Essay of Causes analysis of low level of Scientific Research in Higher Learning and Research Institutions in Rwanda:

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Abstract

This research aims to assess the level of scientific research in Rwanda. Higher learning institutions and research institutions are requested to carry out researches addressing real life problems of society. However, it has been noticed that a little is done as far as research concerned in those higher learning and research institutions. The main goal of this study is to identify the motivating and/or demotivating factors of research in higher learning and research institutions, and provide the way forward for improvement. The methods used for data collection to achieve objectives were documentary research, questionnaires, interview and observation. The motivating and/or demotivating factors were determined using the multiple linear regression approach with a help of SPSS software version 16. The findings showed that lack of motivation, non clear research policy, and low salary are the major factors of low level of publication for academic and research staff. While extra teaching workload in private higher learning institutions was found to have a negative impact on the level of publication. Finally, the paper proposes the way forward for sustained improvement of scientific research in Rwanda and suggests further researches.

Key Words: Higher learning institution, research policy, linear regression analysis, scientific publication.

1. Introduction

1.1. **Background to the study**

This paper on Low level of scientific research in Rwanda is prepared in accordance with the request of Independent Institute of Lay Adventists of Kigali in order to improve the scientific research and to harmonize it with national interests according to MDGs, Vision 2020 and EDPRS goals.

Research is a very important tool in any learning institution at any level either for lecturers or for students and different researchers. Without research, there is no development of knowledge and the information stays un-updated and this may lead to slow or lack of socioeconomic and cultural development of a nation. It is also important to note that one of the major factors utilized to express the importance of a higher learning institution in comparison with others is precisely the number of articles published in reputable journals (SESRTCIC, 2007). This serves as a benchmark against which higher learning institutions gauge themselves in respect to the extent of their contribution to the organized body of knowledge.

As it is well known, the main missions of higher learning institutions being public or private are:

- Training students through teaching (education),
- Carrying out scientific research,
- Community outreach.

This essay is focused on the second mission that is to carry out scientific research in order to find out how to enhance and promote it.

As said above, the reputation of a higher learning institution is often based on the following aspects:

- Publications done by its academic staff (number, quality and their contribution to solving the identified national, regional and/or international problems).
- Quality of academic and research staff (PhD and Masters who are supposed to have conducted researches).
- Number and quality of researches conducted by students in the context of their Bachelor's Dissertations, Masters and PhD Theses, etc.

However, even if this situation is commonly agreed upon, it is necessary to have in mind that there is a minority thought schools which advocates for laxity between research and teaching, putting forward the fact that it is not possible to usefully ensure both. This is justified by the existence of Institute of Research in Science and Technology (IRST), the Institute of National Museums of Rwanda and Institute of Agricultural Science of Rwanda (ISAR), beside National University of Rwanda (Nkusi, 2010). Indeed these institutions were established mainly for research purpose.

1.2 Problem statement

Since high learning institutions existed in Rwanda, after independence, great efforts were used to encourage institutions to achieve their mission. The central role of higher learning institutions has been focusing on training students and preparing them for the professional activities.

However, higher learning and research institutions are requested to carry out researches which solve the real life problems of the society. Therefore they should find ways and means for enhancing research activities falling into the community interests.

Indeed research is one of the core pillars of the university system. Publication of research findings in reputable journals is one of the ways in which these findings are widely dissemininated to stakeholders. Studies showed that research and publishing in Higher Learning Institutions is at low level in Rwanda (Benell, 2008). Due to heavy teaching responsibilities – brought about by the rising student numbers, plus the need to make some extra money to supplement the meager pay and due to many other obstacles that will be described below, lecturers are not motivated to undertake meaningful research and publish their work (Ecuru et al, 2008).

In 2008, Rwanda Science and Research Council organized at Novotel, Kigali, a three-day workshop from 23rd to 25th June, which brought together about eighty scientists drawn from all Rwanda's scientific research and teaching institutions with other participants including the World Bank, International scientists, and a team from the McLaughlin-Rotman Centre for Global Health Canada and members of Rwanda's Private Sector. The workshop concluded that there is need for better coordination of the

scientific community to create synergies of research that enhance the country's economic growth (RSRC, 2008). RSRC believed that there are numerous uncoordinated, untargeted and non-impact oriented research initiatives in the country and that there is rich, unknown pool of knowledge and skills which remain underutilized within and outside Rwanda which can be tapped (RSRC, 2008).

Among other challenges in the sector of scientific research, the following can be mentioned:

- Time allocation to different lecturer's activities namely teaching, scientific research, community outreach, promotion of culture and participation in the higher learning institution management is not determined;

- There is no harmonization of time average that a lecturer-researcher should allocate to research;

- Many lecturers have several contracts with different higher learning institutions, in such a way that their efficiency is affected; instead of synergy and complementary, efforts are thus loosened.

- There is no extended inventory showing the list of national scientists with their qualifications and experiences.

- A lot of consultancy studies are conducted by academic staff for Government, NGOs or international organizations, but they do not lead to publication in scientific

journals and remain unknown to the scientific world and the public.

That is a serious problem that deserves to be examined in depth, and therefore, the main research questions are:

1. How the research policy in Higher Learning Institutions and Research Institutions is being implemented?

2. What is the level of publication in Higher Learning Institutions and Research Institutions in Rwanda?

3. What are the main factors of research in Higher Learning Institutions and Research Institutions in Rwanda and their impact on the level of publication?

1.3 Objectives

The overall objective of this study is to find out how to promote scientific research in higher learning and research institutions in Rwanda. The specific objectives are:

1. To assess whether there is research policy within higher education and research institutions in Rwanda.

2. To estimate the proportion of academic/research staff who publish and who do not publish,

3. To identify the motivating and/or demotivating factors and their impact on scientific research and publication.

4. To propose the recommendations for sustained improvement of scientific research.

2. Understanding scientific research, and its main motivating and demotivating factors

This section defines the scientific research concept, evokes the objectives of carrying out research, explains different types of researches, describes research policy in Rwanda and highlights the motivating and demotivating factors for Scientific Research.

2.1. Definition of research policy

Research refers to a search for knowledge. It has also been defined as a scientific and systematic search for pertinent information on specific subject. Redman and Mory (1923) define research as a "systematized effort to gain new knowledge". Some people consider research as a movement from the known to the unknown. It is actually a voyage of discovery. "We all possess the vital instinct of inquisitiveness for, when the unknown confronts us, we wonder and our inquisitiveness makes us probe and attain full and fuller understanding of the unknown" (Khotari, 2004). Indeed this inquisitiveness is the mother of all knowledge and the method, which man employs for obtaining the knowledge of whatever the unknown, can be termed unknown as research.

Research is an academic activity and as such the term should be used in a technical sense. According to (Khotari, 2004), research comprises defining and redefining problems, formulating hypothesis or suggested solutions; collecting, organizing and evaluating data; making deduction and reaching conclusions; and at last carefully testing the conclusion to determine whether they fit the formulated hypothesis (Russell, 2001).

2.2 Objectives of carrying out research in general

The objective of research is to discover answers to questions through the implementation of scientific procedures (Bynum & Porter, 2005). Therefore the main purpose of research is to find out truth which is hidden and which has not been discovered yet. Even though each research study has its own specific aim, research objectives could fall into the following categories (Kothari, 2004):

1. To gain familiarity with a phenomenon or to achieve new insights into it: *exploratory research studies*.

2. To portray accurately the characteristics of a particular individual, situation or a group: *descriptive research studies*.

3. To determine the frequency with which something occurs or with which it is associated with something else: *diagnostic research studies*.

4. To test a hypothesis of a causal relationship between variables: *hypothesis-testing research studies*.

2.3 Types of research

This sub-section aims to explain the different types of scientific researches that can be conducted, in order to identify those made currently in Rwanda by the Higher Learning Institutions and the Research Institutions and what types are best suited to the country's situation. There are four basic types of research: *descriptive vs. analytical*, *applied vs. fundamental*, *quantitative vs. qualitative*, *conceptual vs. empirical* (Kothari, 2004; Bynum & Porter, 2005).

2.3.1 Descriptive vs. Analytical Research

Descriptive research includes surveys and fact-finding enquiries of different kinds. The major purpose of descriptive research is description of the state of affairs as it exists at present. In social science and business research, the term "ex post facto research" is quite often used for descriptive research studies. The main characteristic of this method is that the researcher has no control over the variables; he can only report what happened or what is happening. The methods of research used in descriptive research are survey methods

of all kinds, including comparative and correlation methods (Kothari, 2004).

In *analytical research*, the researcher has to use facts or information already available, and analyze these to make a critical evaluation of the material.

2.3.2 Applied vs. Fundamental Research

Applied research aims at finding a solution for an immediate problem facing a society or an industrial/business organization (Kothari, 2004; Bynum & Porter, 2005).

Examples of applied research:

- Research aimed at certain conclusion facing a concrete social or business problem.
- Research destined for identifying social, economic or political trends that may affect a particular institution or the copy research or the marketing research or evaluation research.

Fundamental research is mainly concerned with generalizations and with formulation of a theory.

Examples of fundamental research

- Research concerning some natural phenomenon or relating to pure mathematics.
- Similarly, research studies concerning human behavior carried out with a view to make generalizations about human behavior.

2.3.3 Quantitative vs. Qualitative Research

Quantitative research is based on the measurement of quantity or amount. It is applicable to phenomena that can be expressed in terms of quantity (Kothari, 2004).

Qualitative research is concerned with qualitative phenomenon, i.e. phenomena relating to or involving quality. Qualitative research is especially important in the behavior sciences where the aim is to discover the underlying motives of human behavior.

2.3.4 Conceptual vs. Empirical Research

Conceptual research is that related to some abstract idea or theory. It is generally used by philosophers and thinkers to develop new concepts or to reinterpret existing ones (Bynum & Porter, 2005).

Empirical research relies on experience or observation. It is data-based research coming up with conclusions which are capable of being verified by observation or experiment. In such research, it is necessary to get at facts firsthand, at their source, and actively to go about certain things to stimulate the production of desired information. Experimental research is thus characterized by the experimenter's control over the variables under study and his deliberate

manipulation of one of them to study its effects (Kothari, 2004; Bynum & Porter, 2005).

2.4. Research Policy in Rwanda

This section shows the status of research and/or research policy in Rwanda. What does mean "research policy"? According to Khotari (2004), research policy means a set of ideas or a plan of what to do in particular situations that has been agreed officially by a group of people, a business organization, a government in order to perform a detailed study of a subject, especially in order to discover new information or reach a new understanding. They are therefore all the arrangements, rules enacted, implemented strategies, incentives, and other factors to promote scientific research and publication.

Rwandan research policy is presented in Ministerial Instructions N°003/2010 of 09/12/2010 for Research Regulations (Ref. Official Gazette N° Special of the 24/12/2010). But before these instructions, texts related to research policy were found in the following documents: organic law no 20/2005 of 20/10/2005, law no 23/2006 of 28/04/2006, the Republic of Rwanda's Policy on Science, Technology and Innovation of October 2006, Higher Education Policy of July 2008, Presidential order n° 51/01 of 13/07/2010, Vision 2020 and EDPRS.

The Ministerial Instructions N°003/2010 of 09/12/2010 regulating research activities in Rwanda has as overall objective to assist in documentation and coordination of research in Rwanda. Its specific objectives are:

1. Build up strong local research capacity;
2. Foster links between institutions and organisations around the world;
3. Develop a platform for collaboration and knowledge transfer;
4. Assist researchers in collecting the required information for their projects;
5. Document all research activities in Rwanda;
6. Prevent duplication of research;
7. Prevent research misconduct and activities that may be harmful to human health and the environment;
8. Prevent unauthorised collection and transfer of research material and/or information;
9. Protect the rights and welfare of research participants.

According to organic law no 20/2005 of 20/10/2005 governing the organization and functioning of higher education, among the duties and responsibilities of higher learning institutions (HLI), the research related ones are to carry out and promote research in all scientific and technological disciplines and on different problems of the country, and to publish research results and collaborate with other

institutions to ensure their dissemination so as to contribute to the promotion of national development.

On the other side, the law no 23/2006 of 28/04/2006 governing the national council of higher education, states that one of the basic responsibilities of HEC is to enhance the learner's standards, education and research in Institutions of Higher Education; and to monitor and follow-up all activities concerning teaching, learning process and evaluation and appraisal of both teaching and learning activities in Institutions of Higher Education. For example, according to Higher Education Council, the overall workload of a lecturer is 1720 hours (National Council for Higher Education, 2008). But they are not implemented in the same way in all Higher Learning Institutions.

The Republic of Rwanda's Policy on Science, Technology and Innovation of October 2006 has as principal policy objective "To integrate Science, Technology, Scientific Research and Innovation in a framework that shall include capability building, technical transfer initiatives, and the promotion of innovation, in the context of the issues facing Rwanda. Science, Technology and Scientific Research shall be catalyst to underpin all public and private sector activities to enable Rwanda's Vision 2020 to be realized."

Higher Education Policy of July 2008: The underdeveloped human resource base in the country also contributes to the underdeveloped research capacity in higher education. Historically, there has been little awareness as to the importance of research as an essential process in social and economic development. Research therefore has been uncoordinated, often lacking the necessary staff, resources and equipment. The challenge is to put a National Research Strategy in place as soon as possible and requires lecturers as part of their contracts to undertake research that leads to publication in relevant journals. Additionally as well as research being underdeveloped there is an underutilization of the role that higher education plays as absorbers and transmitters of knowledge. Higher Education can play a key role as knowledge brokers – disseminating up to date knowledge to key areas of society. The challenge is to ensure that higher education institutions are encouraging and supporting their staff in undertaking consultancies and engaging in other transfer activities.

According to the Presidential order n° 51/01 of 13/07/2010 establishing quality standards in higher learning institutions, "higher learning and research institutions must have policies and procedures to assure the quality of the research and consultancy undertaken by academic/research staff and students and its ethical acceptability. It is also clearly stated that

all higher learning institutions must keep a record of the research and publications of each of their academic staff. Research activity and publication data must be included in the institutional annual reports to the Higher Education Council. Publication of books and/or articles in recognized or accredited academic journals done by academic staff is also emphasized in the Presidential order stated above."

Additionally, Vision 2020 and EDPRS present the guidelines related to research policy towards the achievement of their objectives. It is clearly stated that the concerted effort to build scientific capacity will be based on the objectives of knowledge acquisition, and deepening, knowledge creation through scientific research, knowledge transfer and developing a culture of innovation, in particular, protecting intellectual property. And one way of achieving that is to reinforce research units in HLIs coupled with the investment in training and development in high quality research to meet the development needs of Rwanda.

2.5. Motivating and demotivating factors to research and publication

The Promotion of Research requires many elements that are relevant among which there are *Research Policy* (defined above), *Motivation*,

Salary, *Workload* and M*aterials* which are defined below.

Motivation: According to Deming (1986), there are two types of motivation: *Intrinsic motivation and extrinsic motivation.*

Intrinsic motivation comes from the sheer joy of performing an act. It releases human energy that can be focused into improvement and innovation of a system (Deming, 1986). Intrinsic motivation refers to motivation that is driven by an interest or enjoyment in the task itself, and exists within the individual rather than relying on any external pressure (Seligman, 1990).

What motivate people to handle research? According to Giovanni (1998), Beaud (2001) and Khotari (2004), the possible motives for doing research may be either one or more of the following (without being limitative):

1. Desire to get a research degree along with its consequential benefits.
2. Desire to face the challenge in solving the unsolved problems.
3. Desire to get intellectual joy of doing some creative work.
4. Desire to be of service to society.
5. Desire to get respectability.
6. Desire to comply with directives of government, employment conditions, curiosity about new things.
7. Desire to understand causal relationships, social thinking and awakening.

Extrinsic motivation comes from the desire for reward or the fear of punishment. Extrinsic motivation comes from outside of the individual. Common extrinsic motivations are *rewards like money* and *grades*, *coercion* and *threat of punishment*. Competition is in general extrinsic because it encourages the performer to win and beat others, not to enjoy the intrinsic rewards of the activity. A *crowd cheering* and *public congratulation* on the individual and trophies are also extrinsic incentives (Bainbridge, 2007).

Salary is a form of periodic payment from an employer to an employee, which may be specified in an employment contract or a fixed amount of money, agreed every year as pay for an employee, usually paid every month (Werther et al, 1985). Sufficient salaries should allow lecturers to devote their free time to scientific research instead of trying to supplement their meager pay by contracts with several institutions.

Workload is the amount of work assigned to or expected from a worker in a specified time period or the amount of work to be done, especially the academic staff. Realistically, teaching workloads vary greatly between lecturers according to their status and their academic ranks (Quick, L. et al, 2005). In Rwanda, according to Higher Council of Education, academic staff workload is broadly

conceived to refer to all academic activities that are related to professional duties and responsibilities. These include but are not limited to: preparation for lecture delivery; lectures & tutorials; assessments (coursework, final exams, and deliberations of exams); laboratory/excursions/practical; distance education-face-to-face sessions; school or clinical practice/internship/supervision of placements; module writing/programmes development/short courses; research project supervision; research; service activities (professional consultancy, delivery of workshops/seminars and conferences, participation on various institute standing and ad hoc committees, leadership in professional and civic organizations etc); guidance and counseling; leadership/administrative responsibilities/academic administration (National Council For Higher Education, 2008)

Materials (library, laboratory, ICT facilities)

For any institution of Higher Education to get Accreditation, in many conditions or requirements, there is quality of the Library contents. Libraries must be developed and equipped with new and enough relevant books, research materials and equipments. There should be a cyber space with high speed internet connection. There must also be a space managed to encourage the discussions in small groups to help students to share their ideas and thoughts on relevant topics after individual research

(Bertrand, 2003), and **laboratory** facilities that provide controlled conditions in which scientific research, experiments, and measurement may be performed (Matson et al, 2007).

3. Material and methods

This section describes the techniques and methods used in the study design in order to achieve the research objectives. It also highlights the way the sampling and data collection were performed.

It is well known that statistical studies (surveys, experiments, observational studies, etc) are always better when they are carefully planned (Fleiss, 1981). The problem should be carefully defined. Experimental or observational units must be selected from the appropriate population. The study must be randomized correctly. Reliable instruments should be used to obtain required information.

Finally, the study must be of adequate size, relative to the goals of the study. It must be 'big enough' that an effect of such magnitude as to be of scientific significance will also be statistically significant. It is just important, however, that the study not be 'too big', where an effect of little scientific importance is nevertheless statistically detectable. Sample size is important for economic reasons: An under-sized study can be a waste of resources for not having the capability to produce useful results,

while an over-sized one uses more resources than are necessary (Russell, 2001).

Therefore, the study population is composed of three clusters, namely, public higher learning institutions (Public HLIs), private higher learning institutions (Private HLIs) and research institutions (RI). The clusters were determined using the cluster sampling technique (Ralph et al., 2002) which is a way of grouping items/objects into different groups based on their characteristics, where items/objects of similar characteristics are grouped together. Our clustering process is justified by the fact that all Public and Private (HLI) have similar characteristics (teaching, doing research and service to community) with slightly different policies, while all Research Institutions (RI) have also their own characteristics and policies different from the ones of HLI.

The probabilistic sampling technique was used in this study in the context of giving equal chance to all academic and research staff to be in determined sample. Due to the fact that the data collection was done by the time where teaching activities were taking end, and that the concerned staff were not often coming to their institutions, five days were spent for each institution, end every staff coming in within the working hours time was given questionnaire by the researchers and/or the institution's faculties to be filled until the determined sample size is reached.

Since the sample size is an important component in a scientific research as stated above, it is determined by using the stratified random sampling as follows. Based on the core objective of this study which is the estimation of the proportion of staff who publish, we assume that the random sample variable (X) is normally distributed with constant mean μ and constant variance σ^2 denoted by $X \sim N(\mu, \sigma^2)$, but for practical purpose it should be standardized and become a random sample variable (Z) with mean zero and variance 1 denoted by $Z \sim N(0,1)$.

Now, let p be the proportion of staff who publish, and $q = 1 - p$ be the proportion of staff who do not publish, such that $p + q = 1$, where p and q comes from the baseline study of Rwanda or the region.

According to Castelloe (2000), the sample size (n) is therefore given by:

$$n = \frac{(1.96)^2 \, pq}{d^2}$$

(1)

where **d** is the level of significance which is usually 5%, and 1.96 is the corresponding value of random variable from a normal distribution at 95% confidence interval.

Since there is no baseline study carried out before, the sample size (n) should be the value which maximizes the product pq.

Mathematically speaking, the maximum value of pq is obtained where $p = q = 0.5$ which is 0.25. Therefore, the sample size in this case is

$$n = \frac{(1.96)^2 * 0.5 * 0.5}{0.05^2} = 384.16 \approx 384$$

(2)

As the obtained sample size (384) is less than the total number of individuals of cluster 1 (Public HLI) which totalizes 941 individuals, statistically speaking we should have taken the proportional number of individuals from each selected institution as a minimum number of people to be surveyed based on the estimated sample size n, which is equal to 384 as shown in Table 1 which corresponds to 40.8% (of 941).

For the other clusters, since the obtained sample size (384) is greater than the total number of individuals of clusters 2 and 3, (249 and 147 respectively), we have taken at maximum the total number of population of each selected institution of the two clusters mentioned above during the data collection (Ralph et al., 2002) as shown in Table 1.

Due to financial and time constraints, few of public, private Higher Learning Institutions (HLI) and Research Institutions (RI) were selected using purposive sampling based on their location, how big they are, types of degree programmes being offered for HLI, and types of research being carried out for RI, as they can be seen in the Table 1 below.

Table 1: Population Size of the selected Samples

Institution	Population size of academic/staff	Sample size* of academic/staff
Cluster 1 (Public HLI)		
National University of Rwanda (NUR)	516	211
Kigali Institute of Science and Technology (KIST)	155	63
Kigali Institute of Education (KIE)	126	51
Kigali Health Institute (KHI)	59	24
Umutara Polytechnic (UP)	85	35
Total	**941**	**384**
Cluster 2 (Private HLI)		
Kigali Independent University (ULK)	81	81
Institute of Lay Adventists of Kigali (INILAK)	79	79
Institute of Agriculture Technology and Education (INATEK)	46	46
Institut d'Enseignement Supérieur de Ruhengeri (INES)	43	43
Total	**249**	**249**
Cluster 3 (Research Institution)		
Institute of Policy Analysis and Research (IPAR)	4	4
Institut Agronomique du Rwanda (ISAR)	101	101
Institut de Recherche Scientifique et Technologie (IRST)	42	42
Total	**147**	**147**

Source: Authors' Primary data (2010)

The sample size is determined using the stratified random technique

After determining the sample size, the data were gathered using self administered questionnaires distributed to academic and research staff from the selected institutions randomly. Before designing the questionnaires, the dialogue with small number of concerned staff was conducted in order to have their opinions about the motivating and/or demotivating factors of level of publication. In this way, the used variables were deduced from their most common opinions. After getting the most common variables, self administered questionnaires were developed accordingly, and tested on thirty academic and research staff from both public, private higher learning institutions and research institutions.

Interviews were conducted with higher officials of the selected institutions and some persons familiar with higher education and scientific research. Additionally we also used the technique of participant observation. The data collection was performed at the appropriate level as shown in Table 2.

Table 2: Statistics of the Distributed Questionnaires

	Number of Distributed Questionnaire	Number of Returned Questionnaire	Percentage of Returned Questionnaire
Cluster 1 (Public HLI)			
NUR	211	174	82%
KIST	63	62	98%
KIE	51	43	84%
KHI	24	24	100%
UP	35	34	97%
Total	**384**	**337**	**88%**
Cluster 2 (Private HLI)			
ULK	81	44	54%
INILAK	79	60	75%
INATEK	46	35	76%
INES	43	25	58%
Total	**249**	**165**	**66%**
Cluster 3 (RI)			
IPAR	4	3	75%
ISAR	101	66	65%
IRST	42	28	67%
Total	**147**	**96**	**65%**

Source: Author's estimates (2010)

Error Calculation assuming stratified random sampling

This section will briefly discuss the standard error of a percentage of collected data. For simplicity, the calculations here assume that the poll was based on a simple random sample from a large population.

The standard error of a reported proportion or percentage p measures the data accuracy,

and is the estimated standard deviation of that percentage.

It can be estimated from just p and the sample size, n, if n is small or equal to the population size, using the following formula (Lohr, 1999).

$$\text{Standard error} = \sqrt{\frac{p(1-p)}{n}}$$

(3)

Table 3: Error Calculation in collected data

Cluster	Sample size (n)	Reported proportion (p)	Non-reported proportion (1 – p)	Standard Error
Public HLI	384	88	12	0.017
Private HLI	249	66	34	0.030
Research Institutions	146	65	35	0.039

Source: Authors' estimates (2010)

Based on the calculated errors of collected data given in Table 3, the error is small in concerned clusters compared to the assumed error (0.05) during the data collection. Therefore, there is no bias in the obtained results caused by the missing data.

For data analysis and interpretation, the approach of linear regression analysis is proposed. The variables to be used in the

model were scaled as follows: the collected information on the chosen variables was grouped in clusters using their percentages, and those percentages were used in the linear regression model as scaled data points. Since the linear regression approach requires the variables to be uncorrelated from each other, the Pearson correlation approach was used to assess the degree of multicollinearity in the variables.

Linear regression analysis is a statistical method used in this study to identify the key motivating and demotivating factors for research in HLI and research institutions. This method is chosen because it helps to assess at which level the independent variables contribute in explaining the variation of the dependent variable, together with being able to predict the future behavior of the dependent variable (Brooks, 2002).

Given a multiple linear regression model

$$Y = \beta X + \varepsilon$$

(4)

Where

$$Y = \begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_t \end{bmatrix}, X = \begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_t \end{bmatrix}, \beta = \begin{bmatrix} \beta_1 \\ \beta_2 \\ \vdots \\ \beta_k \end{bmatrix}, and \; \varepsilon = \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \vdots \\ \varepsilon_t \end{bmatrix}$$

with Y, X, β and ε being the dependent variable, independent variable, parameter estimates and residuals respectively, and t is the total number of observations, and k is the total number of parameter estimates.

In order to obtain the parameter estimates $\beta_1, \beta_2, ..., \beta_k$, the Residual Sum of Square (RSS) would be minimized with respect to all the elements of β (Russell et al., 2004; Peter et al., 2000) which leads to the vector of ordinary least squares (OLS) coefficient estimates for a set of k parameters to be

$$\hat{\beta} = \begin{bmatrix} \hat{\beta}_1 \\ \hat{\beta}_2 \\ . \\ . \\ . \\ \hat{\beta}_k \end{bmatrix} = (X'X)^{-1}X'Y$$

(5)

More specifically, the publication linear regression model to be estimated in this study is:

Model:

$$Pub_t = \beta_0 + \beta_1 Motivation_t + \beta_2 \operatorname{Re} searchPol_t + \beta_3 Salary_t + \beta_4 ExtraWork_t + \beta_5 Materials_t + \varepsilon_t$$

Pub$_t$: Level of publication

Where

Motivation$_t$: Level of motivation

ResearchPol$_t$: Level of research policy

Salary$_t$: Level of salary

ExtraWork$_t$: Level of extra teaching workload

Materials$_t$: level of reading materials (library, access to journals, ICT facilities)

The constructed linear model should be estimated for each cluster, i.e. public, private HLI and research institutions after assessing the level of multicollinearity problem among the independent variables (level of motivation, level of research policy, level of salary, level of extra teaching workload and level of materials), in order to get unbiased results. The main goal in estimating the model mentioned above is to get the values of model parameters $\beta_0, \beta_1, \beta_2, \beta_3, \beta_4, and\ \beta_5$ and check their significance which will help us to identify the impact of the chosen factors on the level of publications in the concerned institutions. All statistical analyses were carried out using Statistical Package for Social Sciences (SPSS) version 16.

4. Results and Discussion

This section presents the results of the research in details. These were obtained through frequencies, percentages, cross-tabulations from descriptive statistics and multiple regression analysis.

4.1. Assessment of Research Policy in Higher Education and Research Institutions

This section describes the findings about research policy in higher learning and research institutions. As discussed above, the research policy means all the arrangements, materials, rules, strategies and incentives in place to promote scientific research and publication. Some indicators of research policy are shown in Table 4.

The first objective of this study was to assess the existence and implementation of research policy in higher learning and research institutions in Rwanda. Based on views of respondents/interviewees, it was found that in all institutions the allocated research budget is used at the low rate, because in some institutions the academic staff does not have enough time to concentrate on research due to big teaching workload. While on the other hand, the concerned staff are not informed about the amount of research budget and the procedures of granting research funds due to lack of clear research policy.

The results presented in Table 4 show that there is no common research policy for higher learning institutions as justified by different teaching workload and research incentives.

Table 4: Information on Research Policy

	Existence of Research Policy	Existence of Scientific Review	Research budget	No. of books in Library	Existence of Research Unit	Research Incentives (Rwf)	Teaching Hours
Public HLI							
NUR	Yes	Yes	53,000,000	200,000	Yes	0	600
KIST	Yes	Yes**	5,000,000	100,000	Yes	0	288
KIE	Yes	Yes	20,000,000	70,000	Yes	0	216
KHI	Yes	Yes	40,000,000	16,565	Yes	0	1700*
UP	No***	No	0	38,243	No	0	336
Private HLI							
ULK	Yes	Yes	25,000,000	43,131	Yes	0	300
INILAK	Yes	Yes	33,000,000	31,000	Yes	0	300
INATEK	Yes	Yes	40,000,000	20,000	Yes	80,000	480
INES	Yes	Yes	12,000,000	20,000	Yes	0	480
Research Institution							
IPAR	Yes	No	Unknown	0	Yes	0	-
IRST	Yes	No	312,676,878	12,000	Yes	0	-
ISAR	Yes	No		16,000	Yes	0	-

Source: Authors' Primary data (2010)

* The teaching hours includes research and other activities.

**Created in 2010
*** In progress

4.2. Estimation of Proportion of Staff who publishes and who does not publish

In this section, the estimates of proportion of academic/research staff who publishes and

who does not publish are presented in the Table 5.

After analysing the data collected from the concerned institutions, it was found that the level of publications is not sufficient in both public and private HLI, but relatively good in research institutions. Indeed, as it can be seen in the Table 5 above, academic staff from public (41.7%) publish more than those from private HLI (35.9%) because of

implementation of the existing research policy. For research institutions, the publications level is relatively high since research is their only mission. The level of publications in the institutions mentioned above is supported by the proportion of academic/research staff by qualification given in Figure 1, with which public HLI have 29.8% PhD holders compared to 9% in private HLI.

Table 5: Estimation of the proportion of staff who publishes and who does not publish

	Level of publication in Public HLI (%)	Level of publication in Private HLI (%)	Level of publication in Research Institution (%)
1 – 3 articles	31.5	31.3	42.4
4 – 6 articles	6.8	2.6	5.9
7 articles and above	3.4	2	3.5
% of staff who publish	**41.7**	**35.9**	**51.8**
% of staff who do not publish	**58.3**	**64.1**	**48.2**

Source: Authors' Primary data (2010)

Figure 1: Proportion of Academic/Research staff by qualification (in %)
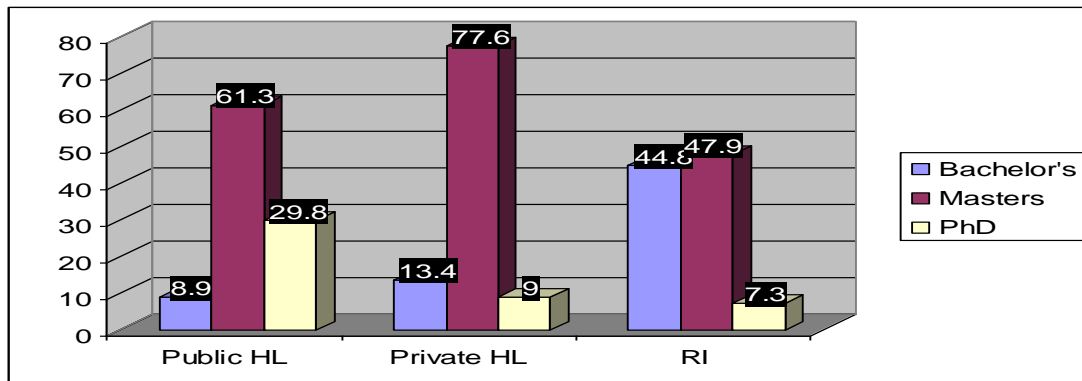
Source: Author's estimates (2010)

4.3. Identification of Motivating/ Demotivating Factors for Scientific Research

In order to identify the motivating/demotivating factors for scientific research, the main research obstacles and their levels were found out first as shown in Table 6.

The results show that lack of motivation is the top main obstacle for scientific research in all concerned institutions, while lack of research policy is taking the second place in both public and private HLI. However, in research institutions, lack of sufficient materials is the second major obstacle due to limited budget allocated to research activities which are usually experimental type and so expensive. On the other side, low salary is ranking on the third place for public HLI and research institutions of Rwanda.

Table 6: Level of obstacles for scientific research (%)

Type of Obstacles ****	Public HLI (%)	Private HLI (%)	Research institution (%)
Lack of motivation	48.1 *	65.5 *	51 *
Lack of research policy	16.6 **	12.1 **	11.5
Low salary scheme	13.8 ***	6.1	16.7 ***
Extra teaching workload	7.7	8.5 ***	0
Lack of sufficient materials	13.8	7.9	20.8 **

Source: Author's estimates (2010)

*   means position one
**   means position two
*** means position three
**** The position of obstacles was determined based on the frequency levels (from the highest to lower frequency).

Before estimating the constructed multiple linear regression model, the level of multicollinearity (correlation) among the independent variables is assessed using the Pearson's correlation (Myers et al., 2003) as shown in Table 8.

The level of multicollinearity (correlation) among the independent variables is low in general given that the obtained correlation coefficients are not approaching either -1 or +1. This means that there is no bias of results to be obtained from the linear model. These results bring to light that even the correlation between salary and motivation is very low (0.324). It may be concluded that this variable has a very little impact on the motivation. Indeed studies showed that the salary alone is not a motivating factor, but it must be combined with other factors such as

work environment, organizational climate, leadership, recognition, etc. (Maslow, 1954; Herzberg et al, 1959; Adams, 1963; Vroom, 1964; Locke, 1968; O'Brien, 2003; Bainbridge, 2007).

Thus, multiple linear regression model is estimated in order to assess the contribution of each demotivating factors to the level of

publications in the concerned institutions. As shown in Table 9 below, the estimated model for three clusters is able to explain above 60% (adjusted R^2) of the total variation of level of publications in the concerned institutions.

Table 8: Pearson's correlation coefficients among the independent variables

	Level of motivation	Level of research policy	Level of salary	Level of extra teaching workload	Level of materials
Level of motivation	1				
Level of research policy	0.277	1			
Level of salary	0.324	0.270	1		
Level of extra teaching workload	0.091	-0.021	0.203	1	
Level of materials	0.095	0.063	0.063	0.052	1

Source: Authors' estimates (2010)

As shown in column P-value of Table 9, the results of the estimated linear regression models confirm that lack of motivation, lack of research policy, and low salary are the major factors of low level of publication for academic and research staff. However, the extra teaching workload in private HLI is another important factor for staff to publish, because in private Higher Learning Institutions, they still use intensive teaching

model which allows academic staff to complete the whole workload in short time and spend the rest of their time in extra teaching rather than doing research.

As conclusion, all the identified factors have a positive impact on the level of publication except the extra teaching workload factor which has a negative impact, as shown in column B of Table 9.

Table 9: Results of publication linear regression model

Variable	Statistics								
	Public HLI			Private HLI			RI		
	B	SE	P-value	B	SE	P-value	B	SE	P-value
Constant	2.957	0.402	0.000	2.772	0.525	0.000	3.3	0.921	0.001
Motivation	0.298	0.191	0.0119*	0.124	0.241	0.0607**	0.250	0.284	0.0652**
Research policy	0.136	0.152	0.372	0.074	0.235	0.751	0.311	0.336	0.357
Salary scheme	0.182	0.166	0.0273*	0.313	0.250	0.211	0.656	0.316	0.040*
Extra teaching workload	-9.77E-03	0.149	0.948	- 0.057	0.254	0.0823**	-	-	-
Materials	0.113	0.145	0.437	0.248	0.271	0.362	0.290	0.288	0.0316*
Sig. F change			0.0538**			0.0697**			0.243
Adjusted R^2	0.62								

Source: Authors' estimates (2010)

* means significant at 5%
** means significant at 10%

4.4 Findings from Interviews and observation

In interviews with higher officials of the selected institutions and some persons familiar with higher education and scientific research, other motivating and demotivating factors to scientific research and publication were discussed, in addition to those assessed above. Some of them have been confirmed through researchers' observation. Those results are summarized below:

- Lack of reading culture by both lecturers and students;
- Lack of research skills and capacity to conduct research;
- Lack of spirit of scientific competitiveness on national and international level;
- Research is costly in terms of time and money;
- Negative attitude toward researcher by some respondents;

- Lack of appreciation for the importance of research to development;

- The research findings are not always utilized by the beneficiaries but they are often forgotten in drawers.

- Currently, very few higher learning institutions organize regularly scientific seminars, symposia or conferences. However, since 2004, NUR organizes each year a scientific research conference that allows lecturers/researchers to present the results of their researches. Then their papers are published in the NUR's scientific review "Etudes Rwandaises" become currently "Rwanda Journal".

- Concerning what types of research are done in Rwanda, it has been indicated that in Higher Learning Institutions, all types are conducted by Lecturers and students, while, in Research Institutions, applied researches are most done.

- Consultancy activities within Higher Learning Institutions are also scientific researches which do not always lead to publication, but they can motivate lecturers/researchers by

allowing them to work in teams, earn money for themselves and their institutions and conduct researches. But partnership between Higher Learning Institutions and companies in terms of research project oriented is not yet effective, compared to research institutions.

- In most of Higher Learning Institutions, academic staff has no offices, but large common rooms which do not allow enough concentration. However the Presidential Order No. 51/01 of 13/07/2010 establishing quality standards in Higher Learning Institutions (Chapter 1, Section 2, paragraph 1.2.1) orders that in all Higher Learning Institutions, "Space for two members of academic staff (Full Time) to use for offices normally should be 2.0 m^2. 1.0 m^2 shall imply room for improvement while less than 1.0 m^2 shall be considered unsatisfactory. "

- In all Higher Learning Institutions, obtaining the Bachelor's degree is subject to the submission of a dissertation which is supervised by qualified academic staff. The

lecturers could carry out scientific articles based on students' dissertations; unfortunately, they are not publishing due to lack of motivation; the supervision allowances provided to academic staff motivate them, in fact, to supervise dissertations, but not to publish. They do not see the importance of publishing because the current promotion and incentives policy is not motivating enough. Another challenge is that the working environment is not favorable due to (1) big number of students allocated to each lecturer for dissertation's supervision compared to standards stated by HEC, (2) low quality of dissertations done by students due to lack of reading culture mentioned above and insufficient time spent by students to their researches.

Moreover, the interviewees also provided some relevant suggestions that will be inserted below in the recommendations.

5. Conclusion and Recommendations

5.1. Conclusion

The aim of the present paper was to find out how to promote scientific research in higher learning and research institutions in Rwanda. As stated previously, the first objective was to assess the research policy within higher learning and research institutions that has a strong influence on how research activities are being conducted. Based on views of respondents/interviewees, it was found out that in all institutions the allocated research budget is used at the low rate, because in some institutions the academic staff does not have enough time to concentrate on research due to big teaching workload. While on the other hand, the concerned staff are not informed about the amount of research budget and the procedures of granting research funds due to lack of clear research policy.

The second objective was the estimation of proportion of academic/research staff who publishes and who does not publish. The obtained results from the survey show that the level of publications is not sufficient in

both public and private HLI, but relatively good in research institutions.

After assessing the level of publication in the concerned institutions, the third objective was to identify the motivating or demotivating factors to scientific research and publication. And the findings revealed that the problem of motivation (salary, working environment, promotion, recognition, research award etc), research policy are the main obstacles for scientific research in both public and private HLI. However, in research institutions, motivation and lack of sufficient materials, and limited budget are the major obstacles.

5.2. Recommendations

From the findings of this study, it was found that the problem of motivation, research policy, low salary, extra teaching workload, materials (library, laboratory, ICT facilities, access to journals, etc) contribute most to the low level of publications in both higher learning and research institutions. Therefore, in order to promote scientific research, it would be useful to:

1. Establish a common clear research policy for all higher learning institutions for which the research procedures should be well explained from the research proposals stage until the final research report. A serious follow-up of research commission should be emphasized. Academic/research staff should be given clear research tasks and responsibilities from which they will be evaluated. The research policy should clearly provide procedures of granting research funds and it should be communicated to the academic staff through all possible ways. Research incentives policy should also be highlighted in the research policy.

2. Create and/or reinforce Research Committee within Higher Learning Institutions.

3. Establish an Interdisciplinary Research Center which will coordinate all researches in order to avoid overlaps and duplication, assess if those researches are linked to national problems solving according to national policies (MDGs, Vision 2020, and EDPRS) and encourage the collaboration in research.

4. Implement properly the national modular system for Higher Education proposed by the Higher Education Council (HEC).

5. Consider the research hours in workload and remunerate them such as supplementary teaching hours are paid.

6. Motivate academic and research staff through (a) providing incentives based on publications, (b) consideration of publications during the recruitment in all areas (not only in teaching career), (c) improving working environment (open communication, job security, leadership and integrity), (d) promotion based more on number of publications and teaching skills than on number of experience years, (e) recognition through public congratulations, (f) research award, etc.

7. Establish a framework where senior researchers train juniors: the lecturers must be trained continuously in conducting scientific research through learning and seminars.

8. Improve Internet access (speed).

9. Provide workplaces (offices) for lecturers enabling an adequate concentration and equipped with ICT facilities according to the Presidential Order No. 51/01 of 13/07/2010 establishing quality standards in Higher Learning Institutions.

10. Organize regularly research seminars, symposiums, and invite Master's and PhD holders or in process to present papers relating to their researches, as it is done by NUR annually since 2004.

11. Organize and implement consultancy units within Higher Learning Institutions. Such an organization will bring lecturers who are currently conducting consultancies individually, to carry them out within their institutions and thus promote research. However, it would be useful to establish mechanisms enabling to publish some of these researches.

12. Reinforce partnerships between Higher Learning Institutions and companies in terms of research project oriented.

13. Enhance mainly applied research which aims at finding a solution for an immediate problem facing a society or an industrial/business organization. Indeed, among the four categories of research discussed above in section 1.3, most respondents prefer applied research given that it is focused to solving concrete problems faced by society.

14. Lecturers should be encouraged to publish articles based on supervised dissertations. However it will be also necessary to comply with the standards of HEC in assigning students (number) to lecturers for supervision.

15. Enhance reading culture for both lecturers and students.

Moreover, in order to supplement this study, it should be good to assess the contribution of research done to the national solving problems. Thus, we recommend to further researchers to take into consideration this component.

Another important future research orientation should be to assess the quality of dissertations done by the students in the context of their impact on national solving problems through checking whether the concerned units (public, private companies and non government organizations) exploit and implement the research results and proposed recommendations.

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