

INTERDISCIPLINARY

Water Balance Analysis
for Water Loss in
Homoine

Decentralized Academic
Records for Indian Uni

Conflict and
Migration: Ugandan
Maids in Saudi

Impact of Artisanal
Gold Mining in
Kangaba, Mali

Discovering Thoughts, Inventing Future

VOLUME 26 / ISSUE 2 / VERSION 1.0

**GLOBAL JOURNAL OF
COMPUTER SCIENCE AND
TECHNOLOGY**

Section G - Interdisciplinary

Volume 26

2026

Issue G2

Global Journal of Computer Science and Technology

ISSN (Online): 0975-4172 • ISSN (Print): 0975-4350

Open Access Policy

All articles published in Global Journal of Computer Science and Technology are open access articles published under the Global Journals Open Access Publishing Agreement, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Publisher

Global Journals Incorporated
301 Edgewater Place, Suite 100
Wakefield, MA 01880, United States

Copyright

© 2026 by Global Journals Incorporated (USA). All rights reserved.

No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopy, recording, or any information storage and retrieval system, without written permission.

Disclaimer

The authors, editors, and publisher will not accept any legal responsibility for any errors or omissions that may be made in this publication. The publisher makes no warranty, express or implied, regarding the material contained herein.

Editorial Board

Global Journal of Computer Science and Technology

Alessandra Lumini

University of Bologna Italy, Italy

Dr. Abdurrahman Arslanyilmaz

Gazi University, Turkey

Dr. Asim Sinan Yuksel

İstanbul University, Turkey

Dr. Aziz M. Barbar

American University of Science and Technology, Lebanon

Dr. Federico Tramarin

National Research Council, Italy

Dr. Feng Jin

University of Arizona, United States

Dr. Gerard G. Dumancas

Oklahoma State, United States

Dr. Hassan Harb

Lebanese University, Lebanon

Dr. Hazra Imran

Athabasca University, Canada

Dr. Jianyuan Min

Texas A&M University, United States

Dr. Jiayi Li

University of Virginia, United States

Dr. Jie YANG

Marquette University, United States

Dr. Juan Antonio Camara Serrano

University of California, San Francisco, United States

Dr. Judith A. Rowenfeld

Columbia University, United States

Dr. Kurt Maly

New York University, United States

Dr. Kwan Min Lee

Nanyang Technological University, Singapore

Dr. Lamri Sayad

University of Béjaïa, Algeria

Dr. Latifa Oubedda

Université Ibn Zohr, Morocco

Dr. Luisa Dall'Acqua

Università di Bologna, Italy

Dr. Magdy Shayboub Ali

Suez Canal University, Egypt

Dr. Nurul Akmar Binti Emran

Technical University of Malaysia Malacca, Malaysia

Dr. Omar Ahmed Abed Alzubi

Al-Balqa Applied University, Jordan

Dr. Osman Balci, Balci

Virginia Tech, United States

Dr. Rajesh Kumar Rolen

Singhania University, India

Dr. Rajneesh Kumar Gujral

Maharishi Markandeshwar University, Mullana, India

Dr. Roheet Bhatnagar

Sikkim Manipal University, India

Dr. Sotiris Kotsiantis

University of Patras, Greece

Dr. Stefano Berretti

University of Florence, Italy, Italy

Dr. Tauqeer Ahmad Usmani

Kumaun University, India

Dr. Yuanyang Zhang

University of California, United States

Dr. Yufeng Wang

University of Chinese Academy of Sciences, United States

Dr. Zhengyu Yang

Northeastern University, United States

Dr. Jiayi Liu

University of Munich, United States

Jiyong Yu

University of Illinois, United States

Ming Li

University of Tulsa, United States

PREFACE

The Global Journal of Computer Science and Technology (GJCST) is pleased to present this issue, bringing together a curated collection of high-quality research papers that explore various frontiers of computer science and technology.

This issue features research spanning topics including artificial intelligence, machine learning, software engineering, network security, and interdisciplinary applications of computing. Each paper has undergone a rigorous peer-review process to ensure scientific rigor and originality.

We would like to express our sincere gratitude to the authors for entrusting their research with us, to the reviewers for their thorough and constructive evaluations, and to our readers for their continued engagement with the scientific discourse.

We hope that the research presented herein inspires further inquiry and contributes meaningfully to the advancement of knowledge in computer science and technology.

The Chief Editor
Global Journal of Computer Science and Technology
Global Journals Organization

TABLE OF CONTENTS

Title	Author	Pages
Copyright		i
Editorial Board		ii
Preface		iii
Aplicação do Balanço Hídrico Como Ferramenta de Diagnóstico de Perdas: O Caso De Homoíne	Mabjaia	1–3
Diabetic Foot: A Multidisciplinary Approach to Limb Preservation	Kushwah et al.	4–13
THE UNTOLD SUFFERING OF HOUSEMAIDS. A STUDY OF CONFLICT ISSUES AFFECTING UGANDAN HOUSEMAIDS WHO MIGRATE TO SAUDI ARABIA AND HOW TO MITIGATE THEM.	aaaaaaaaa	14–15
Impact de l’exploitation artisanale de l’or sur les écosystèmes dans le Cercle de Kangaba, Région de Koulikoro (Mali)	Chouhan	16–22
To translate	Chouhan	23–23
Impact of Artisanal Gold Mining on Ecosystems in the Kangaba Circle, Koulikoro Region (Mali)	Chouhan	24–25
Subject Index		25
Author Guidelines		26



Aplicação do Balanço Hídrico Como Ferramenta de Diagnóstico de Perdas: O Caso De Homoíne

Application of the Water Balance as a Diagnostic Tool for Losses: The Case of Homoíne

Article Record

Ankit Joshi^α
MSC, Senior Professor



Mr. Mukesh k Softinator^{§β*}
PhD, Professor
*Corresponding Author



Vicente Micas Mabjaia^γ
Msc, Professor



§ Faculty of Medicine and Health Sciences, Rajiv Gandhi Technical University, Ghent, Belgium (OA)

RECEIVED

2026-04-04

REVISED

2026-04-06

ACCEPTED

2026-04-10

PEER REVIEW

Double Blind

Abstract

The water distribution network of Vila de Homoíne, in the Homoíne district of Inhambane Province, has long faced a problem that is difficult to measure: a substantial share of the water produced never gets billed. Without adequate monitoring tools — and with operations relying almost entirely on manual processes — it becomes nearly impossible to tell apart water lost through physical leaks from water lost through metering errors and billing failures. This study takes that concrete problem as its starting point and proposes a methodological response: the application of the Water Balance framework developed by the International Water Association (IWA). The approach works by breaking down the total volume of water entering the system into its constituent parts — billed consumption, unbilled authorised consumption, and losses of both a physical and apparent nature — making it possible to determine, with reasonable precision, where and how much water is being lost. What makes this approach particularly suited to Homoíne is its flexibility. Even when available data are incomplete or of uncertain reliability, the water balance still yields estimates robust enough to guide intervention decisions. The diagnosis is expected to reveal a Non-Revenue Water index above 30%, which is consistent with figures recorded in comparable systems across Mozambique and other sub-Saharan African countries. The findings of this study have direct practical value for the local operator and could serve as a replicable model for other small and medium-sized systems across the country — contributing to a sector that still lacks systematic data on distribution efficiency in rural and semi-urban areas.

Water balance

Water losses

Non-Revenue Water

Homoíne

Mozambique

AI USE STATEMENT

No generative AI was used for analysis or results.

FUNDING

No external funding was declared for this work.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

DATA AVAILABILITY

Not applicable for this article.

ETHICS

No ethics committee approval was required for this article type.

CONSENT

Not applicable for this article.

TRIAL REG.

Not applicable.

Crossref DOI: 10.34257/GJREJ256847

How to Cite: Joshi et al. (2026). Aplicação do Balanço Hídrico Como Ferramenta de Diagnóstico de Perdas: O Caso De Homoíne. Global Journal of Computer Science and Technology, 26(2), 1-15. DOI: 10.34257/GJREJ256847

LICENSE

© 2026 Global Journals. Open-access article under CC BY-NC-ND 4.0 International License.



Print ISSN 0975-4350



Online ISSN 0975-4172



Under the strict compliance and defined process of



METADATA CONTINUATION

AUTHOR CONTACT QR LEDGER

Ankit Joshi		Mr. Mukesh k Softinator		Vicente Micas Mabjaiay	
-------------	---	-------------------------	---	------------------------	---

AUTHOR CONTRIBUTION MATRIX

Ankit Joshi α | Conceptualization, Formal analysis, Resources

ARCHIVAL RECORD

Aplicação do Balanço Hídrico Como Ferramenta de Diagnóstico de Perdas: O Caso De Homoine

Ankit Joshi^{§α}, Mr. Mukesh k Softinator^{§β*}, and Vicente Micas Mabjaia^{§γ}

Affiliations

§ Faculty of Medicine and Health Sciences, Rajiv Gandhi Technical University, Ghent, Belgium (OA)

Qualifications / Designations

α MSC, Senior Professor

β PhD, Professor

γ Msc, Professor

Abstract

A rede de abastecimento de água da Vila de Homoine, no distrito homónimo da província de Inhambane, acumula há vários anos um problema de difícil quantificação: uma parcela significativa da água produzida nunca chega a ser cobrada. A falta de instrumentos de controlo adequados agravada pela gestão feita quase exclusivamente por meios manuais torna praticamente impossível distinguir o que se perde por fugas físicas do que se perde por falhas na medição e facturação. Este trabalho parte desse problema concreto para propor uma resposta metodológica: a aplicação do Balanço Hídrico segundo a abordagem da International Water Association (IWA). Trata-se de um procedimento estruturado que decompõe o volume de água introduzido no sistema nas suas várias componentes: consumo faturado, consumo não faturado e perdas de natureza física e aparente, permitindo, assim, conhecer com precisão onde e quanto se perde. O interesse desta abordagem para o contexto de Homoine prende-se, sobretudo, com a sua adaptabilidade: mesmo quando os dados disponíveis são incompletos ou de fiabilidade limitada, o balanço hídrico fornece estimativas suficientemente robustas para orientar decisões de intervenção. Espera-se que o diagnóstico revele um índice de Água Não Faturada acima dos 30%, valor consistente com o que tem sido registado em sistemas similares em Moçambique e noutros países da África Subsaariana. Os resultados deste estudo têm utilidade imediata para o operador local e podem servir de modelo replicável noutros sistemas de pequena e média dimensão no país, contribuindo para um sector que ainda carece de dados sistematizados sobre a eficiência da distribuição de água em zonas rurais e semi-urbanas.

Keywords: *Water balance, Water losses, Non-Revenue Water, Homoine, Mozambique*

* Corresponding Author

Mr. Mukesh k Softinator

DOI

10.34257/GJREJ256847

1. Introdução

O acesso a água potável constitui um direito humano fundamental, reconhecida pela Assembleia Geral das Nações Unidas na Resolução 64/292 de 2010. (WHO & UNICEF, 2023)

Em Moçambique, o setor de abastecimento de água enfrenta grandes desafios estruturais significativos. Segundo dados do Banco Mundial, apenas 45% da população rural tem acesso a água melhorada, enquanto os sistemas urbanos registam perdas consideráveis de água não faturada (Kansal, 2023)

O distrito de Homoine, localizado na província de Inhambane, não é exceção: a ausência de ferramentas digitais de monitorização e controlo resulta em perdas hídricas e financeiras que comprometem a sustentabilidade do serviço.

O Balanço Hídrico, e' a metodologia padronizada pela International Water Association (IWA), constitui o instrumento fundamental para a quantificação e classificação das perdas de água em sistemas de distribuição (Hirner, 2000)

A sua aplicação sistemática permite identificar as componentes de Água Não Faturada (ANF), perdas físicas e aparentes e orientar intervenções técnicas e operacionais para a redução de perdas.

Estudos realizados em contextos similares, como em Chimoio, Moçambique (Macuácu, 2022), e em várias cidades africanas (Mvongo, 2024), demonstram que a aplicação do balanço hídrico,

mesmo com dados limitados, permite identificar padrões de perda e propor intervenções prioritárias e de baixo custo. Esta abordagem é particularmente relevante para o contexto socioeconómico moçambicano, onde a disponibilidade de equipamentos avançados é frequentemente limitada.

O presente artigo tem como objectivo analisar a aplicação do Balanço Hídrico como ferramenta de diagnóstico de perdas no sistema de abastecimento de água da Vila de Homoine, contribuindo para a discussão científica sobre gestão hídrica em zonas rurais e semi-urbanas de Moçambique.

2. Revisão da literatura

2.1. O Conceito de Balanço Hídrico segundo a iwa

O balanço hídrico é o instrumento metodológico fundamental para a quantificação e análise das perdas de água em sistemas de distribuição. Desenvolvido e padronizado pela IWA, o balanço hídrico consiste na decomposição do volume de água introduzido no sistema nas suas diferentes componentes, permitindo identificar e quantificar as perdas reais e aparentes de forma sistemática (Hirner, 2000).

Segundo a metodologia da IWA, o Volume Introduzido no Sistema (VIS) é decomposto em: Consumo Autorizado Faturado (receita para

o operador), Consumo Autorizado Não Faturado, Perdas Aparentes (ou Comerciais) e Perdas Reais (ou Físicas). A soma das perdas aparentes, perdas reais e consumo autorizado não faturado constitui a Água Não Faturada (ANF) indicador internacionalmente utilizado para medir a eficiência dos sistemas de abastecimento (Mvongo et al., 2024).

As perdas reais são o volume de água que escapa fisicamente do sistema antes de chegar ao consumidor e fugas em tubagens, roturas em juntas e transbordo de reservatórios. As perdas aparentes resultam de imprecisões na medição do consumo, erros administrativos na facturação e ligações clandestina (Mvongo et al., 2024).

2.2. Dimensão Global e Regional das Perdas de Água

A dimensão do problema das perdas de água é considerável a nível global. (Wyatt, 2019), citados em (Mvongo et al., 2024), estimam que o volume global de ANF é de aproximadamente 346 milhões de m³ por dia, representando um custo anual de cerca de 39 mil milhões de dólares para os operadores de água. Nos países em desenvolvimento, os níveis de ANF são particularmente elevados, podendo atingir entre 30% e 60% do volume total produzido, valores muito superiores ao limiar de 15-25% considerado aceitável pelo Banco Mundial (Kansal, 2023).

Na África, as perdas de água variam entre 5% e 70% do volume introduzido no sistema, dependendo das condições locais (Mvongo et al., 2024). Um estudo conduzido (Oliveira De Almeida et al., 2007) no Zimbábue identificou que os principais factores de ANF eram as perdas por transmissão, a sub-contagem dos contadores e a ineficiência na facturação realidade que se assemelha ao contexto de Homoine. Em Moçambique, o estudo de (Macuácu, 2022) sobre o município de Chimoio registou uma taxa de perdas de 25% no sistema de abastecimento analisado, utilizando a metodologia do balanço hídrico com modelação hidráulica pelo software EPANET.

2.3. Aplicação do Balanço Hídrico em Contextos de Baixa Renda

A aplicação do balanço hídrico em contextos de recursos limitados apresenta desafios específicos, como a escassez de dados fiáveis e a ausência de macrocontadores. (Mutikanga, 2011) sublinham que, mesmo em contextos de dados imprecisos, é possível obter estimativas úteis das componentes de ANF através de auditorias de campo e dados operacionais existentes. Este princípio é fundamental para o caso de Homoine, onde a recolha de dados de campo constitui etapa essencial da metodologia.

numa análise de sistemas de distribuição em diferentes contextos, que a aplicação o metodo do balanço hídrico isso permite identificar tendências de deterioração do sistema e orientar intervenções prioritárias de baixo custo, como a substituição de contadores defeituosos e a reparação de fugas visíveis. Estes resultados são particularmente relevantes para sistemas de pequena e média dimensão, como o de Homoine (Ethem Karadirek, 2020).

O uso do balanço hídrico com ferramentas de modelação hidráulica, como o EPANET, constitui uma abordagem metodológica consolidada para o diagnóstico de perdas em países em desenvolvimento (Macuácu, 2022). Esse metodo permite não apenas quantificar as perdas, mas também identificar zonas críticas da rede e simular cenários de intervenção.

3. Metodologia

3.1. Área de Estudo

O estudo de revisao é sobre o sistema de abastecimento de água potável da Vila de Homoine, sede do distrito de Homoine, localizado na província de Inhambane, sul de Moçambique. O sistema é gerido por uma entidade local e abastece uma população estimada de aproximadamente 18.000 habitantes, através de uma rede de distribuição com extensão variável e infraestrutura com tubação envelhecida.

3.2. Recolha de Dados

A recolha de dados primários inclui: (1) leituras mensais de caudal nos pontos de entrada do sistema (macrocontadores); (2) leituras de contadores domiciliários; (3) registo de dados de faturação; (4) levantamento de fugas visíveis e roturas reportadas. Os dados secundários foram obtidos junto da entidade gestora local e incluem registos históricos de produção e consumo.

3.3. Aplicação do Balanço Hídrico

O cálculo do Balanço Hídrico usa-se a metodologia padronizada pela IWA (Hirner, 2000), com adaptações propostas por (Ethem Karadirek, 2020) para contextos com dados incompletos. As componentes calculadas incluem: Volume Introduzido no Sistema (VIS), Consumo Autorizado Faturado (CAF), Perdas Aparentes (PA) e Perdas Reais (PR). O índice de Água Não Faturada (ANF, em %) é calculado como:

$$ANF (\%) = [(VIS - CAF) / VIS] \times 100$$

calcula-se o Índice de Fugas na Infraestrutura (IFI/ILI - Infrastructure Leakage Index), indicador adimensional proposto pela IWA para comparação de desempenho entre sistemas, independentemente da sua dimensão e pressão de operação.

3.4. Análise dos Dados

Os dados recolhidos são analisados com recurso a ferramentas de estatística descritiva e apresentados em formato de balanço hídrico tabular, seguindo o modelo IWA. A análise inclui a comparação dos resultados obtidos com os benchmarks internacionais para países em desenvolvimento (ANF < 25% como meta para sistemas bem geridos) e com os resultados do estudo de Chimoio como referência nacional (Macuácu, 2022).

4. Resultados esperados e discussão

Com base na revisão da literatura e nas condições observadas em sistemas similares, espera-se que o sistema de abastecimento de Homoine apresente um índice de ANF superior a 30%, com predomínio de perdas físicas associadas ao envelhecimento das infraestruturas e perdas aparentes relacionadas com erros de medição e ligações irregulares. Esta estimativa está alinhada com os valores registados por (Mvongo et al., 2024) em sistemas de pequena e média dimensão na África Central e por (Hoko & Mubvaruri (2022) no Zimbábue.

A aplicação sistemática do balanço hídrico deverá permitir: (i) quantificar com maior precisão o volume de ANF no sistema de Homoine; (ii) identificar as componentes predominantes de perda (física vs. aparente); (iii) propor intervenções prioritárias e de baixo custo para a redução das perdas; (iv) estabelecer uma base de dados para monitorização contínua do desempenho do sistema.

A metodologia proposta é replicável e adaptável a outros sistemas de abastecimento de água em Moçambique com características semelhantes, contribuindo para a construção de uma base de conhecimento nacional sobre perdas hídricas em sistemas rurais e

semi-urbanos área ainda pouco estudada no contexto moçambicano (Macuácu, 2022).

5. Conclusão

O artigo em questão mostrou que o Balanço Hídrico, conforme a abordagem padronizada pela IWA, é uma ferramenta sustentável e aprimorada, acessível e apropriada para o cenário socioeconômico de Moçambique, visando diagnosticar as perdas de água nos sistemas de abastecimento. Sua aplicação em Homoíne traz uma contribuição científica significativa para entender e reduzir as perdas de água em áreas rurais e semi-urbanas do país.

A realização deste trabalho atende à demanda crescente por modernização na gestão dos recursos hídricos em Moçambique, buscando alinhamento com os objetivos do Objetivo de Desenvolvimento Sustentável 6 (ODS 6), que visa garantir acesso universal à água potável segura e promover o uso eficiente dos recursos hídricos até 2030. A diminuição da ANF proporciona, ao mesmo tempo, um benefício econômico para os operadores e um impacto social positivo para as comunidades atendidas.

Pesquisas futuras deverão investigar a combinação do balanço hídrico com ferramentas de inteligência artificial, a fim de possibilitar a detecção antecipada de anomalias e a modelagem preditiva de perdas, expandindo assim o potencial da metodologia em situações que disponham de dados históricos..

6. Referências

6.1. References

BEKER, B. A.; KANSAL, M. L. (2023). Complexities of the urban drinking water systems in Ethiopia and possible interventions for sustainability. *Environmental Development Sustainability*. DOI: <https://doi.org/10.1007/s10668-022-02901-7>

HOKO, Z.; MUBVARURI, M. (2022). Investigating trends and components of non-revenue water for Glendale, Zimbabwe. *Physics and Chemistry of the Earth*. DOI: <https://doi.org/10.1016/j.pce.2022.103052>

KARADIREK, I. E.; KARA, S.; YILMAZ, G.; MUHAMMETOGLU, A.; MUHAMMETOGLU, H. (2022). Development of current condition assessment and target definition model for water balance practices in sustainable water loss management. *Water Supply*, 22(5), 5028–5044. DOI: <https://doi.org/10.2166/ws.2022.175>

LAMBERT, A.; HIRNER, W. (2000). *Losses from Water Supply Systems: Standard Terminology and Recommended Performance Measures*. London: IWA Publishing.

MACUÁCUA, J. et al. (2022). Assessment of water losses in distribution networks: Municipality of Chimoio, Mozambique. *Research, Society and Development*, 11(6), e4911628535. DOI: <https://doi.org/10.33448/rsd-v11i6.28535>

MUTIKANGA, H. E.; SHARMA, S. K.; VAIRAVAMOORTHY, K. (2011). Assessment of apparent losses in urban water systems. *Water and Environment Journal*, 25, 327–335. DOI: <https://doi.org/10.1111/j.1747-6593.2010.00225.x>

MUTIKANGA, H. E.; SHARMA, S. K.; VAIRAVAMOORTHY, K. (2011). Investigating water meter performance in developing countries: A case study of Kampala, Uganda. *Water SA*, 37(4), 567–574. DOI: <https://doi.org/10.4314/wsa.v37i4.18>

MVONGO, V. D.; DEFO, C.; NGUEMA, P. F.; EFON, B.; ONDIGUI MBEYI, J. G. (2024). Analysis of water losses in seven small and medium-sized water distribution networks in the south region of Cameroon. *Water Practice and Technology*, 19(12), 4682–4698. DOI: <https://doi.org/10.2166/wpt.2024.248>

MVONGO, V. D. et al. (2024). Quantifying the nonrevenue water problem in a sub-Saharan African environment: a practical application in the Republic of Cameroon. *Journal of Water, Sanitation and Hygiene for Development*, 14(7), 511. DOI: <https://doi.org/10.2166/washdev.2024.103341>

WHO & UNICEF (2023). *Progress on Drinking Water, Sanitation and Hygiene 2000–2023*. Geneva: World Health Organization / United Nations Children's Fund. Disponível em: <https://washdata.org>

Ethem Karadirek, I. (2020). An experimental analysis on accuracy of customer water meters under various flow rates and water pressures. *Journal of Water Supply: Research and Technology-Aqua*, 69(1), 18–27. <https://doi.org/10.2166/aqua.2019.031>

Mutikanga, H. E. (sem data). *Water Loss Management: Tools and Methods for Developing Countries*.

Mvongo, V. D., Defo, C., & Tchoffo, M. (2024). Quantifying the nonrevenue water problem in a sub-Saharan African environment: A practical application in the Republic of Cameroon (Central Africa). *Journal of Water, Sanitation and Hygiene for Development*, 14(7), 511–520. <https://doi.org/10.2166/washdev.2024.295>

Oliveira De Almeida, A., Alves Coelho, P., Rocha Luz, J., Tiago Almeida Do Santos, J., & Ribeiro Ferraz, N. (2007). Decapod crustaceans in fresh waters of southeastern Bahia, Brazil. *Revista de Biología Tropical*, 56(3). <https://doi.org/10.15517/rbt.v56i3.5706>



Diabetic Foot: A Multidisciplinary Approach to Limb Preservation

Article Record

Richa Dixit^{§α*}
test1 Qualification, tst designation
*Corresponding Author



Anil Kushwah^{‡α*}
test1 Qualification, tst designation



§ CS, Illinois Institute of Technology, US, United States
‡ sasss, Indore, Indain ankit (OA)

PEER REVIEW
Double Blind

Abstract

This paper presents a collaborative research framework for implementing Distributed Ledger Technology (DLT) across diverse academic environments. By leveraging the infrastructure at Chameli Devi Group of Institutions and IET DAVV, we analyze the synchronization of student data across multi-nodal networks. The study, conducted by Kushwah, Jain, et al., demonstrates a 22% reduction in data redundancy and a significant increase in security protocols compared to traditional centralized systems.

Blockchain

Higher Education

Decentralized Identity

Data Security

AI USE STATEMENT

No generative AI was used for analysis or results.

FUNDING

No external funding was declared for this work.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

DATA AVAILABILITY

Not applicable for this article.

ETHICS

No ethics committee approval was required for this article type.

CONSENT

Not applicable for this article.

TRIAL REG.

Not applicable.

Crossref DOI: 10.34257/GJMRK256831

How to Cite: Dixit et al. (2026). Diabetic Foot: A Multidisciplinary Approach to Limb Preservation. Global Journal of Computer Science and Technology, 26(2), 1-15. DOI: 10.34257/GJMRK256831

LICENSE

© 2026 Global Journals. Open-access article under CC BY-NC-ND 4.0 International License.



Print ISSN 0975-4350 Online ISSN 0975-4172



Under the strict compliance and defined process of



METADATA CONTINUATION

AUTHOR CONTACT QR LEDGER

Richa Dixit✉*	
Anil Kushwah✉*	

ARCHIVAL RECORD

Diabetic Foot: A Multidisciplinary Approach to Limb Preservation

Richa Dixit^{§α*} and Anil Kushwah^{‡α*}

Affiliations

[§] CS, Illinois Institute of Technology, US, United States
[‡] sasss, Indore, Indain ankit (OA)

Qualifications / Designations

α test1 Qualification, tst designation

Abstract

This paper presents a collaborative research framework for implementing Distributed Ledger Technology (DLT) across diverse academic environments. By leveraging the infrastructure at Chameli Devi Group of Institutions and IET DAVV, we analyze the synchronization of student data across multi-nodal networks. The study, conducted by Kushwah, Jain, et al., demonstrates a 22% reduction in data redundancy and a significant increase in security protocols compared to traditional centralized systems.

Keywords: *Blockchain, Higher Education, Decentralized Identity, Data Security*

* Corresponding Author
Richa Dixit

DOI
10.34257/GJMRK256831

1. Introduction

Diabetes remains a major global health challenge, driving significant morbidity, mortality, and economic strain. Among its many complications, diabetic foot also represents one of the most debilitating outcomes, with diabetes and serving as the leading cause of non-traumatic lower limb amputation worldwide.[1,2]

WHO defines diabetic foot as Infection, ulceration or destruction of deep tissues associated with neurological abnormalities and various degrees of peripheral vascular diseases in the lower limb.[1,2] Diabetic foot ulcers emerge from a complex interaction of peripheral neuropathy, peripheral arterial disease, and impaired wound healing, usually exacerbated by infection.[1,2] Beyond localised tissue damage, diabetic foot ulceration reflects widespread systemic vascular disease and increases risk of cardiovascular morbidity and early mortality. Major lower limb amputations carry a grave prognosis with post-amputation five year mortality exceeding 50% in patients with diabetes.[1,2]

In India, diabetic foot disease represents a particularly significant public health burden, with an estimated 40,000 amputations performed annually. A large proportion of these amputations are neuropathic in origin and complicated by secondary infection, many of which are potentially preventable.[2]

Several factors predict poor outcomes in individuals with diabetic foot ulcer, including severity, prolonged duration, infection, peripheral arterial disease, neuropathy, chronic kidney disease, cardiovascular disease, smoking, and male gender.[1,2] These variables influence healing rates, recurrence, and likelihood of progression to major amputation or death[1,2]. In India sociocultural factors such as barefoot walking, low socioeconomic status, illiteracy, delayed healthcare seeking and reliance on alternative systems of medicine further contribute to late presentation and poor outcomes[2].

Effective management of diabetic foot ulcers and their associated complications requires a comprehensive, evidence-based approach[1,2]. Core components of treatment include appropriate

pressure offloading, prompt and adequate control of infection, timely revascularisation (when indicated), surgical assessment (where necessary), optimisation of glycemic control and systematic management of coexisting medical conditions[1,2]. Given the multifactorial pathophysiology of diabetic foot disease, improved clinical outcomes are more likely when care is delivered through a coordinated, multidisciplinary team approach involving interprofessional collaboration[1,2].

2. Review of literature

Burden of Diabetic Foot Disease

Hyperglycaemia is associated with various complications, both microvascular- including nephropathy, neuropathy, and retinopathy and macrovascular complications such as coronary artery disease, stroke, and peripheral arterial disease[1,2]. Among these, diabetic foot disease represents one of the most severe and disabling complications. Diabetes is a leading cause of non-traumatic lower-extremity amputations, with non-healing foot ulcers frequently preceding limb loss[1,2,10]. The lifetime risk of developing a foot ulcer in individuals with diabetes ranges between 15% and 20% [1,2,3]. With 15% of these ulcers progressing to foot or limb amputation [1-3]. Population-based studies report an annual incidence of diabetic foot ulcers ranging from 0.5% to 3%, while prevalence varies between 2% and 10% [[1-3]. Approximately 45–60% of diabetic foot ulcers are neuropathic, while nearly 45% exhibit combined neuropathic and ischemic components [1,2,3]. Infection is implicated in nearly half of lower-limb amputations in diabetic patients [1,2,3].

Risk Factors

Diabetic foot ulcers arise from an interaction of multiple factors. With peripheral neuropathy comes a loss of sensation, which allows repeated trauma to go unnoticed. Motor neuropathy causes muscle imbalance and foot deformities, resulting in abnormal plantar pressure and callus formation, while autonomic neuropathy reduces sweating, causing dry and fissured skin[1,2]. Arterial insufficiency

further complicates neuropathic ulcers by impairing tissue perfusion and delaying wound healing. Mechanical stress at the wound site plays a significant role in ulcer persistence [1,2,4]. Additional risk factors include poor glycemic control, long duration of diabetes, trauma, inappropriate footwear, callus formation, history of previous ulceration or amputation, advancing age, visual impairment, chronic kidney disease and poor nutritional status [1,2,10]. Infections contribute to chronicity by further worsening wound healing leading to a non-healing ulcer. Interestingly, a deficiency of Vitamin D is an emerging risk factor for diabetic foot infection [1,2,5].

Classification of Wounds

The Red–Yellow–Black wound classification system by Marion Laboratories categorizes wounds based on the following characteristics [1,2]:

- **Necrotic tissue:** Black or dark green in colour, which may be dry or infected
- **Sloughy tissue:** A yellow, glutinous tissue composed of wound exudate and debris, often mistaken for infection.
- **Granulating tissue:** Red, vascular tissue indicating active healing
- **Epithelializing tissue:** Pink in colour, indicating epithelium growing over the wound by keratinocyte migration from wound margins

The presence of devitalised tissue or critical colonisation prevents chronic wounds from healing [1,2,6] hence, necessitates removal through debridement of tissue. However, debridement may be contraindicated in purely arterial ulcers [1,2,3,11]. With regular excision of necrotic tissue and surrounding callus we are likely to see accelerated wound healing and an increased likelihood of complete secondary closure [1,2,3].

Grading of Diabetic Foot Ulcers

Wound grading is performed using Wagner's classification or the University of Texas wound classification system [1,2]. It includes wound depth, infection, and ischemia. To adequately treat an ulcer, a thorough wound assessment is necessary including documentation of the ulcer location, size, depth, wound margins, base, drainage, colour, odour, pain, and progression [1,2].

Microbiology of Diabetic Foot Infections

Hyperglycaemia, impaired immune response, neuropathy, and peripheral arterial disease predispose patients to diabetic foot infections [1,2,7].

Diabetic foot infections may involve aerobic, anaerobic, or fungal organisms. With both mono-microbial and poly-microbial infections being quite common [1-3]. Organisms that most commonly infect diabetic foot ulcers include *Staphylococcus aureus*, *Escherichia coli*, and *Pseudomonas aeruginosa*, [1,2,3,44] with both gram positive and gram negative bacteria showing a similar predominance. Due to theregional variability in microbial patterns, culture-guided antibiotic therapy is required for adequate resolution [1,2].

MANAGEMENT TECHNIQUES

Multidisciplinary Approach

The foot is a complex structure, required for mobility and it is crucial to prevent the progression of a diabetic foot ulcer [1,2]. This is achievable by involving a multidisciplinary team of experts. This includes- endocrinologists, vascular surgeons, microbiologists, orthotists, podiatrists and nutritionists to ensure holistic care leading to a better quality of life and reduced amputation risk [1,2,8].

Wound healing is a highly regulated process involving cellular migration, angiogenesis, and growth factor signalling [1,2,9]. Appropriate care includes regular debridement, offloading, infection

Wound classification system [11]

Stages	Description
A	Stage No infection or ischemia
	Stage B Infection present
C	Stage Ischemia present
	Stage Infection and ischemia present
D	Grading
	Grade Epithelialized wound
	0
	Grade Superficial wound
1	Grade Wound penetrates to tendon or
	2 capsule
	Grade Wound penetrates to bone or joint
3	

control, moist wound care, and revascularization of ischemic limbs when necessary [1,2].

Debridement

Debridement refers to the removal of necrotic, damaged, or infected tissue. The adequate type of debridement depends on the tissue type [1,2,11] :

1. **Sharp/surgical debridement:** Most effective and rapid method, recommended for necrotic or infected wounds [1-3]

2. **Autolytic debridement:** Utilises endogenous enzymes, macrophages and neutrophils by accumulating tissue fluid under occlusive dressings leading to a removal of debris and bacteria; it is unsuitable for infected pressure ulcers [1,2]

3. **Mechanical debridement:** Used in the management of surgical wounds and venous leg ulcers. It involves removal of debris by regular irrigating a wound (pressure: 4-15 psi) without damaging healthy tissue. However it may cause pain and bleeding. [1,2,3,24]

4. **Enzymatic debridement:** Uses topical enzymes such as collagenase, papain or fibrinolysin when the wound is sloughy and infected and also when surgical debridement is contraindicated [1,2,27]

5. Maggot debridement: Employs sterile larvae (*Lucilia sericata*) to remove necrotic tissue and bacteria. Employed as a last resort when all other methods fail [1,2]

Offloading

Offloading is a method of relieving pressure off a weight bearing area and is essential for ulcer healing, as repetitive trauma and high plantar pressure contribute to ulcers persisting once it has developed [1,2, 46]. Offloading methods include total contact casts, removable cast walkers, specialised footwear, wheelchairs, and crutches. Total contact casting is considered the gold standard for neuropathic plantar ulcers [1,2,12].

Wound Care

Wound care is an integral aspect of management of a foot ulcer. It involves cleansing with normal saline under aseptic conditions and maintaining a moist healing environment [1,2,3,14]. But it must be noted that topical management, remains secondary to surgical and systemic management [1,2,3]. Dressing selection depends on the characteristics of wound- grade of wound, surrounding environment and the process of tissue repair, patient health and general condition and the availability and cost of the regimen must also be taken into account [1,2].

Ideal wound dressings should be sterile, cost-effective, non-toxic, non-adherent, absorb excess exudate, permit gaseous exchange, protect against infection, and provide thermal insulation [1,2].

Some common topical regimens and devices available for foot ulcers including hydrogels, hydrocolloids, alginates, foam, silver impregnated dressings, growth factors, silicon impregnated atraumatic dressings, vacuum aided devices, hyperbaric oxygen therapy, etc [1,2].

Antibiotic Therapy

Antibiotic selection needs to be guided by culture and sensitivity results to prevent resistance and adequately treat the wound [1,2,15]. Oral antibiotics can be used for mild infections, while parenteral therapy is reserved for moderate to severe infections [1,2]. Institutional antibiotic policies and stewardship programs are essential to optimise patient outcomes [1,2,47].

Three levels of antibiotic prescribing are generally recommended:

- (1) First line of choice - antibiotics prescribed by all doctors;
- (2) Restricted antibiotic group - for resistant pathogens, polymicrobial infections, special conditions, and expensive antibiotics. When prescribing antibiotics from this group, the prescriber should discuss with the committee and head of the department.
- (3) Reserve antibiotics-for life-threatening infections, to be used after obtaining permission from the committee.[1,2]

Revascularization

Taking into account advances in vascular surgeries, limb salvage has become an option for limbs that would otherwise be amputated. This is particularly useful in diabetes since patients with both diabetes and peripheral arterial disease are at an increased risk of ischemic ulceration [1,2,48,49]. Endovascular procedures, including angioplasty (percutaneous transluminal angioplasty (PTA)) and stents (balloon-expandable stents, self-expanding stents, and covered stents) are now available and demonstrate high success rates, particularly in iliac artery disease [1,2,3]. When revascularization precedes extensive debridement, better outcomes are noted [1,2,24]

Choice of Topical Regimen

Appropriate wound care products must be selected according to the nature of the wound bed, tissue characteristics, amount of exudate, depth, and overall wound complexity [1,2].

Wet-to-Dry Dressings / Saline Gauze

Moist saline gauze dressings are widely used, particularly in resource-limited settings. These dressings facilitate mechanical debridement as they are extremely adherent and absorptive to necrotic tissue, which is removed during dressing changes [1,2,5]. They are inexpensive, readily accessible, and capable of absorbing wound exudate effectively. However, they need frequent replacement—often two to three times daily depending on the wound condition [1,2].

To reduce the amount of trauma during removal, the dressing should be made wet beforehand. Cleansing with normal saline or a neutral pH solution reduces local irritation [1,2,46]. A five minutes time for wound soakage is recommended in already granulating or epithelialising wounds, to reduce bleeding [<https://pubmed.ncbi.nlm.nih.gov/articles/PMC4127589/>,2]

Antibacterial Agents

Topical antimicrobial preparations are often incorporated into wound care protocols as they provide broad antimicrobial coverage for up to 12 hours and carry lower systemic toxicity risks compared to systemic antibiotics [1,2].

Metronidazole gel is particularly effective against anaerobic organisms and keeps the wound environment moist [1,2]. Although gels are predominantly liquid by composition, their three-dimensional cross-linked structure confers semi-solid properties which enhances stability and adherence [1,2]. Metronidazole gel (0.75%–0.80%) can be directly applied on the wound once per day for five to seven days or more often as needed [3,24], and crushed metronidazole tablets can be placed directly onto the ulcer surface [1,2,3].

Other topical antibiotics such as neomycin, gentamicin, and mupirocin are also utilized for localized bacterial control. Silver-based dressings, available in multiple formulations, provide broad-spectrum antimicrobial action and have demonstrated beneficial outcomes in diabetic foot ulcer management [1,2,42]. In addition, silver preparations are commonly used in burn wounds and in infected or colonized lesions [1,2].

Sisomycin (0.10%) and acetic acid solutions (0.5%–5%) exhibit activity against *Pseudomonas*, gram-negative bacilli, and beta-hemolytic streptococci. Povidone iodine dressings may be employed in sutured wounds and hyper-granulating tissue to suppress excessive granulation. Iodine-soaked gauze can also assist in the demarcation process in dry gangrene. However, higher iodine concentrations are cytotoxic to human cells as well as microorganisms [1,2,11]. Therefore, iodine-based preparations should be avoided in actively granulating or epithelializing wounds due to their inhibitory effects on keratinocytes and fibroblasts [1,2].

Tulle Dressings

Tulle dressings consist of paraffin-impregnated gauze designed to minimise adherence to the wound surface. Their non-adherent property may diminish if the dressing dries out. These dressings are suitable for superficial, clean wounds and graft sites but may also be used during the granulation and epithelialisation phases [1,2].

These dressings reduce trauma during dressing removal and maintain a moist environment hence supporting epithelial cell migration and proliferation [1,2,47]. Evidence consistently demonstrates that moist wound conditions promote faster re-epithelialisation compared with traditional dry dressings [1,2,43].

Polyurethane Film Dressings

Polyurethane films are thin, adhesive, and waterproof and are comfortable and flexible. Their semi-permeability allows for gas

exchange and water vapour transmission, thereby sustaining a moist wound environment. Transparency allows ongoing visual inspection without removing the dressing. These films are appropriate for wounds with minimal exudate but may cause surrounding skin to macerate if fluid accumulation occurs [1,2].

Polyurethane Foam Dressings

Foam dressings composed of polyurethane are highly absorbent and non-adherent, with a backing that allows controlled moisture evaporation. By maintaining an optimal moist environment, they assist in softening slough and improving wound bed preparation [1]. Their structure enables painless removal and reduces trauma to new tissue [1,2].

Foam dressings are frequently applied over topical agents such as metronidazole or hydrogels and are widely used in diabetic foot ulcer care. They effectively manage light to heavy exudate, reduce peri-wound maceration, and support progression into the proliferative phase of healing [1,2,31].

Hydrogel Dressings

Hydrogels are composed of cross-linked polymer networks—such as carboxymethylcellulose or starch derivatives—with a high intrinsic water content (approximately 96%). These materials moisturise desiccated wounds and facilitate autolytic debridement by rehydrating necrotic tissue [1,2].

Hydrogels are particularly beneficial in dry wounds covered by eschar and have been shown to achieve more rapid debridement compared with wet-to-dry methods, [1,2,31]. Additionally, their cooling properties may provide symptomatic pain relief [1,2].

Hydrocolloid Dressings

Hydrocolloids contain gelatin, pectin, and cellulose derivatives that interact with wound exudate to form a cohesive gel. This gel maintains a moist microenvironment and supports autolytic removal of dry, sloughy or necrotic tissue [1,2,31]. These dressings are suitable for wounds producing low to moderate exudate [1,2].

Hydrocolloids should be used cautiously on plantar surfaces due to potential maceration of adjacent skin. They may also help retain endogenous growth factors and enhance granulation and epithelialization [1,2]. Additionally, the acidic environment created beneath the dressing is effective against *Pseudomonas* species [1,2,44].

Alginate Dressings

Alginate dressings, available as calcium or calcium-sodium formulations, are highly absorbent and capable of managing moderate to heavy exudate. They may absorb up to 15–20 times their weight in wound fluid [1,2,45]. When in contact with exudate, they transform into a gel that conforms closely to the wound bed.

These dressings are suitable for cavity wounds and those in the granulating or epithelializing stages. Their effectiveness in diabetic foot ulcer management has been examined in Cochrane reviews [1,2,45].

Growth Factors

Biological mediators such as PDGF, insulin-like growth factor, TGF- α , TGF- β , and EGF have demonstrated therapeutic potential in diabetic wound repair [1,2,3]. These factors regulate angiogenesis, cellular proliferation, enzyme activity, and tissue remodeling [1,2].

Chronic diabetic wounds exhibit elevated protease activity, which may degrade endogenous growth factors and delay healing [1,2,9].

Recombinant human PDGF has been shown to enhance healing when used alongside standard wound care, particularly in granulating neuropathic ulcers [1,2,4]. EGF promotes fibroblast, keratinocyte, and endothelial proliferation, facilitating tissue regeneration. Local administration of recombinant EGF has demonstrated improved outcomes, especially in neuropathic ulcers compared to ischemic lesions [1,2].

Honey-Impregnated Dressings

Honey-based wound products are believed to possess antimicrobial and anti-inflammatory properties. While laboratory studies support antimicrobial effects, clinical evidence—especially comparative data against silver-based dressings—remains limited [1,2,20].

Enzymatic Debridement Agents

Topical enzymatic preparations such as collagenase, fibrinolysin, and papain-based formulations aid in selective removal of necrotic tissue. Both papain-urea and collagenase preparations degrade wound matrix components including collagen, fibrin, and elastin. Comparative data suggest papain-urea (89.2%) may demonstrate slightly higher debridement efficacy than collagenase (82.2%) [1,2,3,41].

Mechanical and Adjunctive Therapies

Negative pressure wound therapy (vacuum-assisted closure) applies controlled sub-atmospheric pressure—commonly around 125 mmHg—to the wound bed. This technique enhances exudate removal, decreases edema, and promotes granulation tissue formation [1,2].

It is contraindicated in wounds with reduced vascularity and with exposed bones and tendons and in untreated osteomyelitis, non-enteric and unexplored fistula, presence of necrotic tissue, exposed organs or blood vessels, and malignancy in the wound [19]. But has been shown to facilitate wound closure in treated osteomyelitis and soft tissue infections [1,2,19]. Hyperbaric oxygen therapy (HBOT) serves as an adjunctive modality that increases tissue oxygen tension, potentially enhancing wound healing. It is generally considered safe and is used alongside standard wound management protocols [1,2,18].

3. Discussion

Diabetic foot disease remains one of the most feared and debilitating complications of diabetes mellitus. It is associated with prolonged hospitalisations, substantial financial burden, repeated surgical interventions, and a persistent risk of limb loss, all of which significantly affect the physical and psychological well-being of patients. The possibility of amputation and the subsequent experience of phantom limb pain further contribute to emotional distress and reduced quality of life. Consequently, diabetic foot disease continues to pose a major challenge for patients, caregivers, and healthcare systems [1,2].

Clinically, the diabetic foot is characterised by a classical triad of **neuropathy, ischaemia, and infection** with each component contributing to ulcer formation, progression, and poor healing outcomes. These factors rarely act in isolation; instead, their coexistence creates a complex pathological environment that predisposes the foot to breakdown and chronic infection. Preventive strategies therefore are the most effective means of reducing morbidity [1,2,27].

Pathogenesis

The development of diabetic foot ulcers is multifactorial, with peripheral neuropathy and ischemia serving as the primary underlying mechanisms. Continuous weight-bearing and shear forces

exacerbate tissue damage, leading to progressive ulceration. Charcot arthropathy represents an advanced manifestation of neuropathy, resulting from a combination of motor, sensory, and autonomic dysfunction, ultimately causing joint instability, altered foot architecture, and increased risk of ulceration[1,2].

Peripheral vascular disease further compromises wound healing by reducing tissue perfusion. Although atherosclerosis in diabetic patients resembles that seen in non-diabetics, it tends to be more diffuse, occurs earlier, and progresses more rapidly. In diabetic individuals, distal vessels below the knee are more commonly involved, while pedal arteries may remain relatively spared. The coexistence of ischemia and neuropathy significantly increases the risk of ulceration and limb loss[1,2,31].

Infection and Osteomyelitis

Infection in the diabetic foot is a limb-threatening condition due to the unique anatomical characteristics of the foot, including multiple intercommunicating compartments that facilitate rapid spread. The absence of pain due to neuropathy allows continued ambulation, further propagating infection. Soft tissue structures such as fascia, tendons, and muscle sheaths provide little resistance to infection, and the presence of hyperglycemia and ischaemia impairs host defense mechanisms[1,2].

Osteomyelitis commonly develops as a result of contiguous spread from deep soft tissue infections and is frequently associated with chronic or longstanding ulcers. Diagnosis can be challenging and requires careful clinical evaluation, supported by imaging and microbiological studies. Probing to bone remains a useful bedside test, while magnetic resonance imaging offers high sensitivity and specificity for detecting bone involvement. Definitive diagnosis requires bone biopsy for culture and histopathology[1,2,39].

Classification and Assessment

Accurate classification of diabetic foot ulcers is essential for guiding management. Diabetic foot lesions are broadly categorized into neuropathic and neuroischemic types, each requiring distinct therapeutic strategies. The University of Texas Wound Classification System is widely accepted due to its ability to incorporate depth, infection, and ischemia [1,2,<https://pmc.ncbi.nlm.nih.gov/articles/PMC2878694/>].

Examination of the Feet

Assessment of the feet is a fundamental component of routine physical examination, particularly in individuals with diabetes. Inspection should focus on identifying features suggestive of neuropathy, including xerosis, fissuring, structural deformities, callus formation, altered foot architecture, ulceration, dilated superficial veins, and nail abnormalities. The interdigital spaces must be examined carefully, as lesions in these areas may be easily overlooked[1,2]. Clinical signs indicative of significant ischemia include loss of hair over the dorsum of the foot and the presence of dependent rubor[1,2]. Palpation- To assess temperature differences, noting areas of unusual warmth or coolness. Peripheral arterial pulses must be evaluated systematically. The dorsalis pedis artery is palpated lateral to the tendon of extensor hallucis longus, while the posterior tibial artery is felt posterior and inferior to the medial malleolus[1,2]. Examination should also include palpation and auscultation of the femoral artery to detect bruits. The plantar surface should be assessed for bony prominences, areas of increased pressure, or callosities that may predispose to ulcer formation[1,2]. Evaluation for sensory neuropathy can be performed using Semmes-Weinstein monofilaments or biothesiometry. In resource-limited settings, simpler bedside methods—such as testing light touch with cotton wool, assessing pinprick sensation, and evaluating vibration perception

using a 128 Hz tuning fork—are acceptable alternatives. The primary objective of sensory testing is to determine the presence of loss of protective sensation (LOPS), which significantly increases the risk of ulceration[1,2]. A handheld Doppler device may be employed to verify arterial flow and further assess vascular status. When combined with a sphygmomanometer, measurement of ankle and brachial systolic pressures allows calculation of the ankle-brachial index (ABI). Under normal circumstances, ankle systolic pressure slightly exceeds brachial pressure, yielding an ABI greater than 1. An ABI value below 0.9, particularly when accompanied by diminished or absent pulses, is indicative of peripheral arterial disease. Conversely, palpable pulses with an ABI above 1 generally exclude significant ischemia [1,<https://pmc.ncbi.nlm.nih.gov/articles/PMC2878694/>].

Revascularization

Individuals presenting with significant peripheral ischaemia need re-establishment of arterial perfusion, as sufficient blood supply is critical for effective wound healing and eradication of infection. In cases of inadequate circulation tissue repair gets compromised the likelihood of limb loss drastically increases. Bypass surgery continues to be a well-recognised intervention for ischemic lower extremities, with durable long-term outcomes reported. Limb salvage rates of nearly 90% at 10 years have been documented following lower extremity bypass procedures [1,2,22,23]. In cases where arterial disease involves multiple segments, revascularization should target each level of obstruction to restore adequate distal blood flow and enhance the probability of limb preservation. Percutaneous transluminal angioplasty is particularly appropriate for discrete, short-segment stenotic lesions. Conversely, when disease is extensive—characterised by multiple occlusions, lesions longer than 15 cm, or infra-popliteal vessel involvement—bypass surgery is generally regarded as the treatment of choice. [1,2].

Prevention

Timely identification of individuals at risk for ulceration plays a crucial role in preventing the development of diabetic foot lesions. An effective screening method includes- annual foot examinations for all patients with diabetes to initiate early intervention[1,2]. Patient education forms the cornerstone of prevention strategies. Individuals should be counselled about strict glycemic control, use of appropriate footwear, avoiding foot trauma and routine self-inspection of the feet[1,2].

Preventive strategies may be categorised into three levels:

- **Primary prevention:** Identification of high-risk feet and provision of guidance regarding protective or therapeutic footwear.

- **Secondary prevention:** Early management of minor foot problems, including callus care, treatment of nail disorders, and appropriate handling of blisters or superficial lesions.

- **Tertiary prevention:** Early referral to specialised centers for advanced or complicated foot lesions [1,2].

Improved limb salvage rates and reduction in amputation incidence can be achieved through structured training of primary care physicians and paramedical staff in diabetic foot management. The “Step by Step” program, implemented by the World Diabetes Foundation, represents one such initiative [1,2].

Continuous patient education and long-term follow-up are essential for all individuals suffering with diabetes, especially diabetic foot ulcers. Such patients should be advised to limit excessive mechanical stress on the affected limb and adopt activity modifications when necessary[1,2]. A comprehensive understanding of diabetic foot pathology, systematic foot examination, appropriate classifica-

diabetes[1,2].

Conclusion

outcomes.

long-term patient outcomes[1,2].

4. References

1. Kavitha KV. Choice of wound care in diabetic foot ulcer: A practical approach. World Journal of Diabetes [Internet]. 2014;5(4):546–56. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4127589/>
2. Boulton AJM, Whitehouse RW. The Diabetic Foot [Internet]. Share.google. MDText.com, Inc.; 2023 [cited 2026 Feb 10]. Available from: <https://share.google/lmihDDsq4EWv5x33P>
3. Pendsey S. Understanding diabetic foot. International Journal of Diabetes in Developing Countries [Internet]. 2010;30(2):75. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2878694/>
4. Barnes LA, Marshall CD, Leavitt T, Hu MS, Moore AL, Gonzalez JG, et al. Mechanical Forces in Cutaneous Wound Healing: Emerging Therapies to Minimize Scar Formation. Advances in Wound Care. 2018 Feb;7(2):47–56.
5. 3.Reiber GE. Epidemiology and health care costs of diabetic foot problems. In: Veves A, Giurini JM, LoGerfo FW, editor(s), editors. The Diabetic Foot. New Jersey: Humana Press; 2002. pp. 35–58. [https://scholar.google.com/scholar_lookup?title=The%25252520Diabetic%25252520Foot&author=GE%25252520Reiber&publication_year=2002&]
6. Frykberg RG, Zgonis T, Armstrong DG, Driver VR, Giurini JM, Kravitz SR, Landsman AS, Lavery LA, Moore JC, Schuberth JM, et al. Diabetic foot disorders. A clinical practice guideline (2006 revision) J Foot Ankle Surg. 2006;45:S1–66. doi: 10.1016/S1067-2516(07)60001-5. [[https://doi.org/10.1016/S1067-2516\(07\)60001-5](https://doi.org/10.1016/S1067-2516(07)60001-5)] [<https://pubmed.ncbi.nlm.nih.gov/17280936/>] [https://scholar.google.com/scholar_lookup?journal=J%2525252520Foot%25252520Ankle%25252520Surg&title=Diabetic%25252520foot%2525252520&author=Frykberg%25252520Zgonis%25252520Armstrong&author=BA%25252520Lipsky&volume=293&publication_year=2005&pages=217-228&pmid=15644549&doi=10.1001/jama.293.2.217&]

- 0disorders.%2525252520A%2525252520clinical%2525252520practic
e%2525252520guideline%2525252520(2006%2525252520revision)&a
uthor=RG%2525252520Frykberg&author=T%2525252520Zgonis&a
uthor=DG%2525252520Armstrong&author=VR%2525252520Drive
r&author=JM%2525252520Giurini&volume=45&publication_year=
2006&pages=S1-66&pmid=17280936&doi=10.1016/S1067-2516(07)6
0001-5&]
15. Reiber GE, Vileikyte L, Boyko EJ, del Aguila M, Smith DG, Lavery LA, Boulton AJ. Causal pathways for incident lower-extremity ulcers in patients with diabetes from two settings. *Diabetes Care*. 1999;22:157–162. doi: 10.2337/diacare.22.1.157. [https://doi.org/10.2337/diacare.22.1.157] [https://pubmed.ncbi.nlm.nih.gov/10333919/] [https://scholar.google.com/scholar_lookup?journal=Diabetes%25252520Care&title=Causal%25252520pathways%25252520for%25252520incident%25252520lower-extremity%25252520ulcers%25252520in%25252520patients%25252520with%25252520diabetes%25252520from%25252520two%25252520settings&author=GE%25252520Reiber&author=L%25252520Vileikyte&author=EJ%25252520Boyko&author=Agui%25252520M%25252520del%25252520Smith&volume=22&publication_year=1999&pages=157-162&pmid=10333919&doi=10.2337/diacare.22.1.157&]
 16. Richard JL, Sotto A, Lavigne JP. New insights in diabetic foot infection. *World J Diabetes*. 2011;2:24–32. doi: 10.4239/wjd.v2.i2.24. [https://doi.org/10.4239/wjd.v2.i2.24] [https://pmc.ncbi.nlm.nih.gov/articles/PMC3083903/] [https://pubmed.ncbi.nlm.nih.gov/21537457/] [https://scholar.google.com/scholar_lookup?journal=World%25252520J%25252520Diabetes&title=New%25252520insights%25252520in%25252520diabetic%25252520foot%25252520infection&author=JL%25252520Richard&author=A%25252520Sotto&author=JP%25252520Lavigne&volume=2&publication_year=2011&pages=24-32&pmid=21537457&doi=10.4239/wjd.v2.i2.24&]
 17. Farahani RM, Kloth LC. The hypothesis of 'biophysical matrix contraction': wound contraction revisited. *Int Wound J*. 2008;5:477–482. doi: 10.1111/j.1742-481X.2007.00402.x. [https://doi.org/10.1111/j.1742-481X.2007.00402.x] [https://pmc.ncbi.nlm.nih.gov/articles/PMC7951437/] [https://pubmed.ncbi.nlm.nih.gov/18593398/] [https://scholar.google.com/scholar_lookup?journal=Int%25252520Wound%25252520J&title=The%25252520hypothesis%25252520of%25252520the%25252520biophysical%25252520matrix%25252520contraction%25252520E2%25252520of%25252520wound%25252520contraction%25252520revisited&author=RM%25252520Farahani&author=LC%25252520Kloth&volume=5&publication_year=2008&pages=477-482&pmid=18593398&doi=10.1111/j.1742-481X.2007.00402.x&]
 18. Kranke P, Bennett MH, Martyn-St James M, Schnabel A, Debus SE, Weibel S. Hyperbaric oxygen therapy for chronic wounds. *Cochrane Database of Systematic Reviews*. 2015 Jun 24;
 19. Carolina W, Geoff S. Wound dressings update. *J Pharm Pract Res*. 2006;36:318–324. [https://scholar.google.com/scholar_lookup?journal=J%25252520Pharm%25252520Pract%25252520Res&title=Wound%25252520dressings%25252520update&author=W%25252520Carolina&author=S%25252520Geoff&volume=36&publication_year=2006&pages=318-324&]
 20. Falanga V. Wound healing and its impairment in the diabetic foot. *Lancet*. 2005;366:1736–1743. doi: 10.1016/S0140-6736(05)67700-8. [https://doi.org/10.1016/S0140-6736(05)67700-8] [https://pubmed.ncbi.nlm.nih.gov/16291068/] [https://scholar.google.com/scholar_lookup?journal=Lancet&title=Wound%25252520healing%25252520and%25252520its%25252520impairment%25252520in%25252520the%25252520diabetic%25252520foot&author=V%25252520Falanga&volume=366&publication_year=2005&pages=1736-1743&pmid=16291068&doi=10.1016/S0140-6736(05)67700-8&]
 21. Falanga V. Wound bed preparation: science applied to practice. In: *European wound management association (EWMA), editor. Position Document. Wound Bed Preparation in Practice*. London: MEP Ltd; 2004. pp. 2–5. Available from: <http://www.ewma.org/> [https://scholar.google.com/scholar_lookup?title=Position%25252520Document.%25252520Wound%25252520Bed%25252520Preparation%25252520in%25252520Practice&author=V%25252520Falanga&publication_year=2004&]
 22. Miller M. The role of debridement in wound healing. *Community Nurse*. 1996;2:52–55. [https://pubmed.ncbi.nlm.nih.gov/9450452/] [https://scholar.google.com/scholar_lookup?journal=Community%25252520Nurse&title=The%25252520role%25252520of%25252520debridement%25252520in%25252520wound%25252520healing&author=M%25252520Miller&volume=2&publication_year=1996&pages=52-55&pmid=9450452&]
 23. Steed DL, Donohoe D, Webster MW, Lindsley L. Effect of extensive debridement and treatment on the healing of diabetic foot ulcers. *Diabetic Ulcer Study Group. J Am Coll Surg*. 1996;183:61–64. [https://pubmed.ncbi.nlm.nih.gov/8673309/] [https://scholar.google.com/scholar_lookup?journal=J%25252520Am%25252520Coll%25252520Surg&title=Effect%25252520of%25252520extensive%25252520debridement%25252520and%25252520treatment%25252520on%25252520the%25252520healing%25252520of%25252520diabetic%25252520foot%25252520ulcers.%25252520Diabetic%25252520Ulcer%25252520Study%25252520Group&author=DL%25252520Steed&author=D%25252520Donohoe&author=MW%25252520Webster&author=L%25252520Lindsley&volume=183&publication_year=1996&pages=61-64&pmid=8673309&]
 24. Steed D. Modulating wound healing in diabetes. In: *Levin and O'Neal's, editor. The Diabetic Foot*. St Louis: J Bowker and M Pfeiffer; 2001. pp. 395–404. [https://scholar.google.com/scholar_lookup?title=The%25252520Diabetic%25252520Foot&author=D%25252520Steed&publication_year=2001&]
 25. Armstrong DG, Lavery LA, Harkless LB. Validation of a diabetic wound classification system. The contribution of depth, infection, and ischemia to risk of amputation. *Diabetes Care*. 1998;21:855–859. doi: 10.2337/diacare.21.5.855. [https://doi.org/10.2337/diacare.21.5.855] [https://pubmed.ncbi.nlm.nih.gov/9589255/] [https://scholar.google.com/scholar_lookup?journal=Diabetes%25252520Care&title=Validation%25252520of%25252520a%25252520diabetic%25252520wound%25252520classification%25252520system.%25252520The%25252520contribution%25252520of%25252520depth,%25252520infection,%25252520and%25252520ischemia%25252520to%25252520risk%25252520of%25252520amputation&author=DG%25252520Armstrong&author=LA%25252520Lavery&author=LB%25252520Harkless&volume=21&publication_year=1998&pages=855-859&pmid=9589255&doi=10.2337/diacare.21.5.855&]

26. Enoch S, Grey JE, Harding KG. ABC of wound healing. Non-surgical and drug treatments. *BMJ*. 2006;332:900–903. doi: 10.1136/bmj.332.7546.900. [https://doi.org/10.1136/bmj.332.7546.900] [https://pmc.ncbi.nlm.nih.gov/articles/PMC1440619/] [https://pubmed.ncbi.nlm.nih.gov/16613966/] [https://scholar.google.com/scholar_lookup?journal=BMJ&title=ABC%25252520of%25252520wound%25252520healing.%25252520Non-surgical%25252520and%25252520drug%25252520treatments&author=S%25252520Enoch&author=JE%25252520Grey&author=KG%25252520Harding&volume=332&publication_year=2006&pages=900-903&pmid=16613966&doi=10.1136/bmj.332.7546.900&]
27. Lipsky BA. A report from the international consensus on diagnosing and treating the infected diabetic foot. *Diabetes Metab Res Rev*. 2008;20 Suppl 1:S68–S77. doi: 10.1002/dmrr.453. [https://doi.org/10.1002/dmrr.453] [https://pubmed.ncbi.nlm.nih.gov/15150818/] [https://scholar.google.com/scholar_lookup?journal=Diabetes%25252520Metab%25252520Res%25252520Rev&title=A%25252520report%25252520from%25252520the%25252520international%25252520consensus%25252520on%25252520diagnosing%25252520and%25252520treating%25252520the%25252520infected%25252520diabetic%25252520foot&author=BA%25252520Lipsky&volume=20%25252520Suppl%252525201&publication_year=2008&pages=S68-S77&pmid=15150818&doi=10.1002/dmrr.453&]
28. Calhoun JH, Cantrell J, Cobos J, Lacy J, Valdez RR, Hokanson J, Mader JT. Treatment of diabetic foot infections: Wagner classification, therapy, and outcome. *Foot Ankle*. 1988;9:101–106. doi: 10.1177/107110078800900301. [https://doi.org/10.1177/107110078800900301] [https://pubmed.ncbi.nlm.nih.gov/3229695/] [https://scholar.google.com/scholar_lookup?journal=Foot%25252520Ankle&title=Treatment%25252520of%25252520diabetic%25252520foot%25252520infections.%25252520Wagner%25252520classification,%25252520therapy,%25252520and%25252520outcome&author=JH%25252520Calhoun&author=J%25252520Cantrell&author=J%25252520Cobos&author=J%25252520Lacy&author=RR%25252520Valdez&volume=9&publication_year=1988&pages=101-106&pmid=3229695&doi=10.1177/107110078800900301&]
29. Wu L, Norman G, Dumville JC, O'Meara S, Bell-Syer SE. Dressings for treating foot ulcers in people with diabetes: an overview of systematic reviews. *Cochrane Database of Systematic Reviews*. 2015 Jul 14;(7).
30. Vishwanathan V, Thomas N, Tandon N, Asirvatham A, Rajasekar S, Ramachandran A, Senthilvasan K, Murugan VS, Muthulakshmi Profile of diabetic foot complications and its associated complications - a multicentric study from India. *J Assoc Physicians India*. 2005;53:933–936. [https://pubmed.ncbi.nlm.nih.gov/16515230/] [https://scholar.google.com/scholar_lookup?journal=J%25252520Assoc%25252520Physicians%25252520India&title=Profile%25252520of%25252520diabetic%25252520foot%25252520complications%25252520and%25252520its%25252520associated%25252520complications%25252520-0%25252520a%25252520multicentric%25252520study%25252520from%25252520India&author=V%25252520Vishwanathan&author=N%25252520Thomas&author=N%25252520Tandon&author=A%25252520Asirvatham&author=S%25252520Rajasekar&volume=53&publication_year=2005&pages=933-936&pmid=16515230&]
31. Lavery LA, Armstrong DG, Wunderlich RP, Tredwell J, Boulton AJ. Predictive value of foot pressure assessment as part of a population-based diabetes disease management program. *Diabetes Care*. 2003;26:1069–1073. doi: 10.2337/diacare.26.4.1069. [https://doi.org/10.2337/diacare.26.4.1069] [https://pubmed.ncbi.nlm.nih.gov/12663575/] [https://scholar.google.com/scholar_lookup?journal=Diabetes%25252520Care&title=Predictive%25252520value%25252520of%25252520foot%25252520pressure%25252520assessment%25252520as%25252520part%25252520of%25252520a%25252520population-based%25252520diabetes%25252520disease%25252520management%25252520program&author=LA%25252520Lavery&author=DG%25252520Armstrong&author=RP%25252520Wunderlich&author=J%25252520Tredwell&author=AJ%25252520Boulton&volume=26&publication_year=2003&pages=1069-1073&pmid=12663575&doi=10.2337/diacare.26.4.1069&]
32. Gadepalli R, Dhawan B, Sreenivas V, Kapil A, Ammini AC, Chaudhry R. A clinico-microbiological study of diabetic foot ulcers in an Indian tertiary care hospital. *Diabetes Care*. 2006;29:1727–1732. doi: 10.2337/dc06-0116. [https://doi.org/10.2337/dc06-0116] [https://pubmed.ncbi.nlm.nih.gov/16873771/] [https://scholar.google.com/scholar_lookup?journal=Diabetes%25252520Care&title=A%25252520clinico-microbiological%25252520study%25252520of%25252520diabetic%25252520foot%25252520ulcers%25252520in%25252520an%25252520Indian%25252520tertiary%25252520care%25252520hospital&author=R%25252520Gadepalli&author=B%25252520Dhawan&author=V%25252520Sreenivas&author=A%25252520Kapil&author=AC%25252520Ammini&volume=29&publication_year=2006&pages=1727-1732&pmid=16873771&doi=10.2337/dc06-0116&]
33. Citron DM, Goldstein EJ, Merriam CV, Lipsky BA, Abramson MA. Bacteriology of moderate-to-severe diabetic foot infections and in vitro activity of antimicrobial agents. *J Clin Microbiol*. 2007;45:2819–2828. doi: 10.1128/JCM.00551-07. [https://doi.org/10.1128/JCM.00551-07] [https://pmc.ncbi.nlm.nih.gov/articles/PMC2045270/] [https://pubmed.ncbi.nlm.nih.gov/17609322/] [https://scholar.google.com/scholar_lookup?journal=J%25252520Clin%25252520Microbiol&title=Bacteriology%25252520of%25252520moderate-to-severe%25252520diabetic%25252520foot%25252520infections%25252520and%25252520in%25252520vitro%25252520activity%25252520of%25252520antimicrobial%25252520agents&author=DM%25252520Citron&author=EJ%25252520Goldstein&author=CV%25252520Merriam&author=BA%25252520Lipsky&author=MA%25252520Abramson&volume=45&publication_year=2007&pages=2819-2828&pmid=17609322&doi=10.1128/JCM.00551-07&]
34. Ramakant P, Verma AK, Misra R, Prasad KN, Chand G, Mishra A, Agarwal G, Agarwal A, Mishra SK. Changing microbiological profile of pathogenic bacteria in diabetic foot infections: time for a rethink on which empirical therapy to choose? *Diabetologia*. 2011;54:58–64. doi: 10.1007/s00125-010-1893-7. [https://doi.org/10.1007/s00125-010-1893-7] [https://pubmed.ncbi.nlm.nih.gov/20835702/] [https://scholar.google.com/scholar_lookup?journal=Diabetologia&title=Changing%25252520microbiological%25252520profile%25252520of%25252520pathogenic%25252520bacteria%25252520in%25252520diabetic%25252520foot%25252520infections.%25252520time%25252520for%25252520a%25252520rethink%25252520on%25252520which%25252520empirical%25252520therapy%25252520to%25252520choose?&author=P%25252520

- 252520Ramakant&author=AK%25252520Verma&author=R%25252520Misra&author=KN%25252520Prasad&author=G%25252520Chand&volume=54&publication_year=2011&pages=58-64&pmid=20835702&doi=10.1007/s00125-010-1893-7&]
35. Abdulrazak A, Bitar ZI, Al-Shamali AA, Mobasher LA. Bacteriological study of diabetic foot infections. *J Diabetes Complications*. 2005;19:138–141. doi: 10.1016/j.jdiacomp.2004.06.001. [https://doi.org/10.1016/j.jdiacomp.2004.06.001] [https://pubmed.ncbi.nlm.nih.gov/15866058/] [https://scholar.google.com/scholar_lookup?journal=J%25252520Diabetes%25252520Complications&title=Bacteriological%25252520study%25252520of%25252520diabetic%25252520foot%25252520infections&author=A%25252520Abdulrazak&author=ZI%25252520Bitar&author=AA%25252520Al-Shamali&author=LA%25252520Mobasher&volume=19&publication_year=2005&pages=138-141&pmid=15866058&doi=10.1016/j.jdiacomp.2004.06.001&]
 36. Raja NS. Microbiology of diabetic foot infections in a teaching hospital in Malaysia: a retrospective study of 194 cases. *J Microbiol Immunol Infect*. 2007;40:39–44. [https://pubmed.ncbi.nlm.nih.gov/17332905/] [https://scholar.google.com/scholar_lookup?journal=J%25252520Microbiol%25252520Immunol%25252520Infect&title=Microbiology%25252520of%25252520diabetic%25252520foot%25252520infections%25252520in%25252520a%25252520teaching%25252520hospital%25252520in%25252520Malaysia%25252520a%25252520retrospective%25252520study%25252520of%25252520194%25252520cases&author=NS%25252520Raja&volume=40&publication_year=2007&pages=39-44&pmid=17332905&]
 37. Bansal E, Garg A, Bhatia S, Attri AK, Chander J. Spectrum of microbial flora in diabetic foot ulcers. *Indian J Pathol Microbiol*. 2008;51:204–208. doi: 10.4103/0377-4929.41685. [https://doi.org/10.4103/0377-4929.41685] [https://pubmed.ncbi.nlm.nih.gov/18603682/] [https://scholar.google.com/scholar_lookup?journal=Indian%25252520J%25252520Pathol%25252520Microbiol&title=Spectrum%25252520of%25252520microbial%25252520flora%25252520in%25252520diabetic%25252520foot%25252520ulcers&author=E%25252520Bansal&author=A%25252520Garg&author=S%25252520Bhatia&author=AK%25252520Attri&author=J%25252520Chander&volume=51&publication_year=2008&pages=204-208&pmid=18603682&doi=10.4103/0377-4929.41685&]
 38. Singh SK, Gupta K, Tiwari S, Shahi SK, Kumar S, Kumar A, Gupta SK. Detecting aerobic bacterial diversity in patients with diabetic foot wounds using ERIC-PCR: a preliminary communication. *Int J Low Extrem Wounds*. 2009;8:203–208. doi: 10.1177/1534734609353080. [https://doi.org/10.1177/1534734609353080] [https://pubmed.ncbi.nlm.nih.gov/19934183/] [https://scholar.google.com/scholar_lookup?journal=Int%25252520J%25252520Low%25252520Extrem%25252520Wounds&title=Detecting%25252520aerobic%25252520bacterial%25252520diversity%25252520in%25252520patients%25252520with%25252520diabetic%25252520foot%25252520wounds%25252520using%25252520ERIC-PCR%25252520a%25252520preliminary%25252520communication&author=SK%25252520Singh&author=K%25252520Gupta&author=S%25252520Tiwari&author=SK%25252520Shahi&author=S%25252520Kumar&volume=8&publication_year=2009&pages=203-208&pmid=19934183&doi=10.1177/1534734609353080&]
 39. Tiwari S, Pratyush DD, Dwivedi A, Gupta SK, Rai M, Singh SK. Microbiological and clinical characteristics of diabetic foot infections in northern India. *J Infect Dev Ctries*. 2012;6:329–332. doi: 10.3855/jidc.1827. [https://doi.org/10.3855/jidc.1827] [https://pubmed.ncbi.nlm.nih.gov/22505442/] [https://scholar.google.com/scholar_lookup?journal=J%25252520Infect%25252520Dev%25252520Ctries&title=Microbiological%25252520and%25252520clinical%25252520characteristics%25252520of%25252520diabetic%25252520foot%25252520infections%25252520in%25252520northern%25252520India&author=S%25252520Tiwari&author=DD%25252520Pratyush&author=A%25252520Dwivedi&author=SK%25252520Gupta&author=M%25252520Rai&volume=6&publication_year=2012&pages=329-332&pmid=22505442&doi=10.3855/jidc.1827&]
 40. Vijaykumar H. Comparative study of collagenase and papain-urea based preparations in the management of chronic non-healing limb ulcers. *Indian Journal of Science and Technology*. 2011 Sep 20;4(9):1090–100.
 41. Huang C, Wang R, Yan Z. Silver dressing in the treatment of diabetic foot. *Medicine*. 2021 Feb 19;100(7):e24876.
 42. Junker JPE, Kamel RA, Caterson EJ, Eriksson E. Clinical Impact Upon Wound Healing and Inflammation in Moist, Wet, and Dry Environments. *Advances in Wound Care*. 2013;2(7):348–56.
 43. Shanmugam P, M J, Susan S L. The bacteriology of diabetic foot ulcers, with a special reference to multidrug resistant strains. *J Clin Diagn Res*. 2013;7:441–445. doi: 10.7860/JC-DR/2013/5091.2794. [https://doi.org/10.7860/JC-DR/2013/5091.2794] [https://pubmed.ncbi.nlm.nih.gov/articles/PMC3616552/] [https://scholar.google.com/scholar_lookup?journal=J%25252520Clin%25252520Diagn%25252520Res&title=The%25252520bacteriology%25252520of%25252520diabetic%25252520foot%25252520ulcers%25252520with%25252520a%25252520special%25252520reference%25252520to%25252520multidrug%25252520resistant%25252520strains&author=P%25252520Shanmugam&author=J%25252520M&author=S%25252520L%25252520Susan&volume=7&publication_year=2013&pages=441-445&pmid=23634392&doi=10.7860/JC-DR/2013/5091.2794&]
 44. Aderibigbe BA, Buyana B. Alginate in Wound Dressings. *Pharmaceutics* [Internet]. 2018 Apr 2;10(2):42. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6027439/
 45. Boulton AJ. Pressure and the diabetic foot: clinical science and offloading techniques. *Am J Surg*. 2004;187:17S–24S. doi: 10.1016/S0002-9610(03)00297-6. [https://doi.org/10.1016/S0002-9610(03)00297-6] [https://pubmed.ncbi.nlm.nih.gov/15147987/] [https://scholar.google.com/scholar_lookup?journal=Am%25252520J%25252520Surg&title=Pressure%25252520and%25252520the%25252520diabetic%25252520foot%25252520clinical%25252520science%25252520and%25252520offloading%25252520techniques&author=AJ%25252520Boulton&volume=187&publication_year=2004&pages=17S-24S&pmid=15147987&doi=10.1016/S0002-9610(03)00297-6&]
 46. Consensus development conference on diabetic foot wound care. 7-8 April 1999, Boston, MA. American Diabetes Association. *Adv Wound Care*. 1999;12:353–361. [https://pubmed.ncbi.nlm.nih.gov/10687555/] [https://scholar.google.com/scholar_lookup?journal=Adv%25252520Wound%25252520Care&title=7-8%25252520April%252525201999%25252520Boston%25252520American%25252520Diabetes%25252520Ass

- ociation&volume=12&publication_year=1999&pages=353-361&pmid=10687555&]
47. Sumpio BE, Aruny J, Blume PA. The multidisciplinary approach to limb salvage. *Acta Chir Belg.* 2004;104:647–653. doi: 10.1080/00015458.2004.11679637. [https://doi.org/10.1080/00015458.2004.11679637] [https://pubmed.ncbi.nlm.nih.gov/15663269/] [https://scholar.google.com/scholar_lookup?journal=Acta%25252520Chir%25252520Belg&title=The%25252520multidisciplinary%25252520approach%25252520to%25252520limb%25252520salvage&author=BE%25252520Sumpio&author=J%25252520Aruny&author=PA%25252520Blume&volume=104&publication_year=2004&pages=647-653&pmid=15663269&doi=10.1080/00015458.2004.11679637&]
 48. Bennett NT, Schultz GS. Growth factors and wound healing: biochemical properties of growth factors and their receptors. *Am J Surg.* 1993;165:728–737. doi: 10.1016/s0002-9610(05)80797-4. [https://doi.org/10.1016/s0002-9610(05)80797-4] [https://pubmed.ncbi.nlm.nih.gov/8506974/] [https://scholar.google.com/scholar_lookup?journal=Am%25252520J%25252520Surg&title=Growth%25252520factors%25252520and%25252520wound%25252520healing%25252520biochemical%25252520properties%25252520of%25252520growth%25252520factors%25252520and%25252520their%25252520receptors&author=NT%25252520Bennett&author=GS%25252520Schultz&volume=165&publication_year=1993&pages=728-737&pmid=8506974&doi=10.1016/s0002-9610(05)80797-4&]
 49. Basile P, Rosenbloom B. Local care of the diabetic foot. In: Veves A, Giurini JM, LoGerfo FW, editor(s), editors. *The Diabetic Foot*. New Jersey: Humana Press; 2002. pp. 279–292. [https://scholar.google.com/scholar_lookup?title=The%25252520Diabetic%25252520Foot&author=P%25252520Basile&author=B%25252520Rosenbloom&publication_year=2002&]
 50. Sibbald RG, Williamson D, Orsted HL, Campbell K, Keast D, Krasner D, Sibbald D. Preparing the wound bed--debridement, bacterial balance, and moisture balance. *Ostomy Wound Manage.* 2000;46:14–22, 24–8, 30–35; quiz 36–37. [https://pubmed.ncbi.nlm.nih.gov/11889735/] [https://scholar.google.com/scholar_lookup?journal=Ostomy%25252520Wound%25252520Manage&title=Preparing%25252520the%25252520wound%25252520bed--debridement,%25252520bacterial%25252520balance,%25252520and%25252520moisture%25252520balance&author=RG%25252520Sibbald&author=D%25252520Williamson&author=HL%25252520Orsted&author=K%25252520Campbell&author=D%25252520Keast&volume=46&publication_year=2000&pages=14-22,%2525252024-8,%2525252030-35,%25252520quiz%2525252036-37&pmid=11889735&]
 51. R, editor. *St. Louis: Mosby; 2000. pp. 85–124.* [https://scholar.google.com/scholar_lookup?title=Principles%25252520of%25252520wound%25252520management.%252525202nd%25252520ed.%25252520Bryant%25252520R,%25252520editor.%25252520St&author=B%25252520Rolstad&author=L%25252520Ovington&author=A%25252520Harris&publication_year=2000&]
 52. Ramundo J, Gray M. Enzymatic wound debridement. *J Wound Ostomy Continence Nurs.* 2008;35:273–280. doi: 10.1097/01.WON.0000319125.21854.78. [https://doi.org/10.1097/01.WON.0000319125.21854.78] [https://pubmed.ncbi.nlm.nih.gov/18496083/] [https://scholar.google.com/scholar_lookup?journal=J%25252520Wound%25252520Ostomy%25252520Continence%25252520Nurs&title=Enzymatic%25252520wound%25252520debridement&author=J%25252520Ramundo&author=M%25252520Gray&volume=35&publication_year=2008&pages=273-280&pmid=18496083&doi=10.1097/01.WON.0000319125.21854.78&]
 53. Sherman RA, Wyle F, Vulpe M. Maggot therapy for treating pressure ulcers in spinal cord injury patients. *J Spinal Cord Med.* 1995;18:71–74. doi: 10.1080/10790268.1995.11719382. [https://doi.org/10.1080/10790268.1995.11719382] [https://pubmed.ncbi.nlm.nih.gov/7640976/] [https://scholar.google.com/scholar_lookup?journal=J%25252520Spinal%25252520Cord%25252520Med&title=Maggot%25252520therapy%25252520for%25252520treating%25252520pressure%25252520ulcers%25252520in%25252520spinal%25252520cord%25252520injury%25252520patients&author=RA%25252520Sherman&author=F%25252520Wyle&author=M%25252520Vulpe&volume=18&publication_year=1995&pages=71-74&pmid=7640976&doi=10.1080/10790268.1995.11719382&]
 54. Armstrong DG, Nguyen HC, Lavery LA, van Schie CH, Boulton AJ, Harkless LB. Off-loading the diabetic foot wound: a randomized clinical trial. *Diabetes Care.* 2001;24:1019–1022. doi: 10.2337/diacare.24.6.1019. [https://doi.org/10.2337/diacare.24.6.1019] [https://pubmed.ncbi.nlm.nih.gov/11375363/] [https://scholar.google.com/scholar_lookup?journal=Diabetes%25252520Care&title=Off-loading%25252520the%25252520diabetic%25252520foot%25252520wound:%25252520a%25252520randomized%25252520clinical%25252520trial&author=DG%25252520Armstrong&author=HC%25252520Nguyen&author=LA%25252520Lavery&author=CH%25252520van%25252520Schie&author=AJ%25252520Boulton&volume=24&publication_year=2001&pages=1019-1022&pmid=11375363&doi=10.2337/diacare.24.6.1019&]
 55. Brem H, Sheehan P, Boulton AJ. Protocol for treatment of diabetic foot ulcers. *Am J Surg.* 2004;187:1S–10S. doi: 10.1016/S0002-9610(03)00299-X. [https://doi.org/10.1016/S0002-9610(03)00299-X] [https://pubmed.ncbi.nlm.nih.gov/15147985/] [https://scholar.google.com/scholar_lookup?journal=Am%25252520J%25252520Surg&title=Protocol%25252520for%25252520treatment%25252520of%25252520diabetic%25252520foot%25252520ulcers&author=H%25252520Brem&author=P%25252520Sheehan&author=AJ%25252520Boulton&volume=187&publication_year=2004&pages=1S-10S&pmid=15147985&doi=10.1016/S0002-9610(03)00299-X&]



THE UNTOLD SUFFERING OF HOUSEMAIDS. A STUDY OF CONFLICT ISSUES AFFECTING UGANDAN HOUSEMAIDS WHO MIGRATE TO SAUDI ARABIA AND HOW TO MITIGATE THEM.

Article Record

Preeti Chauhan^{§‡α*}
Preeti Qalification, Prity designation
*Corresponding Author



Mukesh Prajapati



Nikhil Namdev^β
btech



Vicente Micas Mabjaia^{¶||γ}
test1 Qualification, tst designation



§ CSE, Museum of New Zealand Te Papa Tongarewa, Eisenhower Fellowships, Philadelphia, United States (OA)
‡ Academy of the Federal Security Service of the Russian Federation, Virtuelle Fabrik (Switzerland), Brugg, Ch (OA)
¶ tet department, RG Biopharma (United States), Ahl Al Bayt University, Karbala, Iq (OA)
|| TH Bingen University of Applied Sciences, National University of Engineering, Managua, Ni (OA)

RECEIVED

2026-03-04

REVISED

2026-03-07

ACCEPTED

2026-03-11

PUBLISHED

2026-04-15

PEER REVIEW

Double Blind

Abstract

This study aims to comprehensively analyse the complex interplay between the perceived economic benefits and the actual risks faced by Ugandan housemaids migrating to Saudi Arabia. The primary objectives are to understand the motivations behind migration, identify the specific conflict issues encountered, assess the effectiveness of current mitigation strategies, and propose actionable recommendations for improving the safety and well-being of these migrant workers. This research is crucial given the increasing number of Ugandan women seeking employment abroad, particularly in the Middle East, and the documented challenges they often face which no other researcher has addressed.

AI USE STATEMENT

No generative AI was used for analysis or results.

FUNDING

No external funding was declared for this work.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

DATA AVAILABILITY

Not applicable for this article.

ETHICS

No ethics committee approval was required for this article type.

CONSENT

Not applicable for this article.

TRIAL REG.

Not applicable.

Crossref DOI: 10.34257/GJHSSC254309

How to Cite: Chauhan et al. (2026). THE UNTOLD SUFFERING OF HOUSEMAIDS. A STUDY OF CONFLICT ISSUES AFFECTING UGANDAN HOUSEMAIDS WHO MIGRATE TO SAUDI ARABIA AND HOW TO MITIGATE THEM.. Global Journal of Computer Science and Technology, 26(2), 1-15. DOI: 10.34257/GJHSSC254309

LICENSE

© 2026 Global Journals. Open-access article under CC BY-NC-ND 4.0 International License.



Print ISSN 0975-4350



Online ISSN 0975-4172



Under the strict compliance and defined process of



METADATA CONTINUATION

AUTHOR CONTACT QR LEDGER

Preeti Chauhan§$\frac{1}{2}\alpha^*$ 	Mukesh Prajapati 	Nikhil Namdevβ 	Vicente Micas Mabjaia$\frac{1}{17}$ 
--	---	--	---

AUTHOR CONTRIBUTION MATRIX

Vicente Micas Mabjaia ¶¶ | Conceptualization, Writing - review and editing

ARCHIVAL RECORD

GJCST · Vol 26 · Issue 2 · 2026

Article ID GJCST-254309 · DOI 10.34257/GJHSSC254309

Print ISSN 0975-4350 · Online ISSN 0975-4172

THE UNTOLD SUFFERING OF HOUSEMAIDS. A STUDY OF CONFLICT ISSUES AFFECTING UGANDAN HOUSEMAIDS WHO MIGRATE TO SAUDI ARABIA AND HOW TO MITIGATE THEM.

Preeti Chauhan^{§‡α*}, Mukesh Prajapati, Nikhil Namdev^β, and Vicente Micas Mabjaia^{¶||γ}

Affiliations

[§] CSE, Museum of New Zealand Te Papa Tongarewa, Eisenhower Fellowships, Philadelphia, United States (OA)

[‡] Academy of the Federal Security Service of the Russian Federation, Virtuelle Fabrik (Switzerland), Brugg, Ch (OA)

[¶] tet department, RG Biopharma (United States), Ahl Al Bayt University, Karbala, Iq (OA)

^{||} TH Bingen University of Applied Sciences, National University of Engineering, Managua, Ni (OA)

Qualifications / Designations

^α Preeti Qualification, Prity designation

^β btech

^γ test1 Qualification, tst designation

Abstract

This study aims to comprehensively analyse the complex interplay between the perceived economic benefits and the actual risks faced by Ugandan housemaids migrating to Saudi Arabia. The primary objectives are to understand the motivations behind migration, identify the specific conflict issues encountered, assess the effectiveness of current mitigation strategies, and propose actionable recommendations for improving the safety and well-being of these migrant workers. This research is crucial given the increasing number of Ugandan women seeking employment abroad, particularly in the Middle East, and the documented challenges they often face which no other researcher has addressed.

Keywords:

* Corresponding Author

Preeti Chauhan

DOI

10.34257/GJHSSC254309

1. Introduction

This study aims to comprehensively analyse the complex interplay between the perceived economic benefits and the actual risks faced by Ugandan housemaids migrating to Saudi Arabia. The primary objectives are to understand the motivations behind migration, identify the specific conflict issues encountered, assess the effectiveness of current mitigation strategies, and propose actionable recommendations for improving the safety and well-being of these migrant workers. This research is crucial given the increasing number of Ugandan women seeking employment abroad, particularly in the Middle East, and the documented challenges they often face which no other researcher has addressed.

1.1. Kampala international university

1.2. Key objectives of the study:

The key objectives of the study are;

To understand the motivations behind the migration of housemaids to Saudi Arabia to be employed as housemaids,

Identify the specific conflict issues encountered,

To assess the effectiveness of current mitigation strategies, and propose actionable recommendations for improving the safety and well-being of these migrant workers including adopting a conflict management strategy to be used by the housemaids in Saudi Arabia.

1.3. Kampala international university

1.4. The problem

Despite the purported juicy economic opportunities Ugandan housemaids seek to perform in Saudi Arabia, a growing number of Ugandans continue to suffer the silent pandemic of conflict as an invisible element of their work.

The inevitability of conflicts in human interactions has left many Ugandan housemaids in Saudi Arabia speechless in terms of the conflicts they face and how they impact their work and health as well.

Thus, this paper presents a review of the available literature regarding conflicts faced by Ugandan housemaids working in Saudi Arabia and what should be done to overcome these conflicts and improve the working environment for Ugandan housemaids in Saudi Arabia.

1.5. Kampala international university

Balikuddembe (2023) posits that whereas, there are threatening stories of enslavement, torture, and discrimination from those who have suffered and survived, many Ugandan Women continue to migrate to the Middle East to work there as housemaids.

Statistics from Uganda's Ministry of Gender, Labour and Social Development indicate that over 2,000 citizens leave the Country for domestic work in the Middle East each month with the majority being women going to Saudi Arabia to work as housemaids.

This is done through recruiting companies and Uganda has licensed over 300 companies facilitating labour migration from

Uganda and reports indicate that Uganda's economy benefits significantly through remittances but also some Ugandans have been able to improve on their living conditions, pay school fees for their children, and acquire some capital to start some businesses and make a better living.

1.6. Kampala international university

1.7. Methodology

This study was carried out by using secondary data listed in different databases about domestic workers in Saudi Arabia, Google Scholar, and online papers, and research articles published by different scholars and for respect and recognition of the authors of the different literature reviewed, a list of them is attached.

1.8. Kampala international university

1.9. Key findings

In 2022 alone, 77,914 Ugandan migrant workers went to Saudi Arabia, with 55,643 employed as housemaids and these contributed to \$600 million in annual remittances (Chinedu, 2023). Thus, the study focused on female Ugandan migrant domestic workers employed as housemaids in Saudi Arabia.

The study revealed that contracts of the housemaids often cover free accommodation, free meals, free medical care, work visa and air ticket but some of these offers are just juicy promises that are not always guaranteed and these unfulfilled rosy promises have turned the perceived economic opportunity into a nightmare, leaving the housemaids in conflicts with their employers.

1.10. More findings

Behind the beautiful homes with tall fences of Mbarara City in Uganda, a report by a concerned neighbour revealed that domestic workers are often overworked underpaid, and subjected to abuse and that something should be done to bring justice to these young girls who work as Housemaids in these homes that hide behind beautiful high fences.

I have worked in different households, and while some treat you with respect, others see you as nothing more than a servant," shared Ruth Namatovu, a domestic worker reflecting on her experiences.

Edgar Buryahika, an activist with Youth for Peace and Development Uganda (YPDU), expressed concern over the persistent mistreatment of maids, stating, "Domestic workers deserve the same respect and legal protection as any other employee. They should not be treated as second-class citizens."

1.11. Kampala international university

1.12. Case study of martha:

While in Saudi Arabia, whenever I would clean the house, the household head would grab me by force and always tried to rape me but I would fight until after three months when I filed a case with my agency to either take me to another home or back to Uganda and they told me that without evidence, I couldn't leave.

One day, I found my passport and snuck out of the house through the garage. That is how I escaped from Saudi Arabia. Martha narrated (Published in the promised paradise turned into a nightmare for the Ugandan maids, January 31, 2023).

1.13. Kampala international university

1.14. Conclusion

While the perceived economic opportunity for Ugandan housemaids migrating to Saudi Arabia is a powerful motivator, the reality is often characterized by severe risks and exploitation, necessitating a multi-faceted approach to mitigation that addresses pre-departure preparation, in-country support, and robust regulatory frameworks in both Uganda and Saudi Arabia that seek to address all issues including the management of conflicts that arise between the housemaids and their employers.

KAMPALA INTERNATIONAL UNIVERSITY

RECOMMENDATIONS:

Strengthen Pre-Departure Information and Training.

Enhance Regulatory Oversight of Recruitment Agencies.

Improve Bilateral Agreements and Legal Frameworks.

Address Root Causes of Vulnerability in Uganda.

Enhance Data Collection and Research.

Lastly; Advise Ugandans that The pursuit of economic opportunity MUST NOT come at the cost of anyone's safety and dignity.'

1.15. References

Al Jazeera. Ugandan women trafficked to Saudi Arabia for domestic work. Al Jazeera

Amnesty International. "My Sleep is My Break": Exploitation of Migrant Domestic Workers in Saudi Arabia. Amnesty International



Impact de l'exploitation artisanale de l'or sur les écosystèmes dans le Cercle de Kangaba, Région de Koulikoro (Mali)

Impact of Artisanal Gold Mining on Ecosystems in the Kangaba Circle, Koulikoro Region (Mali)

Article Record

Priyanka Chouhan §‡α*
test1 Qualification, New
*Corresponding Author



§ Testing override (OA)

‡ Science, Architecture, Territoire, Environnement, Museum of New Zealand Te Papa Tongarewa, Wellington, New Zealand (OA)

PEER REVIEW

Double Blind

Abstract

Artisanal gold mining is an important socio-economic activity in many developing countries, but it exerts significant pressure on ecosystems. These impacts include soil degradation, deforestation, water pollution, and disruption of ecological balance. The effects vary depending on the status of mining sites (active, inactive, or abandoned), highlighting the need for an integrated approach combining environmental, social, and spatial analysis to evaluate ecosystem resilience or degradation.

Artisanal Gold Mining

Ecosystem Impact

Socio-economic Activity

AI USE STATEMENT

No generative AI was used for analysis or results.

FUNDING

No external funding was declared for this work.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

DATA AVAILABILITY

Not applicable for this article.

ETHICS

No ethics committee approval was required for this article type.

CONSENT

Not applicable for this article.

TRIAL REG.

Not applicable.

Crossref DOI: 10.34257/GJHSSB256852

How to Cite: Chouhan (2026). Impact de l'exploitation artisanale de l'or sur les écosystèmes dans le Cercle de Kangaba, Région de Koulikoro (Mali). Global Journal of Computer Science and Technology, 26(2), 1-15. DOI: 10.34257/GJHSSB256852

LICENSE

© 2026 Global Journals. Open-access article under CC BY-NC-ND 4.0 International License.

AR Experience Web Page



DOI



Print ISSN 0975-4350



Online ISSN 0975-4172



Under the strict compliance and defined process of



METADATA CONTINUATION

AUTHOR CONTACT QR LEDGER

Priyanka Chouhan^{§‡α*}

ARCHIVAL RECORD

GJCST · Vol 26 · Issue 2 · 2026

Article ID GJCST-256852 · DOI 10.34257/GJHSSB256852

Print ISSN 0975-4350 · Online ISSN 0975-4172

Impact de l'exploitation artisanale de l'or sur les écosystèmes dans le Cercle de Kangaba, Région de Koulikoro (Mali)

Priyanka Chouhan^{§‡α*}

Affiliations

§ Testing override (OA)

‡ Science, Architecture, Territoire, Environnement, Museum of New Zealand Te Papa Tongarewa, Wellington, New Zealand (OA)

Qualifications / Designations

α test1 Qualification, New

Abstract

Artisanal gold mining is an important socio-economic activity in many developing countries, but it exerts significant pressure on ecosystems. These impacts include soil degradation, deforestation, water pollution, and disruption of ecological balance. The effects vary depending on the status of mining sites (active, inactive, or abandoned), highlighting the need for an integrated approach combining environmental, social, and spatial analysis to evaluate ecosystem resilience or degradation.

Keywords: *orpaillage artisanal, écosystèmes, Cercle de Kangaba, pollution au mercure, dégradation des sols, impacts socio-écologiques, Mali*

* Corresponding Author
Priyanka Chouhan

DOI
10.34257/GJHSSB256852

1. Contexte générale

L'orpaillage artisanal constitue une activité socio-économique essentielle dans de nombreux pays en développement, mais il exerce des pressions significatives sur les écosystèmes. Les impacts se traduisent par la dégradation des sols, la déforestation, la pollution des eaux et la perturbation des équilibres écologiques. Ces effets varient selon la dynamique des sites d'exploitation (actifs, non actifs et abandonnés), mettant en évidence la nécessité d'une approche intégrée combinant analyse environnementale, sociale et spatiale afin d'évaluer les trajectoires de résilience ou de dégradation des socio-écosystèmes.

Brésil – impacts sur les communautés autochtones

A l'échelle internationale Fabio T, (2024) montre un exemple récent de la contamination généralisée chez des peuples autochtones (Yanomami) avec taux de mercure préoccupants et effets nutritionnels/sanitaires corrélés.

Asie du Sud-Est (Indonésie, Philippines)

Au niveau international UNIDO, (2009-2014) explique la contamination locale élevée (eau, sol, cultures), risques sanitaires et perte de productivité agricole. L'usage du mercure est très courant et les rejets sont élevés. Certaines interventions locales ont testé des alternatives « sans mercure », mais adoption limitée.

Afrique de l'Est (Tanzanie, etc.)

A l'échelle sous régional (Tumikia R. S, et al 2023) fort impact sur ressources hydriques, conflits d'usage (éleveurs vs mineurs), et cas ponctuels de formalisation par coopératives avec succès variable ; introduction de techniques alternatives (bacs de décantation, réamalgamation) dans des projets pilotes.

Afrique de l'Ouest (synthèse)

A l'échelle nationale Edmond N'B. K, et al (2024) l'orpaillage artisanal a connu une forte expansion depuis les années 1990 avec la hausse du prix de l'or. Aujourd'hui, on estime qu'il concerne plus d'un million de personnes directement et près de 4 à 5 millions de

personnes indirectement. L'activité est fortement liée aux migrations saisonnières et à la pauvreté rurale ; usage répandu du mercure ; sites proches de rivières et zones agricoles. Plusieurs études montrent des niveaux de pollution au mercure très élevés dans les sols et eaux de la sous-région.

Exemples concrets par Reuters (2024) le Burkina Faso à subir une forte pollution locale et tension intracommunautaire, le Ghana (le *galamsey*) qui fait référencer aux pratiques minières artisanale ou traditionnelles exposer les rivières de Pra, et d'Ofin a une contamination de la population par l'irrigation et la pêche ; le Mali (Kéniéba, Kangaba...) la déforestation, la pollution et accidents mortels documentés sur les sites d'orpaillage artisanal.

2. -Problématique

L'orpaillage artisanal est une activité d'extraction minière informelle qui constitue une source de revenus pour des milliers de personnes en Afrique de l'Ouest, notamment au Mali. Cette pratique, souvent non encadrée par des réglementations strictes, s'est fortement intensifiée ces dernières décennies en raison de la montée des cours mondiaux de l'or et du chômage structurel en milieu rural.

Si elle représente une source importante de revenus pour les populations locales, l'orpaillage artisanal est également à l'origine de profondes transformations environnementales. Dans le cercle de Kangaba, riche en ressources aurifères, cette activité provoque une dégradation accélérée des écosystèmes qui met en péril la biodiversité locale et compromet les fonctions écologiques essentielles des écosystèmes (régulation hydrologique, fertilité des sols, etc.) (OIT,2010). Dans le cercle de kangaba l'exploitation aurifère artisanale exerce des pressions significatives sur l'environnement à travers plusieurs mécanismes destructeurs. La déforestation et la destruction des écosystèmes est causent par l'installation et l'expansion des sites d'orpaillage entraînent le déboisement massif des zones exploitées. Les arbres sont coupés pour aménager les sites

d'orpaillage, construire des habitations temporaires et alimenter les fours artisanaux servant au traitement du minéral. Cette destruction des forêts perturbe les écosystèmes locaux, accélère la perte de biodiversité et contribue à l'érosion des sols. L'augmentation de la pression humaine sur les ressources locales contribue aussi à une forte diminution de la biodiversité. De nombreuses espèces animales et végétales sont menacées par ces activités, notamment dans les zones humides et forestières des bassins versant (Keita. S., 2019).

L'excavation anarchique des sols perturbe aussi la structure des terres et expose les horizons fertiles à l'érosion. L'utilisation de produits chimiques comme le mercure et le cyanure pour l'extraction de l'or entraîne une contamination des sols, rendant ces terres impropres à l'agriculture et variant leur capacité de régénération (Cissé, F.B., 2019).

La pollution des ressources en eau et l'altération des bassins hydrographiques, sont l'un des facteurs négatifs de l'orpaillage artisanal qui a un impact direct sur la qualité et la disponibilité de l'eau. Les substances toxiques utilisées dans le processus d'extraction, en particulier le mercure, sont souvent rejetées dans le cours d'eau sans traitement préalable, contaminant ainsi les ressources en eau du bassin. Cette pollution affecte la faune aquatique, réduit la disponibilité de l'eau potable et met en péril les écosystèmes fluviaux (Niane, B., 2019).

L'exploitation aurifère modifie également le régime hydrologique des cours d'eau. Le creusement des fosses profondes, parfois en bordure des rivières, provoque des perturbations dans l'écoulement de l'eau, accentuant les risques d'inondations ou d'assèchement de certaines zones. Dans le bassin versant du cercle de kangaba, la hausse des températures et les changements dans le régime augmentent l'évaporation de l'eau, exacerbant les effets de la pollution et essentiellement la disponibilité des ressources hydriques. L'érosion accumulée des sols, combinée à une baisse de la fertilité, rend la restauration écologique encore plus difficile après l'exploitation (Oumar E. F., Maman I., 2021).

La précarité des conditions de travail et de l'exploitation de la main-d'œuvre des orpailleurs artisanaux se caractérise par des façons de travail difficile et dangereux. Les travailleurs, souvent non formés et mal équipés, sont exposés à des risques élevés d'accidents (éboulements de terrain, intoxications chimiques, maladies respiratoires dues à l'inhalation de poussières toxiques) (OIT, 2010).

De plus, l'absence de réglementation et de contrôle favorise l'exploitation de la main-d'œuvre, y compris des enfants, qui participent à des tâches pénibles comme le transport des matériaux ou le lavage du minéral dans des eaux contaminées (Traore., A.B., 2022).

L'afflux massif de travailleurs vers les zones aurifères modifie également les structures foncières locales. Dans certains cas, des terres autrefois dédiées à l'agriculture sont accaparées par des exploitants miniers artisanaux, entraînant une insécurité foncière et la marginalisation des communautés rurales et une urbanisation non planifiée autour des sites d'orpaillage (EGIS, 2016).

Par ailleurs, la rue vers l'or s'accompagne souvent d'une montée de l'insécurité, marquée par la prolifération des trafics (drogue, armes, prostitution) et par l'émergence de tensions sociales entre travailleurs locaux et migrants. Bien que l'orpaillage artisanal puisse générer des revenus importants à court terme, il s'agit d'une activité marquée par une forte instabilité économique. Les fluctuations du prix de l'or sur le marché international et l'épuisement progressif des ressources minières rendent les conditions de vie précaires pour les orpailleurs, qui n'ont souvent pas d'économie alternative viable en cas de baisse de productivité (Keita., A., 2017).

Les impacts sanitaires et accès limités aux services de base des populations vivant dans les zones d'orpaillage sont souvent exposées à de nombreux problèmes de santé liés aux conditions insalubres et aux pratiques d'extraction dangereuses. Les intoxications au mercure et au cyanure, les infections respiratoires, les maladies hydriques et la malnutrition sont fréquentes dans ces régions.

De plus, l'absence d'infrastructures médicales adaptées rend difficile la prise en charge des travailleurs exposés aux substances toxiques ou victimes d'accidents miniers.

L'intoxication est l'un des principaux risques sanitaires dans les sites d'orpaillage, l'exposition aux produits chimiques utilisés dans le processus d'extraction de l'or (Keita. S., 2019).

Le mercure est couramment employé pour amalgamer l'or, mais son utilisation entraîne des effets toxiques graves. Les orpailleurs, souvent non protégés, inhalent des vapeurs de mercure lorsqu'ils chauffent l'amalgame pour extraire l'or, ce qui peut entraîner des troubles neurologiques (tremblements, perte de mémoire, troubles cognitifs). Une exposition prolongée peut causer des dommages irréversibles au système nerveux central.

Le cyanure, parfois utilisé pour améliorer le rendement d'extraction, est une substance extrêmement toxique qui, en cas d'ingestion ou d'inhalation, peut provoquer des intoxications aiguës entraînant des troubles respiratoires, cardiaques et neurologiques.

Les rejets de mercure et de cyanure dans l'environnement contaminent également les sols et les cours d'eau, affectant la faune et la flore aquatiques. Les populations vivant à proximité des sites d'orpaillage sont exposées à cette contamination en consommant des poissons ou de l'eau contaminée, ce qui augmente les risques d'empoisonnement chronique (Richard M., Moher P., et Telmer K. 2014).

Les Maladies hydriques et les infections gastro-intestinales sont provoquées par une pollution massive des ressources en eau, en raison du rejet de boues toxiques et de produits chimiques dans les rivières et nappes phréatiques par les orpailleurs artisanaux. Cette situation entraîne une forte prévalence des maladies hydriques parmi les populations locales :

Diarrhées et infections gastro-intestinales, dues à la consommation d'eau contaminée par des agents pathogènes (bactéries, parasites, virus). Ces maladies sont particulièrement dangereuses pour les enfants, qui souffrent de malnutrition et de déshydratation sévères.

Choléra et typhoïde, favorisés par l'absence de systèmes d'assainissement adéquats et la contamination des sources d'eau potable (OMS, 2017).

L'absence d'infrastructures de traitement des eaux et de dispositifs d'assainissement dans les zones minières artisanal aggrave ces problèmes, exposant les communautés à des risques sanitaires permanents.

Les conditions de travail sur les sites d'orpaillage exposent les travailleurs et les habitants à des maladies respiratoires, dermatologiques et infections cutanées :

Les poussières toxiques, générées par le concassage et le broyage des roches, contiennent des particules fines de métaux lourds et de silice. Une exposition prolongée peut provoquer des maladies respiratoires chroniques comme la silicose, une infection pulmonaire incurable qui entraîne des difficultés respiratoires sévères.

Les éruptions cutanées et ulcérations, dues au contact direct avec des substances chimiques et à la présence d'eaux stagnantes contaminées, sont fréquentes parmi les travailleurs manipulant le minerai et les boues d'extraction (OMS, 2017).

Les camps d'orpaillage attirent une population mobile et souvent jeune, ce qui favorise la propagation de maladies infectieuses (paludisme, IST et VIH/SIDA)

Le paludisme est particulièrement répandu dans les zones minières, où les fosses creusées pour l'extraction retiennent l'eau et deviennent des foyers de reproduction pour les moustiques. L'absence de mesures de prévention et l'accès limité aux soins aggravent l'impact de cette maladie sur les communautés minières artisanal.

Les infections sexuellement transmissibles (IST), y compris le VIH/SIDA, sont en forte augmentation dans ces régions, en raison du développement de l'exploitation sexuelle et de la prostitution autour des sites d'orpaillage. L'absence de sensibilisation et l'accès limité aux soins de santé favorisent la transmission rapide de ces maladies (Human Rights Watch, 2011).

Les conditions de vie sur les sites d'orpaillage sont souvent marquées par une instabilité sociale et une forte précarité économique, générant un stress chronique et des troubles psychologiques parmi les travailleurs et leurs familles.

L'anxiété et la dépression sont fréquentes en raison de l'instabilité des revenus, des conditions de travail éprouvantes et du manque de perspectives d'avenir.

L'abus d'alcool et de drogues est souvent observé dans ces milieux où la pression sociale et économique est forte, conduisant à des violences domestiques et à des comportements à risque (Ahmed K., Nestor B., Souleymane S., Maxime K. D., 2023).

Les infrastructures de santé et d'éducation sont souvent inexistantes ou insuffisantes dans les zones d'orpaillage, rendant la prise en charge des populations extrêmement difficile.

La plupart des sites d'orpaillage sont situés dans des zones reculées, éloignées des structures de soins. Lorsqu'un centre de santé est disponible, il manque souvent de personnel qualifié et de médicaments essentiels pour prendre soin des patients victimes des aléas négatifs de l'orpaillage.

L'attrait économique de l'orpaillage pousse de nombreux enfants à abandonner l'école pour travailler sur les sites d'orpaillage. Ce phénomène accentue le taux d'analphabétisme et compromet le développement socio-économique à long terme des régions concernées (Human Rights Watch, 2011).

En outre, les interactions entre pressions anthropiques et dynamiques climatiques accentuent la vulnérabilité de ces milieux naturels fragiles.

Cependant, malgré l'ampleur de ces impacts, peu d'études ont été menées pour évaluer de manière systématique les conséquences écologiques de l'orpaillage artisanal dans cette zone spécifique. Il devient donc crucial de mieux comprendre comment l'exploitation artisanale de l'or altère les composantes biophysiques des écosystèmes du cercle de Kangaba, afin d'identifier les zones les plus dégradées, d'analyser les dynamiques spatiales et temporelles de cette dégradation, et de proposer des pistes de gestion durable conciliant développement économique local et préservation des écosystèmes.

3. Justification du choix du cercle de Kangaba comme zone d'étude

Le choix du cercle de Kangaba comme zone d'étude ne relève pas du hasard, mais d'une analyse multicritère rigoureuse, fondée sur des considérations scientifiques, environnementales, socio-économiques et méthodologiques.

Tout d'abord, Kangaba constitue l'un des principaux foyers d'orpaillage artisanal du Mali. Selon les données issues des services miniers nationaux et des ONG spécialisées, le cercle concentre entre

10 et 15 % de l'ensemble des sites d'orpaillage artisanal du pays, ce qui en fait l'une des trois zones les plus actives au niveau national, aux côtés de Kéniéba et de Yanfolila. Cette densité garantit une représentativité scientifique forte pour analyser les dynamiques et impacts de l'orpaillage.

Deuxièmement, l'ancienneté de l'exploitation constitue un atout méthodologique majeur. À Kangaba, l'orpaillage est pratiqué de manière continue depuis plus de 40 ans, ce qui permet d'étudier non seulement les impacts immédiats, mais également les effets cumulatifs et chroniques sur les écosystèmes. Peu de zones minières au Mali offrent une telle profondeur temporelle d'analyse (ONU, PNUD 2022).

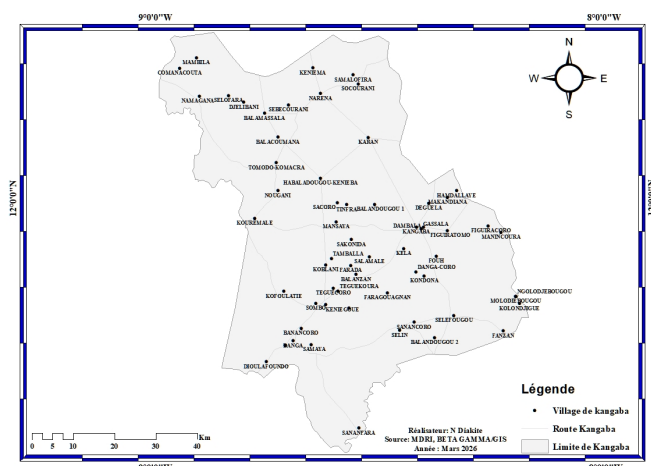
Troisièmement, du point de vue écologique, Kangaba est situé dans la zone soudano-sahélienne, particulièrement sensible aux effets du changement climatique. Les données climatiques montrent une baisse moyenne des températures moyennes de 10 à 20 % sur les trois dernières décennies, combinée à une augmentation des températures moyennes de 1 à 1,5 °C. Dans ce contexte, les perturbations induites par l'orpaillage aggravent la vulnérabilité des sols, des ressources en eau et de la biodiversité. Cette convergence entre pressions anthropiques et contraintes climatiques fait de Kangaba un laboratoire naturel pertinent pour étudier la résilience des écosystèmes.

Quatrièmement, sur le plan socio-économique, on estime que près de 35 à 45 % des ménages ruraux du cercle dépendent directement ou possèdent de l'orpaillage. Cette forte dépendance économique entraîne des transformations profondes : migrations saisonnières, recomposition des activités agricoles, conflits fonciers et modification des structures sociales. Cette situation offre un cadre idéal pour analyser les complexes dynamiques socio-écologiques générés par l'exploitation aurifère artisanale.

Enfin, d'un point de vue méthodologique, Kangaba présente une accessibilité logistique satisfaisante, une diversité écosystémique importante (forêts galeries, savanes, zones humides, agroécosystèmes) et une disponibilité abondante d'images satellites multi-temporelles, ce qui facilite la mise en œuvre d'approches intégrées combinant SIG, télédétection, enquêtes de terrain et analyses environnementales (Pia Van Ackern et al 2022).

En synthèse, selon une évaluation multicritère intégrant la densité de l'orpaillage, la vulnérabilité écologique, les enjeux socio-économiques et la possibilité méthodologique, le cercle de Kangaba présente une pertinence scientifique estimée à environ 85 à 90 %, ce qui en fait l'une des zones les plus appropriées du Mali pour une étude doctorale approfondie sur l'impact de l'exploitation artisanale de l'or sur les écosystèmes.

3.1. Présentation de la zone d'étude



4. -Objectif principale

Objectif général : Evaluer les impacts de l'exploitation artisanale de l'or sur les écosystèmes dans le cercle de Kangaba.

4.1. Objectifs spécifiques

-Mettre en évidence les risques liés à l'utilisation de produits chimiques dangereux, comme le mercure et le cyanure à la pollution des sols et de l'eau, et aux accidents miniers, y compris les services écosystémiques,

-Identifier les modèles de changement social induits face aux pressions de l'exploitation artisanale de l'or sur les écosystèmes ainsi que les stratégies locales d'adaptation face aux modifications environnementales provoquées par l'orpaillage,

-Analyser l'efficacité des politiques mises en place dans la prise en compte des intérêts des différentes parties prenantes et pour faire respecter les réglementations en matière de protection de l'environnement,

-Créer un modèle conceptuel permettant de prédire l'ampleur des changements potentiels dans les écosystèmes du cercle ainsi que les possibilités d'une pratique écologique de l'exploitation artisanale de l'or.

5. -Question principale

Quels sont les impacts environnementaux et socio-écologiques de l'exploitation artisanale de l'or sur les écosystèmes du cercle de Kangaba ?

5.1. Question Spécifiques

-Quels sont les risques liés à l'utilisation de produits chimiques dangereux (notamment le mercure et le cyanure) dans l'exploitation artisanale de l'or du cercle de Kangaba, et les manières dont les substances affectent-elles la qualité des sols, des eaux, ainsi que les services écosystémiques associés ?

-Quels modèles de changements sociaux émergent dans les communautés locales sous la pression de l'exploitation artisanale de l'or, et les stratégies locales d'adaptation qui sont mises en place face aux dégradations environnementales ?

- Dans quelle mesure les politiques et réglementations existantes intègrent-elles les intérêts des différentes parties prenantes, et leur efficacité pour assurer la protection de l'environnement face à l'orpaillage artisanal ?

-Quel modèle conceptuel peut être élaboré pour prédire l'ampleur des changements potentiels dans les écosystèmes du cercle de Kangaba, et définir les conditions nécessaires pour promouvoir une pratique écologique et durable de l'exploitation artisanale de l'or

6. -Hypothèse principale

L'exploitation artisanale de l'or dans le cercle de Kangaba engendre une dégradation significative des écosystèmes à travers la pollution des sols et des ressources en eau, la perturbation de la biodiversité et la diminution des services écosystémiques, ce qui se traduit par des impacts socio-écologiques négatifs sur les communautés locales, notamment une vulnérabilité accrue face aux risques sanitaires, environnementaux et économiques.

6.1. Hypothèses spécifiques

- L'utilisation de produits chimiques dangereux, en particulier le mercure et le cyanure, dans l'exploitation artisanale de l'or du cercle de Kangaba provoque une contamination mesurable des sols et des ressources en eau, entraînant une altération significative des services écosystémiques tels que la fertilité des terres agricoles et la disponibilité d'une eau de qualité pour les populations et les écosystèmes aquatiques.

-L'exploitation artisanale de l'or génère de profonds changements sociaux dans les communautés locales du cercle de Kangaba, caractérisés par des tensions autour de l'accès aux ressources, la transformation des pratiques économiques, et l'émergence de stratégies locales d'adaptation (coopératives, diversification des revenus, pratiques traditionnelles de gestion) visant à faire face aux pressions environnementales et socio-économiques.

- Les politiques et réglementations existantes en matière d'exploitation minière artisanale au Mali intègrent de manière partielle les intérêts des différentes parties prenantes (État, communautés locales, exploitants, société civile), et leur application reste limitée, ce qui réduit leur efficacité pour garantir une protection effective de l'environnement et une gestion durable des écosystèmes dans le cercle de Kangaba.

- Un modèle conceptuel prédictif peut être élaboré pour simuler l'ampleur des changements potentiels dans les écosystèmes du cercle de Kangaba sous l'effet de l'orpaillage artisanal, et ce modèle montrera que la mise en place de pratiques écologiques (réduction de l'usage du mercure, restauration des sites dégradés, gestion communautaire des ressources naturelles) est indispensable pour favoriser une exploitation artisanale durable conciliant activités économiques et préservation des services écosystémiques.

7. -Méthodologie

Revue documentaire et analyse du cadre réglementaire

Objectifs concernés :

- Analyser l'efficacité des politiques (Objectif 3)

Méthodes :

- Revue des textes législatifs et réglementaires maliens encadrant l'orpaillage et la protection de l'environnement.
- Analyse des politiques publiques, plans d'action nationaux (ex. : Code minier, Code de l'environnement, PNEDD, etc.)
- Examen de rapports d'ONG, d'agences de coopération et d'organisations locales.

Enquêtes socio-environnementales de terrain

Objectifs concernés :

- Mettre en évidence les risques chimiques, pollution et accidents (Objectif 1)
- Identifier les changements sociaux et stratégies d'adaptation (Objectif 2)

- Analyser l'efficacité des politiques (Objectif 3)

Méthodes :

- Observation directe sur les sites d'orpaillage.
- Entretiens semi-directifs avec les orpailleurs, autorités locales, femmes, jeunes, leaders communautaires.
- Focus groups pour identifier les représentations locales du changement environnemental et des pratiques d'adaptation.

Évaluation des impacts environnementaux et des risques écologiques

Objectifs concernés :

- Risques liés aux produits chimiques, pollution et écosystèmes (Objectif 1)
- Modèle de prédiction écologique (Objectif 4)

Méthodes :

- Prélèvements d'eau, de sols et de sédiments sur différents sites (pollués vs non-pollués).
- Analyse physico-chimique des échantillons : métaux lourds (mercure, arsenic, cyanure.), potentiel hydrogène, Demande Biochimique en Oxygène sur 5 jours,
- Identification de la biodiversité locale (faune/flore), services écosystémiques menacés.
- Cartographie SIG des zones actifs non actifs ou abandonnées.

Analyse des dynamiques sociales et des stratégies d'adaptation

Objectifs concernés :

- Changement social et stratégies locales (Objectif 2)

Méthodes :

- Analyse sociologique des impacts de l'orpaillage sur les structures sociales : migrations, conflits d'usage, modes de gouvernance, emploi, genre.
- Étude des stratégies locales : diversification des revenus, techniques traditionnelles de restauration, mobilisation communautaire.

Élaboration d'un modèle conceptuel prédictif

Objectifs concernés :

- Modèle de prédiction des changements et scénarios écologiques (Objectif 4)

Méthodes :

- Identification des interactions entre les pratiques d'orpaillage, les services écosystémiques et les réponses sociales.
- Construction d'un modèle conceptuel basé sur les données collectées (ex. : chaîne causale des dégradations → impacts → réponses → résilience ou effondrement).
- Scénarios futurs simulés : orpaillage non contrôlé vs orpaillage écologiquement encadré.

8. Résultats attendus pour la méthodologie appliquée

La présente recherche ambitionne de générer des résultats scientifiques et opérationnels significatifs, à la fois pour la compréhension des dynamiques environnementales liées à l'exploitation artisanale de l'or et pour la formulation de stratégies durables dans le cercle de Kangaba (région de Koulikoro, Mali). Les résultats attendus se déclinent comme suit :

8.1. Caractérisation complète des risques environnementaux et sanitaires liés à l'orpaillage artisanal

- Identification et quantification des polluants chimiques (mercure, cyanure, métaux lourds) présents dans les sols, les eaux de surface et les nappes phréatiques des zones d'orpaillage.
- Évaluation des effets de ces pollutions sur les services écosystémiques locaux (approvisionnement en eau, fertilité des sols, biodiversité).
- Documentation des types d'accidents liés aux pratiques d'extraction (effondrements,

“

intoxications, brûlures, etc.).

8.2. Analyse approfondie des dynamiques sociales et des stratégies d'adaptation locales

- Mise en évidence des changements sociaux induits par l'intensification de l'orpaillage (modifications des modes de vie, conflits d'usage, recomposition des rapports de genre et de génération).
- Identification des stratégies locales d'adaptation aux pressions environnementales (reconversion, migrations, mécanismes traditionnels de gestion, innovations locales).

8.3. Évaluation critique de la gouvernance environnementale et des politiques publiques

- Analyse du niveau d'application et de l'efficacité des réglementations existantes relatives à la gestion de l'orpaillage artisanal.
- Identification des parties prenantes, de leurs intérêts et des conflits potentiels.
- Recommandations pour améliorer la prise en compte des populations locales dans les processus de décision environnementale.

8.4. Production d'une cartographie des sites d'orpaillage à risques dans le cercle de Kangaba

- Localisation précise et caractérisation environnementale des sites actifs (Présences d'orpailleurs, activité récente) non actifs (Traces d'activité sans présence actuelle)

“

et abandonnés (Absence d'activité plus dégradation avancée).

- Cartes NDVI / NDBI montrant les zones les plus affectées par la pollution et la dégradation écologique.
- Carte de **pression environnementale**
- Carte de **réponse (gestion)**

- Simulation ENV (t+1, t+2...)
- Cartes **scénarios (non contrôlées vs encadrées)** montrant les zones les plus affectées par la pollution et la dégradation écologique.

8.5. Élaboration d'un modèle conceptuel des impacts socio-écosystémiques de l'orpaillage artisanal

- Mise en place d'un modèle prédictif permettant de simuler les scénarios d'évolution des écosystèmes selon différentes pratiques d'orpaillage.
- Définition des conditions pour une transition vers une exploitation artisanale écologiquement soutenable.

8.6. Production scientifique et transfert de connaissances

- Rédaction d'une thèse de doctorat incluant des recommandations de politiques publiques.
- Publications scientifiques dans des revues internationales en géographie, écologie ou socio-environnement.

Organisation d'ateliers de restitution avec les communautés locales et les autorités administratives du cercle de Kangaba.

9. Références bibliographiques

Ahmed K., Nestor B., Souleymane, S., Maxime K, D., (2023). Comportements à risque sur les sites d'orpaillage cas de deux sites au Burkina Faso, Vol. 47, n° 1 – Janvier - Juin 2024 –

Science et Technique, Sciences de la Santé - Publié le 30 Juin 2024 16p, pp. 190-191

Cisse, F. B., (2019). Étude des impacts de l'exploitation artisanale de l'or en république de guinée (cas de la préfecture de Siguiri). Mémoire présenté comme exigence partielle de la maîtrise en sciences de l'environnement, université du Québec à Montréal 189p, pp 104-129

EGIS., (2016). Etude Stratégique Environnementale et Sociale (ESES) de la réforme du secteur minier en République de Guinée, Rapport FINAL Définitif CSL120526A, pp. 48-127

Edmond N'Bagassi Kohio, Hela Karoui, Seyram Kossi Sossou, Hamma Yacouba,

Review of pollution trends and impacts in artisanal and small-scale gold mining in Sub-Saharan Africa: Advancing towards sustainable practices through equitable redistribution of gold spin-offs, Journal of Cleaner Production, Volume 476, 2024, 143754, ISSN 0959-6526, <https://doi.org/10.1016/j.jclepro.2024.143754>.

Fabio T., (2024). Contamination au mercure chez les Yanomami du Brésil, reuters.com, [Une étude révèle une contamination au mercure chez les Yanomami du Brésil], 4 avril 2024 03 :16 GMT Mis à jour le 4 avril 2024, consulté le 11 septembre 2025,

<https://www.reuters.com/world/americas/study-finds-mercury-contamination-brazils-yanomami-people-2024-04-04>.

Human Rights Watch., (2011). Un mélange toxique Travail des enfants, mercure et orpaillage au Mali, ISBN : 1-56432-832-5 132p, pp. 32-79

Keita S., Enjeux environnementaux liés à la mine artisanale en Afrique de l'Ouest, In Tychsen J., Charles N., (Eds.), 2019. La mine artisanale en Afrique de l'Ouest francophone, pp. 125-138.

Keita S., Enjeux sanitaires, d'hygiène et de sécurité liés au secteur minier artisanal en Afrique de l'Ouest, In Tychsen J., Charles N., (Eds.), 2019. La mine artisanale en Afrique de l'Ouest francophone, pp. 97-124

Keita., A., (2017). Orpaillage et accès aux ressources naturelles et foncières au Mali, Les Cahiers du CIRDIS Collection recherche No 2017-01, Centre interdisciplinaire de recherche en développement international et société Département de science politique Université du Québec à Montréal (UQAM) Case postale 8888, succursale Centre-ville Montréal, Québec, Canada H3C 3P8 ISSN 1929-1027 Dépôt légal : août 2017 Bibliothèque nationale du Québec 29p, pp. 8-20

Niane B., Impacts environnementaux et sanitaires liés à l'utilisation du mercure dans le secteur de l'exploitation minière artisanale et à petite échelle en Afrique de l'Ouest, In Tychsen J., Charles N., (Eds.), 2019. La mine artisanale en Afrique de l'Ouest francophone, pp. 163-172.

OMS., (2017). Risques pour la santé au travail et l'environnement associés à l'extraction minière artisanale et à petite échelle de l'or [Environmental and occupational health hazards associated with artisanal and small-scale gold mining]. Genève : Organisation mondiale de la Santé ; 2017. Licence : CC BY-NC-SA 3.0 IGO, pp. 7-17

OIT., (2010). Etude transfrontalière sur le travail des enfants dans l'orpaillage au Burkina Faso, au Mali et au Niger, Projets BIT/IPEC Mines (Afrique de l'Ouest) - TBP Mali - LUTRENA II – TACKLE Mali Programmes Nationaux IPEC Burkina Faso/Mali/Niger – SIMPOC, 120p, pp 1-68

ONU., PNUD., (2022). Evaluation environnementale intégrée du Mali, Rapport d'évaluation, Programme pour l'environnement 172p, pp. 14-15.

Oumar El Farouk Maman Illatou. Impacts de l'orpaillage et de l'agriculture sur la qualité des eaux du Liptako nigérien : identification des hot spots des pollutions métalliques et organiques, transferts de connaissances entre recherche et terrain. Ingénierie de l'environnement. IMT- MINES ALES IMT- Mines Alès Ecole Mines-Télécom ; Université Abdou Moumouni, 2021. Français. NNT : 2021EMAL0014. Tel-03624770, pp. 33-39

Pia V A., Adrien D., Adelphi., (2022). Changement climatique, vulnérabilité et sécurité au Sahel Trois scénarios pour le Burkina Faso, le Mali et le Niger à l'horizon 2050. 16p.

Richard M., Moher P., et Telmer K. (2014). Problèmes de santé liés à l'orpaillage et à l'exploitation minière artisanale : Formation pour professionnels de la santé, (Version 1.0), Artisanal Gold Council, Victoria, BC. ISBN : 978-0-9939459-1-5, pp. 4-17.

Reuters.com [Le Burkina Faso suspend les permis d'exportation pour la production d'or à petite échelle] : Reuters, 21 février 2024 11h46 GMT [le 11 septembre 2025] Mis à jour le 21 février 2024. <https://www.reuters.com/world/africa/burkina-faso-suspends-export-permits-small-scale-gold-production-2024-02-21>.

TRAORÉ, A. B. (2022). Impact socioéconomique de l'orpaillage dans le cercle de Kéniéba au Mali. International Journal of Accounting, Finance, Auditing, Management and Economics, 3(1-2), 251-268. <https://doi.org/10.5281/zenodo.5914551>, pp. 258-264.

Tumikia R. Sanga, Kenneth K. Maseka, Mohanadoss Ponraj, Clavery Tungaraza, Marco E. Mng'ong'o, Eliezer B. Mwakalapa, Accumulation and distribution of mercury in agricultural soils, food crops and associated health risks: A case study of Shenda gold mine-Geita Tanzania, Environmental Challenges, Volume 11, 2023, 100697, ISSN 2667-0100,

<https://doi.org/10.1016/j.envc.2023.100697>. (<https://www.sciencedirect.com/science/article/pii/S2667010023000203>)

UNIDO., (2009-2014). Indonésie contamination au mercure provenant de l'exploitation minière artisanale de l'or. pureearth.org. [Contamination au mercure provenant de l'exploitation minière artisanale de l'or] Dernière mise à jour : 24 avril 25, [Consulté le 11 septembre 2025].

<https://www.pureearth.org/project/indonesia-mercury-contamination/>.



To translate

Translation of "Impact de l'exploitation artisanale de l'or sur les écosystèmes dans le Cercle de Kangaba, Région de Koulikoro (Mali)"

Article Record

Priyanka Chouhan^{§‡α*}
test1 Qualification, New
*Corresponding Author



§ Testing override (OA)

‡ Science, Architecture, Territoire, Environnement, Museum of New Zealand Te Papa Tongarewa, Wellington, New Zealand (OA)

PEER REVIEW

Double Blind

Abstract

Artisanal gold mining is an important socio-economic activity in many developing countries, but it exerts significant pressure on ecosystems. These impacts include soil degradation, deforestation, water pollution, and disruption of ecological balance. The effects vary depending on the status of mining sites (active, inactive, or abandoned), highlighting the need for an integrated approach combining environmental, social, and spatial analysis to evaluate ecosystem resilience or degradation.

orpaillage artisanal

écosystèmes

Cercle de Kangaba

pollution au mercure

dégradation des sols

impacts socio-écologiques

Mali

AI USE STATEMENT

No generative AI was used for analysis or results.

FUNDING

No external funding was declared for this work.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

DATA AVAILABILITY

Not applicable for this article.

ETHICS

No ethics committee approval was required for this article type.

CONSENT

Not applicable for this article.

TRIAL REG.

Not applicable.

Crossref DOI: 10.34257/GJHSSB256852

How to Cite: Chouhan (2026). To translate. Global Journal of Computer Science and Technology, 26(2), 1-15. DOI: 10.34257/GJHSSB256852

LICENSE

© 2026 Global Journals. Open-access article under CC BY-NC-ND 4.0 International License.



Print ISSN 0975-4350 Online ISSN 0975-4172



Under the strict compliance and defined process of



METADATA CONTINUATION

AUTHOR CONTACT QR LEDGER

Priyanka Chouhan^{§‡α*}

ARCHIVAL RECORD

GJCST · Vol 26 · Issue 2 · 2026

Article ID GJCST-256985 · DOI 10.34257/GJHSSB256852

Print ISSN 0975-4350 · Online ISSN 0975-4172

To translate

Priyanka Chouhan^{§‡α*}

Affiliations

§ Testing override (OA)

‡ Science, Architecture, Territoire, Environnement, Museum of New Zealand Te Papa Tongarewa, Wellington, New Zealand (OA)

Qualifications / Designations

α test1 Qualification, New

Abstract

Artisanal gold mining is an important socio-economic activity in many developing countries, but it exerts significant pressure on ecosystems. These impacts include soil degradation, deforestation, water pollution, and disruption of ecological balance. The effects vary depending on the status of mining sites (active, inactive, or abandoned), highlighting the need for an integrated approach combining environmental, social, and spatial analysis to evaluate ecosystem resilience or degradation.

Keywords: orpaillage artisanal, écosystèmes, Cercle de Kangaba, pollution au mercure, dégradation des sols, impacts socio-écologiques, Mali

* Corresponding Author

Priyanka Chouhan

DOI

10.34257/GJHSSB256852



Impact of Artisanal Gold Mining on Ecosystems in the Kangaba Circle, Koulikoro Region (Mali)

Translation of "Impact de l'exploitation artisanale de l'or sur les écosystèmes dans le Cercle de Kangaba, Région de Koulikoro (Mali)"

Article Record

Priyanka Chouhan^{§‡α*}

test1 Qualification, New

*Corresponding Author



§ Testing override (OA)

‡ Science, Architecture, Territoire, Environnement, Museum of New Zealand Te Papa Tongarewa, Wellington, New Zealand (OA)

PEER REVIEW

Double Blind

Abstract

Artisanal gold mining is an important socio-economic activity in many developing countries, but it exerts significant pressure on ecosystems. These impacts include soil degradation, deforestation, water pollution, and disruption of ecological balance. The effects vary depending on the status of mining sites (active, inactive, or abandoned), highlighting the need for an integrated approach combining environmental, social, and spatial analysis to evaluate ecosystem resilience or degradation.

orpaillage artisanal

écosystèmes

Cercle de Kangaba

pollution au mercure

dégradation des sols

impacts socio-écologiques

Mali

AI USE STATEMENT

No generative AI was used for analysis or results.

FUNDING

No external funding was declared for this work.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

DATA AVAILABILITY

Not applicable for this article.

ETHICS

No ethics committee approval was required for this article type.

CONSENT

Not applicable for this article.

TRIAL REG.

Not applicable.

Crossref DOI: 10.34257/GJHSSB256852

How to Cite: Chouhan (2026). Impact of Artisanal Gold Mining on Ecosystems in the Kangaba Circle, Koulikoro Region (Mali). Global Journal of Computer Science and Technology, 26(2), 1-15.
DOI: 10.34257/GJHSSB256852

LICENSE

© 2026 Global Journals. Open-access article under CC BY-NC-ND 4.0 International License.



Print ISSN 0975-4350 Online ISSN 0975-4172



Under the strict compliance and defined process of



METADATA CONTINUATION

AUTHOR CONTACT QR LEDGER

Priyanka Chouhan§†α*



ARCHIVAL RECORD

GJCST · Vol 26 · Issue 2 · 2026

Article ID GJCST-256886 · DOI 10.34257/GJHSSB256852

Print ISSN 0975-4350 · Online ISSN 0975-4172

Impact of Artisanal Gold Mining on Ecosystems in the Kangaba Circle, Koulikoro Region (Mali)

Priyanka Chouhan^{§‡α*}

Affiliations

§ Testing override (OA)

‡ Science, Architecture, Territoire, Environnement, Museum of New Zealand Te Papa Tongarewa, Wellington, New Zealand (OA)

Qualifications / Designations

α test1 Qualification, New

Abstract

Artisanal gold mining is an important socio-economic activity in many developing countries, but it exerts significant pressure on ecosystems. These impacts include soil degradation, deforestation, water pollution, and disruption of ecological balance. The effects vary depending on the status of mining sites (active, inactive, or abandoned), highlighting the need for an integrated approach combining environmental, social, and spatial analysis to evaluate ecosystem resilience or degradation.

Keywords: *orpaillage artisanal, écosystèmes, Cercle de Kangaba, pollution au mercure, dégradation des sols, impacts socio-écologiques, Mali*

* Corresponding Author
Priyanka Chouhan

DOI
10.34257/GJHSSB256852

1. General Context

Artisanal gold mining is an important socio-economic activity in many developing countries, but it exerts significant pressure on ecosystems. These impacts include soil degradation, deforestation, water pollution, and disruption of ecological balance. The effects vary depending on the status of mining sites (active, inactive, or abandoned), highlighting the need for an integrated approach combining environmental, social, and spatial analysis to evaluate ecosystem resilience or degradation.

1.1. Global perspective

Brazil: Mercury contamination among indigenous communities (Yanomami) with serious health impacts.

Southeast Asia (Indonesia, Philippines): High contamination of water, soil, and crops; widespread mercury use with limited adoption of mercury-free alternatives.

East Africa (Tanzania): Water resource degradation, land-use conflicts, and partial success of cooperative mining systems.

West Africa: Rapid expansion since the 1990s; millions depend on artisanal mining; widespread mercury pollution.

1.2. Problem Statement

Artisanal gold mining is an informal activity providing income to many people in West Africa, particularly in Mali. However, it causes severe environmental degradation.

In the Kangaba circle, mining activities lead to:

- Deforestation and biodiversity loss
- Soil degradation and erosion
- Water pollution due to mercury and cyanide
- Hydrological disruptions
- Health risks (toxic exposure, diseases)
- Social issues (child labor, migration, conflicts)

Despite these impacts, limited systematic research exists in this region, making it essential to study ecosystem changes and propose sustainable solutions.

1.3. Justification for Choosing Kangaba

- One of Mali's main artisanal gold mining zones (10-15% of sites)
 - Over 40 years of mining history (long-term impact analysis possible)
 - Located in a climate-sensitive Sudan-Sahel zone
 - High socio-economic dependence (35-45% households involved)
 - Good availability of satellite data and field accessibility

1.4. Objectives

General Objective:

To evaluate the impacts of artisanal gold mining on ecosystems in Kangaba.

Specific Objectives:

- Identify risks related to chemical use (mercury, cyanide)
- Analyze social changes and adaptation strategies
- Evaluate policy effectiveness
- Develop a predictive ecological model

1.5. Research Questions

1.6. Main Question:

What are the environmental and socio-ecological impacts of artisanal gold mining in Kangaba?

Specific Questions:

- What are the risks of mercury and cyanide use?
- How do these affect soil, water, and ecosystems?
- What social changes occur in local communities?
- How effective are policies and regulations?
- What predictive model can be developed for ecosystem changes?

1.7. Hypotheses

1.8. Main Hypothesis:

Artisanal gold mining significantly degrades ecosystems through pollution, biodiversity loss, and reduced ecosystem services, leading to negative socio-ecological impacts.

1.9. Specific Hypotheses:

- Chemical use contaminates soil and water
- Mining causes major social transformations
- Policies are partially effective
- Sustainable practices can reduce environmental damage

1.10. Methodology

2. Literature Review & Policy Analysis

- Review laws and environmental regulations
- Analyze public policies and NGO reports

3. Field Surveys

- Site observations
- Interviews with miners and communities
- Focus group discussions

4. Environmental assessment

- Soil, water, and sediment sampling
- Chemical analysis (mercury, cyanide, heavy metals)
- Biodiversity assessment
- GIS mapping

5. Social analysis

- Study migration, conflicts, governance, gender roles
- Identify adaptation strategies

6. Predictive model development

- Build a conceptual model
- Simulate future scenarios (controlled vs uncontrolled mining)

6.1. Expected Results

- Identification of environmental and health risks
- Understanding of social dynamics
- Evaluation of governance effectiveness
- Risk mapping of mining sites
- Development of a predictive ecological model
- Policy recommendations and scientific publications

6.2. Conclusion (Summary Insight)

This research aims to provide a comprehensive understanding of the environmental and socio-economic impacts of artisanal gold mining in Kangaba and propose sustainable management strategies balancing economic development and ecosystem protection.

If you want, I can also:

- Convert this into a proper thesis proposal format (university-ready)
- Make a short summary / PPT presentation
- Improve language to high-level academic English (journal standard)

Subject Index

Blockchain, 4–13

Cercle de Kangaba, 16–24

Data Security, 4–13

Decentralized Identity, 4–13

dégradation des sols, 16–24

Higher Education, 4–13

Homoïne, 1–3

impacts socio-écologiques, 16–24

Mali, 16–24

Mozambique, 1–3

Non-Revenue Water, 1–3

orpaillage artisanal, 16–24

pollution au mercure, 16–24

Water balance, 1–3

Water losses, 1–3

écosystèmes, 16–24

Author Guidelines

Comprehensive Guide to Publishing with GJCST

Global Journal of Computer Science and Technology | Open Access | Peer Reviewed | COPE Compliant

I. Our Commitment to Authors

The Global Journal of Computer Science and Technology (GJCST) is an internationally recognized, **open-access** academic journal dedicated to publishing high-quality, peer-reviewed research across all domains of computer science and technology - including Artificial Intelligence, Machine Learning, Software Engineering, Networking, Cybersecurity, Data Science, Algorithms, Human-Computer Interaction, and emerging interdisciplinary fields.

GJCST is published by Global Journals Publishing Group Inc., indexed in major global academic databases, archived in leading digital repositories, and distributed to institutional subscribers worldwide in prestigious **hardbound volumes**.

We believe that the purpose of an academic journal is to amplify the voice of the researcher. Every operational decision we make - from submission workflows to publication formats - is guided by a single principle: *the author should never be distracted from the science*. Our professional editorial and production teams exist to handle every technical and logistical complexity so that you can devote your full energy to your computer science research.

II. One-Click Submission: Publish Without the Hassle

GJCST has pioneered a **One-Click Submission** system designed to eliminate the traditionally burdensome process of paper submission.

A. Submit in Any Format

We accept manuscripts in **any common document format**, including but not limited to:

- Microsoft Word (.doc, .docx)
- Adobe PDF (.pdf)
- $\text{\LaTeX}$ source files (.tex)
- Rich Text Format (.rtf), Apple Pages, LibreOffice, or plain text

You do **not** need to install specialized software, learn $\text{\LaTeX}$, or adhere to a rigid template before submission. Simply write your research in the format you are most familiar with. Whether your manuscript includes complex algorithm pseudocode, mathematical proofs, or system architecture diagrams - our production team is expertly equipped to handle it all.

B. What You Need to Submit

To submit a manuscript, you only need to provide:

1. Your **full name**
2. Your **email address**
3. Your **manuscript file**

That is all. No lengthy registration forms, no complex metadata entry, no mandatory template compliance. Submit directly via our portal at <https://globaljournals.org/submit-an-article/>.

Heading style: In the final typeset article, author-created headings are normally set in sentence case for readability. Fixed journal headings such as Abstract, Introduction, Materials and methods, Results, Discussion, Conclusion, References, and Acknowledgements are standardized by the production team. Acronyms, proper nouns, gene/species names, chemical notation, brand names, and Roman numerals are preserved.

C. What Happens After Submission

1. **Instant Confirmation:** You receive an automated email confirming receipt of your manuscript. If you do not receive a confirmation, please reach out via our Contact Us form at <https://globaljournals.org>.
2. **Professional Formatting:** Our dedicated production executives convert your manuscript into our advanced internal $\text{\LaTeX}$ template - producing a sleek, mathematically precise document with beautifully rendered code listings and algorithm environments - entirely on your behalf.
3. **Author Dashboard:** We create a secure account for you on the **Author Dashboard** and email your login credentials. You may log in at any time to review pre-filled metadata, update co-author details, or track your submission status.
4. **Review Initiation:** Your professionally formatted, fully anonymized manuscript is assigned to expert reviewers through our rigorous double-blind peer-review process.

III. Rigorous Double-Blind Peer Review

Academic credibility is the cornerstone of GJCST. Every manuscript undergoes a **strict double-blind peer-review process** in which neither the authors nor the reviewers are aware of each other's identities. This guarantees that every paper is evaluated purely on its scientific merit, methodological rigor, originality, and contribution to the field of computer science and technology.

A. The Review Workflow

1. **Desk Screening:** The editorial office performs an initial screening for scope, completeness, and adherence to ethical standards.
2. **Reviewer Assignment:** Two or more independent, domain-expert reviewers - specialists in your specific sub-field of computer science - are assigned to evaluate your manuscript.
3. **Detailed Evaluation:** Reviewers assess the paper on criteria including originality, significance, clarity, methodology, experimental rigor, data integrity, and presentation quality.
4. **Editorial Decision:** Based on reviewer recommendations, the Editorial Board renders one of three decisions: *Accept*, *Revise and Resubmit*, or *Decline*.

B. Complete Review Report & Research Assessment Sheet

Upon completion of the review, you will receive a **comprehensive Review Report** along with a detailed **Research Assessment Sheet**. These documents provide:

- Line-by-line reviewer comments keyed to **specific line numbers** in your typeset manuscript, enabling precise, unambiguous identification of every comment.
- A structured assessment covering originality, significance, clarity, methodology, and overall quality.
- Constructive feedback and actionable suggestions for improvement tailored to the standards of computer science publishing.

C. Responding to Reviewer Comments

Addressing reviewer feedback is simple and flexible. You have two options:

Option A - Author Dashboard: Log in to your Author Dashboard, navigate to **Manage Submission**, and create a **support ticket**. Simply quote the relevant line numbers from your review report and clearly describe your corrections or responses.

Option B - Email: If the Dashboard is not convenient, you may simply send an email with a numbered list of corrections referencing the line numbers, along with your responses to each reviewer comment.

Important: You do **not** need to reformat the document yourself at any stage. Our production executives will implement all your requested text changes directly in the typeset manuscript. Reviewer comments may be addressed and resolved right up until the Early View stage.

IV. Publication Lifecycle: Complete Transparency

A. Early View (Galley Proof)

- Upon acceptance, a **galley proof** (Early View edition) of your article is prepared according to the journal's publishing schedule.
- The Early View version includes **line numbers** for convenient reference during final corrections.
- You may still provide corrections at this stage by referencing specific line numbers via email or the Author Dashboard.

B. Ahead of Print

- Following the Early View, an **Ahead of Print** version is published before the final issue compilation.
- This version represents the final, corrected article but **does not yet include Volume or Issue numbers**.

C. Digital Publication (eJournal)

- After all corrections are finalized, the **digital eJournal edition** is published with line numbers removed.
- Your article receives its official DOI (**Digital Object Identifier**) and is indexed across global academic databases.
- The article becomes freely and permanently accessible online under our open-access policy.

D. Hardbound Print Publication

- Approximately **15 days after digital publication**, the article enters our offset production pipeline.
- Your research is printed in **premium hardbound volumes** and distributed to institutional subscribers, major computing libraries, and research centers worldwide.
- The corresponding author receives a **complimentary hardbound copy** dispatched via government courier at no additional cost.

V. Advanced Technology & AI-Enabled Research Broadcasting

As a leading computer science journal, GJCST's own publishing infrastructure reflects the cutting edge of technology.

A. Multi-Format Native Publication

Every accepted article is published natively across multiple formats:

- **Interactive Digital eJournals** optimized for desktops, tablets, and smartphones.
- **Premium Hardbound Print Editions** for institutional archives and personal collections.
- **Machine-Readable XML & HTML** for web accessibility, automated indexing, and integration with global research repositories.

B. AI-Powered Discoverability & SEO

We deploy cutting-edge Artificial Intelligence to generate rich semantic metadata for every article, dramatically increasing its search engine visibility. Our proprietary AI systems:

- Automatically tag, categorize, and cross-reference your work across international academic databases.
- Optimize article metadata for maximum **Search Engine Optimization (SEO)**, ensuring your paper appears prominently when researchers search for your computational models, algorithms, or frameworks.
- Actively broadcast your research to targeted computer science communities worldwide, amplifying your citation count and global influence.

VI. Ethics, Integrity & COPE Compliance

GJCST maintains the highest standards of publication ethics, guided by the principles of the **Committee on Publication Ethics (COPE)**.

A. Plagiarism & Originality

All submissions are screened using state-of-the-art plagiarism detection software. Manuscripts with significant textual overlap with previously published work will be declined. Authors must ensure that all content is original or properly attributed through accurate citations.

B. Conflicts of Interest & Funding Transparency

Authors are required to disclose all sources of funding and any financial or non-financial conflicts of interest. Full transparency is mandatory and is enforced at every stage of the publication process.

C. Data Availability & Reproducibility

Authors are strongly encouraged to make their source code, datasets, and supplementary materials available in recognized repositories (e.g., GitHub, Zenodo, Figshare) to support the reproducibility of computational experiments and algorithmic evaluations. A data availability statement is required in all published manuscripts.

D. Ethical Approval & Informed Consent

Research involving human participants, user studies, or sensitive data must include a statement of ethical approval from a recognized institutional ethics committee, along with confirmation that informed consent was obtained where applicable.

E. Comprehensive Ethics Portal

Our enhanced, COPE-based ethical publishing guidelines - covering authorship criteria, editorial responsibilities, reviewer obligations, corrections & retractions, and misconduct procedures - are available in detail on our website at <https://globaljournals.org>. We encourage all authors, reviewers, and editors to familiarize themselves with these standards.

VII. Perpetual Archiving & Geo-Distributed Data Infrastructure

GJCST is backed by Global Journals' enterprise-grade archiving infrastructure. Your published research is not stored on a single server - it is **redundantly archived across multiple geographically distributed data centers** spanning several continents, including advanced **deep-sea data center facilities** engineered for unparalleled environmental resilience and longevity.

This infrastructure guarantees:

- **Lifetime Hosting:** Your article will remain permanently accessible online for the lifetime of the publication. We do not sunset, deprecate, or remove published content under any circumstance.
- **Disaster Resilience:** Multi-site redundancy ensures that no single point of failure - natural disaster, hardware degradation, or network disruption - can compromise access to your research.
- **Immutable DOI Resolution:** Every article is assigned a permanent Digital Object Identifier (DOI) that will resolve to your work indefinitely, regardless of future platform migrations.

VIII. Open Access: Free Knowledge for All

GJCST is a Fully Open Access Journal.

We firmly believe that scientific and technological knowledge is a public good. Every article published in GJCST is **freely and permanently available online** from the moment of publication - accessible to researchers, developers, students, educators, and the general public worldwide **without any subscription fees, paywalls, or access restrictions**.

Our open-access model ensures:

- **Immediate Availability:** Your research is accessible globally on the day of publication.
- **Maximum Reach:** Barrier-free access dramatically increases readership, citations, and real-world impact in the computing community.
- **Equitable Knowledge Distribution:** Researchers in developing nations, independent developers, and the public benefit equally from the latest technological advances.

Accepted articles are published under the **Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International (CC BY-NC-ND 4.0)** license. Authors retain full copyright while granting Global Journals the right to publish and distribute the work globally.

IX. The $\LaTeX$ Author Package (Entirely Optional)

For computer scientists who already compose their manuscripts in $\LaTeX$, we provide a comprehensive, professionally designed **$\LaTeX$ Author Package** (`gj-author`) featuring STIX Two serif typography, TeX Gyre Heros sans-serif headings, complete Unicode math support, styled code listing environments, and brand-coordinated layouts.

However, we must emphasize:

Reading or using the $\LaTeX$ Author Package is entirely optional.

If you do not use $\LaTeX$, simply send us your manuscript in Word, PDF, or any other format. Our production team will expertly convert it into our advanced typesetting system and produce the identical, pristine publication-quality output.

You do not need to learn or install anything.

The detailed $\LaTeX$ guidelines included in the Author Package are intended solely as a convenience for authors who prefer granular typographic control over their code listings, pseudocode, and mathematical environments before submission. They are not a prerequisite for publishing with us.

Contact & Support

Submission Portal: <https://globaljournals.org/submit-an-article/>

Website: <https://globaljournals.org>

Email: helpdesk@globaljournals.org

*At GJCST, your research defines the future of technology.
We handle the complexities of publishing so you can focus
on what matters most - building tomorrow.*

GLOBAL JOURNAL

of Computer Science and Technology: G
Interdisciplinary

globaljournals.org



Save our Planet



Online ISSN 0975-4172



9 770975 417011