

Economics of Paper Use in Higher Learning Institutions and Its Implications to Climate Change

Zella AY*

Department of Economic Studies, The Mwalimu Nyerere Memorial Academy (MNMA)-Zanzibar, Dar es Salaam, Tanzania

Abstract

This paper was an attempt to reveal the less known economics of paper use in higher learning institutions and its contribution to climate change using The Mwalimu Nyerere Memorial Academy (MNMA)-Zanzibar as a case study. The cross-sectional research design was employed. Data were collected using a paper survey tool and interviews. Simple calculations were used to address the cost incurred each semester to buy paper at MNMA. The annual amount of trees exploited from the environment to make paper used by MNMA was estimated using a conversion ratio developed by FAO. Amount of carbon released to the atmosphere was estimated by using formula adopted by WWF. The investigation found that MNMA-Zanzibar has a total semester paper consumption of about 364 reams of different types. The semester cost of buying these reams was found to be about 2,910,000 TZS. Environmental cost was estimated at about 27 trees exploited to suffice semester paper use at MNMA-Zanzibar. The exploited trees per semester releases total carbon of 6.91 tons+2.01 tons and 2.78 tons+1.15 tons for Montane and Lowland forest trees species respectively suitable for paper production. The study concluded that, there is huge consumption of paper in higher learning institutions. The study suggested interventions for reducing massive consumption of papers in higher learning institutions includes introduction of paper use policy which will include among other measures such as electronic storage; paperless meeting, paper reuse, two side printing, sharing of documents electronically and awareness creation on paper use.

Keywords: Paper use; Economics of paper use; Environmental cost; Climate change

Introduction

Background information

Climate change and resource depletion are the world's greatest environmental challenge for 21st century [1]. Vulnerabilities and effects of these challenges differ continentally and Africa might experience the most severe impacts than other continents [2,3]. Growing evidence has shown that Green House Gas (GHG) emission such as Carbon Dioxide (CO₂) and Sulphur Dioxide (SO₂) are some of the major causes of climate change [4]. However Africa contributes relatively less to GHG in the world [5], but possess high portion of forests used as carbon sink. Forests processing industries for pulp and paper productions are not exempted from this scenario. For instance in Canada and the United States' of America pulp and paper industries pose as the third largest polluter to air, water, and land in both, and releases over 100 million kg of toxic pollution each year [6]

Paper use seems to be indispensable though it has a great burden to the users. As many people who work in an office can attest, paper is ubiquitous [7]. Paper is an office necessity for some essential tasks, but it has an environmental cost. Saving it reduces impact into the environment as manufacturing of paper from trees requires a lot of natural resources including trees, water and energy [8].

About 300 million tons of papers are produced each year worldwide whereby its consumption globally has reached 366 million tons and is rising steadily at an annual rate of 3.6%. The United States of America is by far the world's largest producer and consumer of paper with per capita consumption is over six times greater than the world average. For instance in 2004, the United States used 8 million tons of office paper (3.2 billion reams), which is equivalent to 178 million trees [8].

Large amounts of paper are mostly manufactured from trees where over 30 million acres of forests are destroyed annually [9]. The process involves the production of pulps from trees, straws, cotton, and recycled papers. The process of making paper can either be chemical

or mechanical. It is reported that deforestation for paper production significantly contributing to CO₂ emissions; where estimates of carbon released from deforestation of tropical forests range from 0.5 to 3 billion tons of carbon per year [10].

Regardless of its importance, paper has been reported to have many adverse impacts to the environment, right from when it is manufactured until to time of its disposal, collectively known as paper pollution [11]. The impact continues even after being disposed because once in a landfill, paper has the potential to decompose and produce methane, a greenhouse gas with 21 times the heat-trapping power of carbon dioxide [12]. Transportation throughout the trade system also has significant environmental impacts because harvested trees or recovered paper are transported to pulp mills, rolls of paper are transported to converters, and finished paper products are transported to wholesale distributors and then on to their retail point of sale. Transportation at each of these stages consumes energy and results in greenhouse gas emissions.

Production of recycled paper saves our natural resources because it is estimated that one-ton of recycled paper saves approximately 17 trees. In addition, it serves energy and water which was to be used in pulping [13]. Producing recycled paper involves between 28-70% less energy consumption than virgin paper, saving 4,100 kWh of energy if ton of 100% recycled paper used and 7,000 gallons of water. It also keeps

*Corresponding author: Zella AY, Department of Economic Studies, The Mwalimu Nyerere Memorial Academy (MNMA), Zanzibar, Dar es Salaam, Tanzania, Tel: +255 24 2250315; E-mail: zellahadi@gmail.com or adil.zellah@mnma.ac.tz

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more than 60 pounds of pollution out of the air and saves 3.3 cubic yards of landfill space, which is increasingly important as many local landfills near their capacity. Recycled paper also produces fewer polluting emissions to air (95% of air pollution) and water green source [13].

In economic and environment point of view, people need to realize that the cost of buying paper is just the tip of the paper iceberg. Saving paper saves money due to the fact that, for each sheet of paper used, a company or institution incurs not only purchasing cost, but also a storage, copying, printing, postage, disposal and recycling costs. The purpose of this study was to analyze contribution of paper use to climate change in Africa higher learning institution using The Mwalimu Nyerere Memorial Academy-Zanzibar as a case study.

Problem statement

Despite the great role plays by paper in documentation of information, examinations and meetings in higher learning Institutions but reports asserts that, paper have many adverse impacts to the environment and contributing to climate change evidenced from manufacturing process to its disposal [14]. Additionally, the financial costs of paper extend far beyond just purchasing the paper. There are also costs associated with storage, lost documents, copying, document obsolescence, labor inefficiency, printing, postage, disposal and recycling costs [7].

There is scanty information on the use of paper in higher learning institutions worldwide, but in Africa the situation is much worse. Few studies were conducted concerning amount, monetary and environmental cost of paper in higher learning institutions but are not comprehensive or uncertain. For instance, Humboldt State University in America used 2,637,137 sheets of paper in the year 2009; 1,900,696 in 2010 and 957,543 in 2011 [15]. Trend shows decline consumption of over 63% from 2009 to 2011. This drop was ascribed as a result of policy adoption of 'pay only what you print' introduced by the University (ibid). Furthermore, University of Toronto in Canada used more than one billion sheets in the year 2005 with a price amounted \$6,000,000 [16].

Globally over 13 million hectares of forest are destroyed annually, of which more than 40% is used in the paper production [16]. A study conducted by the Clark University in the US found that, the university uses 5,999,976 sheets of paper each year. This amount is equivalent to 720 trees harvested per year by the estimation that 1 tree is equivalent to 8333.3 sheets. However, in Africa especially Sub-Saharan countries like Tanzania, there are dearth information regarding monetary costs associated with consumption of paper in higher learning institutions, volume of trees exploited in relation to the amount of paper consumed and its impact to the environment. These papers are used for various purposes including meetings, documentations and examinations. However, there is no documentation on the amount of paper used, the associated costs of buying papers, the volume of trees exploited in relation to the amount of paper consumption and associated amount of carbon released to the atmosphere. Therefore this study aimed at filling these knowledge gaps using The Mwalimu Nyerere Memorial Academy (MNMA)-Zanzibar as a case study. The findings from this study suggests the best ways to reduce paper consumption in higher learning institutions; best cost effective paper consumption strategies and alternatives to paper use, as a result of saving money and our environment towards adopting paper use reduction policies. Furthermore, the findings will help to address global policies on mitigating climate change through Reducing Emissions from Deforestation and Forest Degradation (REDD+) initiatives.

Objectives of the study

Main objective: The main objective of this study was to assess economics of paper use in higher learning institutions and its contribution to climate change using The Mwalimu Nyerere Memorial Academy (MNMA)-Zanzibar as a case study.

Specific objectives: Specifically the study intended to:

- Determine the semester amount of paper used for different purposes at MNMA.
- Estimate the semester cost of buying paper at MNMA.
- Estimate the semester number of trees exploited in relation to the amount of paper consumed at MNMA.
- Estimate the semester amount of carbon realized to the atmosphere resulted from trees exploited in relation to the amount of paper consumed at MNMA.

Research Methodology

Description of the study area

This study was conducted at The Mwalimu Nyerere Memorial Academy (MNMA)-Zanzibar. MNMA-Zanzibar is located on plot no. 75 at Bububu area near Military Hospital in West Unguja District. The Academy is 08 Kilometers away from Stone Town Center.

MNMA-Zanzibar was established in 2011 as a part of MNMA located at Kigamboni Dar es Salaam. MNMA-Zanzibar is a Government Higher Learning Institution full registered by National Council for Technical Education (NACTE) on 27th August, 2015 with registration number REG/TLF/106. The Academy ranks the second position among the best Higher Learning Institution in Zanzibar as per TCU report on 23rd February 2015.

The Mwalimu Nyerere Memorial Academy is initially a product of Kivukoni College. In February, 1958 the National Conference of Tanganyika African Nation Union (TANU) which was held in Tabora passed a Resolution to establish a college for adults in the lines of Ruskin College of Oxford University. The College was to be a tool for spreading understanding of social, political and economic problems facing underdeveloped countries such as Tanganyika among people who were likely to become leaders in newly independent country but who did not have qualifications necessary to enter educational institutions. The Adult College was formally established on 29th July, 1961 as a private company under Companies Ordinance (Cap 212).

The College opened with 43 students only. Subjects taught were Political Science, History, Sociology, Literature, Geography, Administration, Law, Modern Languages plus other relevant subjects.

In 1971, Kivukoni College was transformed into an Ideological College. The College was considered best suited to inculcate the Party Ideology of Socialism and Self-Reliance. The main functions of Kivukoni Ideological College were:

- To spread and reinforce the ideology of the Party (TANU) through interpreting, teaching, analysing and defending it and in so doing raise the level of understanding of leaders and masses at large.
- To be a source of ideas to help the Party promote the development of Tanzania.
- To be a source of information and an advisory organ on various issues regarding the ideology of the Party.

- Kivukoni Ideological College had eight zonal colleges, namely Zanzibar, Lushoto, Murutunguru, Hombolo, Msaginya, Mahiwa, Kihinga and Ilonga. Kivukoni Ideological College and its zonal colleges offered the following subjects:
- Ideology and Politics.
- History: The History of the Party.
- Political Economy.
- Management and Administration.
- People's Combat and.
- Social Science Research Methodology.

All zonal colleges except Zanzibar were closed and handed-over to the Government of The United Republic of Tanzania in 1992 due to adoption of the multi-party system which became operational with effect from 1st July, 1992. In order to enable Kivukoni Ideological College to assume a new role under a multi-party system, the college was transformed into an academic institution and named Kivukoni Academy of Social Sciences (KASS).

The Memorandum and Articles of Association which established Kivukoni Academy of Social Sciences gave mandate to the Academy to undertake the following functions:

- To take over the assets and liabilities of Kivukoni College.
- To provide instruction to students in various branches of Social Sciences relevant to the promotion and advancement of social, political, scientific and technological development of a developing country.
- To provide and assist in the study of Social Sciences and allied subjects through classes, or any other means suitable to that end and cooperate with any bodies that are or may be doing similar or connected work.
- To carry out and or sponsor research activities in various branches of Social Sciences and allied subjects and provide consultancy services.
- To award certificates, diplomas, testimonials, transcripts in a manner that shows the results of examinations administered by KASS.
- To administer any scholarships or other monies which may become available to KASS, and to conduct tests in a manner likely to assist in the selection of students for whom KASS is designed.

In terms of training programmes, KASS offered a one year Certificate in Youth Work and two year Diploma Programmes in Social Studies, Economic Development and Gender Issues in Development. A national need for expansion of higher education necessitated Kivukoni Academy of Social Sciences to be transformed into a public higher learning institution. The Mwalimu Nyerere Memorial Academy (MNMA) was established by an Act of Parliament No. 6 of 2005. The Act became operational on 1st October, 2005 by publication of Government Notice No. 433 of 23rd December, 2005. The Academy took-over functions, assets and liabilities of the former Kivukoni Academy of Social Sciences.

The Academy has been renamed after Mwalimu Nyerere in honour and recognition of his contribution as the Father of the Nation and the

Founder of Kivukoni College. MNMA-Zanzibar currently conducts training in ten (10) degree programmes, thirteen (13) diploma programmes and nine (9) certificate programmes.

The current academic members of staff stand at 58 and 16 administrative staff. The student population stands about 859 that include Certificates, Diplomas and Undergraduate (NTA Level 4-7).

Research design

The study used a cross-sectional design which involved collection of data at a single point in time [17]. This type of study design utilizes different groups of people who differ in the variable of interest at a time. Also it shares other characteristics such as socioeconomic status, educational background, and ethnicity.

Sampling procedure

Sampling frame: The sampling frame was a list of paper consuming departments and units at MNMA-Zanzibar.

Sampling units and sample size: The sampling unit is the paper consuming department/unit. For purpose of this study, sampling unit defined as a department/unit in MNMA-Zanzibar involving with paper using activities from includes meetings and examinations. Examinations included; continuous assessment tests, end of semester examinations, probation examinations, students' research proposals, research project reports and dissertations for the semester starts March 2016 to July 2016.

Eight offices directly dealing with academic matters were purposively selected as source of data used in this study. These included: The office of Deputy Principle (Academic, Research and Consultancy), four offices of the Heads of Academic Departments, office of Quality Assurance Officer, Library, and office of Admission and Examination officer.

In addition, six administrative offices were also purposively selected as a source of data. These included: the Principal, Chief Administrative officer, Bursar's office, Planning Unit, Dean of students, Supplies Unit.

Data was also obtained from one prominent Stationery shop operating at the campus and is mainly involved in printing and binding student's field and research reports was also used in this study.

Data collection methods

Paper survey tool adopted from Brazil et al. was used to collect information so as to address objectives: (i) and (ii) Interviews were administered to appropriate officers, including: secretaries, human resource officer, and purchasing officer of respective offices. To address objective (iii) simple calculations were made using results derived from objective (i), based on the conversion ratio adopted from FAO and as was used by Clark University (2012). To address objective (iv) calculations were made using results obtained from objective (iii) based on procedures adopted from WWF [18-21].

Data analysis

Semester amount of paper used at MNMA-Zanzibar: The amount of paper used per semester was estimated by multiplying the average total number of scheduled meetings as per MNMA Almanac by the average number of meeting documents and the average number of pages in each document.

The average semester number of paper used for examinations was estimated by summing up the amount of ruled paper used for

continuous assessment tests in respective Academic departments and answer booklets used for end of Semesters 1 and 2 probation examinations for semester starts March-July, 2016.

The average annual amount of paper used for students' field reports was estimated by multiplying the number of documents presented in March-July, 2016 semester by the average number of paper sheets making each report.

The average annual amount of paper used by prominent stationery shop at MNMA-Zanzibar was estimated by the number of reams purchased and used in March-July, 2016 semester.

Semester cost of buying paper at MNMA-Zanzibar: Total cost of buying paper was estimated by multiplying the total number of reams of paper used in March-July, 2016 semester by the prices of each paper type (i.e., 9,000 TZS for white print/copier, 15,000 TZS for colored print/copier, 28,000 TZS for Manila, 6,000 TZS for ruled paper and 710 TZS for examination booklets).

Semester number trees exploited for MNMA-Zanzibar paper needs: Total number of trees exploited from the forest for semester paper needs was estimated by dividing the average number of reams of paper used in a semester by an estimated paper calculator factor of one tree is equivalent to 16.67 reams FAO [22].

Estimation of the amount of carbon released to the atmosphere as a result of paper use at MNMA-Zanzibar: Total carbon released to the atmosphere includes above ground live carbon (AGLC) plus mean soil carbon. AGLC was estimated for each tree (stem) with a new improved biomass allometric equation, and assuming 50% of biomass is carbon [23]. Wood specific gravity (WSG) was estimated as the mean value for each species from a database of 2961 records from 844 species [24]. In our case (Tanzania) Montane forest or Lowland forest vegetation types used for paper productions, whereas species involved are *Pinus* spp., *Juniperous procera*, *Araucaria* spp., *Podocarpus* spp. The use of WSG is found to be more efficient in calculating above ground tree biomass especially when including much broader range of vegetation types [20,23]. The following equation was used in calculating above ground tree biomass.

$$AGB (kg) = 0.112 \times [WSG (g.cm^{-3}) \times DBH2 (cm^2) \times Height (m)]^{0.916}$$

The soil carbon was expressed as the % organic carbon with the following formula adopted from WWF, 2015:

$$soc(\%) = \frac{(meq.K_2Cr_2O_7 - meq.FeSO_4) \times 0.003 \times 100 \times f \times MCF}{Mass(g) \text{ air dry soil sample}}$$

Where:

MCF: Moisture correction factor; f: Correction factor of the organic carbon not oxidized by the treatment (normally approx. 1.3). Computation of soil carbon density was based on soil mass per unit area obtained as the product of soil volume and soil bulk density determined from the bulk density samples in g/cm³. Soil samples are expected to be re-analyzed by the use of CHN analyzer for doing comparative analysis.

Results and Discussion

An overview

Semester MNMA-Zanzibar paper consumption, cost and the number of trees used to manufacture such amount of paper, amount of carbon released as a result of amount of paper used in the March-July, 2016 semester was investigated and reported in this work.

MNMA-Zanzibar purchased and used various types of paper to suit various activities as reported and discussed under various subchapters in this work. The major paper consuming activities were found to be meetings, documentations and examinations as presented and discussed under various subchapters in this work.

Semester paper consumption at MNMA-Zanzibar

Consumption by MNMA-Zanzibar: MNMA-Zanzibar has an estimated annual consumption of 364 reams of various types of paper in the period of March-July, 2016 semester (Table 1). White print/copier paper was the most used paper; where about 242 reams were used, accounting for about 66.5% of all paper types used over the period. The second mostly used type was the ruled paper, where 122 reams (33.5%) were used during the period.

White print/copier paper is mostly used for routine office correspondences, printing of meeting documents and examinations. Ruled paper was found to be used for continuous assessment tests. Colored print/copier and Manila paper were not found to be used to prepare at this semester.

These findings imply that, there is an extensive semester paper consumption at MNMA-Zanzibar compared to the number of students which were 507 students in all programs (Tables 1-4) in March-July, 2016, a similar study conducted in 2009 at the Humboldt State University in California (USA) with more students, degree programs and Departments than SUA indicated that the University used 5274 reams of paper [25].

Paper consumption by academic departments at MNMA-Zanzibar: Paper consumption by individual MNMA Academic and Administrative offices was also analysed and reported in this work. The amount of paper consumed by various academic offices is presented in Tables 5. Academic offices in this work included four academic departments (Gender, Education, Economic and Social Studies) under the Deputy Principal (Academic, Research and Consultancy).

MNMA-Zanzibar administrative offices used 12 reams of white/copier papers in March-July, 2016 semester. Most paper was used to prepare documents for various Academy meetings, letters, memos and office documents.

Semester paper consumption by prominent stationery shop at MNMA-Zanzibar: Most student assignments, field reports in the period were printed and bound at one stationery shop located in the Academy premises. In March-July, 2016 semester, the shop used 73 reams of white print/copier paper and six reams of Manila paper for printing and binding services.

Semester cost for paper procurement at MNMA-Zanzibar

There is a centralized procurement unit at MNMA-Zanzibar. The current paper purchasing practice in the Academy follows the Public Procurement Act of 2011 and Public procurement regulations of 2013. Purchasing is normally done from suppliers who are permanent tenderers to the Academy. Paper was ordered depending on the need and the budget. The prices of paper however do fluctuate, depending on the value of the US\$ over the Tanzanian shilling.

MNMA-Zanzibar purchased about 242 reams of white print/copier and 122 reams of ruled paper in March-July, 2016 semester, as reported in section Consumption by MNMA-Zanzibar. On saving cost, 86 reams out of 242 reams of white/copier paper (A3 type) were used to make 3,050 semester examination booklets.

S. No.	Programme	M	F	Total
1.	B Basic Technician Certificate in Youth Work (NTA Level 4)-Semester I	2	7	9
2.	Basic Technician Certificate in Community Development (NTA Level 4)-Semester I	16	31	47
3.	Basic Technician Certificate in Community Development (NTA Level 4)-Semester I	1	7	8
4.	Technician Certificate in Community Development (NTA Level 5)-Semester I	2	7	9
5.	Technician Certificate in Community Development (NTA Level 5)-Semester II	1	2	3
6.	Higher Diploma in Gender and Development (NTA Level 7)-Semester II	5	8	13
Total		27	62	89

Table 1: Department of gender studies.

S. No.	Programme	M	F	Total
1.	B Technician Certificate of Education in Geography and History (NTA Level 5)-Semester II	2	2	4
2.	Higher Diploma of Education in Kiswahili and English Language (NTA Level 7)-Semester II	2	1	3
3.	Higher Diploma of Education in History and English Language (NTA Level 7)-Semester II	3	0	3
4.	Higher Diploma of Education in History and Kiswahili (NTA Level 7)-Semester II	1	0	1
5.	Higher Diploma of Education in Geography and English Language (NTA Level 7)-Semester II	1	0	1
6.	Higher Diploma of Education in Geography and Kiswahili (NTA Level 7)-Semester II	1	0	1
Total		10	3	13

Table 2: Department of education.

S. No.	Programme	M	F	Total
1.	B Basic Technician Certificate in Record, Archive and Information Management (NTA Level 4)-Semester I	2	37	39
2.	B Basic Technician Certificate in Record, Archive and Information Management (NTA Level 4)-Semester II	1	4	5
3.	B Technician Certificate in Record, Archive and Information Management (NTA Level 5)-Semester I	2	3	5
4.	B Technician Certificate in Record, Archive and Information Management (NTA Level 5)-Semester II	2	5	7
5.	B Basic Technician Certificate in Human Resource Management (NTA Level 4)-Semester I	21	29	50
6.	B Basic Technician Certificate in Human Resource Management (NTA Level 4)-Semester II	3	8	11
7.	B Technician Certificate in Human Resource Management (NTA Level 5)-Semester I	2	4	6
8.	B Technician Certificate in Human Resource Management (NTA Level 5)-Semester II	2	2	4
9.	B Higher Diploma in Human Resource Management (NTA Level 7)-Semester II	7	9	16
10.	B Higher Diploma in Management of Social Development (NTA Level 7)-Semester II	6	5	11
Total		48	106	154

Table 3: Department of social studies.

The total cost of the paper procured by MNMA-Zanzibar during March-July, 2016 semester was about 2,910,000 TZS using the prices of paper during the study period as presented in Table 6. The white print paper and the examination booklets used most of the money incurred during the period, accounting for about 74.9% of the total value.

Estimation of the number of trees exploited for semester at MNMA-Zanzibar

The number of trees exploited at semester basis to suffice MNMA-Zanzibar paper requirements in March-July, 2016 semester was estimated to be about 27 trees, based on the calculation factor of 16.67 white print/copier reams from one tree [22,26].

This figure may however, be larger when other paper types are included in the calculation. This estimated amount implies that MNMA paper consumption has a considerable impact to the environment. A similar study conducted at Clark University [26-30] showed that the University used paper worthy 504 trees in a year.

Estimation of the amount of carbon released to the atmosphere as a result of paper use at MNMA-Zanzibar

Total carbon released to the atmosphere ranges from 181.42-330.32 kg/tree amounted 4.90-8.92 tons of carbon released to atmosphere per semester when paper are produced from Montane forest tree species. Whereas, if paper produced from Lowland forest tree species carbon released per semester ranges from 60.62 kg/tree to 145.44 kg/tree amounted 1.64-3.93 tons. The result implies that Montane forest stores carbon at least twice as much as Lowland forest (Table 7).

S. No.	Programme	M	F	Total
1.	B Basic Technician Certificate in Economic Development (NTA Level 4)-Semester I	6	4	10
2.	Basic Technician Certificate in Economic Development (NTA Level 4)-Semester II	4	4	8
3.	Technician Certificate in Economic Development (NTA Level 5)-Semester I	2	1	3
4.	Technician Certificate in Economic Development (NTA Level 5)-Semester II	6	3	9
5.	Higher Diploma in Economics of Development (NTA Level 7)-Semester II	10	12	22
6.	Basic Technician Certificate in Accountancy (NTA Level 4)-Semester I	5	7	12
7.	Basic Technician Certificate in Accountancy (NTA Level 4)-Semester II	4	5	9
8.	Technician Certificate in Accountancy (NTA Level 5)-Semester I	1	7	8
9.	Technician Certificate in Accountancy (NTA Level 5)-Semester II	2	1	3
10.	Basic Technician Certificate in Business Administration (NTA Level 4)-Semester I	11	20	31
11.	Basic Technician Certificate in Business Administration (NTA Level 4)-Semester II	3	4	7
12.	Technician Certificate in Business Administration (NTA Level 5)-Semester I	5	12	17
13.	Technician Certificate in Business Administration (NTA Level 4)-Semester II	2	4	6
14.	Basic Technician Certificates in Procurement and Supply (NTA Level 4)-Semester I	7	15	22
15.	Basic Technician Certificates in Procurement and Supply (NTA Level 4)-Semester II	6	12	18
16.	Basic Technician Certificates in Information Communication Technology (NTA Level 4)-Semester I	13	19	32
17.	Basic Technician Certificates in Information Communication Technology (NTA Level 4)-Semester II	8	14	22
18.	Technician Certificates in Information Communication Technology (NTA Level 4)-Semester I	7	5	12
Total		102	149	251

Table 4: Department of economic studies.

Department	Print/copier White	Ruled	Examination Booklets
Gender Studies	22	21	15
Education	22	3	2
Social Studies	36	37	26
Economic Studies	65	61	43
Grand total	144	122	86

Table 5: Semester amount of paper (reams) consumed by academic departments at MNMA-Zanzibar.

Paper type	Amount (reams)	Unit cost (TZS)	Total cost (TZS)
Print/copier white	242	9000	2,178,000
Ruled	122	6000	732,000
Total	-	-	2,910,000

Table 6: Total semester spending by MNMA-Zanzibar on paper for the March-July, 2016 semester.

Vegetation	Mean AGLC (kg/tree)	Mean soil carbon (kg/tree)	Total carbon (kg/tree)	Total carbon (kg/semester)
Montane forest	89.02 ± 33.30	165.29 ± 68.09	255.87 ± 74.45	6908.49 ± 2010.15
Lowland forest	59.41 ± 41.54	42.91 ± 20.96	103.03 ± 42.41	2781.81 ± 1145.07

Table 7: Amount of carbon released to the atmosphere per semester at MNMA-Zanzibar as a result of paper use.

Conclusion

The study examines the economics of paper use in high learning institutions and its contribution to climate change using The Mwalimu Nyerere Memorial Academy-Zanzibar as a case study. The study concludes that paper use contributes much to climate change evidenced by the amount of carbon released to the atmosphere each semester (6.91 tons+2.01 tons and 2.78 tons+1.15 tons for Montane and Lowland forest trees species respectively suitable for paper production). On other hand, number of students enrolled in various courses of higher learning institution is proportional to the number of paper per semester. This mean that, more students enrolled more carbon released to the atmosphere evidenced by MNMA-Zanzibar used 364 reams when having 507 students plus 73 reams used by prominent stationery shop.

Also, high paper demand at MNMA -Zanzibar cost cash amount of about 2,910,000 TZS per semester for buying papers. Consequently, environmental cost of about 27 trees exploited each semester to sustain paper supply at MNMA-Zanzibar.

Recommendations

MNMA-Zanzibar uses a considerable amount of paper in a semester, which in turn has cost to the Institution and to the environment. However, the amount of paper used can be minimized if the Academy will put in place a paper use reduction policy which will include the following recommendations:

- Encourage paper users to opt for two sides printing.
- Conduct paper-less meetings by encouraging participants to use their personal computers for reviewing documents and note-making.
- Encourage sharing information by the use of projector.
- Encourage the use of message programs such as email to exchange information.

- Encourage that reports, forms and announcements to be put on a central bulletin board or electronically on the Academy Website rather than producing printed versions.
- Encourage review and edit of draft documents on-screen by using the word processing “track change” feature instead of printing out hard copies for markup.
- Encourage the use electronic storage whenever practical instead of storing hard copies.

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