2.50290787509589282283902873218\dots$$

is the ratio between the width of a tine and the width of one of its two subtines (with the exception of the tine closest to the fold).

Both of the preceding numbers are applicable to a large class of dynamical systems. They are believed to be transcendental, albeit that claim remains to be proven.

Finally, Catastrophe Theory (which is also a special case of more general Singularity Theory in Geometry) considers the special case in the study of dynamical systems where the long-run stable equilibrium can be identified with the minimum of a smooth, well-defined potential function called Lyapunov Function. Since small changes in certain parameters of a nonlinear system can cause equilibria to appear or disappear, or to change from attracting to repelling and vice versa, this can lead to large and sudden changes of the behavior of a system. Investigated in a larger parameter space, Catastrophe Theory reveals that such Bifurcation points tend to occur as part of well-defined qualitative geometrical structures. Other aspects of Catastrophe Theory include Elementary Catastrophes, the potential functions of one active variable (Fold Catastrophe, Cusp Catastrophe, Swallowtail Catastrophe, and Butterfly Catastrophe), potential functions of two active variables (Hyperbolic Umbilic Catastrophe, Elliptic Umbilic Catastrophe, and Parabolic Umbilic Catastrophe) and Arnold's notation, which are beyond the scope of this paper.



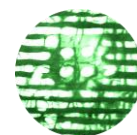
As I also discuss in *African Mathematics: From Bones to Computers*, mathematical aspects of Bifurcations are ubiquitous in ancient Egyptian artefacts. Indeed, classic Egyptians were quite involved with symbolism. Thus, their artefacts were designed and aligned cosmologically. The cosmological, astronomical, astrophysical, astrological and mathematical abilities of classic Egyptians were highly organized and quite advanced, and they performed truly remarkable feats of urban planning and architecture (Bangura, 2012:125).

For example, in their work on Auric Time Scale, Sergey Smelyakov, Geoff Stray and Jan Wicherink (2006a & 2006b) assert that in terms of proportions, the scale is reflected in the artefacts of Egypt. According to them, the Auric Time Scale I with the radix ϕ not only describes the crucial epochs in the known history of the Earth and humanity, it also adequately reflects the spectrum of the basic periods of Nature and society, including the geological and Solar activity cycles and artefacts of Egypt. In essence, embedded in Egyptian artefacts are representations of those events that have their impact on worldly events.

In order to get a sense of the connection between Egyptian artefacts and Bifurcations, it makes sense to quote verbatim what Smelyakov and his colleagues mean by Auric Time Scale. According to them, “In the narrow sense, the Auric Time Scale (ATS) is the series G of the Golden section powers (infinite to both ends), which is accompanied by the series $G^* = 2G$ of its double values; for its unity, $\phi^0 = 1$ the average Solar cycle length $T_0 = 11.07$ year, or Tropical year is taken” (Smelyakov et al., 2006a:1). They add that “In the broad sense, the ATS is a theory suggesting that for both principal aspects of time (periods and chronology), these series, T and T^* , describe the length of the bulk of the basic periods in nature and society, and the major part of the most important historical and natural events in the evolutionary context, respectively” (Smelyakov et al., 2006a:1). I examine two examples of early Egyptian artefacts with aspects of Bifurcation in detail in *African Mathematics: From Bones to Computers*: (1) ancient Egyptian calendars and (2) the pyramid texts of Set (Seth, Seti, Setekh, Setesh, Suty, Sutekh) of Nubet (Bangura, 2012:126-144).

E-clustering

This section shows how E-clustering can be used to tap into the vast amount of resources available from African and African-Diaspora institutions of higher education, scholars and researchers to engage in sustainability and tipping point work. It begins with a review of the three interrelated attributes of E-clustering: (1) the importance of times-technologies—i.e. telecommunication, information technology, multimedia, entertainment, and security technologies that support networking; (2) the concept of cluster-building; and (3) the cluster strategy. After that, an E-clustering strategy for utilizing African and African-Diaspora institutions of higher education, scholars and researchers is suggested. Before doing all this,



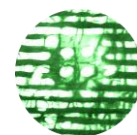
however, it behooves me to note that the scientific notion of “clustering” is not new, although “E-clustering” is.

Scientific clustering emerged as an important statistical application in the early 1980s as researchers studying similarly situated entities employed the Cluster Analysis methodology: a number of techniques that are utilized to create a classification. A clustering method is a multivariate statistical procedure that empirically forms “clusters” or groups of highly similar entities. It starts with a dataset containing information about a sample of entities and attempts to reorganize these entities into relatively homogenous “clusters” or groups (Aldenderfer and Blashfield, 1984:7).

E-clustering, according to Ute Hansen (2004a), is an economic approach based on the concept of “cluster-building.” In this case, an economic cluster initiates the networking of all participants in a value-added chain. The objective is to bundle the potentials and competences for increasing the innovation power and competitiveness of the partners in a cluster. Given Internet technology, even business and government networking in rural areas can obtain a driving force. Internet technologies such as infrastructure, applications, platforms, and broadband can enable the business processes among companies, academic institutions, research institutes and governments to be networked. E-business and E-government/E-administration cause fundamental structural changes of the private and public sectors. Given this reality, there is a need for economic and technology policy. This need is taken into account in E-clustering. The partners in an E-cluster can be networked by processes that are more standardized and so able to be supported by online applications. The E-cluster will require a central infrastructure and services. Knowledge management, E-learning, E-marketplaces, personnel management and E-government will be the main processes and services of an E-cluster.

As a side note, it must be acknowledged that there is some tension between many Africans on the continent and those in the Diaspora due to perceived suspicions. Africans on the continent see their brothers and sisters in the Diaspora having an interest in Africa only for their own self-interests, while those in the Diaspora perceive those on the continent of trying to keep them out because they are afraid of the competition they might present. Whether or not these suspicions are founded, it is now quite obvious that both groups must work together if they are to overcome their marginalization in the global arena. This is the reality that undergirds the renewed calls for a Pan-African Union, the African Renaissance and other initiatives. It is also this reality that underlies this essay.

Thus, I draw from a series of six papers (2004a, 2004b, 2005a, 2005b, 2006a, 2006b) by Ute Hansen of the Ministry of Economic Affairs, Employment and Transport of the State of Schleswig-Holstein in the Federal Republic of Germany who developed E-clustering as an



innovative approach for economic policy. The three interrelated attributes of this approach mentioned earlier are described in the following subsections.

The Importance of Times-technologies for an Innovative Economic Policy

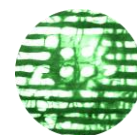
According to Hansen, times-markets (i.e. a wide range of instruments that cluster the volatility of markets and time periods) comprise a major mechanism for the transformation from industrial to information society. Developing rapidly and causing innovations in all industries, times-technologies can be an accelerator for the economic and technological development of a region. The digitization and networking precipitated by the development of broadband infrastructure and applications can push the convergence of different media: information technology and telecommunications industries. Changing business processes, new integrated value-added chains, different organizational structures and innovative products will spur increased employment and economic growth.

The strategy of an economic and technology policy that focuses on clusters ensures innovation, growth and employment in a region. Times-cluster (reports of field clustering that occur during the same time) performs two important functions for the processes of innovation. The first function is that due to cross-function technologies, times-cluster accelerates innovation and, thus, the technological and economic development of the application-clusters like life sciences and tourism. The second function is that time-cluster itself is an application-cluster. These functions of times-cluster provide a great potential for innovation and growth for a region to become economically competitive and dynamic. The realization of the strategic E-clustering strategy can lead to an interlocking of the regional times-cluster policy and user-cluster policy.

The Cluster-building Concept

Hansen points out that the goal of a policy that is geared towards cluster-building is to support regional networks of competitive and cooperative actors in a cluster. An economic cluster initiates and pushes the networking of all participants in a value-added chain, which are companies, institutions such as universities and research institutes, customers, suppliers, employees, representatives of interest groups, and the public sector. A cluster consists of independent organizations that strive for economic growth and efficiency. In accordance with the concept of cluster-building, it is the intensity of the interaction of the actors, not the individual actors, that has a positive effect on the competitiveness of a regional cluster.

The focus of cluster analysis then is the regional or geographic agglomeration of networked organizations and individuals. Efficiency and specialization are derived because the geographic concentration of firms in internationally successful industries often occurs as the influence of the individual determinants in the “diamond” and their mutual reinforcement are



heightened by the close geographic proximity within a region. A concentration of rivals, customers, and suppliers will promote efficiencies and specialization. Even more important is the influence of geographic concentration on improvement and innovation.

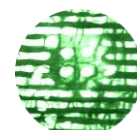
The cluster-building concept inherits a new dimension because the innovative time-technologies provide new technological possibilities to support the process of cluster-building. Independent of time and location, the actors of a cluster are able to take part in information, communication and transaction processes with internal and external partners of a cluster. The ability of a cluster to be competitive hinges upon its capacity to digitalize the internal cluster processes and the processes among different clusters. Thus, the competitive advantages of a regional and local cluster-building are enforced by the digitalization of the cluster processes. The concept of local and geographic clustering has to be extended by the E-clustering concept.

A paradox concerning regional clustering and the process of globalization implicitly undergird the E-clustering approach. Since the classical factors of production are now more accessible due to globalization, competitive advantage in advanced industries is increasingly determined by differential knowledge, skills, and rates of innovation that are embodied in skilled people and organizational routines. The development of skills and the important influences on the rate of improvement and innovation have become local. The paradox is that as global competition becomes more open, the home base becomes more, not less, significant.

Processes of knowledge management and learning are increasingly being supported by information and communication technology (ICT). As a result, the competitiveness of a regional cluster in the global market will depend on the extent to which the cluster specific process of knowledge management and learning are standardized and digitized. Employing E-knowledge management and E-learning applications will allow the cluster to concentrate on the cluster specific and regional competitive factors described in the paradox of regional clustering and the process of globalization.

An E-clustering approach of a regional economic and technological policy means, on the one hand, a digitized network of the actors of a process-oriented cluster organization and, on the other hand, a digitized network of different clusters. Consequently, distinction should be made between internal and external processes.

A cluster is characterized by a critical mass of actors in a value-added chain that can be focused on technology, processes, or industries. Thus, E-clusters will yield the following positive effects: (a) accelerate the distribution of knowledge, (b) reduce transaction costs, (c) provide for an infrastructure, (d) produce economies of scale, (e) cause external economies, (f) produce



economies of specialization, (g) stimulate competition and cooperation, and (h) enforce the internationalization of the economic and cluster-specific relations.

The focus of a cluster policy then is the potential growth of a regional cluster. The acceleration of the innovation processes fostered by cooperation and competition leads to increased employment and growth in the region. An all-embracing cluster has to take into account and to balance out business, economic, technological, employment and educational objectives in order for a management instrument to be applied that meets these requirements. Robert S. Kaplan and David P. Norton's "balanced scorecard" (1996) is a management instrument that can be applied to delineate a concept for a comprehensive cluster strategy. The outcome will be a strategic frame for E-clustering that is transferable to all regional cluster initiatives or strategies.

The E-clustering Strategy

Hansen identifies four major characteristics of E-clustering strategy. The first characteristic is the use of a balanced scorecard as a strategic instrument—i.e. a strategic management system that, on the one hand, is appropriate to evaluate a strategy and, on the other hand, has its main function during the realization of the strategy. The balanced scorecard depends strictly on times-supported processes. A cluster organized by these particular processes is imperative for the application of the balanced scorecard to develop a cluster strategy. The balanced scorecard concept is therefore based on the assumption that managers of the public and private sectors have visions and have also developed a mission and a cluster strategy. The process of developing a scorecard proceeds in the following seven stages:

Stage 1: Evaluation of the strategy by taking the vision and mission into account

Stage 2: Deduction of the strategic objectives

Stage 3: Connection of the strategic objectives

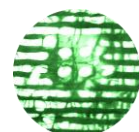
Stage 4: Determination of the measured values

Stage 5: Determination of the assigned values

Stage 6: Determination of the strategic activities

Stage 7: Interconnection with the operational planning

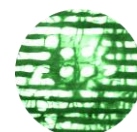
The strategic objectives are linked to measured values with a long-term focus. To realize the objectives and measured values, strategic activities must be planned. In addition, milestones



that have to ensure the connection between strategy and the operational plan must be specified. Thus, the balanced scorecard must entail a vision, a mission, a strategy, perspectives, objectives, activities, measured values, and a cause-effect-chain.

The second characteristic entails the vision, mission and strategy, which must be integrated into the objectives of the regional economic policy. The goal is to maximize the welfare objectives concerning stability, growth, structure, and distribution. The economic policy should always be geared towards innovation, growth, and employment. In order to develop the model of a cluster policy, a vision, a mission, and a strategy are needed. The model serves as the starting point for the conception of the E-clustering balanced scorecard. It is the first step in the dynamic strategic process: i.e. the scorecard process. Cluster actors must therefore participate in the scorecard process because all results, like the model, have to be accepted by the whole cluster.

The third characteristic is about the perspectives of an E-cluster, which are needed to establish a balanced system of objectives and measured values that are necessary to develop a comprehensive strategy. An E-cluster in its formative phase should develop five interrelated perspectives. The first is the economic perspective of an E-cluster, which represents the final output produced by all economic cluster activities. The decisive goal is to improve the economic output and, thus, the gross value-added. The second is the partner and cooperation perspective, which is immensely essential for the cluster strategy. The cluster actors, particularly the companies, the universities, the research institutes, and the public institutions, should organize themselves in network and in cooperation in order to bundle and, therefore, increase their potentials and competences. The third is the cluster perspective, which entails the internal and cluster overlapping processes that are critical for the successful market position of the cluster. The collaborative processes are part and parcel of the main E-cluster processes. Innovation, knowledge management, learning and government/public processes are used to illustrate the perspective processes of the cluster strategy. The fourth is the improvement and development perspective, which focuses on activities and measured values that represent, on the one hand, the improvement and development of competencies of the cluster actors and, on the other hand, the optimal application of times-technologies in the cluster processes. This strategic perspective is oriented towards the growth of the cluster because the human capital and the times-technologies are vital motors for innovation. The main processes of the cluster are collaborative processes that can be supported by times-technologies that will generate a benefit for the cluster actors and for the cluster as a whole. These processes include (a) E-innovation in which companies, research institutes, universities, and government participate; (b) E-knowledge management and learning through which the processes and contents of knowledge management and learning are digitized so that the cluster actors could use them on demand at any time and from anywhere; and (c) E-



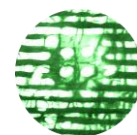
government through which strategies are realized with the objective to organize public services as processes and to support them with times-technologies. The fifth is the organization and policy perspective which is concerned with the objectives and activities of the cluster management and the cluster policy. During the formative stage of the development of a cluster, it is imperative to integrate the organization and policy perspective in the balanced scorecard.

The final characteristic is the cause-effect-chain, which must be developed because its assumptions concern the perspectives' overlapping effects that must be controlled and evaluated. The objective is to determine whether the assumptions about the effects are valid. The following questions must be raised and probed: How is cooperation influenced by the funding activities of the public sector? Is the influence of the cooperation within the cluster on the innovation processes of a cluster significant? Which effects on the gross value-added and the employment are to be expected? Cause-effect-chains of the balanced scorecard are all based on assumptions concerning the dependencies of objectives and measured values. A controlling and, if necessary, an adaptation of the balanced scorecard are needed to empirically test the assumptions. To produce reliable assertions with the instrument of the cause-effect-chain, statistical methods must be applied.

African and African-Diaspora Education and Research-cluster

What I suggest here is a prototype E-cluster that would enable various educational and research entities/actors in Africa and the African Diaspora manage critical aspects of their operations from a single interface. The African and African-Diaspora Education and Research-cluster, henceforth AADER-cluster, aims to identify some possible solutions to sustain and support education and research in Africa and its Diaspora. Thus, the E-cluster entails tools designed to pull down geographical distances and facilitate information and knowledge sharing. The general key elements are (a) geographical concentration, (b) specialization, (c) multiples actors, and (d) critical mass. The main challenges for the AADER-cluster are globalization and dematerialization, both of which call for radical redefinitions of physical proximity (local or global) and cultural identity (new or old). These developments have created the need for social or indigenous knowledge preservation while at the same being open to internationalization.

I recommend three project steps. The first step is to set up a model of the E-cluster and test it. The second step is to implement the model, and I suggest the use of action research methodology: i.e. research that involves the active participation or inclusion of groups under study (for more on this technique, see, for example, Bangura and McCandless, 2007). The final step is to evaluate the outcomes of the model in order to be able to replicate it in similar circumstances.

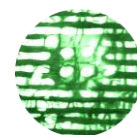


As represented in Figure 1, I identify three potential clusters that can be digitized into a network for the AADER-clustering strategy: (1) Institutions of Higher Education, (2) Research Institutes, and (3) Scholars. The following subsections entail descriptions of these clusters.

Institutions of Higher Education Cluster

The Association of African Universities (AAU), the International Association of Universities (IAU) and the United Nations Educational, Scientific and Cultural Organization (UNESCO) *Guide to Higher Education in Africa* (2007) entails entries for over 900 institutions of higher education, university and non-university level, in 47 African countries. It provides background information on the countries' educational systems, admissions and graduation requirements or qualifications, and higher education agencies.

In almost every African nation, however, there is dissatisfaction with the performance of the higher education system. Universities and colleges are characterized by frequently failing administrations, incessant strikes, wage crises, poor standards, and student violence. When the idea of privatizing higher education gained prominence in the mid-1980s, it seemed to be the ideal answer to the malaise that affects the university systems. The idea was quite simple: privatizing academic institutions will lead to efficient and improved academic systems. Privatization is defined as a situation whereby "governments divest themselves of functions by transferring them to private voluntary organizations or allowing them to be performed by the private sector" (Rondinelli et al., 1990:128). Africa's privatization initiatives in higher education are of two types: (1) full privatization, whereby a government provides no funds to an institution; and (2) partial privatization, whereby a government provides part of the funding of an institution and the rest is provided by the private sector. Believers in the free market felt that privatization was the panacea to the dissatisfaction with the performance of Africa's higher education institutions, since it provided a system of free choice in the educational world analogous to the market system in the economic world. The appeal of privatizing higher education was that the move would encourage competition, which would thereby shake up the educational systems and force them to be more attentive to the diverse needs that the systems should satisfy. In short, privatization appeared to be the economist's ideal answer to a complex question.



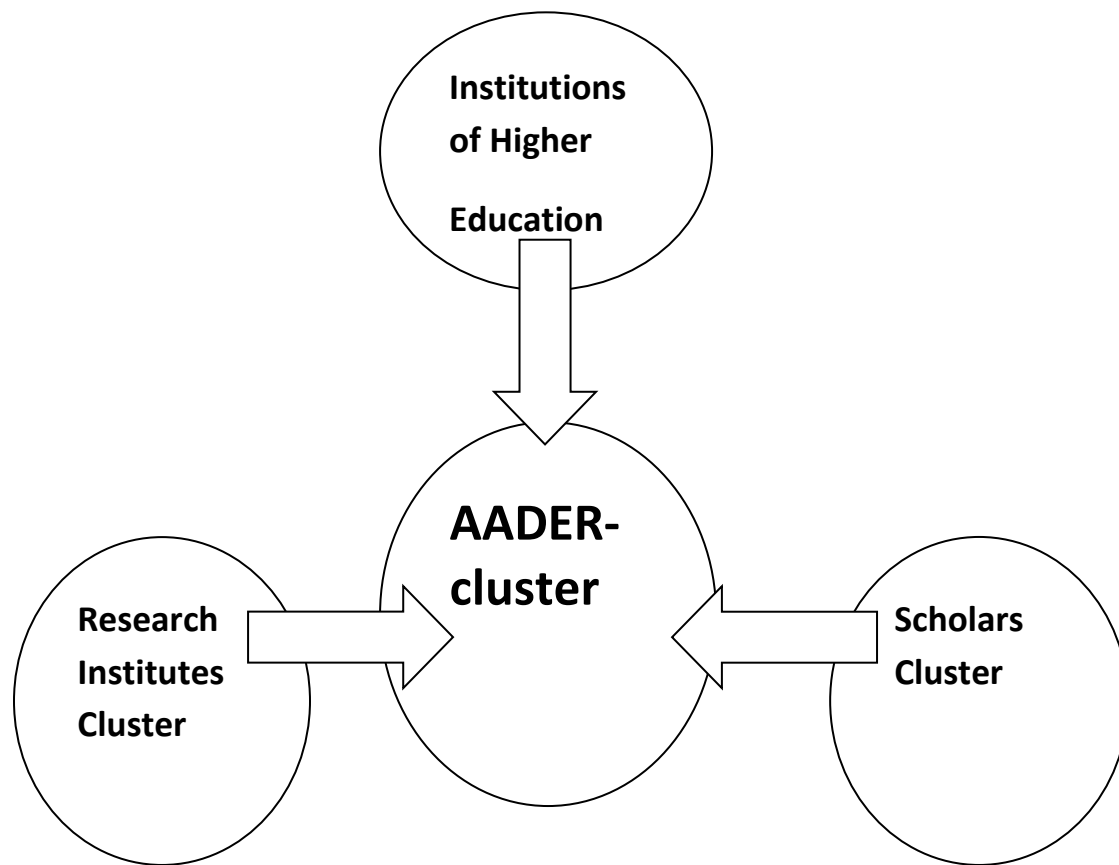
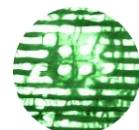


Figure 1: AADER-clustering Strategy

Joel Samoff and Bidemi Carrol (2004a) note that the higher education private sector in Africa is small but growing. In countries where private institutions exist, they include universities, specialty colleges, open universities, distance learning institutions, and more. Providers of private higher education include religious institutions, private companies, nongovernmental organizations, and extensions and private universities overseas. With a few exceptions, most of the private institutions are teaching institutions specializing in particular fields, and their funding approach focuses on student fees. Some of the overseas institutions that once participated in the launching of African universities are now directly competing with those universities for students and public resources (Samoff and Carrol, 2004a:110-111).

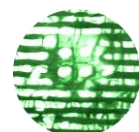
Another major aspect concerning privatization initiatives in Africa's higher education is the role of international financial institutions. In another study by Samoff and Carrol (2004b), they



demonstrate the changing agenda and consequences of the World Bank as an example of the role of international financial institutions in Africa's higher education. They note that in the early 1960s, the bank's agenda was clear, as it sought to help Africa develop the specific skills that African countries needed. Human development, couched within the concept of "manpower planning," was to be higher education's major mission. This high priority objective called for the investment of significant public resources in higher education. Within a decade, note Samoff and Carrol, that independence era perspective of the bank began to change. The bank's position was that since university graduates could expect substantial individual personal benefits, public expenditures on higher education, particularly student accommodation, meals, transport, and stipend, investment in higher education was not a contribution to national development but a misdirection of resources. Employing rate of return analysis as the assessment tool of choice, the bank showed that African societies could benefit more by investing in basic education. The agenda pushed was for universities and other institutions of higher education to reduce per-student costs, substantially increase student fees, and privatize. By the 1990s, Samoff and Carrol point out, severe deterioration of higher education institutions, African insistence on a holistic perspective to the development of the education sector, and fascination with the knowledge era all combined to force another policy reversal. The new agenda insists that student fees and privatization should continue, but notes that since knowledge has emerged as the most important factor of production, higher education has a special role and once again should receive significant public support and funding. As dependence has become a fact of life for many African countries, these nations' universities are scrambling to fit the new agenda and secure the resources with it and at the same time seek to preserve some autonomy of action in the face of strong national and international constraints.

But the privatization schemes have met storms of protest from inside and outside the establishments all across Africa. Professors view it as a way of union busting, administrators are afraid that they would lose control over budgets and appointments, and students whose parents cannot afford to pay college tuition are afraid of being left to relatively deteriorating academic institutions. Moreover, while privatization provides freedom of choice, it also destroys the egalitarian principles of education since rich parents could send their children to more expensive schools while poor parents could not. Consequently, the simple economics of the privatization schemes have been placed in direct confrontation with the political economy of the higher education systems, reflecting vested interests and views of groups that saw their values threatened.

Still, in the face of widespread opposition, the idea of privatization has persisted and has led African governments to embrace it. Nonetheless, since higher education systems usually are intransigent in their opposition, governments have found it difficult to implement the idea fully.



Thus, whether one evaluates privatization of higher education in Africa as a success or a failure, it will show how the simple economics of choice applied to an institutional structure can be modified by the realities of political economy, in which vested interests alter the way the market is permitted to work.

In essence, under a system of educational privatization, competition will cause a larger variety of educational environments to exist. If public universities and colleges are allowed to co-exist with private academic institutions, public institutions would have to provide services of equal quality to those of private ones. Not surprisingly, officials of public institutions have routinely fought the implementation of privatization systems.

Furthermore, several major aspects account for the undercurrent of globalization and internationalization in Africa's higher education. To begin with, the theoretical and policy implications of globalization in the continent's higher education systems require a broader context in investigating the educational and development goals of the various states. This means that analysts must go beyond the narrow market perspective and factor in the broadest socio-cultural and political dimensions of the phenomenon. Next, even though proponents of globalization and structural adjustment programs (SAPs) continue to insist on a minimal state, Africans must be equally united in insisting on their relevance in shaping and providing the contexts for social development. Moreover, Africans must realize that development continues to be a contested process; thus, they must be united in insisting that the implicit proposition of homogenizing both policy and outcomes within globalization is untenable.

A higher education cluster will promote inter-exchange, contact and cooperation among higher education institutions in Africa and its Diaspora; collect, classify and disseminate information on higher education and research; promote cooperation among academic institutions in curriculum development and in the determination of equivalent degrees; encourage increased contacts between Africans and the international academic world; study and make known the educational and related needs of African institutions and, as far as possible, to coordinate the means whereby those needs may be met; encourage the development of wider use of African languages; and organize, encourage and support seminars and conferences among African faculty members, administrators, students and others dealing with problems of higher education in the continent and the Diaspora. In essence, this cluster will serve as the apex and principal means for consultation, exchange of information and cooperation among the universities and other higher education institutions in Africa and its Diaspora. The major question here then is the following: What are the potentials of the African-Diaspora institutions of higher education?

The potential for strong academic collaboration between African institutions of higher education and their counterparts in the African Diaspora hinges on Historically Black Colleges



and Universities (HBCUs). These are institutions founded primarily for the education of African Americans, although their charters were not exclusionary. Most HBCUs are 50 to 100 years old; the oldest HBCU dates back to 1837. Of the 105 HBCUs, 17 have land-grant status. About 214,000 or 16 percent of all African American higher education students in the United States are enrolled at HBCUs, which comprise three percent of all colleges and universities nation-wide (US Department of the Interior, 2010). As shown in Table 1, a majority of the HBCUs are four-year public and private institutions.

Of the 105 HBCU institutions in America today, 27 offer doctoral programs and 52 provide graduate degree programs at the Master's level. At the undergraduate level, 83 of the HBCUs offer a Bachelor's degree program and 38 of these schools offer associate degrees (American School Search, 2010).

HBCUs enjoy a presidential executive order that was inaugurated in 1980 by President Jimmy Carter when he signed Executive Order 12232, which established a federal program "... to overcome the effects of discriminatory treatment and to strengthen and expand the capacity of historically black colleges and universities to provide quality education." The order has been reauthorized by every President since Jimmy Carter. By the authority vested in the President by the Constitution and the laws of the United States of America, the order was initiated to advance the development of the nation's full human potential and to advance equal opportunity in higher education, strengthen the capacity of HBCUs to provide the highest quality education, increase opportunities for these institutions to participate in and benefit from Federal programs, and ensure that the United States has the highest proportion of college graduates in the world by the year 2020 (The White House. 2010).

Table 1: Summary of Interesting Facts About HBCUs

Type Institution	No. of Institutions Per Type	Percent of Total HBCUs
4-Year Public	40	38.09%
4-Year Private	49	46.66%
2-Year Public	11	10.48%



2-Year Private	5	4.76%
Total	105	100%

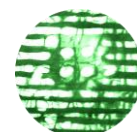
Source: US Department of the Interior, 2010.

There is established in the Department of Education the President's Board of Advisors on Historically Black Colleges and Universities (the Board). The Board consists of 25 members appointed by the President, who also designates one member of the Board to serve as Chair, who in turn coordinates with the Executive Director to convene meetings and help direct the work of the Board. The Board includes representatives of a variety of sectors, including philanthropy, education, business, finance, entrepreneurship, innovation, and private foundations, as well as sitting HBCU presidents (The White House, 2010).

The Initiative works with executive departments, agencies, and offices, the private sector, educational associations, philanthropic organizations, and other partners to increase the capacity of HBCUs to provide the highest-quality education to a greater number of students, and to take advantage of these institutions' capabilities in serving the nation's needs through five core tasks (The White House. 2010):

- (1) strengthening the capacity of HBCUs to participate in Federal programs;
- (2) fostering enduring private-sector initiatives and public-private partnerships while promoting specific areas and centers of academic research and programmatic excellence throughout all HBCUs;
- (3) improving the availability, dissemination, and quality of information concerning HBCUs to inform public policy and practice;
- (4) sharing administrative and programmatic practices within the HBCU community for the benefit of all; and
- (5) exploring new ways of improving the relationship between the Federal Government and HBCUs.

Each executive department and agency designated by the Secretary of Education prepares an annual plan of its efforts to strengthen the capacity of HBCUs through increased participation in



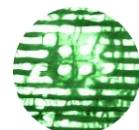


appropriate Federal programs and initiatives. Where appropriate, each agency plan addresses, among other things, the agency's proposed efforts to:

- (a) establish how the department or agency intends to increase the capacity of HBCUs to compete effectively for grants, contracts, or cooperative agreements and to encourage HBCUs to participate in Federal programs;
- (b) identify Federal programs and initiatives in which HBCUs may be either underserved or underused as national resources, and improve HBCUs' participation therein; and
- (c) encourage public-sector, private-sector, and community involvement in improving the overall capacity of HBCUs.

Many HBCUs have established collaborative programs with institutions of higher education in Africa. For example, in 1980, Lincoln University (LU) established an International Programs Office (IPO). With this office in place, LU confirmed its determination to play an increasingly important role in international development. Through two consecutive United States presidential appointments, Dr. Wendell G. Rayburn, Past President of Lincoln University, served as a member of the Board for International Food and Agricultural Development and Economic Cooperation (BIFADEEC); this organization assists the United States Agency for International Development (USAID) administrator in carrying out the title XII mission of the Agency (Lincoln University, 2010).

LU's permanent faculty members are involved in many international projects. One of LU's agronomists served as the Chief of Party for a major USAID Natural Resource Management project in Uganda and prior to that served with USAID/REDSO/ESA in Nairobi, Kenya as a natural resource/agronomy advisor for the entire region and Chief of Party in Guinea. LU was the lead institution for two concurrent ongoing multi-million dollar USAID projects in Malawi, East Africa, with the University of Malawi's Bunda College of Agriculture. One was in the area of human nutrition and animal science, and the other to establish the Agricultural Sector Policy Unit at Bunda. LU continues to collaborate with the University of Missouri in their linkage activities involving the University of Western Cape in South Africa. Lincoln along with three other HBCUs is partnered with ACDI/VOCA on a Worldwide Farmer to Farmer program with the greatest concentration in the Greater Horn of Africa. LU is involved in a long-term project with University of Minnesota in Senegal in the area of horticultural commodities trade with the United States. This project is a part of USAID's continent wide Trade and Investment Policy Program (ATRIP). LU has just concluded a four-year, multi-million dollar USAID project in Egypt with the Midwest Universities Consortium for International Activities (MUCIA), led by

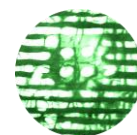


the University of Illinois. This Cooperative Agreement for the Institutional Linkages Activity (ILA) of the Agricultural Exports and Rural Income (AERI) project partner institutions, included Purdue University, The Ohio State University, University of Minnesota, University of Florida, Lincoln University, and Chemonics International, in addition to several Egyptian and European institutions. The project strengthened public/private international relations, assisted Egyptian universities with graduate capacity building and also included a biotechnology component (Lincoln University, 2010).

Since its inception, LU's IPO has brought and conducted non-AID type development opportunities involving the university, including Workshop in Agribusiness Management in the Caribbean, funded by the United Nations Development Program (UNDP), the Organization of American States (OAS), and the Caribbean Development Bank (CDB); Grain Consumption and Preparation in Upper Volta, funded by the Center for Women in Development of South East Consortium for International Development (SECID); Growth of External Debt of Selected Caribbean Basin Countries and its implication for U.S. Trade in Farm Products, funded by the United States Department of Agriculture (USDA); and training of Women Leaders in Cooperative and Business Management from Zimbabwe funded by USIA and administered by IIE (Lincoln University, 2010).

LU has a strong involvement in participant training. Over the past several years, LU has trained more than 800 international participants both long- and short-term in public administration, agriculture, natural resources, farm cooperatives, private sector development, electric cooperative, and many other areas of human endeavors. Through its International Programs activities, the university has brought participants involving USAID/Reimbursable Training Program (RTP) Nigerian Task Force and the Technical Teacher Training Program (TTTP); the Phelps Stokes Fund for African Paramedics Training (APT) and the Southern African Manpower Development Assistance Program (SAMDAP); the Presidential Training Initiatives for the Island Caribbean (PTIIC), the Central American Peace Scholarship (CAPS), Andean Peace Scholarship (APS) and others. LU has been training people from various countries in private sector development including AID participants from Bolivia, Peru, Costa Rica, and several other African countries. The International Programs Office was awarded a short-term training program in the area of public administration for several high level governmental officials from Slovakia charged with the task of decentralizing the Slovak government (Lincoln University, 2010).

Since its inception, LU has been involved with the Cochran Middle Income Country (MIC) training program administered by USDA/OICD. Through the MIC program, Lincoln has provided short-term (1-12 weeks) custom-tailored training for professionals from China, Cape





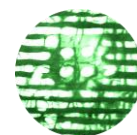
Verde, Cote d'Ivoire, The Gambia, Ghana, Kenya, Madagascar, Morocco, Tunisia, Nigeria, Uganda, South Africa, Tanzania, Malaysia, Korea, Taiwan, Hong Kong, India, Pakistan, Vietnam, Bangladesh, Thailand, Oman, Turkey, Yemen, Poland, Albania, Belarus, Slovakia, the Czech Republic, former Yugoslavia, Armenia, Bosnia, Herzegovina, Croatia, Georgia, Lithuania, Moldova, Slovenia, Bulgaria, Ukraine, Russia, Kyrgyzstan, Uzbekistan, Turkmenistan, Kazakhstan, Tajikistan, Mexico, Costa Rica, Colombia, Honduras, Peru, Bolivia, Venezuela, the Dominican Republic, Haiti, and Trinidad and Tobago. LU also has been providing solicited and unsolicited custom tailored short-term training programs for various USAID missions worldwide, including a recent collaboration with USDA for the training of a high level Nigerian Agricultural Ministry team (Lincoln University, 2010).

In August of 2007, LU hosted its first USDA/FAS/Norman F. Borlaug International Agricultural Sciences and Technology Fellow from Bahrain. A second fellow from Egypt arrived in early 2008 (Lincoln University, 2010).

LU faculty members are encouraged to incorporate an international dimension into their teaching and research, and administrative policies and procedures are in place to support this mission. Time spent on overseas assignments is regarded as time spent in residence, and is cumulative toward the length of service in granting leaves and in promotion and tenure considerations (Lincoln University, 2010).

Another example worth noting is the African Higher Education Partnership Initiative (AHEPI), an initiative of the African Studies Center at Michigan State University (MSU). Building on several initiatives in 1998, AHEPI was initiated at MSU in the summer of 1999 in response to what the faculty perceived as a series of crises undermining African higher education institutions and the urgent need to use partnerships with those institutions far more strategically. In order to firm up the initiative, during the summer of 2000, some MSU professors consulted higher education institutions and organizations in Africa, initially in Ghana, Nigeria, Senegal, Ethiopia, South Africa, Tanzania, and Zimbabwe. They also attended the UNESCO-sponsored World Higher Education Conference. In 2000-2002, a series of roundtables, lectures, discussions, and conversations with visiting scholars and administrators were organized to discuss the needs of African universities and what should be the response of foreign partners (African Studies Center at Michigan State University, 2010).

The major goal of AHEPI is to strengthen African universities and their partnerships with MSU. The initiative's premise is that the world needs strong African universities, research institutes, and technical institutions to attend to the pressing indigenous problems of poverty, disease, governance, and conflict, to innovatively address issues on the continent with African and global knowledge, and to make Africa's unique contributions on the world stage to the





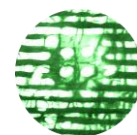
world's pressing global issues and research literatures. Since 1998, the MSU faculty has acted on the conviction that the first agenda for scholars of Africa in the wealthier nations should be to develop serious partnerships with African scholars and institutions and to understand better how foreign partner institutions should most productively link to African tertiary education institutions (TEIs) to our mutual benefit in this decade (African Studies Center at Michigan State University, 2010).

The Caribbean with its 56 colleges and universities (Career Orientation On-Line Rotary, 2010) offers another potential for African higher education linkages. For example, the University of the Virgin Islands' Historically Black Colleges and University Undergraduate Program (HBCU-UP) supports science, technology, engineering and mathematics (STEM) excellence by providing mentoring and funding for undergraduates for STEM research during the academic year. As part of the service learning experience, HBCU-UP Scholars serve as peer tutors to support science and math enrichment. Scholars supported by HBCU-UP must be interested in a career in research in science, mathematics, engineering or technology, work closely with faculty mentors, and have specific responsibilities. The HBCU-UP is funded by the National Science Foundation (University of the Virgin Islands, 2010).

Research Institutes Cluster

The United Nations University Web site lists entries for only two regional research institutions, six research institutes, and 14 research universities in Africa, 17 research institutions engaged in research on Africa located in the United States and Europe, but more than 100 useful research sites, numerous United Nations Africa links, and equally numerous interesting African sites and international agencies that are also engage in some forms of research on Africa (<http://www.unu.edu/africa/00internet.html>). A Google search yielded about 12,400,000 hits for United States institutes and other organizations engaged in African research, about 226,000 hits for those in the Caribbean, and 873,000 for those in Europe.

A research institutes cluster will promote inter-exchange, contact and cooperation among researchers in Africa and its Diaspora; collect, classify and disseminate information on research; promote cooperation among research institutions; encourage increased contacts between African and African-Diaspora researchers and the international research world; study and make known the research and related needs of African and African-Diaspora research institutions and, as far as possible, to coordinate the means whereby those needs may be met; encourage the development of wider use of African languages; and organize, encourage and support seminars and conferences among African and African-Diaspora researchers. In essence, this cluster will serve as the apex and principal means for consultation, exchange of information and cooperation among research institutions in Africa and its Diaspora. The following paragraphs provide



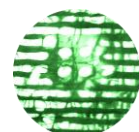


examples of a few collaborative research endeavors between researchers in Africa and the Diaspora.

The West African Research Association (WARA) seeks to enhance United States and West African scholarship and increase interest in international affairs among Americans through a reciprocal program of research exchange between American and West African scholars and institutions. The WARA was founded in 1989, for the purpose of promoting scholarly exchange and collaboration between American and West African researchers. Its stated objectives are to (West African Research Association, 2010):

- (a) provide United States and West African scholars access to research resources and expand research opportunities;
- (b) create a point of contact for United States and West African researchers, allowing the intersection of their respective research traditions;
- (c) foster collaborative research efforts, conferences and projects;
- (d) reinforce institutions on both sides of the Atlantic to supplement documentation resources and award fellowships to American and West African scholars;
- (e) encourage interest in international affairs and careers among American graduate students; and
- (f) disseminate information on West Africa-related research issues and periodically organize meaningful and landmark seminars, symposia and conferences when experts and researchers and creative artists and thinkers from different horizons and backgrounds can meet and exchange fruitfully ideas, preoccupations, research results and stimulating thinking.

Prior to its founding, no other institution of its kind had existed in Sub-Saharan Africa. The Council of American Overseas Research Centers (CAORC), with the help of a grant from the Smithsonian Institution, hosted the first meeting of African and American scholars to establish objectives for the association. CAORC groups under its umbrella within the Smithsonian Institute fifteen American overseas research centers around the world. WARA, the only such center located in Africa South of the Sahara, is the newest addition to this umbrella (West African Research Association, 2010).



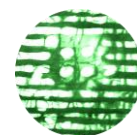


WARA is a member of the Council of American Overseas Research Centers, and is now included in the ECA/CAORC annual grant (since September 1999). WARA has also been accorded membership in the Association of African Studies Programs (AASP), and is now recognized as a bona fide affiliated member of the African Studies Association (ASA), thereby linking it with mainstream organizations dedicated to the development of African area studies and research exchanges with Sub-Saharan Africa. WARA programs complement the efforts of the 15 National Resource Centers (NRC) for African Language and Area Studies (Title VI Centers) to improve the cross-cultural learning of students and faculty in the United States through study in Africa and they partially satisfy the NRC's concern for the paucity of quality overseas study programs umbrella (West African Research Association, 2010).

WARA's overseas office, the West African Research Center (WARC) in Dakar, Senegal, provides an institutional presence and lends continuity and stability to programs sponsored by postsecondary United States institutions. The overseas center and its programs create a point of contact for United States and West African researchers, encourage the intersection of respective research traditions, and foster collaborative research efforts. WARA seeks to reinforce institutions on both sides of the Atlantic, supplement documentation resources in West Africa and make available to United States scholars West African research data and primary documents by assisting in the introduction of West African librarians to online delivery services and the Internet umbrella (West African Research Association, 2010).

WARA fellowships and internships funded by grants from the United States Department of Education have made it possible for under-served categories of educators and students to experience professional exchanges and carry out research projects in West Africa. Thanks to the recent inclusion under the ECA/CAORC funding umbrella, WARA has now been able to hire a fulltime highly qualified long-term Center director, and also start a very promising collaborative Researchers-in-Residence Fellowship Program involving West African and United States scholars. A new Travel Grant Program for West African scholars attending international meetings in their fields in the United States has also been instituted. Other equally stimulating regional programs and activities are also on the drawing board. Moreover, the long-term benefits to national interests in the areas of business and foreign policy accrue by developing a close awareness of the societies in which Americans operate. WARA programs and overseas center provide effective institutional linkages between the American public and West African communities umbrella (West African Research Association, 2010).

Through its by-laws, WARA has established a Board of Directors composed of representatives elected by institutions and representatives elected by the general membership. Their role is to assure that the WARA mandate is fulfilled. The directors elect officers to oversee program operations and manage association memberships. The officers, in close cooperation with the overseas center director, are charged with the coordination and execution of programs



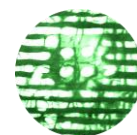


taking place in the United States and in West Africa. The WARA secretariat, headquartered at the University of Wisconsin since January of 1997, manages the recruitment and administration of a rapidly increasing United States membership, and disseminates information through the bi-annual publication of the WARA Newsletter. The United States WARA secretariat remains in constant communication with the Dakar Center, at all times umbrella (West African Research Association, 2010).

In 1992, the Senegalese government provided a site for the establishment of the association's overseas research center, the West African Research Center (WARC), in Dakar. The center opened, officially, in January of 1994 and its directors have been funded by the United States Information Agency (USIA) through the Fullbright-Hays scholar award program. The overseas center, under the leadership of its initial directors, Dr. Eileen Julien and Dr. Leigh Swigart and the WARA board, has moved quickly to establish itself as a regional research center of excellence in West Africa. The Center director is now Dr. Wendy Wilson-Fall, an Anthropologist by training with a strong research involvement in the West African sub-region as a whole (Nigeria, Niger, Burkina Faso, Senegal, and Mali). WARA has relocated its Research Center (WARC/CROA) to a permanent and much more spacious and functional premises at Fann Residence, near the Université Cheikh Anta Diop, in Dakar since early September of 1997. Just as for the earlier temporary premises, these permanent premises of 15 rooms and dependencies were made available to WARA/WARC through a decision from the Office of former President Abdou Diouf of Senegal. This means more adequate space for the library of more than 10,000 volumes and for the installation of electronic equipment obtained through a joint WARA/MSU (Michigan State University)/USIA grant umbrella (West African Research Association, 2010).

In 2003, the African Society of Human Genetics (AfSHG) was established. The aim of AfSHG is to equip the African scientific community and policy-makers with the information and practical knowledge they need to contribute to the field of genetics research and to attract global attention to the efforts of African scientists. An important goal of this organization is to provide opportunities for networking and collaboration among professionals working on genetic and genomic issues relevant to Africa. By achieving these goals, AfSHG will help diminish the widening gap between Africa and the Western world in biomedical science (Rotimi, 2004).

The inaugural conference of AfSHG was held on December 8-12, 2003 in Accra, Ghana. The theme for the meeting was “Biomedical Research in Africa with Emphasis on Genetics.” The meeting began with a review of socioeconomic and health conditions on the African continent. The importance of current realities for building a strong foundation for developing genetics and genomics in Africa was considered. Genomic variation in the African Diaspora was explored with attention to understanding the differential distribution of diseases, including malaria, tuberculosis, AIDS, diabetes, hypertension and cancer. Challenges surrounding the design and

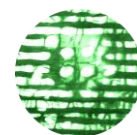


implementation of the only biobank in Africa, The Gambia National DNA Collections, were described. Current and potential applications of bioinformatics for the expansion of genetics and genomic research in Africa were reviewed. Gene-environment interaction and its impact on the distribution of common complex diseases in Africa and the African Diaspora were critically assessed. Ethical issues surrounding voluntary participation and informed consent in genetic research conducted in African settings and the current status of bioethics in medical education were discussed (Rotimi, 2004).

Membership in AfSHG is open to any individual who is interested in issues of human genetics in Africa, including, but not limited to, education, clinical care, research, public health, ethics, law and policy. The field of genetics represents a continually expanding global enterprise. Successful international application of scientific and technological knowledge associated with genetics depends on cooperative arrangements between professionals living in diverse African countries and between Africans and their counterparts residing in other areas of the world. Collaborative partnerships in genomics and genetics will contribute greatly to promoting a sustained commitment to the development of the field of genetics in Africa. AfSHG envisions itself as the organization that will be a driving force in building a strong foundation for scientists and scholars working in genomics and genetics issues in Africa. Information on the AfSHG is available at <http://www.afshg.org/> (Rotimi, 2004).

The African Diaspora Archaeology Network (ADAN) provides a focal point for archaeological and interdisciplinary studies of the African Diaspora, with news, current research, information and links to other Web resources related to the archaeology and history of descendants of African peoples. Through this engagement with the African Diaspora, the ADAN seeks to connect an intellectual community that considers the historical processes of culture, economics, gender, power, and racialization operating within and upon African descendant communities (African Diaspora Archaeology Network, 2010).

The ADAN publishes a quarterly online Newsletter, with essays, analytical papers, project reports, announcements, book reviews, and news updates that serve a readership of several thousand stakeholders, researchers, and educators across the globe. One can navigate within the organization's Web site by clicking on the subjects on the world map displayed at the top of each menu page. In addition to the many collaborating researchers who participate in this network, this Internet resource and quarterly Newsletter are edited by Chris Fennell and hosted by the Department of African American Studies and the Department of Anthropology at the University of Illinois in Urbana-Champaign (African Diaspora Archaeology Network, 2010).



Scholars Cluster

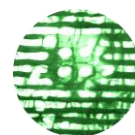
The discourse on the limited availability of African scholars in the continent centers on what has been characterized as “brain drain.” In the absence of methodologically grounded findings on the topic of “brain drain,” however, I am beginning to wonder whether we have uncritically accepted a concept that is lacking scientific import. “Brain drain” from one country to another typically, albeit not exclusively, is perceived to be from the developing to the developed country. In a small number of cases in which the flow is from one developed country to another, it is said to be the consequence of the immigrant’s inability to maximize his/her economic potential in his home country. And in another small number of cases where the flow is from a developed to a developing country, it is said to be driven by a missionary impulse to aid the developing nation.

The major empirical studies on “brain drain” of which I am aware are those by Gould and Findlay (1994), Choi (1995), Cao (1996), Johnson and Regets (1998), and Carrington and Detragiache (1999). From these works, which lack methodological rigor, two major findings emerge. The first of these findings is that the education of the immigrant plays a major role in the immigration decision. The largest group of immigrants in these studies came with secondary education from other North American countries; the second largest group consisted of highly educated immigrants from Asia and the Pacific, with those from the Philippines being the largest in the latter group. The same is then said of immigrants from Africa.

The problem with these works is that they are marred by a serious methodological shortcoming: i.e. a large number of the estimates are based on missing data. Thus, much serious empirical work is needed before a definitive statement can be made about “brain drain.”

The second major finding proffers a “brain circulation.” These works suggest that many foreign-born scholars return home after finishing their education or engage in a cycle of work abroad. These works also suffer from serious methodological shortcomings. To begin with, the survey samples are comprised of foreign-born scientists and engineers. Next, of the half of all foreign doctoral students who are estimated to leave the United States after obtaining their degrees, the percentage is not uniform among the countries of origin. Also, the exact percentage is not provided for those who are estimated to network with their counterparts back home. Nonetheless, based on my knowledge, experience and own work in the United States and on the continent, and the amount of remittances Africans in the Diaspora send to Africa, especially during crises situations, which now range in billions of dollars, I am more convinced of the “brain circulation” perspective.

In the case of Africa, Damtew Teferra’s essay, while also lacking in methodological rigor and also by now a bit dated, has some interesting findings, albeit anecdotal. The following

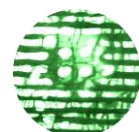


paragraphs entail synopses of the findings from his study. To begin with, Teferra notes that although data for Africa are very scanty, available sources show that the figure for immigrant scholars and those who stay on is very high compared to the small critical mass of its trained and qualified scholars. Britain alone, he points out, hosts over 8,000 recent Somali refugees, many of whom are businessmen and academics. A 1985 World Bank report, he adds, reveals that more than 70,000 trained Africans have chosen to remain in Europe; in the United States, about half that figure may also have stayed in the country (Teferra, 1997).

According to Teferra, due to its huge higher education system, scholarship opportunities, and less stringent immigration policies, the United States has been a more attractive market to pursue scholarship compared to other Western countries. The United States also still has a more favorable immigration policy for trained professionals. This atmosphere contrasts with the fact that opportunities for higher education, especially graduate studies, are quite limited and fiercely competitive in Africa. One therefore continues to see a steady flow of African immigrants to the United States in pursuit of academic excellence. Teferra notes that in the 1986/1987 academic year alone, more than 31,000 African students traveled to the United States: 48.2 percent were from West Africa, 20.9 percent from East Africa, 17.3 percent from North Africa, and 16 percent from Southern Africa. Nigeria, Egypt, South Africa, Ethiopia, Kenya and Liberia were the leading African nations sending students to the United States from the 1960s to the 1990s. In the 1987/1988 academic year, approximately 41 percent of African students were enrolled in graduate programs and 55 percent in undergraduate programs (Teferra, 1999).

Drawing from many sources and his own personal observation, Teferra opines that most African scholars and students prefer to stay in the United States rather than other Western countries. He points out that in Addis Ababa University, Ethiopia, where he worked for over ten years, for example, of about 20 faculty members from the Physics Department who left for doctoral studies, none returned. This is in contrast with almost all those who studied in Europe, the old Eastern Bloc, and Scandinavia that returned. Teferra adds that the Mathematics Department at the university also suffered from the same problem and had to recruit fresh graduates almost every year. These trends, he believes, correspond quite well with the general perception that immigrant scholars with science backgrounds have better job opportunities in the American market than do their counterparts in the humanities and the social sciences (Teferra, 1999).

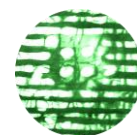
Concerning “brain drain” within Africa itself, Teferra says that the flow of scholars from one developing country to another is not considered “brain drain” in the accepted sense. Instead, it is considered a sign of solidarity, cooperation, and collaboration among developing countries. He points out that many African scholars work across their borders to meet the need for



professionals in many African institutions. He observes that the preference of recruiting professionals from abroad in most African institutions is changing in favor of African scholars for social, economic, cultural and scientific reasons (Teferra, 1999).

In terms of the socio-cultural setting, Teferra asserts that African scholars are better able to adapt and work within the continent where the socio-cultural realities are quite similar in many countries. He believes that this may also be the case with Muslims who travel across the continent into the Middle East. In terms of scientific approaches, Teferra is of the opinion that African-trained scholars live with the underlying problems of the continent; this gives them a competitive advantage over other scholars in approaching, assessing, and solving problems. He notes that many problems in Africa are common and interrelated; thus, well-informed, experienced and indigenous scholarship is imperative for sustainable socioeconomic development. Hence, it has now become evident to African institutions that many overseas consultants, especially from the West, who are usually on short-term contracts, are short-sighted when it comes to the complex social, cultural, political and economic as well as regional and local realities of Africa. And in terms of economic benefits, Teferra posits that many African scholars value the opportunity of working abroad in areas of their expertise, which usually comes with good financial remunerations. But, still, he points out, the cost of employing these scholars is often lower for the recruiting institutions than employing their Western counterparts. He makes the point that Western scholars have become so expensive that even buying round-trip tickets for external examiners has become taxing for most African institutions. Nonetheless, Teferra also notes that the movement of scholars within the continent has its downside as well. For example, he points out that the massive outflow in some countries of Southern Africa has reached such staggering proportions that it has caused severe shortages of personnel. Zambia, Malawi and Zimbabwe have had a flood of scholars to Botswana, South Africa, Swaziland and Namibia, creating severe shortages in the former countries (Teferra, 1999).

Concerning efforts to halt the “brain drain,” Teferra mentions various national, regional and international efforts that have been launched. He cites a prominent international initiative launched by the United Nations Development Program (UNDP) and the International Organization for Migration (IOM) geared toward attracting African scholars who are resident in the United States to work in Africa. He notes that through the Transfer of Knowledge through Expatriate Nationals (TOKTEN) program, the UNDP recruited many professionals including Africans in developed countries to volunteer their services for short, well-prepared consultancy assignments in their countries of origin. A number of African governments, he adds, have also taken measures to attract their scholars living abroad by providing them free housing, duty-free status, and other benefits. He further points out that some ill-advised national initiatives such as



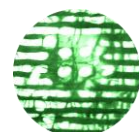
strict regulations hindering the exodus of scholars and students in order to curb the “brain drain” have had adverse effects, as they end up discouraging potential returnees (Teferra, 1999).

Teferra concludes by recommending that African governments should wholeheartedly embrace the fact that scholars are the core of development, self-reliance, and sustainability. He adds that this fact should be accompanied by the commitment of more resources and autonomy, responsibility, academic freedom, and good working facilities, not only to encourage those scholars abroad to return but also to discourage those at home from leaving. This, he believes, will ultimately strengthen nation-building capacity in Africa (Teferra, 1999).

A scholars cluster will promote inter-exchange, contact and cooperation among African and non-African scholars in Africa and its Diaspora; collect, classify and disseminate information on scholars; promote cooperation among academic institutions; encourage increased contacts between African and African-Diaspora scholars and the global educational world; study and make known the faculty and related needs of African and African-Diaspora academic institutions and, as far as possible, to coordinate the means whereby those needs may be met; encourage the development of wider use of African languages; and organize, encourage and support seminars and conferences among African and African-Diaspora scholars. In essence, this cluster will serve as another apex and principal means for consultation, exchange of information and cooperation among academic institutions in Africa and its Diaspora.

The potential for research linkages in the African Diaspora is tremendous as Black populations in various Diaspora regions are undergoing a cultural and civil rights awakening. Leading these movements is a new breed of African-centered scholars. And as we can recall, it was African-Diaspora scholars, particularly those in the Caribbean and the United States such as Henry Sylvester-Williams, Edward Wilmot Blyden, George Padmore, C. L. R. James, W. E. B. Du Bois and Walter Rodney, who ushered the concept and movement of Pan-Africanism that attracted continental African intellectuals and leaders such as Kwame Nkrumah, Ahmed Sékou Touré, Julius Nyerere, Jomo Kenyatta, Patrice Lumumba, Gamal Abdel Naser, Kenneth Kaunda, Robert M. Sobukew, Amílcar Cabral, and many others to struggle for the liberation and assertion of Africa. Today, we see Diaspora African leaders like Hugo Chavez of Venezuela taking up the mantle for the revival of the Pan-African agenda.

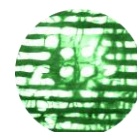
In the Caribbean, as I have demonstrated elsewhere (Bangura, 2007), since an overwhelming majority of Caribbean countries’ populations are African and mixed African and other ethnic Caribbeans, ranging from 18.9 percent in Puerto Rico to 100 percent in Anguila (see Table 2), they represent a great potential for scholarly collaboration.



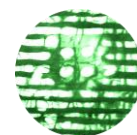
In Latin America, Black populations are undergoing their own cultural and civil rights awakening. In Nicaragua, Afro-Latinos are engaged in a quiet but powerful civil and cultural movement that flickers. While in neighboring Honduras, the Black Garifuna community fights to preserve its culture. In Colombia, the first Black general serves as an example of Afro-Latino achievements (Burch, 2007). Also, Blacks are everywhere present in Latin America. There are an estimated 100 million people of African descent living in the region, making up 45 % of Brazil's population. There are also sizeable African populations in Colombia and Venezuela (USCIA, 2010).

Table 2: Population Estimates, 2005

Country or Colonized Territory	Estimated Total Country Population	Percent of Population African	Percent of Population Mixed African and Other(s)
Anguilla	13,254	100.0%	----
Antigua and Barbuda	68,722	91.3%	2.4%
Aruba	71,566	83.7%	----
Bahamas	301,790	85.0%	----
Barbados	279,254	90.0%	6.0%
Belize	279,457	24.9%	----
Bermuda	65,365	58.0%	----
Cayman Islands	44,270	20.0%	40.0%
Cuba	11,346,670	11.0%	51.0%
Dominica	69,029	89.2%	----
Dominican Republic	8,950,034	11.0%	73.0%



Grenada	89,502	82.0%	13.0%
Guadeloupe	448,713	90.0%	----
Guyana	438,144	10.0%	31.0%
Haiti	8,121,622	95.0%	4.0%
Jamaica	2,731,832	90.9%	7.3%
Martinique	432,900	90.0%	----
Montserrat	9,349	90.0%	----
Netherlands Antilles	219,958	85.0%	----
Puerto Rico	3,916,632	8.0%	10.9%
Saint Kitts and Nevis	38,958	95.0%	----
Saint Lucia	166,312	90.0%	6.0%
Saint Vincent and The Grenadines	117,534	77.4%	19.0%
Surinam	756,283	36.0%	7.0%
Trinidad and Tobago	1,088,644	39.5%	18.4%
Turks and Cacois Islands	20,556	90.0%	----
Virgin Islands, British	22,643	83.0%	----



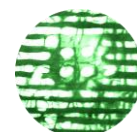
Virgin Islands, United States	108,708	78.0%	9.9%
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Source: Bangura, 2007:18-19).

As I have also demonstrated (Bangura, 2007), a great deal of African language varieties (ALVs) are still alive in the Caribbean as shown in Table 3.

Table 3: African Language Varieties Spoken by Country

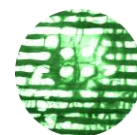
Country or Colonized Territory	African Language Varieties
Anguilla	African-English Creole
Antigua and Barbuda	African-English Creole
Aruba	Papiamentu/u
Bahamas	African-English Creole Haitian African-French Creole/Kweyol
Barbados	African-English Creole/Patois
Belize	Garifuna African-English Creole/Kriol
Bermuda	African-English Creole/Slanguage
Cayman Islands	African-English Creole/Patois



Cuba	<p>Yoruba</p> <p>Haitian African-French Creole/Kweyol</p> <p>Arará</p> <p>Congo/Bantu</p> <p>Abakwa/Ñañigos</p> <p>Jamaican African-English Creole/Patois</p>
Dominica	<p>African-English Creole</p> <p>African-French Creole/Kweyol</p>
Dominican Republic	<p>African-Spanish Creole</p> <p>Haitian African-French Creole/Kweyol</p>
Grenada	African-French Creole/Patois
Guadeloupe	African-French Creole/Kweyol
Guyana	African-English Creole/Creolese
Haiti	African-French Creole/Kweyol
Jamaica	<p>African-English Creole/Patois</p> <p>Twi</p> <p>Yoruba</p> <p>Kikongo</p> <p>Mahi</p> <p>(Also varieties of these languages referred to as Nago, Tambo, and Goombeh)</p>
Martinique	African-French Creole/Kweyol



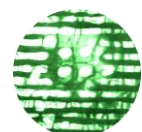
Montserrat	African-English Creole
Netherlands Antilles	Papiamentu/u Haitian African-French Creole/Kweyol Dominican Republic African-Spanish Creole
Puerto Rico	African-Spanish Creole/Bozal Creole
Saint Kitts and Nevis	African-English Creole
Saint Lucia	African-English Creole African-French Creole/Kweyol
Saint Vincent and the Grenadines	African-French Creole/Patois
Surinam	African-English Creoles: Sranan Tongo Ndyuka Aluku Paramaccan Kwinti Guyanese African-English Creole/Creolese African-Portuguese Creoles: Saramaccan Matawai



Trinidad and Tobago	African-English Creole African-French Creole/Kweyol Yoruba Kikongo Hausa Fon
Turks and Caicos Islands	African-English Creole Dominican African-English Creole Dominican African-French Creole/Kweyol Haitian African-French Creole/Kweyol
Virgin Islands, British	African-English Creole/Calypso
Virgin Islands, United States	African-Danish Creole African-Dutch Creole African-English Creole

Source: Bangura, 2007:23-25.

In the United States, there are approximately 65.7 million African Americans, comprising 13.5 percent of the total population. They are projected to make up 15 percent of the total population by 2050 (US Census Bureau, 2010). Indeed, African Americans are Africa's most important external human resource, precisely because they constitute a large concentration of people of African ancestry lodged in the most powerful nation in the world, and certainly a nation with immense capacity to do Africa harm or good. Like other minorities in the United States, African Americans have indicated special interest in some foreign policy issues. For more than a century, prominent African American activists and scholars emphasized the important linkage between American foreign policy towards Africa and their struggle for equal rights. As economic activities have become overwhelmingly global in nature, African Americans are increasingly stressing the importance of international affairs for their own economic advancement.



In Canada, Black Canadians form the third largest visible minority group, after the South Asian and the Chinese. Black Canadians, Caribbean Canadians and African Canadians are designations used for people of Black African descent who reside in that country. The terms are used by and of Canadian citizens who trace their ancestry back to Black populations indigenous to Sub-Saharan Africa. The majority have relatively recent origins in the Caribbean, while some trace their heritage to the first slaves brought by British and French colonists to the mainland of North America. A minority of the population are of recent Black African origin. Many Canadians identify as Black even if they may have multi-ethnic ancestries (The World Bank, 2008).

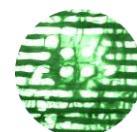
Blacks in Europe, also referred to as Afro-Europeans, although this term is also used to describe people of mixed European and African descent, especially in the former European colonies, are Black people who are residents or citizens of European countries. They include immigrants as well as European-born people of Black African descent (Lusane, 2002:9). The number of sub-Saharan African migrants in Europe is between 3.5 and eight million, concentrated mainly in Belgium, France, Italy, the Netherlands, Portugal, Spain, and the United Kingdom. These figures are likely underestimates of the African migrant population due to factors such as illegal migration (Council of Europe Parliamentary Assembly, 2008).

The first Blacks in Russia were the result of the slave trade of the Ottoman Empire and their descendants still live on the coasts of the Black Sea. Czar Peter the Great was recommended by his friend Lefort to bring in Africans to Russia for hard labor. Alexander Pushkin was the descendant of the African princeling Abram Petrovich Gannibal, who became Peter's protégé, was educated as a military engineer in France, and eventually became *general-en-chef*, responsible for the building of sea forts and canals in Russia (Gnamankou, 1995; Hugh, 2005).

During the 1930s, 15 African American families moved to the Soviet Union as agricultural experts. As African states became independent in the 1960s, the Soviet Union offered them the chance to study in Russia; over 40 years, 400,000 African students came, and many settled there (MediaRights, 2001). There are also non-African people within what was the Soviet Union who are colloquially referred to as "the Blacks" (*chernye*). Gypsies, Georgians, and Chechens fall into this category (Humphrey, 2002).

Some Blacks of unknown origin once inhabited the southern Abkhazian today are assimilated to Abkhaz (Richter, 1930). Also, beginning several centuries ago, a number of Sub-Saharan Africans, usually via Zanzibar and from places like Kenya, The Sudan, Ghana, and Nigeria were brought by Turkish slave traders during the Ottoman Empire to plantations around Dalaman, Menderes and Gediz valleys, Manaygat, and Cukurova (Güncelleme, 2008).

In the United Kingdom, two million, excluding British Mixed, split evenly between Afro-Caribbeans and Africans. In the 2001 United Kingdom Census, 565,876 people identified their ethnicity as Black Caribbean, 485,277 as Black African, and 97,585 as Black Other, making a



total of 1,148,738 in the census' Black or Black British category (UK Office for National Statistics, 2003). Mid-2007 estimates for England show a drop in the Black British population at 1,448,000 compared to 1,158,000 in mid-2001 (UK Office for National Statistics, 2009:5).

For France, estimates of between two to three million people of African descent are provided, although a quarter of the Afro-French or French African population lives in overseas territories. It is estimated that four out of five Black people in France are of African descent, with the remainder being of Caribbean ancestry (Bennhold, 2006:2).

In the case of Italy, estimates of 755,000 to 900,000 people of African descent are provided. The largest group is from North Africa; a minority is from Sub-Saharan Africa. Black Caribbeans are a negligible percentage originating from Cuba, Trinidad and Tobago, Dominica, Guadeloupe, Martinique, and the Dominican Republic (Istituto Nazionale di Statistica, 2006).

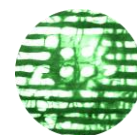
In the Netherlands, there are about 500,000 of Surinamese and Dutch Antilles descent. They mainly live in the islands of Aruba, Bonaire, Curaçao and Saint Martin (which is half French), but many Afro-Dutch people also live in the Netherlands (Council of Europe Parliamentary Assembly, 2008).

In the Indian and Pacific Oceans, there are a number of communities in South Asia that are descended from African slaves, traders or soldiers (Ali, 1996). These communities are Siddi, Sheedi, Makrani, and Sri Lanka Kaffirs. Some of these communities, such as Jamal-ud-Din Yaqut or Hoshu Sheedi, and the Murud-Janjira fort, have become quite prominent. Some Pan-Africanists also consider other Africoid peoples as African Diaspora peoples. Some of these groups are the Negritos of the Malay Peninsula, Orang Asli (Rashidi, 2000); the Papuans of New Guinea (Tangghama, 2007); certain peoples of the Indian subcontinent, notably Vedda people and Dravidians such as Tamils; and the aboriginal peoples of Melanesia and Micronesia (Elango, 2002; Tudu, 2002; Rashidi, 1991).

Conclusion

That a comprehensive and balanced cluster is required to expand the potentials of mathematicians and experts in other disciplines to engage in sustainability and tipping point work for Africa is hardly a matter of dispute. Thus, the process orientation and the application of times-technologies are the key factors for the development of an AADER-cluster and for the realization of the innovation and growth objectives of the cluster.

To optimize the strategic process in an AADER-cluster, the participation of all institutions of higher education, scholars and researchers in African and African Diaspora states is imperative. The determination of the vision, mission and strategy in particular requires the process of participation. From the cluster strategy, individual strategies and balanced scorecards



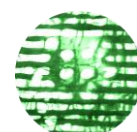


of the various clusters can be deduced. The strategic network of all actors will decisively improve the competitiveness of an AADER-cluster.

Indeed, an important issue in the implementation process of innovative actions is the existence of innovation management of tools necessary to support the innovation process from the generation of ideas to launching successful ventures throughout the innovation life cycle. The availability of innovation infrastructure and support tools becomes a crucial factor for the deployment of innovative actions in Africa and its Diaspora. This action line will provide the necessary tools and methods needed to enhance the innovation capacity and the networking interoperability. These goals and tools should be widely and freely available to all actors using Internet technologies. The collective effort will take the form of a portal for innovation management, concentrated in supporting innovation actions.

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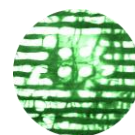
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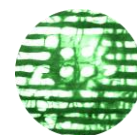
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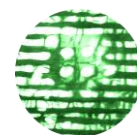
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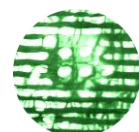
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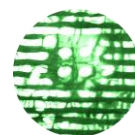
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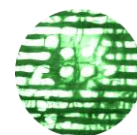
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Abdul Karim Bangura is a professor of Research Methodology and Political Science at Howard University. He is also a researcher-in-residence of Abrahamic Connections and Islamic Peace Studies at the Center for Global Peace in the School of International Service at American University. He holds five PhDs in Political Science, Development Economics, Linguistics, Computer Science, and in Mathematics. He is the author of 86 books and more than 600 scholarly articles. The winner of more than 50 prestigious scholarly and community service awards, among Bangura's recent awards are the 2012 Cecil B. Curry Book Award for his *African Mathematics: From Bones to Computers*, the 2014 Diopian Institute for Scholarly Advancement's Miriam Ma'at Ka Re Award for his article titled "Domesticating Mathematics in the African Mother Tongue" published in the *Journal of Pan-African Studies*, and the 2015 Special United States Congressional Award for "outstanding and invaluable service to the international community." Bangura is fluent in about a dozen African and six European languages, and studying to increase his proficiency in Arabic, Hebrew, and Hieroglyphics. He is also a member of many scholarly organizations, has served as President and then United Nations Ambassador of the Association of Third World Studies, and is a Special Envoy of the African Union Peace and Security Council.

