

Reconstructing a Damaged *Cangkuang Pegon* *Tafsir*: Recovering Local Islamic Intellectual Heritage through Digital Philology in West Java

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Abstract

This study examines the *Tafsir al-Qur'an Pegon Candi Cangkuang* (TAPCC), a seventeenth- to eighteenth-century Qur'anic commentary manuscript preserved at the Cangkuang Temple Cultural Heritage Site in West Java, Indonesia. Written in Javanese Pegon script, the manuscript contains interlinear Qur'anic interpretations that reflect the vernacular exegetical tradition of early Islamization in the Sundanese region. Extensive material deterioration has rendered numerous Pegon glosses faded, fragmented, or partially illegible, substantially limiting scholarly access to the manuscript's interpretive content. Although previous research addressed the manuscript's historical background and codicological features, no systematic attempt has been made to recover its damaged textual readings through digital philological methods. This study addresses that gap by employing an integrated digital philological-codicological approach combining high-resolution digital imaging, controlled image enhancement, diplomatic transliteration, and contextual philological reconstruction. The analysis focuses on selected folios from the Surah al-Kahf section that exhibit severe ink deterioration and partial loss of gloss. The findings demonstrate that digital image enhancement substantially improves the readability of faded Pegon writing and enables the recovery of several previously inaccessible interlinear readings. The reconstructed glosses reveal a pedagogical *tafsir* structure grounded in the *makna gandhul* tradition characteristic of *pesantren*-based Qur'anic instruction. Codicological evidence further situates the manuscript within seventeenth- to eighteenth-century Mataram manuscript traditions and illuminates the transmission of Islamic knowledge across Javanese and Sundanese scholarly networks. These findings contribute to the growing scholarship on vernacular Islam, Nusantara manuscript heritage, and the methodological potential of digital philology for recovering damaged Islamic textual traditions in Southeast Asia.

Keywords: *Cangkuang exegesis; digital philology; codicology; pegon; text reconstruction.*

Abstrak

Penelitian ini mengkaji Tafsir al-Qur'an Pegon Candi Cangkuang (TAPCC), sebuah manuskrip tafsir Al-Qur'an abad ke 17-18 yang tersimpan di Situs Cagar Budaya Candi Cangkuang, Jawa Barat. Ditulis dalam aksara Pegon Jawa, manuskrip ini memuat penafsiran Al-Qur'an secara interlinear yang merefleksikan tradisi tafsir vernakular pada masa awal Islamisasi di wilayah Sunda. Kondisi fisik manuskrip yang mengalami kerusakan menyebabkan banyak glosa Pegon memudar, terfragmentasi, dan sebagian tidak lagi terbaca sehingga membatasi akses terhadap kandungan teksnya. Berbeda dengan penelitian sebelumnya yang lebih menitikberatkan pada aspek historis dan kodikologis manuskrip, penelitian ini berfokus pada rekonstruksi filologis digital terhadap glosa Pegon yang rusak serta signifikansinya bagi kajian tafsir Al-Qur'an lokal. Penelitian ini menggunakan pendekatan filologi digital-kodikologi dengan memanfaatkan citra digital resolusi tinggi, teknik peningkatan kualitas gambar, transliterasi diplomatik, dan rekonstruksi filologis kontekstual. Analisis difokuskan pada beberapa folio yang mengandung glosa Pegon rusak, terutama pada bagian Surah al-Kahfi. Hasil penelitian menunjukkan bahwa peningkatan kualitas citra secara digital mampu meningkatkan keterbacaan teks yang memudar dan memungkinkan pemulihan sejumlah bacaan yang sebelumnya tidak terbaca. Glosa yang berhasil direkonstruksi memperlihatkan struktur tafsir pedagogis berbasis tradisi makna *gandhul* yang lazim digunakan dalam pembelajaran pesantren. Bukti kodikologis juga menunjukkan keterkaitan dengan tradisi manuskrip Mataram abad ke-17–18 serta adanya transmisi pengetahuan Islam melalui jaringan intelektual Jawa dan Sunda. Penelitian ini menunjukkan bahwa filologi digital dapat mendukung pemulihan filologis manuskrip Pegon yang rusak sekaligus berkontribusi pada pelestarian dan pengkajian warisan tafsir Al-Qur'an lokal di Nusantara.

Kata Kunci: *Tafsir Cangkuang; filologi digital; kodikologi; pegon; rekonstruksi teks.*

Introduction

Qur'anic studies have increasingly developed into an interdisciplinary field that extends beyond theological and juridical concerns toward the historical, material, and cultural dimensions of the Qur'anic text (Fedeli, 2020). A significant manifestation of this trajectory is the growing scholarly attention to Qur'anic manuscripts, which function not merely as textual records but as material artefacts preserving traces of intellectual transmission, local pedagogies, and socio-cultural encounters within Muslim societies (Akkerman, 2019; Imdad, 2025). Within this broader tradition, Qur'anic exegetical manuscripts occupy a particularly important position because they simultaneously preserve religious interpretation and local cultural expression (Erashiah & Zain, 2025; Gallop, 2015).

In the Nusantara context, however, surviving *tafsir* manuscripts remain considerably fewer than Qur'anic codices and other Islamic textual genres, despite their critical importance for reconstructing regional intellectual histories and vernacular traditions of Qur'anic interpretation (Rohmana, 2024). The study of these manuscripts therefore offers a productive avenue for understanding how local Muslim communities negotiated Islamic knowledge through regional languages, scripts, and pedagogical conventions (Bhatt et al., 2025; Lambek, 1990).

Among the understudied examples of this tradition is the *Tafsir al-Qur'an Pegon Candi Cangkuang* (TAPCC), a seventeenth- to eighteenth-century Qur'anic commentary manuscript preserved at the Cangkuang Temple Cultural Heritage Site in West Java, Indonesia. Written in Javanese Pegon script, the manuscript contains interlinear Qur'anic interpretations that reflect the vernacular exegetical practices of early Islamization in the Sundanese region. Earlier studies by Darmawan and Riyani (2019) documented the manuscript's historical background, codicological features, and linguistic characteristics, while Irawan (2024) examined its *rasm* and *qira'at* dimensions. These contributions are valuable; however, both studies relied primarily on readable sections of the manuscript and did not address the methodological problem posed by damaged and partially illegible Pegon glosses. As a result, substantial portions of the manuscript's interpretive content remain inaccessible, limiting scholarly understanding of its pedagogical structure, vernacular translation strategies, and function within local traditions of Qur'anic learning. The absence of a systematic attempt to recover these damaged readings constitutes an important gap in current scholarship.

This limitation is particularly significant given the manuscript's fragile physical condition. Preliminary observation of the digitized folios reveals faded ink, oxidation stains, and partially illegible Pegon glosses, especially in sections where interlinear commentary has undergone material deterioration. Access to the original manuscript is further restricted by conservation requirements and museum preservation policies, which limit opportunities for sustained physical examination. Under these circumstances, conventional philological methods that rely primarily on direct manuscript inspection are insufficient to recover damaged textual readings. These conditions highlight the need for non-invasive digital philological approaches that enhance textual legibility while preserving the manuscript's physical integrity. Digital image-based reconstruction therefore serves not merely as a preservation technique but as a necessary methodological response to the practical constraints of accessing and interpreting deteriorated manuscript materials.

Recent developments in Digital Humanities have expanded manuscript studies beyond digitization and archival access toward computationally assisted textual recovery, image-based philology, and the reinterpretation of damaged cultural heritage materials (Poleg, 2023; Terras, 2022). Nevertheless, many digital manuscript projects in Southeast Asia have focused primarily on cataloguing and preservation, while comparatively fewer studies have explored how digital image enhancement techniques may contribute directly to philological reconstruction and the recovery of previously inaccessible textual readings. The present study is positioned within this emerging methodological debate and examines digital philology not merely as a tool of preservation but as an integrated framework for recovering damaged Pegon interpretations and restoring scholarly access to the manuscript's interpretive content.

Against this background, this study addresses three research questions. First, how can digital philological techniques improve the readability of damaged Pegon glosses in the TAPCC manuscript? Second, what codicological and palaeographical characteristics define the manuscript within the broader tradition of Javanese-Sundanese Islamic writing? Third, what do the reconstructed interlinear glosses reveal about local pedagogical practices of Qur'anic interpretation? To address these questions, the study employs an integrated digital philological-codicological approach that combines high-resolution digital imaging, controlled image enhancement, diplomatic transliteration, and contextual philological reconstruction, while situating the recovered readings within the historical and cultural context of Nusantara Islamic learning traditions.

This study argues that integrating classical philological analysis with digital image-based reconstruction provides an effective methodological framework for recovering damaged textual readings in Nusantara *tafsir* manuscripts. The findings contribute to broader discussions on vernacular Islam by illustrating how Qur'anic knowledge was transmitted through local linguistic and cultural forms, a process recognized as central to Islamization in Southeast Asia (Ricci, 2011). The reconstructed glosses also reinforce existing observations on the role of Pegon script as a medium of Islamic literacy and knowledge transmission in Java and Sunda (Pudjiastuti, 2009; Rohmana, 2017). Furthermore, the manuscript's *makna gandhul* structure provides material evidence of pedagogical practices associated with *pesantren*-based learning, where textual comprehension was facilitated through concise vernacular glosses placed directly within the Arabic text. From a methodological perspective, the study demonstrates how the physical condition of a manuscript shapes the accessibility of historical knowledge and how digital philological approaches can expand the boundaries of traditional scholarship by enabling the recovery of previously unreadable materials (Poleg, 2023; Terras, 2022). Accordingly, this research contributes to digital philology and Nusantara manuscript studies, while also engaging wider debates on vernacular Islamic intellectual traditions, manuscript materiality, and the transmission of Qur'anic learning across the Indonesian archipelago.

Literature Review

Philology, Codicology, and the Materiality of Qur'anic Manuscript

Contemporary manuscript studies increasingly emphasize that manuscripts should not be understood merely as containers of texts, but as material artefacts that preserve traces of intellectual transmission, scholarly practices, and socio-cultural history (Poleg, 2023). Within Islamic manuscript studies, philology and codicology function as complementary approaches for examining both textual and material dimensions of manuscripts (Fadeli et al., 2025). Philology primarily concerns the reconstruction, transmission, and interpretation of texts, while codicology focuses on the physical aspects of manuscripts, including writing materials, ink, layout, binding, and scribal features (Gacek,

2009; Haneef, 2025). Through these approaches, manuscripts can be analyzed not only as literary products, but also as historical witnesses reflecting patterns of religious learning, circulation of knowledge, and regional scholarly networks.

In Qur'anic manuscript studies, scholars such as Déroche (2005) and Fedeli (2020) have demonstrated that paleographical and codicological analysis plays a crucial role in reconstructing the historical development of Qur'anic transmission. The material condition of manuscripts, including damaged folios, faded ink, marginal annotations, and writing styles, often provides important evidence regarding chronology, usage, and textual authority (Yalew et al., 2025). This perspective shifts manuscript studies away from purely textual criticism toward what is now commonly referred to as the “materiality of the text.” Nevertheless, most studies on Nusantara Qur'anic manuscripts still prioritize descriptive cataloguing and historical identification, while relatively limited attention has been given to reconstructing damaged textual sections, particularly through digital-based philological approaches.

Within the Indonesian context, philological and codicological studies of Islamic manuscripts have been significantly advanced by scholars such as Oman Fathurahman and Ali Akbar. Fathurahman (2015) emphasizes that Nusantara manuscripts should be approached not only as textual sources but also as cultural artefacts that document the transmission of Islamic knowledge across local scholarly networks. Similarly, Ali Akbar's studies of Qur'anic manuscripts in Indonesia demonstrate the importance of integrating codicological observation, textual analysis, and historical contextualization in order to understand regional traditions of Qur'anic transmission (Akbar, 2023). Their works have expanded manuscript studies beyond cataloguing and description by highlighting the relationship between material features, intellectual history, and local Islamic learning traditions. Nevertheless, most existing studies remain focused on manuscript identification, classification, and textual description, while relatively few address the recovery of damaged textual sections through digital philological methods.

Vernacular Tafsir and the *Pegon* Intellectual Tradition in Nusantara

Studies on vernacular Islam in Southeast Asia have shown that the transmission of Islamic knowledge was deeply connected to the adaptation of local languages and scripts. Ricci (2011) argues that the localization of Islamic intellectual traditions through vernacular languages constituted one of the most important mechanisms of Islamization in the Indian Ocean world. In the Nusantara context, local scripts such as Jawi and Pegon became important media for translating, teaching, and interpreting Islamic texts within local cultural environments (Baidowi & Ma'rufah, 2025; Husniyah et al., 2025). Through these scripts, Islamic knowledge became accessible to communities that lacked

advanced proficiency in Arabic, thereby enabling the emergence of localized exegetical and pedagogical traditions.

Within the *pesantren* tradition, Pegon script played a particularly significant role in the development of interlinear interpretation (*makna gandhul*), a pedagogical model in which local glosses were inserted between or beneath Arabic lines to facilitate learning. Scholars such as Gallop (2015) and Rohmana (2017) note that Pegon manuscripts in Java and Sunda demonstrate a strong integration between Islamic scholarship and vernacular literary culture. The use of local linguistic structures within Qur'anic interpretation reflects not only translation practices but also intellectual negotiation between Islamic authority and local cultural identity. However, previous studies generally focus on linguistic characteristics and historical transmission, while the pedagogical and knowledge-transmission functions of Pegon tafsir manuscripts remain underexplored, especially in manuscripts that have suffered severe physical deterioration.

Digital Philology and Manuscript Reconstruction

The emergence of digital humanities has significantly transformed contemporary manuscript studies, particularly through the development of digital philology as a framework for documenting, analysing, and recovering historical texts. Within this framework, several related but distinct processes must be differentiated. Digital preservation primarily concerns the long-term safeguarding of manuscript materials through digitization and archival management. Digital enhancement refers to the application of image-processing techniques to improve the visual quality of manuscript images, enabling faded ink, damaged letter forms, and obscured textual features to become more legible. By contrast, transcription involves the systematic reproduction of textual content as it appears in the manuscript, while transliteration converts that content from one script into another according to established conventions. Reconstruction constitutes a further analytical stage in which damaged, incomplete, or illegible readings are restored through philological comparison, contextual interpretation, and palaeographical analysis (Evans, 2024; Perino et al., 2024).

This distinction is particularly important in the study of deteriorated Islamic manuscripts, where enhanced visual access does not automatically produce readable or recoverable texts. Digital enhancement may reveal previously obscured letter traces, yet philological reconstruction remains necessary to establish plausible readings and restore textual continuity. Accordingly, digital philology should be understood not merely as a preservation strategy, but as an integrated methodological approach that combines image enhancement, textual analysis, transcription, transliteration, and reconstruction in order to recover damaged textual evidence while maintaining scholarly transparency.

Within this framework, the present study focuses specifically on the reconstruction stage. Digital enhancement is employed to improve the readability of damaged Pegon glosses in the TAPCC manuscript, while diplomatic transliteration and contextual philological analysis are used to recover partially illegible interlinear interpretations. By integrating these procedures, the study moves beyond descriptive documentation toward the recovery of textual readings that contribute to a better understanding of vernacular Qur'anic interpretation and *pesantren*-based pedagogical traditions in the Javanese-Sundanese context.

Method

This study employed a digital philological-codicological approach within a descriptive qualitative paradigm, examining the TAPCC manuscript as both a textual object and a material artefact situated within the historical context of Islamization in West Java. The Cangkuang Temple Cultural Heritage Site in Leles, Garut, was selected as the research site because it preserves one of the few extant Pegon tafsir manuscripts associated with the early Islamic scholarly tradition of the Priangan region. The manuscript is particularly significant for its representation of a cultural encounter between Javanese Islamic literary traditions and the Sundanese environment, evidenced by the use of Javanese Pegon script within a predominantly Sundanese-speaking community, making it relevant to studies of vernacular Qur'anic interpretation and local Islamic intellectual history in the Nusantara.

The study integrated limited fieldwork with systematic digital document analysis. Fieldwork comprised direct observation of the manuscript storage environment and semi-structured interviews with the site manager and custodians, addressing preservation practices, conservation methods, digitization procedures, and access regulations. As direct physical examination was not permitted due to conservation and security policies, primary data consisted of high-resolution digital images produced by the custodians, supplemented by metadata on folio condition, physical damage, page arrangement, and preservation history (Terras, 2022). Secondary data were drawn from existing catalogues, codicological reports, and scholarly literature on Pegon manuscripts and Nusantara tafsir traditions.

As employed here, digital philology denotes an image-based approach integrating classical philological principles with digital enhancement techniques, without recourse to automated text recognition or AI-based transcription. Digital images serve as primary textual witnesses, examined through zooming, contrast adjustment, and visual sharpening. Nevertheless, enhancement alone cannot establish reliable readings; interpretation of partially illegible passages remains dependent on manual palaeographical comparison, contextual reading, and analysis of recurrent orthographic patterns. Reconstructed readings are therefore treated as philologically informed interpretations grounded in observable visual evidence rather than definitive restorations, consistent with current

scholarship positioning digital enhancement as a complement to, rather than a substitute for, human textual criticism (Dumitrescu & Stan, 2025; Fischer, 2017).

The corpus comprised 139 folios (278 recto-verso pages). All folios were examined for codicological description and textual condition. Given the varying degrees of deterioration observed, including faded ink, fragmented letterforms, and partially illegible glosses, this study adopted a focused reconstruction strategy rather than attempting comprehensive manuscript reconstruction. The opening folio of Surah al-Kahf was selected as the principal sample due to severe deterioration substantially affecting the readability of the interlinear Pegon commentary, with additional damaged glosses from other folios examined for comparative purposes. Sample selection was governed by four criteria: presence of glosses unreadable through ordinary inspection; visible ink deterioration affecting letter identification; disruption of syntactic or semantic continuity; and availability of sufficient contextual evidence to support reconstruction.

Data collection and analysis proceeded through four stages. First, the corpus was documented through digital images with accompanying condition metadata. Second, image enhancement was performed using GIMP and the NCH Software Suite through controlled adjustments of contrast, brightness, and sharpness, applied selectively to the reconstruction sample. Third, diplomatic transliteration and contextual philological analysis were conducted, with reconstructed readings established through comparison of letter traces, glossing conventions, syntactic structures, and lexical patterns. Fourth, codicological analysis across the full corpus assessed writing materials, ink characteristics, page dimensions, and textual arrangement (Bausi et al., 2020). Each reconstructed reading was validated through three convergent criteria: correspondence of reconstructed letterforms to visible manuscript traces, palaeographical consistency with securely legible forms elsewhere in the manuscript, and lexical and syntactic plausibility within recurrent glossing patterns. Uncertain readings were classified as tentative and excluded from interpretative conclusions.

The final stage situated the reconstructed glosses within the broader context of Javanese-Sundanese Islamic learning traditions of the seventeenth and eighteenth centuries, with particular attention to the pedagogical function of interlinear Pegon commentary in *pesantren*-based Qur'anic instruction. The study is thus conceived not merely as textual recovery, but as an effort to recover and contextualize the textual, pedagogical, and cultural significance of local Qur'anic interpretive traditions through an integrated digital philological framework. The scope and components of analysis can be summarised in Table 1 below.

Table 1.
Scope of the Manuscript Corpus and Digital Reconstruction Procedures

No.	Component	Scope
1.	Total manuscript corpus	139 folios (278 pages recto-verso)
2.	Digital images analysed	Complete manuscript corpus
3.	Reconstruction sample	Beginning folio of Surah al-Kahf
4.	Additional cases	Selected damaged Pegon glosses
5.	Interview informants	1 museum manager/manuscript custodian
6.	Digital enhancement software	GIMP and NCH Software Suite
7.	Reconstruction method	Diplomatic transliteration, palaeographical analysis, contextual philological reconstruction
8.	Validation procedure	Visual, palaeographical, lexical, and contextual verification

Result

Digital Reconstruction and Philological Recovery of the TAPCC Manuscript

The TAPCC manuscript constitutes an important yet understudied component of local Islamic intellectual heritage in West Java. Based on local manuscript traditions and its association with the Cangkuang cultural landscape, the manuscript is commonly attributed to E.D. Arif Muhammad, a figure remembered in regional Islamic historiography as an early agent of Islamization in the Priangan area. Although the absence of a colophon precludes definitive attribution of authorship, the manuscript's provenance remains closely linked to the Islamic scholarly environment that developed around Cangkuang during the 17th and 18th centuries.

Codicological evidence provides a stronger basis for contextualizing the manuscript than biographical attribution alone. The manuscript is written on *daluang* paper (*Broussonetia papyrifera*), a writing material widely used in Sundanese manuscript culture between the seventeenth and nineteenth centuries (Andrea Acri, 2010; Ekadjati, 2003). Its use of Javanese Pegon script, interlinear *makna gandhul* glosses, concise explanatory notes, and pedagogical layout corresponds closely to *pesantrén*-based traditions of Qur'anic instruction associated with the broader Mataram intellectual sphere (Behrend, 1998). These features indicate that the manuscript functioned primarily as a teaching-oriented tafsir text intended to facilitate vernacular Qur'anic learning among local Muslim communities.

The manuscript is currently preserved at the Cangkuang Cultural Heritage Museum in Garut, along with other Islamic manuscripts associated with the local scholarly tradition. As documented in previous inventory studies, the Cangkuang collection contains numerous religious manuscripts that reflect diverse aspects of Islamic learning. Within this corpus, the TAPCC manuscript is particularly significant because it preserves interlinear Pegon interpretations whose deteriorated condition

necessitates philological reconstruction before their textual and pedagogical contents can be adequately analysed.

Table 2.
Manuscripts from the Collection of the Cangkuang Tample Museum

Manuscripts Category	Manuscript Code	Description	Documentation
Pegon Qur'anic Exegesis Manuscript	KMCC.001/Is	Manuscript of <i>Tafsir al-Qur'an Pegon Candi Cangkuang</i> (TAPCC), written in Pegon script with interlinear exegetical glosses.	
Fiqh Manuscripts	KMCC.002/Is – KMCC.008/Is	Manuscripts of Islamic jurisprudence that reflect local pedagogical traditions in ritual and legal instruction.	
Tawhīd Manuscripts	KMCC.009/Is – KMCC.011/Is	Manuscripts concerning Islamic theology, focusing on foundational doctrinal teachings within the local Muslim community.	
Linguistic Manuscripts	KMCC.012/Is – KMCC.014/Is	Three manuscripts on Arabic linguistic sciences, particularly <i>naḥw</i> and <i>ṣarf</i> , reflecting the pedagogical tradition of Islamic learning.	
Prayer and Sermon Manuscripts	KMCC.015/Is – KMCC.017/Is	Two manuscripts containing prayers and devotional texts, alongside one <i>khutbah</i> (sermon) manuscript. These manuscripts are preserved using traditional conservation methods, including wooden display cases, camphor, and silica gel to minimize further deterioration.	

The corpus of manuscripts traditionally attributed to Arif Muhammad, including the TAPCC, reflects a considerable range of Islamic scholarly interests within the Cangkuang region. The diversity of subjects represented in these texts, including theology, jurisprudence, Arabic grammar, devotional literature, and Qur'anic interpretation, suggests an environment in which multiple aspects of Islamic learning were transmitted and studied. While the available evidence does not permit definitive

conclusions about the organization of instruction, the manuscript corpus suggests that religious education likely played an important role in local intellectual life.

This range of texts appears consistent with pedagogical patterns commonly associated with Javanese *pesantren* traditions, in which theological instruction, legal learning, linguistic training, and devotional practices were interconnected components of Islamic education. Although the precise educational context of Kampung Pulo cannot be reconstructed with certainty, the manuscript collection suggests a relatively broad framework for religious learning and knowledge transmission. Accordingly, these manuscripts may be understood not only as historical textual artefacts but also as material traces of Islamic scholarly activity and local processes of religious transmission in the Sundanese region during the seventeenth to eighteenth centuries.

As for the physical condition of the TAPCC manuscript, it constitutes an essential aspect of this study, as it provides the primary basis for codicological identification, conservation assessment, and philological reconstruction. In manuscript studies, the examination of physical features commonly includes writing materials, dimensions, script and language, text layout, patterns of damage, and external elements such as binding and marginal annotations (Wardah, 2022, 53). These material characteristics are significant not only for determining the manuscript's age and historical circulation, but also for understanding the broader processes of textual transmission and local Islamic intellectual production in the Nusantara context.

Figure 1-2.

Number of Lines in the Manuscript at the Beginning of Surah Al-Isra and Visual of the Manuscript Cover, Made of *Daluang* Paper (Digital Version).



From a codicological perspective, the physical condition of TAPCC constitutes a crucial basis for reconstruction and preservation analysis. The manuscript is catalogued under the title *Naskah Al-Qur'an Abad XVII*, with the inventory code KMCC.001, and is written on *daluang* paper made from the bark fibers of the *saeh* tree (*Broussonetia papyrifera*). Empirical examination of the digitized images reveals the distinctive longitudinal fiber structure characteristic of *daluang* paper. The manuscript exhibits significant material deterioration, including browning discoloration, oxidation

stains along the folio edges, faded ink, and partial physical damage, all commonly associated with aged organic manuscripts.

Tabel. 3.
Codicological Characteristics of the TAPCC Manuscript

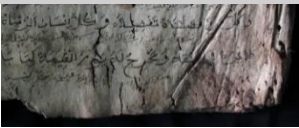
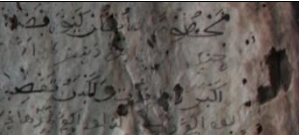
No.	Codicological Aspect	Description
1.	Inventory Code	KMCC.001
2.	Material	<i>Daluang</i> paper, made from <i>Broussonetia papyrifera</i>
3.	Dimensions	31.5 × 23.5 cm
4.	Writing Area	Approximately 18 × 25 cm
5.	Number of Folios	139 folios (278 pages recto–verso)
6.	Text Coverage	Surah al-Naḥl (Q.16) to Surah al-Šāffāt (Q.37)
7.	Script Type	Naskh for Qur’anic text; riq’ah for tafsir
8.	Writing System	Javanese Pegon with interlinear <i>makna gandhul</i>
9.	Ink Colors	Black for main text; red for surah titles and corrections
10.	Layout	11 lines of Qur’anic text with 11 interlinear tafsir lines
11.	Page Numbering	None
12.	Binding Condition	Original binding lost; traces of natural-fiber stitching remain
13.	Additional Features	Marginalia in red Pegon annotations; no surviving colophon

The manuscript’s external features provide important evidence of its history of use and transmission. Several folios contain marginal annotations in red Pegon script that differ from the main text and may have functioned as supplementary notes, corrections, or reading aids during the manuscript’s period of use. The absence of a separate glossary suggests that the text was intended for readers already familiar with Pegon literacy conventions. Although the original cover and binding have not survived, traces of traditional stitching remain visible on several central folios, indicating a locally produced binding structure that was later reinforced during conservation. Taken together, these codicological features suggest that the manuscript was actively used and circulated over time, reflecting patterns of religious learning and manuscript transmission comparable to those found in other Islamic manuscript traditions of Java and Sunda.

Digital Philological Reconstruction of the Pegon Text of the Cangkuang Temple Qur'an *Tafsir* Manuscript

The process of reconstructing the Pegon text in the TAPCC manuscript was carried out using high-resolution digital images provided by the manager of the Cangkuang Temple Cultural Heritage Site. The analysis began with mapping the visual damage on each folio, including insect holes, vertical and horizontal tears, water stains, faded ink, missing folios, and distortion of the *daluang* fibers. In more detail, the following are the results of the analysis related to the damage to the manuscript:

Table 4.
Types of Physical Damage Observed to the Manuscript

Type of Damage	Impact on Manuscript	Reconstruction Procedure	Documentation
Tears and Fiber Cracks	Causes partial loss and distortion of Pegon text, particularly in the marginal areas.	Digital enhancement combined with contextual philological reconstruction	
Perforations (Bookworm Damage)	Marginal glosses and minor textual sections are partially lost due to perforation.	Internal comparison with adjacent text and palaeographical analysis	
Water stains and damp marks	Reduces ink contrast and makes direct reading difficult, requiring digital enhancement for textual recovery.	Contrast adjustment, sharpening, and zoom analysis	
Loss of Folios	Produces semantic and structural gaps in the tafsir narrative.	No reconstruction possible; recorded as lost text	—
Physical Deformation (Warping and Buckling)	Distorts page structure and complicates the reading and digitization process.	Image correction and manual reading verification	

The assessment of damage severity was based on the extent to which each form of deterioration affected textual legibility. Damage was classified as recoverable when sufficient traces of letter forms or diacritical marks remained visible after digital enhancement. It was classified as partially recoverable when reconstruction required contextual philological interpretation, while sections with complete folio loss or total ink disappearance were designated as unrecoverable and excluded from textual reconstruction.

Based on observations of the folios that were successfully accessed, it was found that the damage tended to be concentrated on the margins at the bottom, top, and sides of the pages, which is a common characteristic of *daluang* manuscripts due to their hygroscopic nature and susceptibility to high humidity (Hinzler 1993; Gallop 2017). Meanwhile, the center of the folio remains in fairly good condition, making the characters more easily accessible.

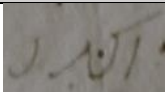
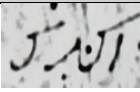
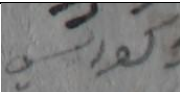
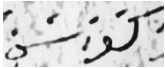
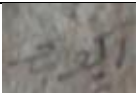
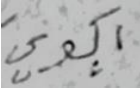
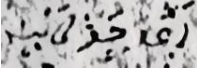
Next is the paleographic analysis of the manuscript. Paleographic analysis constitutes a fundamental stage in manuscript studies, particularly when the physical condition of a text compromises the legibility of letters and words. Within philological scholarship, paleography involves the examination of letterforms, stroke structures, pen movement, and local graphemic variants, serving to establish the relative dating of manuscripts, situate them within specific intellectual traditions, and support the reconstruction of faded or missing textual (Derolez, 2006; Parkes, 1993). In the case of TAPCC, palaeographically analysis not only assists in recovering illegible Pegon glosses but also

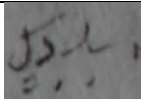
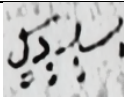
contributes to understanding the manuscript's scribal practices and its relationship to broader Javanese-Sundanese traditions of Islamic writing.

In the Nusantara context, Pegon script exhibits considerable visual diversity shaped by Javanese, Sundanese, and Madurese scribal traditions, especially in the use of diacritical dots, ligatures, and additional vowel markers (Fathurahman, 2015; Gallop, 2015; West, 2021). Accordingly, paleographic analysis of the Tafsir Candi Cangkuang manuscript is essential for elucidating the text's visual characteristics, identifying patterns of script deterioration, and providing a reliable foundation for the digital reconstruction of Pegon readings in damaged sections.

It should be noted that the Pegon script is essentially similar to the Arabic script, differing only in the number of letters used. Because the Pegon script is based on the dialectics and the Carakan Javanese script, the number of Pegon letters is adjusted to match the 20 letters of the Javanese script. In addition, of these twenty letters, there are seven letters that are not recognized in Arabic letters, namely ج (ca) ف (pa), د (dha), ع (nga), ي (nya), ك (ga), dan ط (tha), with each of these letters given one or three additional dots to distinguish them from the original Arabic letters (Pudjiastuti, 2009, Note 274). Therefore, the presentation of the TAPCC text analysis results will be adjusted to match the manuscript's writing style, with support from digital reading efforts.

Table 5.
Paleographic Evidence and Digital Reconstruction of Selected Pegon Readings

Damaged / Faded Form	Manuscript Documentation	Enhanced Reading – Transliteration & Translation	Basis for Validation
Ink fading is obscuring several characters, particularly in the middle and final strokes.		 <i>Akedik</i> (a little)	Reconstructed through enhancement of faded letter contours; validated by the consistent Pegon forms of <i>alif-kaf-dal-ya-kaf</i> , comparison with parallel letter shapes elsewhere in the manuscript, and lexical correspondence with the common Javanese word <i>akedik</i> .
Ink deterioration affecting the medial consonant and final vowel marker.		 <i>Kawasa</i> (capable)	Validated through recovery of obscured strokes after contrast adjustment, palaeographic comparison with intact occurrences of <i>waw</i> and <i>sin</i> , and contextual suitability within the explanatory gloss.
Surface stains are obscuring several letters in a two-word phrase.		 <i>Agawe</i> (creating)	Confirmed through identification of the distinctive Pegon letter <i>ga</i> (ك), comparison with similar forms in other folios, and lexical plausibility within Javanese interpretive language.
Oxidation stains partially cover the initial and medial characters.		 <i>Angucap kabeh</i> (...say)	Reconstruction based on enhanced visibility of letter boundaries, verification of Pegon forms for <i>nga</i> , <i>ca</i> , and <i>pa</i> , and semantic coherence of the phrase within the surrounding commentary.

Fading and abrasion affecting several medial strokes.			Validated through recovery of surviving letter traces, comparison with recurring Pegon representations of the Javanese phoneme <i>dh</i> , and lexical consistency with common Javanese vocabulary used throughout the manuscript.
		<i>Sedhidhik</i> (a little)	

Source: Analysis of the Pegon text in the TAPCC manuscript indicates that its script conforms to the

17th-18th-century Pegon tradition in the archipelago, characterized by upright letterforms, short descenders, light pen pressure, and the absence of complex ligatures typical of Middle Eastern *naskh*. This typology is commonly found in early Islamic Javanese and Sundanese religious manuscripts (Gallop, 2012; Oman Fathurahman, 2010). Although the letter forms exhibit internal consistency, fading *daluang* ink has caused significant damage, necessitating digital reconstruction. For instance, the *kāf* (ك), written with an extended horizontal tail and an open upper curve, remains identifiable in torn areas through residual strokes enhanced by contrast adjustment, while the *sīn* (س), often written without teeth in several folios, creates orthographic ambiguity when ink fades, requiring internal collation across folios for accurate reading.

A critical feature of the TAPCC manuscript appears in the use of localized Pegon letters, particularly the representation of /g/ as *kāf* with three dots below (ك), whose diacritical marks are frequently lost in damaged sections, causing visual ambiguity with standard *kāf*. Digital enhancement techniques, including contrast stretching and ink-trace analysis, enable the identification of residual pen-pressure patterns on the dots that are absent in regular *kāf* forms. Similarly, the phoneme /ny/ is rendered as *yā'* with three dots beneath (ي), a mark prone to disappearance on fibrous *daluang* paper; its reconstruction relies on phonological validation through Sundanese-Javanese syllabic patterns, as in *kang nyata*. The phoneme /p/, written as *fā'* with three dots (ف), also risks misreading as /f/ when the dots fade, requiring lexical validation, since words such as *aparek* are phonologically incompatible with /f/ in Old Javanese; the reading /p/ is thus more plausible.

An example of concrete reconstruction can be seen in the word *agawe* (“to make”), where the diacritical dots identifying the Pegon letter for /g/ are almost entirely lost. Using a deep zoom of 300-400% and contrast enhancement, faint traces of ink and pen-pressure marks beneath the base letter remain visible. Comparison with clearly preserved occurrences of the same letter elsewhere in the manuscript reveals strong palaeographical similarity in stroke structure and dot placement, supporting the reconstruction of the reading as *agawe*. In another case, the word *sedhidhik* (“a little”) exhibits a nearly vanished lower dot on the letter representing /dha/. Its reconstruction was validated through lexical comparison with Old Javanese vocabulary and by reference to recurring orthographic patterns in the manuscript, where the scribe consistently employed the *dha* variant in comparable linguistic contexts.

The reconstruction validation was carried out in two ways. First, internal collation, which involves comparing the graphemes and words on the still-legible pages to infer the letters in the damaged fragments. Second, contextual reading, which is checking whether the reconstruction makes the interpretation coherent with the commented verse. Thus, digital paleographic reconstruction not only restores the form of letters but also the linguistic and cultural structure of the text, allowing previously uninterpretable texts to be accessed and reinterpreted.

Re-reading the Pegon Tafsir through Digital Philology

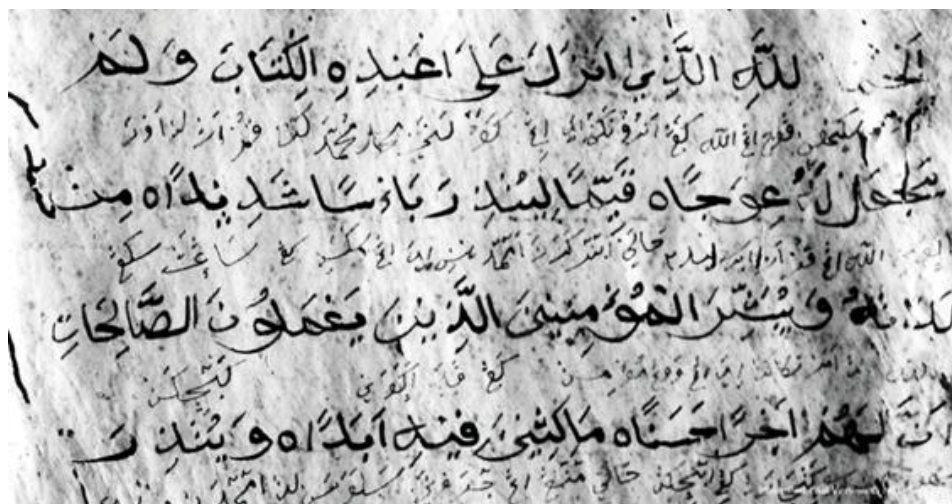
Revitalization is an effort to restore vitality (functionality) or revive works, literature, or culture so that they can be adopted and elaborated upon by contemporary society. In this case, revitalization plays a role that goes beyond similar efforts, such as preservation and conservation (Davit, 2025, Note 23). The stage of revitalizing the meaning of interpretation began after paleographic reconstruction and visual restoration successfully reopened part of the Pegon letter structure that had previously been obscured by physical damage. While the previous section focused on diagnostic recovery, namely identifying ink traces, letter curves, and phonemic points, this section shifts to how this recovery enables the rereading of interlinear comments containing religious meanings. The main focus is on tracing the intellectual horizon of local Javanese exegetes embedded in short Pegon glosses. Thus, the revitalization of the meaning of interpretation in this study is a hermeneutic process grounded in material data from reconstruction, rather than in linguistic speculation or historical claims lacking textual basis.

The structure of the interpretation in the manuscript shows a consistent pattern of interlinear interpretation (*gandhul* meaning), which is a commentary model inserted directly below the lines of the Qur'an. This pattern has been widely known in the Javanese *pesantren* tradition since the 17th-19th centuries, used as a pedagogical tool so that students can understand Arabic syntactic structure through concise local glosses that directly refer to specific words (Azra, 2013; Gusmian, 2015). A similar pattern is seen in the TAPCC folios, where each word or phrase in the verse is accompanied by an informative, rather than interpretive, Javanese-Pegon equivalent. The consistency of this pattern reinforces the manuscript's position as a teaching interpretation rather than a thematic or Sufi one, as in the Acehnese or Malay traditions.

Philologically, the reconstruction uses two main validation procedures, as mentioned earlier. Concrete examples illustrate this methodology. In the first two verses of Surah Al-Kahfi, with perforated edges, faded colors, stains, image enlargement (zoom up to 200-300%), and simple contrast enhancement, reveal the original lines and shapes of the letters by comparing the shapes of similar words in other folios. Thus, words that were originally read as Arabic are clearly Javanese-Pegon glosses that direct the local meaning towards the lexicon of the related verses. In addition,

digital reconstruction serves not as conservative restoration, but as a philological tool to restore legibility and reopen access to interpretive meaning (Stokes, 2004).

Figure 3.
Image of the Manuscript Resulting from Digital Image Processing Using GIMP and NCH Software Suite at the Beginning of Surah Al-Kahfi.



“Sekabehane puji ing Allah kang Anurunake ing kawulane Muhammad kitab Qur’an. Lan ora agawe Allah ing Qur’an bengkok. Hale bener kerana ameden-medeni ira ing siksa kang sanget saking Allah. Lan ambrita aken ing wong mukmin kang padha agawe kabecikan. Setuhune kabeh ganjaran kang becik hale meneng ing jerone selawase.”

“All praise belongs to Allah, who has revealed the Qur’ān to His servant, Muhammad. Allah has not placed therein any crookedness or deviation. Rather, it is upright and true, serving to warn people of a severe punishment from Allah and to give glad tidings to those who believe and perform righteous deeds that they shall receive an excellent reward. They will abide therein forever.”

Although unable to restore the manuscript to its original condition, the application of simple digital reconstruction, through image enlargement (zoom) and contrast enhancement in faded areas, has proven to have a significant effect on the legibility of the text. This technique allows researchers to reveal traces of ink that were previously hidden by *daluang* fibers, moisture stains, or surface damage. In the early folios, which were originally difficult to identify because the ink color blended with the paper background, this visual enhancement process reopened the contours of the Pegon letters, including the curved patterns, tails, and additional dots that determine phoneme reading.

Thus, digital reconstruction does not repair the physical damage to the manuscript, but serves as an important tool for restoring legibility and ensuring a more accurate reading of the text structure.

Through the reconstruction of these parts, the interpretive horizon that had been buried by material damage can be revived. A systematic reading shows that Arif Muhammad combined classical Arabic syntactic structures with simple, direct, and pedagogical 18th-19th century Javanese diction. Thus, the revitalization of meaning does not merely reopen the text, but also reconnects this manuscript with its intellectual tradition, namely the tradition of interlinear interpretation in Javanese Islamic boarding schools, which served as a vehicle for the transmission of basic knowledge of the Qur'an outside the intellectual centers of the Middle East.

At the epistemological level, this revitalization demonstrates that manuscripts function not merely as historical artifacts but as sites of meaning production. Through digital reconstruction, the manuscript is restored as a readable text, enabling renewed analysis of its themes, pedagogical strategies, and religious vocabulary. This process simultaneously reopens access to local intellectual heritage and deepens scholarly understanding of interpretive diversity in the archipelago, particularly the Javanese Pegon interlinear tradition, which remains underexplored within contemporary digital philological studies.

Discussion

Javanese Pegon in a Sundanese Context: Vernacular Islam and Interregional Knowledge Transmission

One of the most significant findings of this study is the presence of Javanese Pegon glosses within a manuscript preserved in a predominantly Sundanese cultural environment. At first glance, this linguistic configuration appears paradoxical because the manuscript originated from the Priangan region of West Java, an area commonly associated with the Sundanese language and literary traditions. However, the use of Javanese Pegon suggests that the transmission of Islamic knowledge in the archipelago did not operate within rigid ethnolinguistic boundaries. Rather, it reflects the existence of interconnected scholarly networks through which religious texts, pedagogical methods, and linguistic conventions circulated across regions.

This finding supports the broader thesis of vernacular Islam proposed by Ricci, who argues that Islamic knowledge in South and Southeast Asia expanded through the translation, adaptation, and localization of Arabic religious texts into vernacular languages while maintaining connections to transregional Islamic intellectual traditions. In this context, the TAPCC manuscript illustrates how Javanese Islamic literacy practices extended beyond their original linguistic sphere and became embedded within a Sundanese setting. The use of Pegon therefore should not be understood merely

as a script choice but as evidence of a broader intellectual process through which local communities appropriated Islamic teachings through accessible linguistic forms while remaining connected to wider networks of religious learning (Ricci, 2011).

The manuscript also contributes to ongoing discussions on the circulation of Islamic manuscripts in the Indonesian archipelago. A. H. Johns (1965) and Fathurahman (2015) have demonstrated that the transmission of Islamic knowledge frequently occurred through manuscript copying, adaptation, and teaching networks that linked various regions of the archipelago. The presence of Javanese linguistic features within TAPCC may indicate that the manuscript, or the pedagogical tradition underlying it, was influenced by scholarly contacts with Central or Coastal Java, where Pegon literacy was more firmly established. Rather than representing an isolated local product, TAPCC appears to embody a process of interregional intellectual exchange in which Islamic knowledge moved across cultural and linguistic frontiers (Ricci, 2011).

Furthermore, the findings resonate with Rohmana's studies on Pegon literacy in West Java, which demonstrate that Sundanese Islamic intellectual traditions often interacted closely with Javanese textual cultures. Rather than replacing local identities, these interactions generated hybrid forms of religious expression that combined local cultural contexts with broader Islamic educational traditions. The coexistence of a Sundanese cultural environment and Javanese Pegon glosses in TAPCC therefore provides valuable evidence for understanding vernacular Islam as a dynamic process of cultural negotiation rather than a simple localization of religious knowledge (Rohmana, 2024). Consequently, the manuscript expands our understanding of how Islamic intellectual traditions developed through interconnected regional networks that transcended linguistic and ethnic boundaries in premodern Indonesia.

***Makna Gandhul* and *pesantren* Pedagogy: Typical Tradition or Local Adaptation?**

A second important finding concerns the manuscript's use of *makna gandhul*, the interlinear glossing system characteristic of traditional *pesantren* learning. The presence of concise Pegon annotations placed directly beneath Arabic words indicates that the manuscript functioned primarily as a pedagogical text rather than a comprehensive exegetical treatise. This instructional format enabled students to follow Arabic grammatical structures while simultaneously accessing vernacular explanations, thereby facilitating the study of Qur'anic texts for learners with limited Arabic proficiency.

Previous studies of *pesantren* pedagogy have shown that *makna gandhul* constituted one of the most important educational technologies in traditional Islamic learning. Through this system, teachers provided word-by-word explanations that preserved Arabic syntax while conveying meaning in local

languages. Such a method was particularly effective in the *bandongan* and *sorogan* traditions, where students learned by closely following oral explanations delivered by religious teachers. In this respect, the TAPCC manuscript closely conforms to pedagogical patterns documented in numerous Javanese and Madurese *pesantren* manuscripts and therefore should not be regarded as an entirely unique instructional model.

Nevertheless, the manuscript exhibits a distinctive characteristic that differentiates it from many previously studied examples. While the pedagogical structure follows the conventional *makna gandhul* format, its preservation within the cultural landscape of Cangkuang demonstrates the geographical expansion of *pesantren*-based textual practices into the Priangan region. This suggests that the pedagogical infrastructure associated with Javanese Islamic learning had become sufficiently influential to shape local Qur'anic education beyond its original centers of transmission. Consequently, TAPCC represents both continuity and adaptation: continuity in its adherence to established *pesantren* pedagogical conventions, and adaptation in its integration within a Sundanese socio-cultural environment.

The manuscript therefore contributes to a broader understanding of how educational traditions facilitated the spread of Islamic knowledge across the archipelago. Rather than transmitting doctrine alone, *makna gandhul* served as a pedagogical bridge between Arabic religious texts and vernacular linguistic realities. The TAPCC manuscript illustrates how this educational model enabled local communities to engage with the Qur'an through familiar linguistic frameworks while simultaneously participating in wider Islamic intellectual traditions.

Digital Philological Reconstruction: Contributions, Limitations, and Implications for Manuscript Preservation

The third major contribution of this study lies in its application of digital philological reconstruction to recover damaged portions of the manuscript. The findings demonstrate that image-based enhancement techniques can substantially improve the readability of deteriorated Pegon texts, particularly in cases involving faded ink, weakened diacritical marks, low-contrast writing, and partially obscured glosses. By combining contrast adjustment, sharpening, magnification, and palaeographical comparison, previously illegible textual segments became sufficiently visible to permit informed philological interpretation.

The successful reconstruction of several damaged Pegon glosses highlights the potential of digital philology as a practical tool for manuscript preservation and textual recovery. Rather than replacing conventional philological methods, digital enhancement functions as a complementary approach that increases textual visibility and facilitates more accurate palaeographical analysis. The reconstructed

readings presented in this study demonstrate that meaningful textual recovery is possible when residual traces of writing remain preserved within the manuscript image. In this sense, digital philology contributes not only to manuscript preservation but also to the recovery of interpretive accessibility, enabling scholars to engage with textual materials that would otherwise remain unreadable.

At the same time, the study reveals important methodological limitations. Digital enhancement cannot recover information that has been completely lost. Areas affected by severe tearing, missing folios, extensive fungal damage, or total ink disappearance remain resistant to reconstruction because no visual traces survive for analysis. In such cases, reconstruction necessarily depends on contextual interpretation, comparison with parallel textual traditions, and informed philological judgment. Consequently, reconstructed readings should be understood as philologically grounded interpretations rather than definitive restorations of the original text.

These limitations underscore the need for a balanced understanding of digital philology. The approach should not be viewed as a technological solution capable of restoring every damaged manuscript, but rather as a methodological framework that expands the range of evidence available to researchers. Its greatest strength lies in enhancing the visibility of surviving textual traces and supporting more rigorous philological interpretation. Given the large number of fragile Qur'anic manuscripts preserved across Indonesia, many of which are deteriorating, the integration of digital reconstruction and classical philology offers a promising strategy for future preservation efforts. By providing a replicable model for recovering damaged Pegon and vernacular Islamic manuscripts, this study contributes to broader initiatives to safeguard Nusantara manuscript heritage while enriching scholarship on vernacular Islam, Qur'anic pedagogy, and the intellectual history of Southeast Asian Islam.

Conclusion

This study has demonstrated that integrating digital image enhancement and philological analysis constitutes a viable methodology for recovering damaged textual features in Pegon manuscripts. Through systematic application of contrast adjustment, magnification, palaeographical comparison, and multi-stage contextual validation, several faded and partially obscured interlinear glosses in the TAPCC manuscript were successfully reconstructed, with the opening folio of Surah al-Kahf serving as the principal case. These reconstructed readings yield philologically grounded evidence for understanding the manuscript's deployment of Javanese Pegon script, its adherence to the *makna gandhul* pedagogical format, and its position within the broader tradition of vernacular Qur'anic interpretation in the Nusantara.

Beyond textual reconstruction, the findings carry wider implications for the intellectual history of Islamic learning in West Java. The presence of Javanese Pegon glosses within a Sundanese cultural setting attests to the cross-regional circulation of Islamic knowledge and to the manuscript's embeddedness in *pesantren*-based traditions of Qur'anic instruction. In this respect, TAPCC represents not merely a local textual artefact but a material trace of the transregional scholarly networks that shaped Islamic education in the early modern Indonesian archipelago.

Two limitations of the present study warrant explicit acknowledgement. First, the reconstruction was conducted exclusively through digital image analysis rather than sustained direct examination of the physical manuscript, precluding detailed assessment of ink characteristics, paper texture, and other codicological features accessible only through hands-on inspection. Second, digital enhancement proved effective only where residual ink traces remained visible; text lost to complete physical deterioration could not be recovered through image-based methods alone. Reconstructed readings are accordingly treated as philologically informed interpretations rather than definitive restorations.

These limitations nonetheless delineate a productive agenda for future research. Multispectral imaging would substantially enhance the recovery of traces that are imperceptible under standard lighting conditions. Comparative philological studies encompassing Pegon *tafsir* manuscripts from across the Javanese and Sundanese regions would enable more precise identification of scribal conventions, textual dependencies, and regional variation in Qur'anic commentary traditions. Collaborative frameworks engaging philologists, manuscript conservators, and digital heritage specialists would further strengthen both the accuracy of textual reconstruction and the long-term preservation of Nusantara's Qur'anic manuscript heritage. Collectively, such directions would advance not only the recovery of individual manuscript texts but also the broader scholarly understanding of vernacular Islamic intellectual traditions in Southeast Asia.

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