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Avoided CO_2 Emissions from Reduced Thesis Printing: A Four–Year BiPSU Case Study with Regional and National Projections in the Philippines

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ABTRACT

The growing shift toward digital academic workflows presents an important opportunity to reduce paper consumption, conserve forest resources, and mitigate greenhouse gas emissions within the higher education sector. The present study estimates the environmental benefits of reduced thesis printing at both the institutional (Biliran Province State University – BiPSU) and national levels in the Philippines over a four-year student cohort. Using enrollment-based projections, paper-to-tree conversion factors, and life-cycle emission estimates for A4 paper, we quantify pages saved, equivalent trees conserved, and avoided CO_2 emissions associated with minimizing hardbound thesis requirements.

Results indicate that, across a four-year cohort of 11,141 students, BiPSU could avoid approximately 3.34 million printed pages in total, equivalent to 610 trees saved and 15.09 t CO_2e avoided over the period (3.77 t CO_2e annually). Based on an Elsevier/Science Direct benchmark of 5,476 A4 sheets per tree, the annual reduction of 218,048 pages corresponds to roughly 40 mature trees saved each year, while life-cycle estimates suggest 0.94–1.03 t CO_2e avoided annually from paper production alone. At the national scale, reduced thesis printing across all higher education institutions could save over 1.54 billion pages, conserve 281,615 trees, and avoid 6,962.68 t CO_2e over the same four-year window (1,740.67 t annually).

These findings demonstrate that even a single provincial university can generate measurable climate benefits, while regional and national scaling of digital thesis policies could produce substantial cumulative reductions in emissions and forest resource demand. The results will support the adoption of a one–hardbound-copy policy with mandatory digital archiving, establishment of centralized institutional repositories, and alignment of academic requirements with climate and sustainability commitments.

Keywords: Carbon emission reduction; Forest conservation; Paper consumption; Thesis digitization

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Introduction

The global environmental footprint of paper production remains a significant concern within sustainability science, as the pulp and paper industry ranks among the most energy-intensive and carbon-emitting sectors worldwide (Sun, 2018). Analyses indicate that the lifecycle of paper products is associated with extensive greenhouse gas emissions, arising from various stages including energy use, raw material extraction, manufacturing, and transportation across the supply chain (Del Rio, 2022). The pulp and paper sector is a substantial consumer of primary energy and contributes notably to industrial CO_2 emissions as a result of traditional production pathways, highlighting the necessity to consider the environmental impacts across the entire product lifecycle (Corcelli et al., 2018; Mohammadi et al., 2019).

Life cycle assessments (LCA) demonstrate that optimizing or even bypassing certain stages of the paper lifecycle can lead to significant reductions in greenhouse gas emissions (Bull, 2014) . Studies indicate that eliminating stages such as the extraction of forest-based raw materials or the pulping process can notably decrease CO_2 emissions from paper products. This evidence suggests that strategies focusing on consumption reduction should be prioritized alongside initiatives for material recycling and cleaner production practices (Ewijk et al., 2017). Life-cycle research findings are particularly relevant for academic institutions, where paper use for documentation, archiving, and binding is often an overlooked contributor to their overall carbon footprints (Ewijk et al., 2017).

In addition to their role as centers of knowledge production, universities and research institutions represent

significant consumers of resources, including paper needed for administrative functions and scholarly output. Despite advances in digital archiving and electronic thesis submissions, many institutions still require multiple hardbound thesis copies, leading to considerable annual paper use. Thus, it follows that reducing physical printing aligns with broader industrial evidence indicating that decreasing paper consumption, particularly for non-essential purposes, can mitigate environmental impacts without compromising the quality of academic outputs— a conclusion supported in LCA literature across various paper-intensive sectors (Han et al., 2024).

From a policy perspective, aligning academic documentation practices with sustainability objectives necessitates a rigorous assessment of the environmental benefits linked with reduced hardcopy requirements. While sustainability reporting frameworks and carbon strategies are well-documented within large publishing entities and supply chains, evaluations within higher education institutions remain limited. Research on decarbonizing the pulp and paper industry reveals that systemic changes—particularly those aimed at demand reduction and circular-economy solutions—can lead to significant emissions reductions throughout paper life cycles (Corcelli et al., 2018; Mohammadi et al., 2019).

In the context of climate mitigation, there is an increasing focus on upstream emission sources, including the production and consumption of materials. The reduction of emissions associated with less paper use not only lowers direct carbon outputs from institutions but also helps preserve forest carbon stocks by decreasing the demand for virgin fibers (Counsell, 2007). Although specific LCA data concerning printed materials used in universities is limited, existing comparative life-cycle assessments demonstrate that minimizing material usage in high-volume paper consumption scenarios can provide substantial opportunities for emissions reduction and resource conservation (Ewijk et al., 2017).

The current study investigates these dynamics through a case study of Biliran Province State University (BiPSU) in the Philippines, where multi-copy hardbound thesis requirements are prevalent. By utilizing actual departmental data on student enrollment, thesis lengths, and copy requirements, this research quantifies the prospective environmental impacts of adopting a one-copy hardbound policy alongside a commitment to digital archiving. The objective is to frame institutional policy reform within a life-cycle emissions context, informed by credible research, ultimately aiming to offer evidence-based recommendations for enhancing sustainable knowledge dissemination practices in higher education.

Methodology

Research Design and Data Collection

The study employed a quantitative estimation approach centered on Biliran Province State University (BiPSU) as a primary case study, with subsequent expansion to regional and national scales. The design combined institution-specific primary data with secondary enrollment statistics to generate both empirical and projected estimates of environmental benefits associated with reduced thesis printing. This multi-scalar approach was adopted to provide both a detailed institutional assessment and a broader picture of potential impacts across the Philippine higher education system.

Primary data for BiPSU were collected for AY 2024–2025 through a structured Google Form survey administered to deans and department heads of all academic schools. Respondents provided program-level information on (a) the number of graduating students completing a thesis, (b) the average thesis length (including appendices), and (c) the number of required hardbound copies per student. These variables were selected because they directly determine the volume of paper used in thesis production.

A total of 16 responses were received, of which 15 were complete and retained for analysis. Textual responses (e.g., “around 100 pages,” “three to four copies”) were standardized into numeric values through a systematic extraction and validation process. The cleaned dataset served as the empirical basis for estimating actual annual printed pages at BiPSU prior to scaling up to a four-year cohort and broader projections.

Estimation of Printed Pages and Potential Paper Savings

Annual printed pages at BiPSU were first calculated using actual graduating-student data under the existing policy using the formula:

$$\text{Printed Pages} = \text{Graduating Students} \times \text{Average Pages per Thesis} \times \text{Copies Required}$$

A counterfactual scenario was then modeled in which each student would submit only one archival hardbound copy, with all additional copies replaced by digital submission. The difference between the status quo and this scenario represented the annual pages saved due to policy change.

To capture a broader and more representative institutional impact, the analysis was expanded to a four-year cohort based on total enrollment (11,141 students) rather than only graduating students. For this projection, a standardized assumption of 100 pages per thesis was applied uniformly across all students. This value was derived from the observed range of thesis lengths reported across BiPSU schools and served as a reasonable institutional average for scaling estimates beyond a single graduating batch.

Total four-year pages saved were computed using the 100-page assumption and then divided by four to obtain annual averages. This approach allowed the study to present both cumulative and yearly estimates, aligning BiPSU results with national projections that also used a four-year analytical window.

Regional and National Scaling

To extend the analysis beyond BiPSU, the same 100-page-per-student assumption was applied to regional and national enrollment data for AY 2023–2024. This assumption ensured methodological consistency across institutions and regions despite variations in actual thesis practices. Using total enrollment rather than only graduating students provided a more comprehensive estimate of potential paper savings if digital thesis policies were widely adopted.

For each region, total pages saved over a four-year period were estimated as:

Pages Saved=Total Enrollment × 100 (thesis length) × 3 (thesis hardbound copies).

(where three copies were assumed as the prevailing practice, and savings represented two copies replaced by digital submission). Regional totals were then aggregated to generate national-level estimates of pages saved, trees conserved, and emissions avoided.

Although this scaling approach relies on standardized assumptions, it is grounded in empirical BiPSU data and provides a defensible first-order projection of potential environmental benefits across the Philippine higher education sector. The method allows meaningful comparison between BiPSU, regional, and national results within a unified analytical framework.

Conversion of Saved Pages to Trees and Avoided CO_{2e}

To translate page savings into ecological terms, this study adopted a peer-reviewed conversion factor derived from an Elsevier/ScienceDirect analysis of paper consumption (Chakladar et al., 2011), which estimates that approximately 5,476 A4 sheets are equivalent to one mature tree, based on a reported ratio of 11.5 million sheets corresponding to 2,100 trees. This conversion has been applied in previous environmental assessments of paper use and provides a defensible basis for linking paper consumption to forest resource impacts.

Although Silver (2005) reported a conversion of approximately 8,000 sheets per tree, this value was not adopted in the present study because it was derived from paper produced specifically for journal printing, which typically involves higher-quality, coated, and image-intensive paper rather than standard office paper. In contrast, the conversion factor proposed by Chakladar et al. (2011) pertains to ordinary office paper, which more closely resembles the type of paper used for thesis documents, which are predominantly text-based. Accordingly, the number of trees saved in this study was calculated as:

Trees Saved = Total Pages Saved ÷ 5,476

Carbon implications were estimated using life-cycle emission factors reported in the *Journal of Cleaner Production*, which indicate that producing one A4 sheet of office paper generates approximately 4.29–4.74 g of CO_2-equivalent (CO_2e) across its production and distribution chain (Dias and Arroja, 2012). Avoided emissions were calculated using the formula: Avoided CO_2e (tonnes) = Pages Saved × (4.29–4.74 g) ÷ 1,000,000. This approach reflects emissions avoided from reduced paper manufacturing rather than emissions from forest clearing.

To further contextualize climate benefits, the study also estimated the preserved carbon sequestration potential of saved trees using the widely cited value that a mature tree absorbs approximately 21.8 kg of CO_2 per year (using ~48 lb CO_2/year per mature tree) (USDA, 2015). This value was multiplied by the estimated number of trees saved to approximate continued annual carbon uptake that would remain intact under the proposed digital thesis policy.

Preserved Annual CO_2 Uptake = Number of Trees Saved × 21.8 kg CO_2 $tree^{-1}$ yr^{-1}

Assumptions and Limitations

Regional and national estimates were based on the number of enrolled students in State Universities and Colleges (SUCs) and scaled using a standardized 100-page thesis length derived from BiPSU data, rather than institution-specific thesis records from each region. The analysis also assumed a requirement of four hardbound copies per student, consistent with prevailing practice in many institutions; hence, potential savings were calculated on the basis of reducing this requirement to a single archival copy with digital submission for the remaining three.

Consequently, the results represent projected potential savings under a hypothetical digital thesis policy rather than observed historical reductions in paper use. Nevertheless, the 100-page thesis assumption and four-copy baseline are empirically grounded in BiPSU's reported practices, and all subsequent conversions relied on established peer-reviewed factors. As such, the approach provides a defensible first-order estimate of potential environmental benefits while acknowledging that actual impacts may vary across institutions and regions.

Results and Discussion

Paper Use, Page Savings, and Distribution across Schools

The analysis of departmental survey responses for AY 2024–2025 revealed that Biliran Province State University (BiPSU) printed an estimated 359,176 hardbound thesis pages under the existing multi-copy submission policy (Table 1). The figure represents the institutional baseline of paper consumption associated with thesis production and reflects the cumulative effect of varying student numbers, thesis lengths, and copy requirements across academic programs. The data show substantial heterogeneity among departments: programs in the School of Management and Entrepreneurship (SME) and Teacher Education accounted for a disproportionately large share of total printed pages due to both higher student enrollment and higher copy requirements. This pattern suggests that policy interventions targeting high-volume programs would yield the greatest environmental benefits.

Table 2. Summary of estimated paper, tree, and carbon savings associated with reducing hardbound thesis requirements to one archival copy per student at Biliran Province State University (AY 2024–2025).

Metric	Value
Total printed pages (status quo) AY 2024–2025	355,176
Total pages saved if reduced to 1 hardbound copy AY 2024–2025	216,048
Conversion used: sheets per tree	5,476
Estimated trees saved (AY 2024–2025)	39.5
CO_2e per A4 sheet (low, g)	4.29
CO_2e per A4 sheet (high, g)	4.74
Estimated avoided CO_2e (low, tonnes)	0.927
Estimated avoided CO_2e (high, tonnes)	1.024

When a counterfactual policy of requiring only one archival hardbound copy per student was applied, the university could save approximately 218,048 pages annually (Table 2). This

Table 1. Estimated printed pages and potential page savings by department at Biliran Province State University for AY 2024–2025 under a one-hardbound-copy policy.

School	Program	Students	Avg. Pages/Thesis*	Hardbound Copies Required per Student	Printed Pages – Status Quo	Pages Retained – One Hardbound	Pages Saved	Reduction (%)
School of Agribusiness and Forest Resource Management	Forestry	15	100	4	6,000	1,500	4,500	75.0%
School of Arts and Sciences	BA Economics	44	157	2	13,816	6,908	6,908	50.0%
School of Engineering	BSEE	20	100	2	4,000	2,000	2,000	50.0%
School of Engineering	Civil Engineering	70	100	3	21,000	7,000	14,000	66.7%
School of Graduate Studies	EdD, DM, and MAEd Programs	80	80	4	25,600	6,400	19,200	75.0%
School of Management and Entrepreneurship	BSHM	301	80	4	96,320	24,080	72,240	75.0%
School of Management and Entrepreneurship	BSTM	246	60	4	59,040	14,760	44,280	75.0%
School of Teacher Education – Biliran Campus	Teacher Education	150	30	3	13,500	4,500	9,000	66.7%
School of Teacher Education – Main Campus	Bachelor of Secondary Education	113	120	3	40,680	13,560	27,120	66.7%
School of Teacher Education – Main Campus	BECED and BSNED Programs	36	100	3	10,800	3,600	7,200	66.7%
School of Teacher Education – Main Campus	BEED	20	100	3	6,000	2,000	4,000	66.7%
School of Teacher Education – Main Campus	BTLED & BPED	28	100	3	8,400	2,800	5,600	66.7%
School of Technology and Computer Studies	STCS Programs	408	123	1	50,020	50,020	0	0.0%

reduction represents more than 60% of current thesis-related paper use and demonstrates that institutional policy, rather than individual student behavior, is the dominant driver of paper consumption. The savings arise not from shorter theses but from eliminating redundant printed copies, indicating that digital archiving can achieve large environmental gains without altering academic standards or scholarly outputs.

At the school level, the School of Management and Entrepreneurship exhibited the highest potential savings (116,520 pages), followed by the School of Teacher Education – Main Campus (43,920 pages) and the School of Graduate Studies (19,200 pages). These differences reflect both program size and copy requirements, as some departments still mandate three to four hardbound copies per student. In contrast, the School of Technology and Computer Studies showed no page savings because it already requires only one hardbound copy, illustrating that internal best practices already exist within BiPSU.

The uneven distribution of savings highlights the importance of differentiated policy implementation rather than a one-size-fits-all approach. Schools with higher copy requirements should be prioritized for policy reform and capacity-building on digital archiving systems. At the same time, departments that already limit hardbound copies can serve as internal models of sustainable practice for the rest of the university.

Forest and Carbon Implications of Reduced Printing

Translating page savings into ecological terms, the estimated 218,048 pages saved per year correspond to approximately 40 mature trees saved annually**,** based on a peer-reviewed conversion factor of 5,476 A4 sheets per tree**.** Over a three-year period, assuming stable thesis production patterns, this would amount to roughly 120 trees preserved**,** a meaningful contribution to local and regional forest conservation efforts. Although this number may appear modest, it is significant when scaled across multiple universities in the Philippines, where thousands of theses are produced annually.

From a climate perspective, reducing paper production would also avoid approximately 0.94–1.03 tonnes of CO_2-equivalent emissions per year**,** based on life-cycle estimates of 4.29–4.74 g CO_2e per A4 sheet (Table 2; Fig. 1)**.** These avoided emissions stem primarily from reduced energy use in pulping, paper manufacturing, and transportation. Over three years, BiPSU could therefore prevent roughly 2.8–3.1 tonnes of CO_2e**,** equivalent to the annual emissions of several passenger vehicles or thousands of kilometers of air travel.

Beyond manufacturing emissions, preserving standing trees also maintains ongoing carbon sequestration capacity. Using a conservative estimate that one mature tree absorbs about 21.8 kg of CO_2 per year using (~48 lb CO_2/year per mature tree)**,** saving 40 trees annually would retain approximately 0.87 tonnes of CO_2 uptake capacity each year**.** While this figure represents future sequestration rather than immediate emission reductions, it underscores the dual climate benefit of reduced paper use: fewer emissions now and greater carbon storage over time.

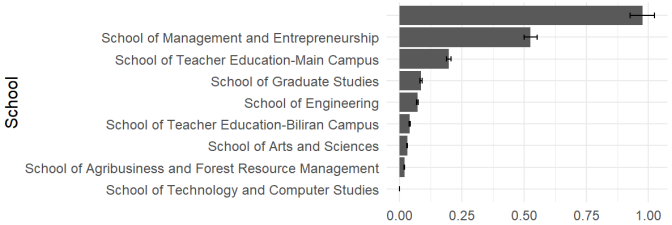

Figure 1. Estimated carbon emissions avoided by school under a one-hardbound-copy policy at Biliran Province State University for AY 2024–2025. *Bars represent midpoint estimates of avoided CO_2e from reduced paper use, calculated using 4.29–4.74 g CO_2e per A4 sheet; error bars show the uncertainty range associated with this conversion factor.*

The school-level carbon results further reinforce the equity dimension of sustainability policy. The School of Management and Entrepreneurship alone could avoid approximately 0.50–0.55 tonnes of CO_2e per year (Fig. 2)**,** accounting for nearly half of total institutional savings. Meanwhile, the School of Teacher Education – Main Campus would avoid about 0.19–0.21 tonnes**,** and the School of Graduate Studies about 0.08–0.09 tonnes**.** Overall, the findings demonstrate that a relatively simple administrative change—reducing hardbound thesis copies—can yield measurable environmental benefits without compromising academic integrity. The results align with global trends in digital scholarship and sustainable publishing, as documented in the literature on recycled paper use and paper reduction in academic and media sectors. For BiPSU, adopting a primarily digital thesis archiving system would represent a practical, cost-effective, and scientifically justified climate action.

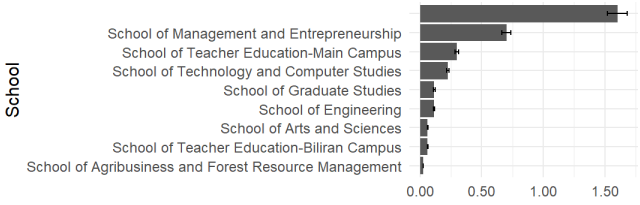

Figure 2. Estimated carbon emissions produced from hardbound thesis printing by school at Biliran Province State University for AY 2024–2025. *Bars represent midpoint estimates of CO_2e based on life-cycle emission factors of 4.29–4.74 g CO_2e per A4 sheet; error bars indicate the low–high range of this emission factor*

Regional-Level Projection of avoided CO_2 Emissions from Reduced Thesis Printing

At the institutional scale, the case of BiPSU demonstrates that even a single university can contribute measurable climate benefits through reduced paper consumption in thesis production. Based on a four-year student cohort of 11,141, BiPSU is estimated to save approximately 3.34 million pages of paper, equivalent to 610 trees saved and 15.09 t CO_{2e} avoided over the full period, or 3.77 t CO_{2e} avoided annually (Table 3). Although this represents only about 0.22% of the national total, the result is important because it illustrates the cumulative environmental value of digital academic practices at the campus level. When scaled across multiple institutions adopting similar policies, the collective impact could become substantial. This further suggests that university-led digital transformation is a practical and scalable strategy for reducing educational sector emissions

Table 3. Comparison of national and BiPSU-level estimated avoided CO_2 emissions associated with reduced thesis printing, based on total student enrollment over a four-year cohort. *The table presents enrollment, total and annual pages saved, equivalent trees saved, and total and annual avoided CO_2e, assuming all students within the four-year window are included in the estimation.*

Region	Enrollment	Total pages saved	Annual pages saved	Total equivalent trees saved	Annual equivalent trees saved	Total avoided CO2e mid t	Annual avoided CO2e mid t
National (All Regions)	5,140,409	1,542,122,700	385,530,675	281,615	70,404	6,962.68	1,740.67
BiPSU	11,141	3,342,300	835,575	610	153	15.09	3.77

At the national level, the aggregate effect of reduced thesis printing across all higher education institutions is far more significant. The total estimated avoided emissions of 6,962.68 t CO_2e over a four-year window reflects the large scale of student enrollment in the Philippines and the traditionally paper-intensive nature of academic requirements (Table 4). The corresponding annual reduction of 1,740.67 t CO_2e highlights the consistent climate benefit that could be achieved if digital submission systems were institutionalized nationwide (Table 4). These results support the argument that policy interventions promoting paperless academic workflows can meaningfully contribute to national climate mitigation efforts while also reducing institutional costs and resource use.

When projected at the regional level, the distribution of avoided emissions is closely aligned with student population size rather than geographic area (Fig. 3). Regions with higher enrollments—such as NCR, Region 4A, Region 3, and Region 7—show the greatest potential for avoided CO_2e because they generate the highest volume of theses and printed materials (Fig. 4). In contrast, regions with smaller student populations (e.g., CAR, Region 13, and Region 4B) contribute less in absolute terms, but still represent important cumulative savings when considered collectively. Further, the pattern suggests that regional education authorities could prioritize digital submission policies in high-enrollment regions to maximize climate benefits while gradually expanding implementation elsewhere.

Overall, the comparison between BiPSU, regional projections, and national totals highlights a multi-scalar climate mitigation opportunity within the higher education sector. While individual institutions like BiPSU make relatively small contributions in isolation, their collective action across regions could produce meaningful national reductions in paper-related emissions. These findings support integrating digital thesis policies into sustainability frameworks at institutional, regional, and national levels,

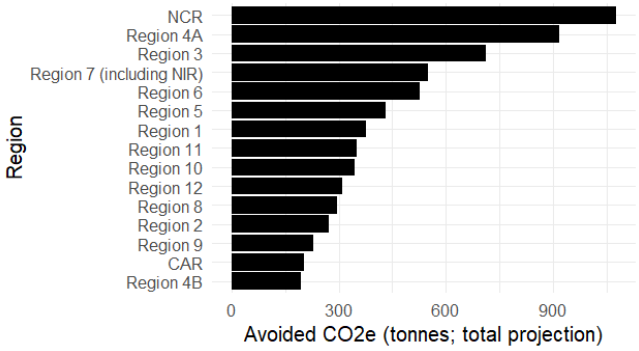

Figure 3. Total projected avoided CO2e emissions by region under a shift from four to one hardbound thesis copy, assuming all currently enrolled students complete a thesis (four-year cohort). *Estimates represent the midpoint of a life-cycle emission range of 4.29–4.74 g CO2e per A4 sheet and are based on an average thesis length of 100 pages. Regions shown represent the top 15 contributors to total avoided emissions*

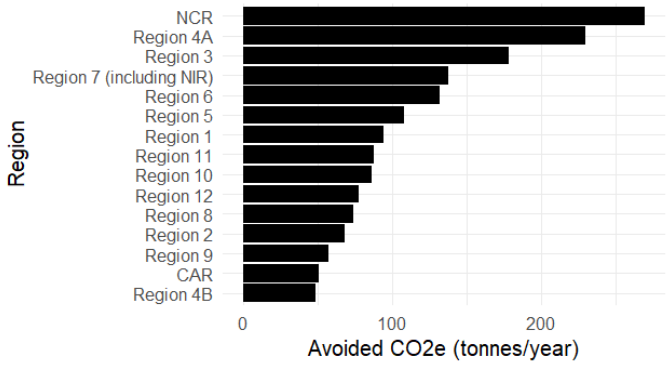

Figure 4. Annualized avoided CO2e emissions by region from reduced thesis printing, obtained by dividing the four-year cohort projections by four to approximate one graduating cohort per year. *Calculations are based on an average thesis length of 100 pages and a midpoint emission factor of 4.29–4.74 g CO2e per A4 sheet. Bars represent the top 15 regions in terms of annual avoided emissions.*

linking educational innovation with climate action and

Conclusion

The current study demonstrates that reducing hardbound thesis requirements at Biliran Province State University (BiPSU) is a practical and effective sustainability intervention. Based on AY 2024–2025 data and a four-year cohort of 11,141 students, shifting to a one-hardbound-copy policy with digital archiving could avoid approximately 3.34 million printed pages in total, equivalent to 610 trees saved over four years (153 annually). Applying established life-cycle emission factors, this corresponds to 15.09 t CO_2e avoided over four years (3.77 t annually) from paper production, while also preserving the ongoing carbon sequestration capacity of standing trees. These indicate that meaningful environmental benefits can be achieved through simple administrative reform rather than costly technological investments, challenging the necessity of multi-copy thesis requirements that add little academic value but generate environmental costs. resource conservation.

Table 4. Projected paper and carbon savings from shifting all enrolled students from a four-copy to a one-copy hardbound thesis policy across Philippine SUCs and for BiPSU. *Values are reported as (a) total projected savings assuming all currently enrolled students complete a thesis, and (b) annualized estimates obtained by dividing totals by four to approximate one graduating cohort per year. Estimates are based on an average thesis length of 100 pages, a conversion factor of 5,476 A4 sheets per tree, and a life-cycle emission range of 4.29–4.74 g CO_2e per sheet*

Region	Enrollment	Total pages saved	Annual pages saved	Total equivalent trees saved	Annual equivalent trees saved	Total avoided CO2e mid t	Annual avoided CO2e mid t
CAR	149,843	44,952,900	11,238,225	8,209	2,052	202.96	50.74
NCR	795,248	238,574,400	59,643,600	43,567	10,892	1077.16	269.29
Region 1	277,021	83,106,300	20,776,575	15,176	3,794	375.22	93.81
Region 2	200,642	60,192,600	15,048,150	10,992	2,748	271.77	67.94
Region 3	526,553	157,965,900	39,491,475	28,847	7,212	713.22	178.30
Region 4A	677,356	203,206,800	50,801,700	37,109	9,277	917.48	229.37
Region 4B	144,185	43,255,500	10,813,875	7,899	1,975	195.30	48.82
Region 5	319,612	95,883,600	23,970,900	17,510	4,377	432.91	108.23
Region 6	390,006	117,001,800	29,250,450	21,366	5,342	528.26	132.07
Region 7 (including NIR)	407,022	122,106,600	30,526,650	22,299	5,575	551.31	137.83
Region 8	218,490	65,547,000	16,386,750	11,970	2,992	295.94	73.99
Region 9	168,298	50,489,400	12,622,350	9,220	2,305	227.96	56.99
Region 10	255,216	76,564,800	19,141,200	13,982	3,495	345.69	86.42
Region 11	258,459	77,537,700	19,384,425	14,160	3,540	350.08	87.52
Region 12	228,439	68,531,700	17,132,925	12,515	3,129	309.42	77.36
Region 13	124,019	37,205,700	9,301,425	6,794	1,699	167.98	42.00
TOTAL	**5,140,409.00**	**1,542,122,700**	**385,530,675**	**281,615**	**70,404**	**6962.68**	**1740.67**

When projected to the regional and national level, the potential impact is far greater. Using a standardized 100-page thesis assumption across State Universities and Colleges, reduced printing could save over 1.54 billion pages nationally, conserve 281,615 trees, and avoid 6,962.68 t CO_2e over four years (1,740.67 t annually). Regions with higher student enrollment—such as NCR, Region 4A, Region 3, and Region 7—would yield the largest benefits, suggesting that prioritizing digital thesis policies in these areas could maximize climate returns while gradually scaling implementation nationwide. More broadly, the results highlights the role of universities in modeling sustainable knowledge production, showing that digital thesis systems can reduce waste, lower student costs, enhance accessibility, and contribute to forest conservation and climate mitigation goals.

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