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Paperless Campus: The Real Contribution towards a Sustainable Low Carbon Society

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Abstract: *Massive global deforestation is not only caused by deforestation of tropical forests in developing countries, but also deforestation of natural forests in developed countries. Pulp and paper industry is one of the main players of deforestation. Globally, paper consumption increases by 3% per year. Currently, global paper consumption is around 350 million tons. The paper industry itself consumes 35% of all trees to produce paper. We have to cut one tree to produce 16.7 reams of paper (equal to 8,333.3 sheets). Annually, more than 900 million trees are cut for paper industries in the world. On average, individual consumption of paper is currently around 4,873.1 sheets per year, per student (or equal to 0.6 trees per year, per student). The papermaking process simultaneously contributes significantly to the pollution of water and air. Paper production factories emit 6.5 pounds of CO_2 per ream of paper production or around 80 million tons of CO_2 per year. In Canada and the USA, the pulp and paper industry is the third largest industrial polluter releasing over 100 million kgs of toxic waste every year. This study carried out students interviews (n=118) followed by a structured questionnaire in the Graduate School for International Development and Cooperation (IDEC), Hiroshima University, Japan to generate empirically supported assessment and explore the factors of the educational institutions that are responsible for creates forest degradation and deforestation. To fulfill the research objectives, this study used the Probit model and cost-benefit analysis (CBA). This study identified more paper consumption creates hindrance for establishing a sustainable low carbon society. Provision of behavioral change of stakeholders, government intervention, financial and technical assistance from development partners and electronic gadget manufacturers, and sometimes social corporate responsibility (CSR) can promote a paperless campus and ensure a sustainable low carbon society. The findings of this paper provide a robust basis for policy makers, researchers, and stakeholders for further research and development of specific policies and plan in this field to lessen the forest degradation and deforestation and establish a paperless campus.*

Keywords: *Paperless campus, Sustainability, Low carbon society*

I. Introduction

Every forest ecosystem service worldwide is now in a captious position. The decline of the region's forests can be attributed to a range of deforestation drivers. Every two seconds, an area of forest the size of a football pitch is lost (Greenpeace, 2012). The largest forest areas of intact forest landscapes have been lost forever (Baucher et al., 2011). Moreover, massive global deforestation is not only caused by deforestation of tropical forests in developing countries, but also deforestation of natural forests in developed countries. Forest area reduction occurs mainly in Tasmania, Indonesia, Malaysia, Brazil, Finland, and Australia. Boreal forests consisting of conifer and deciduous trees in Canada and Russia are also threatened.

The pulp and paper industry is one of the main players (USA, Canada, Sweden, Finland, and Japan) of deforestation (Paper Facts, 1985). As in most other regions and the world as a whole, historically, growth in pulp and paper production and consumption has been far higher than in other product sectors (Environmental Group, 2006). In the Asia–Pacific region, consumption has increased fourfold since 1980 from 35 million to 130 million tons in 2005. Production has increased by almost just as much, from 30 million it increased to 95 million tons over the same period (FAO CDR, 2007). See Fig.1.1. for more details.

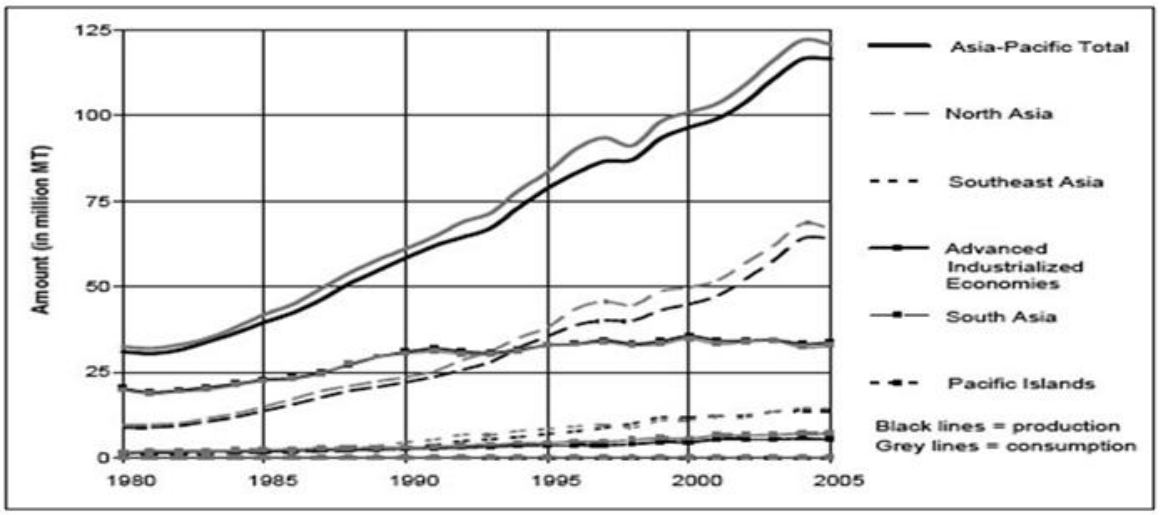

Figure 1.1: Trends in paper and paperboard production and consumption, 1980-2005
(Source: FAO Corporate Documents Repository, 2011)

Globally, paper consumption increases by 3% per year (DeRosa, 2007). Currently, global paper consumption is around 350 million tons (TAPPI, 2001). The paper industry itself consumes 35% of all trees (Ecology, 2013). We have to cut one tree to produce 16.7 reams (equal to 8,333.3 sheets) to 22.6 reams (equal to 8,350 sheets) of paper (Conserve Tree, 1988). In general, over 900 million trees are cut annually for paper industries (Green America, 2004). On average, individual consumption of paper is currently around 4,873.1 sheets per year per student (or equal to 0.6 trees per year per student) (In Forum, 2014).

Through the process of photosynthesis[1], trees remove from 100 to 120 billion tons of carbon each year (Conserve Earth, 2014). Trees help remove carbon dioxide (CO_2) from the main industrial factories (automobiles, manufacturing, airplanes,…). Like the other manufacturing industries, the papermaking process simultaneously contributes significantly to the pollution of water and air, and deactivates the carbon cycle and losses the carbon sink. Paper production factories emit 6.5 pounds of CO_2 with respect to the production of one ream of paper. Annually, it emits 80 million tons of CO_2 per year (DeRosa, 2007). Each tree, used in making paper, removes about one metric ton of carbon dioxide from the atmosphere every year. In Canada and USA, the pulp and paper industry is the third largest industrial polluter releasing over 100 million kgs of toxic waste every year (Dudley et al., 1996). Sweden and Finland's pulp industries are the largest sources of pollutions during papermaking processes in northern Baltic (Soderholm and Bergquist, 2012). Likewise, energy consumption for transporting pulp and paper inputs and outputs takes (10%-20%) of total operating costs (Blanco et al., 2004).

The increasing trend of paper production and consumption leads to more serious future negative environmental impacts. Some alternative measures can play an important role to reduce paper in the working place and academic arena for the protection of the forests and up gradation of the environment. Some organizations and offices have already introduced e-office and provide services to its customers through electronically. Speediness, transparence, cost effectiveness, accuracy, versatility, diligence, large volumes of data storage capacity and reduction of paper usage are the principal criterion of an e-office. Paperless campus also performs the liking activities of e-office. The paperless campus is a new pedagogical approach where most of the pedagogic activities are dependent on electronic gadgets (computer, internet, copier, scanner, and projector). Electronic books, an e-learning campus, digital libraries, computer-based learning, data-base management systems, video conferences, distance learning, smart card applications, web mail, teleconference and web-based applications are common components of a paperless campus. It works by alleviating the amount of times one physically handles documents, while maximizing the efficiency of the work by being able to retrieve information electronically and at the time that one needs it (Reaz et al., 2007). In short-run perspective, it requires relatively high initial cost but in long-run perspective, it requires less maintenance cost. It also reduces educational expenses because it is free from other associate coasts (printing services, delivery, mailing, storage, processing, disposing and recycling). According to Lambert (n.d.),

[1] Photosynthesis is a process used by plants and other organisms to convert light energy, normally from the sun, into chemical energy that can be later released to fuel the organisms' activities.

"Lamar University of Texas, USA had struggled with increasing printing costs and tracking student involvement data. To deal with such types of problems, this university has developed a web-based system. Many daily academic activities and processes have now been taken through online. Within one year of implementation of this project (2009/2010 - 2010/2011), the results are better than expected, in which copier machine usage and costs of printing are reduced by 51.2% (from 81,095 copies to 39,613 copies). The outside printing costs have also dropped and it is about 54.9% (from $2,325 to $1,048) respectively" (OrgaSync, 2014).

Paperless campus always focuses on the usage of less paper and more gadgets to perform academic activities. Using less paper is just as much about saving green as being green. It can save trees as well as the environment. It promotes social capital and is contributing to avoid natural resource degradation. In addition, paperless campus increases social or individual capability of students and professors and improves and expands their communication.

Anaheim University of USA, Lamar University of USA, Western Governors University of USA, Yale University of USA, Loyola University of USA, UK Open University, Hong Kong University, and Multimedia University of Malaysia are the pioneers of the paperless University. Some of the other Universities in USA, Canada, Japan and Australia have succeeded in conducting paperless campus.

The findings of this paper provide a robust basis for policy makers, researchers, and stakeholders for further research and development of specific policies and plan in this field to lessen the degradation and deforestation and increase the benefits of a paperless campus. In addition, the findings of this paper are also helpful for the university that wants to establish a paperless campus in the future.

The general objective of this paper is to identify the web-based instruments or infrastructure[2] which is helpful to establish a paperless campus. The specific objectives of this paper are to assess the feasibility of paperless campus, compare between paper base and paperless academic activities and develop an approach for the management strategy of a paperless campus.

II. Literature Review

There are very few numbers of existing peer-reviewed studies focused on the necessary conditions of the paperless campus and the negative impacts of paper usage on the environment in the world. There is a wide range of universities attempting to "go paperless." Some universities in USA, Canada, Japan, UK and Australia took initiative and successfully established a paperless campus. Prior studies on paperless campus revealed that the real paperless environment must begin at the cultural level. The paperless argument is a function neither of budget nor of environmental issue. Rather, if any campus wants to go paperless, the change begins with culture (Young, 2002). But this argumentum issue is not relevant for all universities in the world. Shifting the culture and campus social norms from the paper-based student evaluations to a paperless system is no easy task. There are certain significant barriers like achieving a high return from students and maintaining the integrity of the data for our tenure candidates (Bellevue College, 2014).

Most of the universities, especially in developing and under developed countries, have also wished to establish paperless campus. There initiatives are definitely laudable but there exist several weaknesses in the implementation of the establishment of a proper paperless campus. Developing and under developed countries have strong cultural level to quickly adapt their stakeholders with the paperless environment but they have financial deficiencies to set up the paperless campus in their respective universities. Furthermore, paperless academic activities depend upon the performance of continuous electricity. But continuous electricity in developing and underdeveloped countries is rare in practice. As a consequence, a paperless campus doesn't get a shape in reality. Financial and technical support from the government, mega gadget manufacturers, developing partners and donor agencies plays an important role to establish a paperless campus. Sometimes, corporate social responsibility (CSR) can also work in favor of a paperless campus and protect the forests and the environment. None of the studies in the world have completely touched upon or have precisely spoken on the issue/subject of a paperless campus and its requirement of the financial and technical supports. This paper will try to focus on the paperless campus from the point of cultural, financial, technical and CSR points of view.

III. Data And Methodology

3.1. Selected graduate school

Hiroshima University is one of the leading public universities in Japan. Among all of its 11 graduate schools, graduate school for international development and cooperation (IDEC) is the largest and most important graduate school in Hiroshima University. It was established in April, 1994 with a special mission of actively nurturing experts to address the various challenging issues which are frequently faced by developing countries. IDEC has brought together leading researchers and exceptional students from around the world. IDEC

[2] Web-based instruments or infrastructure is basically channel which is responsible for upload and downloads the class routine, class note, power point presentation, academic calendar, hand out, synopsis, cultural activities, advertisement of job market and so on.

is consequently becoming a distinguished center of excellence in the field of international cooperation studies with the 3 pillars of research and education: international peace cooperation, international environmental cooperation and international educational cooperation. It has now 325 individuals (274 students, 38 teachers and 13 stuffs).

As an organization who dedicates its academic life towards a low carbon society, IDEC has made efforts with regarding to paper consumption to reuse, recycle, and reduce paper usage. Through waste management, professors, students and supporting staffs of IDEC have been trying to recycle paper. On reusing, they are familiar to reuse one-sided used paper. And in terms of reducing, stakeholders of IDEC are recommended to do two-sided printing. Furthermore, most of the professors conduct online examinations. They prefer submissions of assignments and reports of the students through e-mail. Students and professors can upload and download any important and relevant academic documents in/from the "Web City"[3]. All stakeholders of IDEC also get information and news about class, vacations, festivals, found and lost, jobs, scholarships, summer school, research, seminars, trainings, and internships through the "Momiji"[4]. IDEC provides laptops and desktop computers for each student for their designated study years (2 years for master's students and 3 year for doctoral students). The whole IDEC tries to eliminate its partial paper based academic activities and incorporate full paperless academic activities to its area.

Although efforts have been exercised, however the results were less than expected. IDEC paper consumption is not reduced yet, but still increasing on average by 1% per year. Figure 3.1 shows that IDEC paper consumption in 2009 was around 1,552.5 thousand sheets and reached 1,583.8 thousand sheets by 2011 which is almost approximately one third of per year global average students paper consumption. It is estimated that globally per students consume around 4,873.1 sheets of paper in a year. It is equivalent to 0.6 trees per year per student (Cleveland State University, 2014).

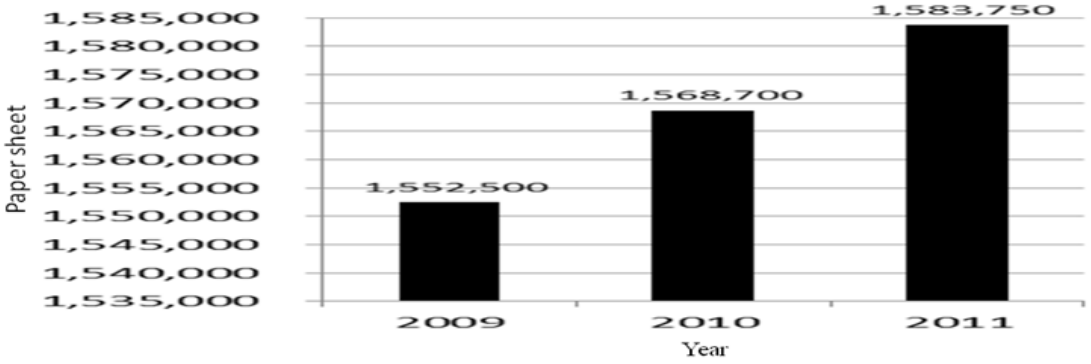

Figure 3.1: IDEC paper consumption (paper sheets)
(Source: Prepared by the authors ,2012)

Moreover, what is more surprising is the fact that IDEC has to spend 5.6 times more for printing than spending for paper, which is around 4.8 million Yen[5] in 2009, 5.0 million Yen in 2010, and 5.2 million Yen in 2011. Ink expense is also growing faster, 3.5% per year. Hence, IDEC expenses for paper and ink is still increasing and reached almost 6.0 million Yen in 2011. Average individual expenses for paper and printer ink is around 18,279 Yen per year per student (or 50.8 Yen per day, per student).

3.2. The data

To represents the population as a whole, a complete and accurate the sample framework is necessary. In this paper, the sampling unit was the students in the IDEC. The sample size is n=118. This paper followed the simple random sampling methods to collect cross-section data from the students. Personal interviews were conducted by the National Oceanic and Atmospheric Administration (NOAA) guided structured questionnaire survey to collect relevant data and information during the months (March-May) in 2012.

3.3. The analytical approach

A Probit or Normit model approach is used to identify the role of different initiatives for establishment of paperless campus and to check robustness of the estimated parameters of the model. The Probit model is suitable for binary response or decisions (Iqbal et al., 2014, p.54). It is also suitable for cumulative density

[3] Web-based instruments or infrastructure is basically channel which is responsible for upload and downloads the class routine, class note, power point presentation, academic calendar, handout, synopsis, cultural activities and advertisement of job market and so on.
[4] Web-based instruments
[5] Japanese Yen

function that emerges from the normal cumulative function (CDF)[6] (Munizaga and Alvarez-Daziano, 2001). Related continuous explanatory variables and including binary response are considered for investing and comparing the probability of student's attitude towards a low carbon society. The model assesses the factors that influence the low carbon society as follows:

$$CS=\beta_0+\beta_1\sum RIC+\beta_2\sum RS+\beta_3\sum BC+\beta_4\sum PAA+\beta_5\sum CSR+\mu_i \quad (1)$$

Where,

1. CS represents carbon sequestration and is considered as the dependent variable,
2. RIC represents respondents individual characteristics,
3. RS respondents sex (1=mail, 0=female),
4. BC represents the behavioral change of the respondents towards the academic activities (1= Yes for behavioral change, 0=otherwise),
5. PAA represents paperless academic activities in the campus (1=Yes for paperless academic activities, 0=otherwise),
6. CSR represents corporate social responsibility (1=contributes to a paperless campus, 0=otherwise).

Like the other explanatory variables, the dependent variable holds the binary characteristics. The Binary (one or zero response) variable is used to estimate in the following way, where carbon sequestration is the result of the paperless campus =1, and 0=otherwise.

$$Pr(y=1)=\theta(\beta'x) \quad (2)$$

Where, Pr denotes the probability and θ denotes the cumulative density function of the normal distribution which gives the likelihood for both cases y=1 and y=0. $\beta'x$ is known as the Probit score of equation (2).

For comparing the advantage and disadvantage of paper-based and paperless academic activities, this paper also used the present-value (PV) approach of cost-benefit analysis (CBA). A natural starting point for a discussion of investment demand is the rational of the PV criterion and its implications for the determinations of investment (Branson, 1994, p.219). Present value is calculated by the current worth of a future sum of money or stream of cash flow given a specific rate of return. Mathematical form of the present-value is given as follows:

$$PV_t = -C+R_t+\frac{R_{t+1}}{1+r}+\frac{R_{t+2}}{(1+r)^2}+K\,K\,K\,K\,K\,K\,K\,K\,K\,K+\frac{R_{t+n}}{(1+r)^n} \quad (3)$$

Under the present-value criterion, any institution can compute a present value for possible projects it might undertake and then rank the projects in order of their present values (PVs). This ranking is represented in Fig. 3.2.

[6] If a variable x follows the normal distribution with mean μ and variance σ^2, its probability density function (PDF) is $f(x)=\frac{1}{\sqrt{2\sigma^2\pi}}e^{-(x-\pi)^2/2\sigma^2}$ and its cumulative density function (CDF) is $f(x)=\int_{-\alpha}^{\alpha}\frac{1}{\sqrt{2\sigma^2\pi}}e^{-(x-\mu)^2/2\sigma^2}$ where x_o is some specified value of x.

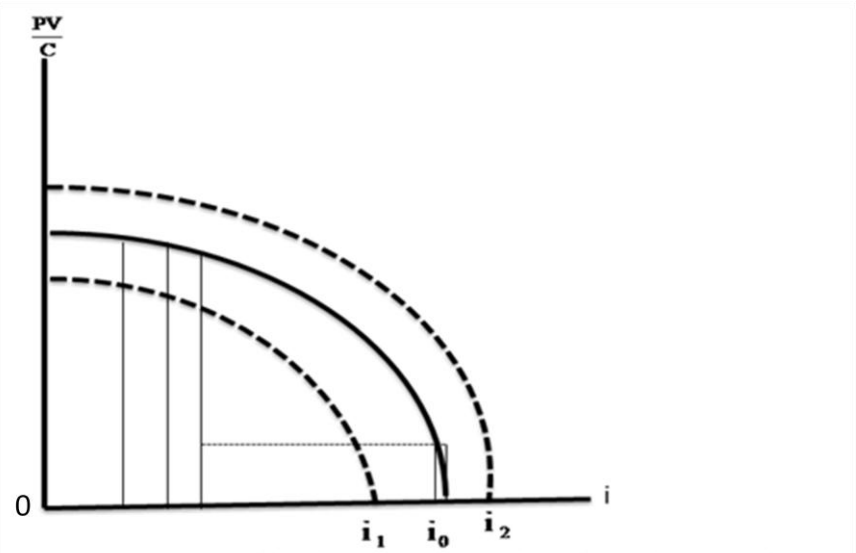

Figure 3.2: Ranking investment project in order to their PVS
(Source: Branson, 1994)

The vertical axis measures the present value of each investment relative to its cost and the horizontal axis measures the real value of the sum of all investment projects. In order to maximize its present value the firm should invest in all projects that have a PV > 0. This gives an equilibrium level of real investment for the institutions of i_o where the present value of the marginal project is zero. If the expected benefits in each period were to increase the curve shifts up and vice-versa.

3.4. Description of the variables that are used in the Probit model

This paper uses different variables in its model. These variables are described as follows:

CS: Carbon sequestration is the process of capture and long-term storage of atmospheric carbon dioxide (CO_2) (Sedjo and Sohngen, 2012).

RIC: Respondent individual characteristic includes the age of the respondent.

RS: Respondent sex that includes the sex of the students.

BC: Behavioral change of the stakeholders in the educational institutions always required less paper usage. Reuse, recycle and reduce of papers usages are the common practice of behavioral change.

PAA: Paperless academic activities always required computer, web and internet based academic environment.

CSR: Corporate Social Responsibility is defined as the voluntary activities undertaken by a company either private or government to operate in an economic, social and environmentally sustainable manner.

The above mentioned variables are used in the Probit model to quantify their impacts on the low carbon society in the IDEC. Table 3.1 describes the used variables in the Probit model with their expected sign.

Table 3.1: Description of variables with expected sign

Dependent/Independent Variable	Category	Description	Expected sign
Dependent variable			
Carbon absorption			
CS (Carbon sequestration)	Binary	1: carbon sequestration is the result of the paperless campus 0: Otherwise	
Independent variable			
RIC (Respondent's individual characteristics)	Continuous	Age of the students, professors and stuffs	(+/-)
RS (Respondent's sex)	Binary	1: Male 0: Female	(+/-)
BC (Behavioral change)	Binary	1: Yes to change 0: Otherwise	(+)
PAA (Paperless academic activities)	Binary	1: Yes for online academic activities 0: Otherwise	(+)
CSR (Corporate social responsibility)	Binary	1: Contributes to a paperless campus 0: Otherwise	(+)

(Source: Prepared by the author, 2012)

IV. Results and discussion

As shown in table 4.1 below, most of the variables are significant with expected sign at the 1%, 5% or 10% levels.

Table 4.1: Regressions coefficient estimates for a low carbon society

Independent variable	Coefficient	P-value
RIC	0.501325	0.2308
RS	0.189067	0.1167
BC	0.102891*	0.0850
PAA	0.510902***	0.0012
CSR	0.230085*	0.0571
Constant	1.342160***	0.0000
Pseudo R^2	0.619225	
n (Number of observations)	118	

*** Significant at 1% probability level, ** Significant at 5% probability level and * Significant at 10 % probability level

(Source: Estimated by the authors, 2012)

According to the estimated results of the Probit model, all of the variables are significant except age and sex of the respondents. Among all the significant variables, behavioral change of the students, professors and supporting staffs of IDEC, their paperless academic activities and corporate social responsibility (CSR) are positively correlated with the carbon sequestration which implies that increase in any of the significant variable resulted in increase in the carbon sequestration. Similarly, decrease in any of the significant variable resulted in decrease in the carbon sequestration. But we cannot saw anything about respondent's sex and age. The coefficients of the model ranges from 0.102891 to 0.510902 (except intercept/constant value) and the Pseudo R^2 value indicate that 61% of the variation of the carbon sequestration is explained by the associated variables.

The estimated value of present-value of paper-based and paperless academic activities of IDEC for the different periods is shown in Table 4.2.

Table 4.2: Present values of paper-based and paper less academic project

	Cost	Return in Period1	Return in period2	Return in period3…….	Return in period5	PV r = 0
Paper-based project	2	0	0	0…….....	0	0
Paper-less Project	7	2	2	2……...2		3

(Source: Estimated by the authors, 2012)

This paper did not consider the rate of interest because in Japan, the rate of interest is very low compare to those of the other countries. Paper and ink of printer cost for the different years are assumed to be at constant value for the paper-based projects. Paper-based academic activities destroyed forests and weakening of forest is responsible for the degradation of the environment. As a consequence, paper-based projects did not make any additional value or return. On the other hand, paperless projects had zero return, when it was being built. After the starting year, paperless project was able to protect trees and forest and it didn't require more additional cost for buy new computers and other related gadgets. As we know, on average, individual consumption of paper is now around 4,873.1 sheets per year per student (or equal to 0.6 trees per year per student). Thus, every student at the paperless campus are able to protect 0.6 trees and at DEC it will protect 195 trees (0.6 trees × 325 students, professors and supporting staff) which has market value ¥1,950,000 (195 trees × ¥10,000 worth of per tree (assumed value)). This paper assumed that the market value ¥1,950,000 has weighted value 2. This paper also assumed computer-based academic activities required ¥ 13,000,000 (40,000 ¥ worth of per computer × 325 students, professor and supporting staffs) which has assumed weighted value 7. With r = 0, paperless projects have a present discounted value 3, which is greater than the present discounted value of paper-based projects.

V. Policy Options and Conclusion

Establishing a paperless university campus or an educational institution is not a difficult task. Appropriate guidelines, strategies and policies can play an important role to establish a paperless campus. Paperless campus provides quality education and research, reduces deforestation and forest degradation and ensures a low carbon society. Some relevant actions can help to lead the educational institutions or university campuses from paper-based to paperless. Based on the estimated results of the Probit model and present discounted values, this paper suggests that every educational institution or university should shift its current academic activities towards more environmental or low carbon-emitting activities.

Sometimes behavioral changes of students, academicians, researchers, teachers, and supporting staffs can also promote to establish a paperless campus. Reducing margins and font sizes or adjusting document layouts to reduce the number of pages, skipping the cover sheet of any document or report, circulating documents for editing or approvals electronically, printing on both sides of each sheet of paper, printing to order, bringing computers to meetings instead of printing documents, sharing information by projecting it, using a message program such as e-mail and face book to exchange information, and distributing meeting handouts electronically can significantly reduce paper usages. Paperless academic activities and CSR from corporate or government levels can also help to establish a paperless campus by practicing more e-learning based education and providing free and cheap laptop, software, training and related activities. Students, teachers, supporting staffs, government, development partners, internet providers, electronic gadget producer work as actors for the establishment of a paperless campus.

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