Summary

Short Name:	Transnational Tropical Forest-river Complex Ecosystems
Title:	Service Value Assessment and Comprehensive Protection Approaches for Transnational Tropical Forest-River Complex Ecosystems
Time Request:	[*not provided*] Mo.
Funding Request:	[*not provided*] K€

Funding Agency Summary

Funding Agency	Request
National Natural Science Foundation of China (NSFC)	240.0
National Research and Innovation Agency from Indonesia (BRIN)	181.0
Fund for Science, Technology, and Innovation (FONSTI - Côte d'Ivoire)	31.0

Personnel

ID	Role(s)	Family Name	First Name	Organization	Country	Financial and In-Kind Resources
50327	Partner PI	YIN	Xinan	Beijing Normal University	China	National Natural Science Foundation of China (NSFC)
50335	Partner PI	AMINATUN	Tien	Yogyakarta State University	Indonesia	National Research and Innovation Agency from Indonesia (BRIN)
53430	Partner PI	CHEN	Junhao	Chinapower Construction Group	China	National Natural Science Foundation of China (NSFC)
51016	Partner PI	DIARRA	Brahima	Oceanological Research Center (Centre de Recherches Océanologiques)	Côte d'Ivoire	Fund for Science, Technology, and Innovation (FONSTI - Côte d'Ivoire)
51015	Partner PI	GUEYE	Monnoin Frédéric	Alassane Ouattara University	Côte d'Ivoire	Fund for Science, Technology, and Innovation (FONSTI - Côte d'Ivoire)
50339	Partner PI	HUTAMA	Ponty Sya'banto Putra	Yogyakarta State University	Indonesia	National Research and Innovation Agency from Indonesia (BRIN)
50338	Partner PI	KHOTIMAH	Nurul	Yogyakarta State University	Indonesia	National Research and Innovation Agency from Indonesia (BRIN)
50341	Partner PI	KISWANTO	Kiswanto	Mulawarman University	Indonesia	National Research and Innovation Agency from Indonesia (BRIN)
51014	Partner PI	KONATE	Mory Latif	San Pedro Polytechnic University (Université Polytechnique de San Pedro)	Côte d'Ivoire	Fund for Science, Technology, and Innovation (FONSTI - Côte d'Ivoire)
50349	Partner PI	KOUAKOU	N'Guessan Gilbert	African Tropical Wood (Bois Tropicaux d'Afrique)	Côte d'Ivoire	Fund for Science, Technology, and Innovation (FONSTI - Côte d'Ivoire)
50347	Partner PI	KOUAME	N'Guessan François	Alassane Ouattara University	Côte d'Ivoire	Fund for Science, Technology, and Innovation (FONSTI - Côte d'Ivoire)
51013	Partner PI	KOUASSI	Loukou Firmin	Ivorian Society of Production, Studies and Consulting (Société Ivoirienne de Réalisation, d'Etudes et Conseil)	Côte d'Ivoire	Fund for Science, Technology, and Innovation (FONSTI - Côte d'Ivoire)
50350	Partner PI	KRA	Gérard Landry Konan	Development Research Center (Centre De Recherche Pour Le Developpement)	Côte d'Ivoire	Fund for Science, Technology, and Innovation (FONSTI - Côte d'Ivoire)
50329	Partner PI	LIU	Haifei	Beijing Normal University	China	National Natural Science Foundation of China (NSFC)
50343	Partner PI	LIU	Yimeng	Beijing Normal University	China	National Natural Science Foundation of China (NSFC)
50336	Partner PI	MAARIF	Faqih	Yogyakarta State University	Indonesia	National Research and Innovation Agency from Indonesia (BRIN)
50340	Partner PI	SASAERILA	Hidayat Yorianta	Al Azhar University of Indonesia	Indonesia	National Research and Innovation Agency from Indonesia (BRIN)
50337	Partner PI	SUBA	Rachmat Budiwijaya	Mulawarman University	Indonesia	National Research and Innovation Agency from Indonesia (BRIN)
50799	Partner PI	SUPRAYOGI	Bambang	Sumatran Elephant Foundation (Yayasan Gajah Sumatera)	Indonesia	National Research and Innovation Agency from Indonesia (BRIN)

50334	Partner PI	TARYONO	Siswantoyo Margo	Yogyakarta State University	Indonesia	National Research and Innovation Agency from Indonesia (BRIN)
50519	Partner PI	YAO	Kouassi Patrick	Alassane Ouattara University	Côte d'Ivoire	Fund for Science, Technology, and Innovation (FONSTI - Côte d'Ivoire)
50330	Partner PI	YU	Jialin	Rural Development Institute, Chinese Academy of Social Sciences	China	National Natural Science Foundation of China (NSFC)
50331	Partner PI	YU	Yuanhe	Rural Development Institute, Chinese Academy of Social Sciences	China	National Natural Science Foundation of China (NSFC)

Project Information

Title: Service Value Assessment and Comprehensive Protection Approaches for Transnational Tropical Forest-River Complex Ecosystems
Acronym: Transnational Tropical Forest-river Complex Ecosystems

Theme(s): [Area 1 - Reduce deforestation, and promote sustainable development and locally-led economies, Area 2 - Ecosystem Function, Connectivity, and Climate Change Science, Area 3 - Environmental Justice and Governance]

Start: 2026-03-01 (YYYY-MM-DD)
End: 2029-02-28 (YYYY-MM-DD)
Duration: 36 months

Summary:

Many tropical forests extend across several countries, and numerous rivers are located within and around the forests. These tropical forests are closely interconnected, and the forests and rivers interact giving rise to a transnational forest-river complex ecosystem. In previous protection and restoration projects, tropical forests were regarded as isolated ecosystems, overlooking their intimate connection with rivers, which led to a divergence between the actual and anticipated outcomes of forest protection and restoration measures. In contrast to research conducted on isolated forest ecosystems and individual national levels, research on transnational tropical forest-river complex ecosystems reveals the mechanisms of forest degradation and the value of forest restoration. Moreover, it fully exploits the ecological resilience and economic potential inherent in these complex systems and augments the likelihood of forest restoration. This project was directed towards reducing or controlling deforestation by coordinating protection and restoration measures for tropical forests and rivers, with an emphasis on the correlation between the forests and rivers as well as combining measures adopted by different countries. Integrating the ecological service functions of forests and rivers reveals their interactions and comprehensive benefits on a transnational scale and proposes a methodology for safeguarding the interests of stakeholders. The transnational cooperation pathway combines the economic outputs of forests and rivers. As the level of economic development and cultural characteristics affect policy implementation, this project will involve participants from China (characterized by a relatively high-income level and Confucianism-Taoism integrated culture), Indonesia (exhibiting a relatively low-income level and Islamic culture), and Cote d'Ivoire (endowed with a relatively poor economic situation and tribal culture-modern civilization integrated culture) to enhance the practicability of the results.

Project
Keywords:

Transnational; Forest; River

Reviewers

Suggested Reviewers:

(1)Professor Yali Wen College of Forestry Economics and Management, Beijing Forestry University, China Tsinghua East Road No.35 Haidian District, Beijing , China E-mail: wenyali2003@163.com (2)Professor Paul Wood Department of Geography, Loughborough University, UK Leicestershire, LE11 3TU, UK E-mail: P.J.Wood@lboro.ac.uk (3)Professor Martin Thoms Riverine Landscapes Research Laboratory, University of New England, Australia Armidale, NSW, 2351, Australia E-mail: mthoms2@une.edu.au

Potential Reviewers to Avoid (for direct competition reasons or conflict of interest):

none

Participating Organizations

Org Id	Org. Name	Org. Type	City	Country
50345	African Tropical Wood (Bois Tropicaux d'Afrique)	Private Sector	Yamoussoukro	CIV
50342	Al Azhar University of Indonesia	Academic, Training and Research	Kebayoran Baru	IDN
50344	Alassane Ouattara University	Academic, Training and Research	Bouaké	CIV
50323	Beijing Normal University	Academic, Training and Research	Beijing	CHN
50325	Chinapower Construction Group	Other Public Sector	Beijing	CHN
50346	Development Research Center (Centre De Recherche Pour Le Developpement)	Academic, Training and Research	Bouaké	CIV
51008	Ivorian Society of Production, Studies and Consulting (Société Ivoirienne de Réalisation, d'Etudes et Conseil)	Other Public Sector	Abidjan	CIV
50374	Mulawarman University	Academic, Training and Research	Samarinda	IDN
51010	Oceanological Research Center (Centre de Recherches Océanologiques)	Academic, Training and Research	Abidjan	CIV
50324	Rural Development Institute, Chinese Academy of Social Sciences	Academic, Training and Research	Beijing	CHN
51009	San Pedro Polytechnic University (Université Polytechnique de San Pedro)	Academic, Training and Research	San Pédro	CIV
50796	Sumatran Elephant Foundation (Yayasan Gajah Sumatera)	National NGO	Malang	IDN
50333	Yogyakarta State University	Academic, Training and Research	Yogyakarta	IDN

Organization 50345 - African Tropical Wood (Bois Tropicaux d'Afrique)

Name:	African Tropical Wood (Bois Tropicaux d'Afrique)
Acronym:	
Org. Type:	Private Sector
Address Line 1:	Bois Tropicaux d'Afrique
Address Line 2:	(+225) 07 07 66 79 74
PO Box:	B. P. 196 Yamoussoukro
City/Town:	Yamoussoukro
State/Province/Region:	Yamoussoukro
Country:	CIV
Postal/ZIP code:	001
Website:	www.bta-atw-ci.org

Organization 50342 - Al Azhar University of Indonesia

Name:	Al Azhar University of Indonesia
Acronym:	
Org. Type:	Academic, Training and Research
Address Line 1:	Universitas AL Azhar Indonesia
Address Line 2:	Jalan Sisingamangaraja, Samping Masjid Agung Al Azhar
PO Box:	
City/Town:	Kebayoran Baru
State/Province/Region:	Jakarta Selatan
Country:	IDN
Postal/ZIP code:	12110
Website:	www.uai.ac.id

Organization 50344 - Alassane Ouattara University

Name: Alassane Ouattara University
Acronym:

Org. Type: Academic, Training and Research

Address Line 1: Ahougnassou, route de béoumi - BPv 18 Bouaké 01
Address Line 2:
PO Box: BPV 18
City/Town: Bouaké
State/Province/Region: Bouaké
Country: CIV
Postal/ZIP code: 01

Website: https://univ-ao.edu.ci/

Organization 50323 - Beijing Normal University

Name: Beijing Normal University
Acronym:

Org. Type: Academic, Training and Research

Address Line 1: 19 Xinjiekouwai Street
Address Line 2: Haidian District
PO Box:
City/Town: Beijing
State/Province/Region: Beijing
Country: CHN
Postal/ZIP code: 100875

Website: www.bnu.edu.cn/

Organization 50325 - Chinapower Construction Group

Name: Chinapower Construction Group
Acronym:

Org. Type: Other Public Sector

Address Line 1: No. 22 Chegongzhuang West Road, Haidian District, Beijing, China
Address Line 2:
PO Box:
City/Town: Beijing
State/Province/Region: Beijing
Country: CHN
Postal/ZIP code: 100048

Website: http://pr.powerchina.cn

Organization 50346 - Development Research Center (Centre De Recherche Pour Le Developpement)

Name: Development Research Center (Centre De Recherche Pour Le Developpement)
Acronym:

Org. Type: Academic, Training and Research

Address Line 1: CENTRE DE RECHERCHE POUR LE DEVELOPPEMENT
Address Line 2: +225 07 69 25 33 92
PO Box: BP V 18
City/Town: Bouaké
State/Province/Region: GBEKE

Country: CIV
Postal/ZIP code: 01

Website: https://crd-uao.org/

Organization 51008 - Ivorian Society of Production, Studies and Consulting (Société Ivoirienne de Réalisation, d'Etudes et Conseil)

Name: Ivorian Society of Production, Studies and Consulting (Société Ivoirienne de Réalisation, d'Etudes et Conseil)
Acronym:

Org. Type: Other Public Sector

Address Line 1: +225 07 09 03 65 67
Address Line 2:
PO Box: BP 531
City/Town: Abidjan
State/Province/Region: Abidjan
Country: CIV
Postal/ZIP code: 01

Website:

Organization 50374 - Mulawarman University

Name: Mulawarman University
Acronym:

Org. Type: Academic, Training and Research

Address Line 1: Gn. Kelua Samarinda
Address Line 2:
PO Box:
City/Town: Samarinda
State/Province/Region: Kalimantan Timur
Country: IDN
Postal/ZIP code:

Website: https://unmul.ac.id/

Organization 51010 - Oceanological Research Center (Centre de Recherches Océanologiques)

Name: Oceanological Research Center (Centre de Recherches Océanologiques)
Acronym:

Org. Type: Academic, Training and Research

Address Line 1: 29, rue des pêcheurs - BP V 18 Abidjan, Côte d'Ivoire
Address Line 2:
PO Box: BP V 18
City/Town: Abidjan
State/Province/Region: Abidjan
Country: CIV
Postal/ZIP code: 01

Website: www.cro.edu.ci

Organization 50324 - Rural Development Institute, Chinese Academy of Social Sciences

Name: Rural Development Institute, Chinese Academy of Social Sciences
Acronym:

Org. Type: Academic, Training and Research

Address Line 1: 5,Jianguomennei Avenue
Address Line 2:
PO Box:
City/Town: Beijing
State/Province/Region: Beijing
Country: CHN
Postal/ZIP code: 100732

Website: http://rdi.cssn.cn/ehome/

Organization 51009 - San Pedro Polytechnic University (Université Polytechnique de San Pedro)

Name: San Pedro Polytechnic University (Université Polytechnique de San Pedro)
Acronym:

Org. Type: Academic, Training and Research

Address Line 1: BP, 1800 San Pedro
Address Line 2: +225 05 03 89 91 63
PO Box: BP 1800
City/Town: San Pédro
State/Province/Region: San Pédro
Country: CIV
Postal/ZIP code: BP

Website: https://usp.edu.ci/

Organization 50796 - Sumatran Elephant Foundation (Yayasan Gajah Sumatera)

Name: Sumatran Elephant Foundation (Yayasan Gajah Sumatera)
Acronym:

Org. Type: National NGO

Address Line 1: Jalan KH Malik No. 50 A Buring Malang 65132, East Java, INDONESIA
Address Line 2: Jalan Sei Batu Gingging No. 69, Kel. PB Selayang I, Kec. Medan Selayang Medan 20131 INDONESIA
PO Box:
City/Town: Malang
State/Province/Region: East Java
Country: IDN
Postal/ZIP code:

Website: https://yagasu.or.id/

Organization 50333 - Yogyakarta State University

Name: Yogyakarta State University
Acronym:

Org. Type: Academic, Training and Research

Address Line 1: Jl. Colombo No.1 Yogyakarta 55281
Address Line 2:
PO Box:
City/Town: Yogyakarta
State/Province/Region: Daerah Istimewa Yogyakarta
Country: IDN
Postal/ZIP code: 55281

Website: https://www.uny.ac.id/

Personnel

ID	Family Name	First	Organization	Org. City	Org. Country	Consortium Lead?	Operating Capacity	Funding Source
50327	YIN	Xinan	Beijing Normal University	Beijing	China	Yes	Natural Scientist	National Natural Science Foundation of China (NSFC)
50335	AMINATUN	Tien	Yogyakarta State University	Yogyakarta	Indonesia	No	Natural Scientist	National Research and Innovation Agency from Indonesia (BRIN)
53430	CHEN	Junhao	Chinapower Construction Group	Beijing	China	No	Societal Partner / Stakeholder Representative	National Natural Science Foundation of China (NSFC)
51016	DIARRA	Brahima	Oceanological Research Center (Centre de Recherches Océanologiques)	Abidjan	Côte d'Ivoire	No	Natural Scientist	Fund for Science, Technology, and Innovation (FONSTI - Côte d'Ivoire)
51015	GUEYE	Monnoin Frédéric	Alassane Ouattara University	Bouaké	Côte d'Ivoire	No	Natural Scientist	Fund for Science, Technology, and Innovation (FONSTI - Côte d'Ivoire)
50339	HUTAMA	Ponty Sya'banto Putra	Yogyakarta State University	Yogyakarta	Indonesia	No	Social Scientist / Humanist	National Research and Innovation Agency from Indonesia (BRIN)
50338	KHOTIMAH	Nurul	Yogyakarta State University	Yogyakarta	Indonesia	No	Natural Scientist	National Research and Innovation Agency from Indonesia (BRIN)
50341	KISWANTO	Kiswanto	Mulawarman University	Samarinda	Indonesia	No	Natural Scientist	National Research and Innovation Agency from Indonesia (BRIN)

51014 KONATE	Mory Latif	San Pedro Polytechnic University (Université Polytechnique de San Pedro)	San Pédro	Côte d'Ivoire	No	Natural Scientist	Fund for Science, Technology, and Innovation (FONSTI - Côte d'Ivoire)
50349 KOUAKOU	N'Guessan Gilbert	African Tropical Wood (Bois Tropicaux d'Afrique)	Yamoussoukro	Côte d'Ivoire	No	Societal Partner / Stakeholder Representative	Fund for Science, Technology, and Innovation (FONSTI - Côte d'Ivoire)
50347 KOUAME	N'Guessan François	Alassane Ouattara University	Bouaké	Côte d'Ivoire	No	Natural Scientist	Fund for Science, Technology, and Innovation (FONSTI - Côte d'Ivoire)
51013 KOUASSI	Loukou Firmin	Ivorian Society of Production, Studies and Consulting (Société Ivoirienne de Réalisation, d'Etudes et Conseil)	Abidjan	Côte d'Ivoire	No	Societal Partner / Stakeholder Representative	Fund for Science, Technology, and Innovation (FONSTI - Côte d'Ivoire)
50350 KRA	Gérard Landry Konan	Development Research Center (Centre De Recherche Pour Le Developpement)	Bouaké	Côte d'Ivoire	No	Social Scientist / Humanist	Fund for Science, Technology, and Innovation (FONSTI - Côte d'Ivoire)
50329 LIU	Haifei	Beijing Normal University	Beijing	China	No	Natural Scientist	National Natural Science Foundation of China (NSFC)
50343 LIU	Yimeng	Beijing Normal University	Beijing	China	No	Social Scientist / Humanist	National Natural Science Foundation of China (NSFC)
50336 MAARIF	Faqih	Yogyakarta State University	Yogyakarta	Indonesia	No	Natural Scientist	National Research and Innovation Agency from Indonesia (BRIN)

50340	SASAERILA	Hidayat Yorianta	Al Azhar University of Indonesia	Kebayoran Baru	Indonesia	No	Natural Scientist	National Research and Innovation Agency from Indonesia (BRIN)
50337	SUBA	Rachmat Budiwijaya	Mulawarman University	Samarinda	Indonesia	No	Natural Scientist	National Research and Innovation Agency from Indonesia (BRIN)
50799	SUPRAYOGI	Bambang	Sumatran Elephant Foundation (Yayasan Gajah Sumatera)	Malang	Indonesia	No	Societal Partner / Stakeholder Representative	National Research and Innovation Agency from Indonesia (BRIN)
50334	TARYONO	Siswantoyo Margo	Yogyakarta State University	Yogyakarta	Indonesia	No	Social Scientist / Humanist	National Research and Innovation Agency from Indonesia (BRIN)
50519	YAO	Kouassi Patrick	Alassane Ouattara University	Bouaké	Côte d'Ivoire	No	Natural Scientist	Fund for Science, Technology, and Innovation (FONSTI - Côte d'Ivoire)
50330	YU	Jialin	Rural Development Institute, Chinese Academy of Social Sciences	Beijing	China	No	Social Scientist / Humanist	National Natural Science Foundation of China (NSFC)
50331	YU	Yuanhe	Rural Development Institute, Chinese Academy of Social Sciences	Beijing	China	No	Social Scientist / Humanist	National Natural Science Foundation of China (NSFC)

Consortium Lead - Natural Scientist: YIN, Xinan (ID: 50327)

Family Name: YIN
First Name(s): Xinan
Title(s): Prof. Dr.

ORCID: 0000-0002-8078-5391
Email: yinxinan@bnu.edu.cn
Phone:

Funding Type: Award
Funding Source: National Natural Science Foundation of China (NSFC)

Operating Capacity: Consortium Lead - Natural Scientist

Role in the Project: As the consortium leader, I plan the overall research objectives and sub-objectives of the consortium, and ensure the cooperation among the teams from each country. In addition, I keep the research progress and quality, and ensure the successful completion of the project.

Primary Org.: Beijing Normal University (ID: 50323)

Department: School of Environment

Unit / Laboratory:

Position: Director of department of environmental ecology

Location(s): CHN

Research Area(s): Ecology

Career Level: midCareer

Highest Academic Level: Doctoral or equivalent level

Year Academic Level Obtained: 2012

Areas of Knowledge: Plant; River; Hydropower; Carbon trade

Partner Details: Xin'an Yin is the Professor of ecology and Director of the Department of Environmental Ecology at the Beijing Normal University, China. He is serving as an associate editor of River Research and Applications and an expert in guiding and assisting the construction of the Central Ecological and Environmental Fund in China. He was selected as one national top young talent of the "10000 people plan" in China. His major research interests lie in the interdisciplinary study of ecology, focusing on interactions among the hydrological, environmental and ecological processes. This research has expanded to consider forest-river complex ecosystems as Social – Ecological Systems to enhance the science required to underpin the management of forests and rivers. He has hosted over and participated in more than 20 national, provincial and ministerial projects, such as the National Key R&D Program, the National Natural Science Foundation of China (5 projects), the Fok Yingdong Education Fund, and the Beijing Science and Technology Rising Star. His research has resulted in over 100 refereed journal papers. He has won 1 Science and Technology Progress Award of the Ministry of Education, China and 1 Innovation Achievement Award of China's Industry-University-Research Cooperation.

Publications: （1）Plant management：Qiu, X.T., Liu, H.R., Yin, X.A. (Corresponding author) & Qin, J.L. (2021) 'Combining the management of water level regimes and plant structures for waterbird habitat provision in wetlands', Hydrological Processes, 35(5): e14122.（2）River ecology：Yin, X.A., Hu, P. & Zhou, J.G. (2022) 'Environmental flow mechanism and management for river-lake-marsh systems', Hydrological Processes, 36(6): e14629.（3）Economic outputs of rivers：Yin, X.A., Liu, Y.M., Yang, Z.F., Zhao, Y.W., Cai, Y.P., Sun, T. & Yang, W. (2018) 'Eco-compensation standards for sustaining high flow events below hydropower plants', Journal of Cleaner Production, 182: 1-7.（4）Carbon trade：Sun, Y.Y., Zhang, J., Mao, X.Q., Yin, X.A. (Corresponding author), Liu, G.Y., Zhao, Y.W. & Yang, W. (2021) 'Effects of different types of environmental taxes on energy–water nexus', Journal of Cleaner Production, 289(20): 125763.（5）Citizen welfare：Yin, X.A., Yang, L., Gao, T., Liu, Y., Gao, Z.J., Tan, Y. & Wang, J.Q. (2024) 'Non-inferior solutions for virtual water strategies: Model development and a case study in northern China', Journal of Hydrology, 634: 131124.

Natural Scientist: AMINATUN, Tien (ID: 50335)

Family Name: AMINATUN

First Name(s): Tien

Title(s): Prof. Dr. S.S. M.Si.

ORCID: 0000-0001-7428-0250

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Phone: +62-82138267965

Funding Type: Subaward

Funding Source: National Research and Innovation Agency from Indonesia (BRIN)

Operating Capacity: Natural Scientist

Role in the Project: Being secretary for the project.

Primary Org.: Yogyakarta State University (ID: 50333)

Department: Biology

Unit / Laboratory: Ecology and Environmental Science

Position: Professor

Location(s): IDN
Research Area(s): [Ecology, Environmental sciences]

Career Level: lateCareer
Highest Academic Level: Doctoral or equivalent level
Year Academic Level Obtained: 2012

Areas of Knowledge: Ecology; Environmental science

Partner Details: None

Publications: (1) Aminatun, T., Suwasono, R. A., & Putri, R. A. (2021) 'Flora and fauna diversity in selangkau forest: A basis for developing management plan of cement industrial complex in east Kalimantan, Indonesia', Biodiversitas, 22(10): 4555–4565. (2) Aminatun, T., Kuswarsantyo, Suhartini, Rangpan, V., Prasojo, Z. H., & Andreyani, A. (2022) 'Sustainable community forest management in West Kalimantan: A case study of the Dayak Katab Kebahan community', Jurnal Pengelolaan Sumberdaya Alam dan Lingkungan, 12(1): 158–174.

Societal Partner / Stakeholder Representative: CHEN, Junhao (ID: 53430)

Family Name: CHEN
First Name(s): Junhao
Title(s):

ORCID:
Email: chen_jh4@hdec.com
Phone: 18810525092

Funding Type: Subaward
Funding Source: National Natural Science Foundation of China (NSFC)

Operating Capacity: Societal Partner / Stakeholder Representative
Role in the Project: project management

Primary Org.: Chinapower Construction Group (ID: 50325)
Department:
Unit / Laboratory:
Position:

Location(s): CHN
Research Area(s): [Environmental sciences, Electrical engineering]

Career Level: earlyCareer
Highest Academic Level: Doctoral or equivalent level
Year Academic Level Obtained: 2018

Areas of Knowledge: Oversea electric investment, Project management, environmental pollution

Partner Details: Junhao Chen has a strong academic foundation in environmental science and engineering, with educational achievements spanning bachelor's, master's, and doctoral degrees from China Agricultural University.He participates in the National Key R&D Program of the Ministry of Science and Technology (2022YFC3202704) and leads the China Postdoctoral Science Foundation project (2022M722959). As the sole first author, he has published papers in Journal of Cleaner Production, Chemical Engineering Journal, and Science of The Total Environment. He also co-holds two Chinese patents related to persulfate catalysis for water treatment and antibiotic reduction in livestock waste.

Publications: (1)Junhao Chen; Xuan Jiang; Yue Zhang; Yixin Zhang; Ying Sun; Li Zhang. Organic matter conversion and contributors to bioavailability in biogas slurry treated by biochar/persulfate during the oxidation pond process. Journal of Cleaner Production, 2022, 355: 131770; (2)Junhao Chen; Xiaolu Yu; Cheng Li; Xin Tang; Ying Sun. Removal of tetracycline via the synergistic effect of biochar adsorption and enhanced activation of persulfate. Chemical Engineering Journal, 2020, 382: 122916; (3)Junhao Chen; Xuan Jiang; Xin Tang; Ying Sun; Lei Zhou. Use of biochar/persulfate for accelerating the stabilization process and improving nitrogen stability of animal waste digestate. Science of The Total Environment, 2021, 757: 144158; (4)Xiaolu Yu; Xiaoxia Liu; Hang Liu; Junhao Chen; Ying Sun. The accumulation and distribution of five antibiotics from soil in 12 cultivars of pak choi. Environmental Pollution, 2019, 254: 113115; (5)Xiaolu Yu; Junhao Chen; Xiaoxia Liu; Ying Sun; Hongju He. The mechanism of uptake and translocation of antibiotics by pak choi (Brassica rapa subsp. chinensis). Science of The Total Environment, 2022, 810: 151748

Natural Scientist: DIARRA, Brahima (ID: 51016)

Family Name: DIARRA
First Name(s): Brahima
Title(s): Associate Researcher

ORCID: 0009-0007-9508-3038
Email: diarbrahim@gmail.com
Phone: (+225) 07 59 15 01 65

Funding Type: Subaward
Funding Source: Fund for Science, Technology, and Innovation (FONSTI - Côte d'Ivoire)

Operating Capacity: Natural Scientist
Role in the Project: Demonstrate how mangrove macroinvertebrates contribute to ecosystem services such as carbon sequestration, soil fertility, and coastal protection in Côte d'Ivoire; examines their role in maintaining mangrove health and proposes tailored conservation and protection strategies to strengthen these ecosystems against environmental threats.

Primary Org.: Oceanological Research Center (Centre de Recherches Océanologiques) (ID: 51010)
Department: Aquatic Living Resources
Unit / Laboratory: Benthos
Position: Head of the laboratory

Location(s): CIV
Research Area(s): [Forestry and arboriculture, Economics, Sustainability Science]

Career Level: earlyCareer
Highest Academic Level: Doctoral or equivalent level
Year Academic Level Obtained: 2022

Areas of Knowledge: Mangrove; Macroinvertebrates; Conservation

Partner Details: None

Publications: (1)Diarra, B., Konan, K.J., Yapo, L.M. & Kouassi, K.P. (2018) 'Aquatic macroinvertebrates associated with free-floating macrophytes in a marginal lentic ecosystem (Ono Lagoon, Côte d' Ivoire)', Journal of Entomology and Zoology Studies, 6(3)[*not provided*]432-1441; (2) Diarra, B., Konan, K.J., Yapo, M.L. & Kouassi, K.P. (2018) 'Macroinvertebrate communities associated with Hydrilla verticillata (Royle, 1839) and relationship with environmental factors in Ono Lagoon, Southeast of Côte d'Ivoire', International Journal of Environment, Agriculture and Biotechnology, 3(6): 2091-2102.

Natural Scientist: GUEYE, Monnoin Frédéric (ID: 51015)

Family Name: GUEYE
First Name(s): Monnoin Frédéric
Title(s): Doctor Lecturer

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Funding Type: Subaward

Funding Source: Fund for Science, Technology, and Innovation (FONSTI - Côte d'Ivoire)

Operating Capacity: Natural Scientist
Role in the Project: Intervening in the disciplines of ornithology and the ecology of organisms in a forest; working on the conservation and management of animal biodiversity and their habitats; working on themes related to hydrobiology and mammalogy.

Primary Org.: Alassane Ouattara University (ID: 50344)
Department: Animal Biology and Ecology
Unit / Laboratory: Animal biological sciences Laboratory
Position:

Location(s): CIV
Research Area(s): [Biology, Animal science, Forestry and arboriculture]

Career Level: midCareer
Highest Academic Level: Doctoral or equivalent level
Year Academic Level Obtained: 2021

Areas of Knowledge: Ornithology; ecology; hydrobiology

Partner Details: First steps in scientific research began in 2009 during the studies in hydrobiology and later for obtaining a Master in ecology; Work focused mainly on birds from various environments (urban, aquatic, coastal, developed and forest) and their habitats; Participated as a consultant in a project on the "Restoration of forests and degraded lands in a context of climate change in western Côte d'Ivoire".

Publications: (1) Odoukpé, S.G.K., Kouassi, K.N., Gueye, F.M., Kouadja, S.K.E. & N'da, S.A. (2023) 'Utilisation par les oiseaux d'eau des bas-fonds rizicoles aménagés dans le district de Yamoussoukro, Côte d'Ivoire', Malimbus, 45(2): 55– 69; (2) Odoukpé, S.G.K., Gueye, F.M., Kouassi, K.N. & N'da, A.S. (2023) 'Structure and dynamics of granivorous birds in rice fields lowlands of the Yamoussoukro district, central Côte d'Ivoire', Journal of Advances in Biology & Biotechnology, 26(8): 30-40; (3) Odoukpé, S.G.K., Gueye, F.M., Koné, S.Y. & Yaokokoré-Béibro, H.K. (2023) 'Diversité, structure du peuplement et distribution des oiseaux d'eau de la zonehumide de Grand-Bassam (Sud-Est, Côte d'Ivoire)', International Journal of Biological and Chemical Sciences, 17(4): 1430-1442; (4) Odoukpé, K.S.G., Assa, E.S. & Gueye, M.F. (2023) 'Etat des lieux de l'avifaune de quelques forêts classées du centre de la Côte d'Ivoire: Diversité spécifique, structure du peuplement et menaces', International Journal of Innovation and Applied Studies, 39(1): 87 – 99; (5) Odoukpé, K.S.G., Kra, K.H., Gueye, M.F., Zréhon, W.M. & Yaokokoré-Béibro, K.H. (2022) 'Données préliminaires sur l'avifaune de la Réserve Naturelle Partielle d'Aghien (Sud-Est Côte d'Ivoire)', Bulle

Social Scientist / Humanist: HUTAMA, Ponty Sya'banto Putra (ID: 50339)

Family Name: HUTAMA
First Name(s): Ponty Sya'banto Putra
Title(s): Dr. (front title), S.E., M.Si., Ak., CA. (back title)

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Funding Type: Subaward
Funding Source: National Research and Innovation Agency from Indonesia (BRIN)

Operating Capacity: Social Scientist / Humanist
Role in the Project: Working on economic and finance.

Primary Org.: Yogyakarta State University (ID: 50333)
Department: Accounting
Unit / Laboratory:
Position: Head of Study Program

Location(s): IDN
Research Area(s): [Taxation, Accounting]

Career Level: midCareer

Highest Academic Level:	Doctoral or equivalent level
Year Academic Level Obtained:	2020
Areas of Knowledge:	Behavioral Accounting; Taxation; Carbon trade and tax
Partner Details:	None
Publications:	Hutama, P.S.P., Rahmawati, Payamta, Djuminah (2020) 'Does Moral Principles and Ethical Behaviour Influence Indonesian Taxpayer Preference to Participate in Tax Amnesty Programs?', International Journal of Economics, Business and Management Research, 4(10): 85-102.

Natural Scientist: KHOTIMAH, Nurul (ID: 50338)

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Funding Type:	Subaward
Funding Source:	National Research and Innovation Agency from Indonesia (BRIN)
Operating Capacity:	Natural Scientist
Role in the Project:	Working on carbon sink, forestry, economic management and government management.
Primary Org.:	Yogyakarta State University (ID: 50333)
Department:	Geography Education Department
Unit / Laboratory:	Geography Laboratory
Position:	Associate Professor
Location(s):	IDN
Research Area(s):	[Environmental sciences, Environmental geography, Emergency and disaster management]
Career Level:	midCareer
Highest Academic Level:	Doctoral or equivalent level
Year Academic Level Obtained:	2017
Areas of Knowledge:	Environment; Geography; Disaster Mitigation
Partner Details:	None
Publications:	None

Natural Scientist: KISWANTO, Kiswanto (ID: 50341)

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Funding Type:	Subaward
Funding Source:	National Research and Innovation Agency from Indonesia (BRIN)
Operating Capacity:	Natural Scientist

Role in the Project: Working on ecosystem restoration and forest carbon stocks

Primary Org.: Mulawarman University (ID: 50374)
Department: Department of Forestry
Unit / Laboratory: Laboratory of Silviculture
Position: Assistant Professor

Location(s): IDN
Research Area(s): [Ecology, Forestry and arboriculture, Environmental sciences]

Career Level: midCareer
Highest Academic Level: Doctoral or equivalent level
Year Academic Level Obtained: 2018

Areas of Knowledge: Silviculture; Ecosystem Restoration; Forest Carbon Stocks

Partner Details: Key accomplishments in silviculture, ecosystem restoration, and forest carbon stocks, such as: significant progress in sustainable forest management and climate change mitigation. (1) Formulating spatial modeling for silviculture systems in Indonesia In order to characterize the current conditions, which are one of the factors considered when formulating forest management policies, silviculture systems have been developed by integrating geographic information systems and remote sensing technology. (2) Developing spatial models for forest restoration strategies The priority locations and categories of forest ecosystem restoration activities can be determined through the use of spatial data modeling. The quantity of land criticality, topography, and land vulnerability can be characterized by this modeling. (3) Engaging in the Forest Carbon Partnership Facility - Carbon Fund (FCPF-CF) in East Kalimantan Province, Indonesia; Participation in a diverse array of activities that are the primary functional tasks and functions of the Measurement, Monitoring, and Reporting (MMR) Working Group in the Forest Carbon Partnership Facility - Carbon Fund (FCPF-CF) in East Kalimantan Province, Indonesia (4) Participated in a diverse array of forest and land ecosystem restoration activities, such as those conducted in natural forest areas and ex-fire and coal mining areas.

Publications: (1) Kiswanto, M., Mardiany, A., & Tsuyuki, S. (2023) 'Silvicultural decisions to formulate forest restoration strategies using geospatial approaches', IOP Conference Series: Earth and Environmental Science, 1282(1). (2) Kiswanto, M., Mardiany, M., Murtinah, V., & Tsuyuki, S. (2024) 'Geospatial approaches for formulating multisystem silviculture in the tropical forests', IOP Conference Series: Earth and Environmental Science, 1315(1): 012078. (3) Kiswanto, S., Setiawati, M. D., & Tsuyuki, S. (2021) 'Impact of Local REDD+ Intervention on Greenhouse Gas Emissions in East Kalimantan Province, Indonesia', in Climate Impacts on Sustainable Natural Resource Management (pp. 1–18). John Wiley & Sons, Ltd. (4) Kiswanto, S., Setiawati, M. D., Wahyulianto, I., & Tsuyuki, S. (2022) 'Tracking Transitions of Tropical Deforestation in East Kalimantan, Indonesia Using Time-Series Landsat Images from 2000 to 2016', in Towards Sustainable Natural Resources: Monitoring and Managing Ecosystem Biodiversity (pp. 11–39). Springer International Publishing. (5) Diana, R., Kiswanto, Hardi, E. H., Palupi, N. P.et al. (2023) 'Soil carbon stock in different of mangrove ecosystem in Mahakam Delta, East Kalimantan, Indonesia', E3S Web of Conference, 373.

Natural Scientist: KONATE, Mory Latif (ID: 51014)

Family Name: KONATE
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Title(s): Doctor Lecturer

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Funding Type: Subaward
Funding Source: Fund for Science, Technology, and Innovation (FONSTI - Côte d'Ivoire)

Operating Capacity: Natural Scientist
Role in the Project: Working on plants investigations.

Primary Org.: San Pedro Polytechnic University (Université Polytechnique de San Pedro) (ID: 51009)
Department: Agriculture New Technologies, Fisheries Resources and Agro-industry
Unit / Laboratory: Training and Research Unit in Agriculture
Position:

Location(s): CIV
Research Area(s): [Ecology, Agriculture]

Career Level: earlyCareer
Highest Academic Level: Doctoral or equivalent level
Year Academic Level Obtained: 2021

Areas of Knowledge: weeds assessment and characterization; plant Ecology; agriculture

Partner Details: Her studies started by the growth experience of two savannah palm species like Phoenix reclinata and Raphia sudanica. Later she was involved in the study of the cashew orchards' weeds in relation with the agricultural technics and the ecological factors.

Publications: (1) Abdoul Rahim Falk Ky, Mory Latif Konaté, N'Guessan François Kouamé (2024) 'Variation de l'épaisseur des parenchymes du limbe de l'anacardier (Anacardium occidentale L.) en fonction de l'éclairement solaire en Côte d'Ivoire', Afrique Science, 24(1): 60-70; (2) Konate, M.L., Silue, N., Ouattara, N.D., Bakayoko, A., & Kouamé, N.F. (2024) 'Germination trials of Phœnix reclinata Jacq. and Raphia sudanica A. Chev. two palm species of Guinean Savanah', Journal of Agricultural, Food Science & Biotechnology, 2(3): 237-242; (3) Latif Mory Konaté, Abdoul Rahim Falk Ky, Ali Mangara, François N'Guessan Kouamé, Daouda Koné (2023) 'Cashew Orchards' weeds in high diseases and pests prevalence zone in Côte d'Ivoire', Indian Journal of Weed Science, 55(1): 72-78; (4) Abdoul Rahim Falk Ky, Latif Mory Konaté, Ali Mangara, François N'Guessan Kouamé (2022) 'Pratiques paysannes de gestion des adventices dans les vergers de l'anacardier dans trois Départements en Côte d'Ivoire', Reb-Pasres, 7(2): 59-67; (5) Latif Mory Konaté, Doudjo Noufou Ouattara, François N'Guessan Kouamé, Adama Bakayoko (2021) 'Diversity and uses by farmers of cashew (Anacardium occidentale L.) orchards weeds in Côte d'Ivoire', Ethnobotany Research and Applications, 21(1).

Societal Partner / Stakeholder Representative: KOUAKOU, N'Guessan Gilbert (ID: 50349)

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Funding Type: Subaward
Funding Source: Fund for Science, Technology, and Innovation (FONSTI - Côte d'Ivoire)

Operating Capacity: Societal Partner / Stakeholder Representative
Role in the Project: Working on implementations of findings and studies recommendations

Primary Org.: African Tropical Wood (Bois Tropicaux d'Afrique) (ID: 50345)
Department:
Unit / Laboratory:
Position: Senior Engineer

Location(s): CIV
Research Area(s): Forestry and arboriculture

Career Level: lateCareer
Highest Academic Level: Masters or equivalent level
Year Academic Level Obtained: 2012

Areas of Knowledge: Cashew orchards reforestation; administrative socio-economic implementation; forest ecosystem

Partner Details: Identification and mapping of potential plots for reforestation following the identified species and their characterization in cashew orchards; Inventory of fauna, flora, invasive plants, non-wood forest products and forest stands of the N'Zi Riverlodge domain; Forestry assistance to for the first national forest flora inventory in Côte d'Ivoire from 2019 to 2021.

Publications:	François N'Guessan Kouamé, Gilbert Kouakou, Chantal Bah-Kouamé, Firmin Loukou Kouassi (2021) 'Structure et diversité floristique en forêt dense de la Côte d'Ivoire', Afrique Science, 18(6): 159-176.

Natural Scientist: KOUAME, N'Guessan François (ID: 50347)

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First Name(s): N'Guessan François
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Funding Type: Award
Funding Source: Fund for Science, Technology, and Innovation (FONSTI - Côte d'Ivoire)

Operating Capacity: Natural Scientist
Role in the Project: Working on forestry and tropical flora

Primary Org.: Alassane Ouattara University (ID: 50344)
Department: Biology and Geology
Unit / Laboratory: Plants and Earth Sciences
Position: Director

Location(s): CIV
Research Area(s): Forestry and arboriculture

Career Level: lateCareer
Highest Academic Level: Doctoral or equivalent level
Year Academic Level Obtained: 1998

Areas of Knowledge: African tropical flora; Forestry; Assessment

Partner Details: With a high knowledge of the flora of Sierra Leonean, Liberian and Ivorian forests assessment since 1998. Implementations of ECOSYN and BIOTA projects involving Belgian, German and Dutch Universities since 1997. Lead of 14 teams for the first national forest flora inventory in Côte d'Ivoire from 2019 to 2021. Author of two scientific books and many book chapters on West African flora. Mentor of four PhD doctorate and more than 20 Master. High experience of scientific teams' management and flora assessment tools and skills.

Publications: (1) Kouamé, F.N., Kouakou,G., Bah-Kouamé, C.& Kouassi, F.L.(2021) 'Structure et diversité floristique en forêt dense de la Côte d'Ivoire', Afrique Science, 18(6): 159-176. (2) Kouamé, F.N., Adama B., CBah-Kouamé, C.,Gnésio Téré, H.& Dougouné, B.G. (2021) 'Composition floristique des forêts denses en Côte d'Ivoire', Afrique Science, 19(4): 147-158. (3) Kouamé, F.N., Marina L.A.K.(2021) 'The effects of anthropogenic activities on the regeneration of flora in Duekoué and Scio forests in Southwestern Côte d'Ivoire', International Journal of Biodiversity and Conservation, 13(1): 22-34. (4) Kouamé, F.N., Massa R.B.& Dibié T.E.(2020) 'Distribution and ecological drivers of family Celastraceae in Côte d'Ivoire', African Journal of Plant Science, 14(8): 325-337. (5) Kouamé, F.N., Bongers,F., Poorter,L.& Traoré, D. (2004) 'Climbers and logging in the Forêt Classée du Haut-Sassandra, Côte d'Ivoire', Forest Ecology and Management, 194: 259-268.

Societal Partner / Stakeholder Representative: KOUASSI, Loukou Firmin (ID: 51013)

Family Name: KOUASSI
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Title(s): Senior Engineer

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Funding Type: Subaward
Funding Source: Fund for Science, Technology, and Innovation (FONSTI - Côte d'Ivoire)

Operating Capacity: Societal Partner / Stakeholder Representative
Role in the Project: Working on GIS studies and implementations.

Primary Org.: Ivorian Society of Production, Studies and Consulting (Société Ivoirienne de Réalisation, d'Etudes et Conseil) (ID: 51008)
Department: SIREC
Unit / Laboratory:
Position:

Location(s): CIV
Research Area(s): Forestry technology

Career Level: lateCareer
Highest Academic Level: Masters or equivalent level
Year Academic Level Obtained: 1994

Areas of Knowledge: Forestry assessment process; Cashew orchards reforestation; administrative socio-economic implementation

Partner Details: Identification and mapping of potential plots for reforestation following the identified species and their characterization in cashew orchards; inventory of fauna, flora, invasive plants, non-wood forest products and forest stands of the N'Zi Riverlodge domain; forestry assistance to for the first national forest flora inventory in Côte d'Ivoire from 2019 to 2021.

Publications: François N'Guessan Kouamé, Gilbert Kouakou, Chantal Bah-Kouamé, Firmin Loukou Kouassi (2021) 'Structure et diversité floristique en forêt dense de la Côte d'Ivoire', Afrique Science, 18(6): 159-176.

Social Scientist / Humanist: KRA, Gérard Landry Konan (ID: 50350)

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Title(s): Doctor

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Funding Type: Subaward
Funding Source: Fund for Science, Technology, and Innovation (FONSTI - Côte d'Ivoire)

Operating Capacity: Social Scientist / Humanist
Role in the Project: Being co-investigator and team member of the project.

Primary Org.: Development Research Center (Centre De Recherche Pour Le Developpement) (ID: 50346)
Department: SOCIOLOGY
Unit / Laboratory: Laboratoire Population, Genre et Développement
Position:

Location(s): CIV
Research Area(s): Social policy

Career Level: earlyCareer
Highest Academic Level: Doctoral or equivalent level
Year Academic Level Obtained: 2016

Areas of Knowledge: Participatory diagnosis ; Education ; gender

Partner Details:	Dr KRA Gérard Landry Konan holds participated in numerous research projects in rural areas and in the field of education and child labour, either as co-investigator or principal investigator. These include the study of the working conditions of domestic workers in Côte d'Ivoire, commissioned by the International Labour Office of Côte d'Ivoire, and the study on the empowerment of women and young people in the agricultural sector in Bouaké and Gagnoa, study carried out in collaboration with the CNRA and Africa Rice, the baseline study on Save The Children's 'Child Protection In Cocoa plantations in the Soubré department 2017-2020' project and the study on children's participation in Nestlé's cocoa supply chain carried out by ICI with TRUST International. He was principal consultant for CIREF International on the 'Baseline Assessment of the Cocoa Sustainability Initiative III (CSI III) Project' and associate researcher in studies such as the analysis of the situation of 150 schools as part of UNICEF's 'Child-Friendly School' (CFS) project, UNICEF's 'Pupil well-being and safety in Côte d'Ivoire schools', and AFD's 'Experiencing inequalities in Côte d'Ivoire'.
Publications:	(1) KOFFI, N. & KRA, G.L. (2024) 'Pédagogie numérique dans les universités publiques ivoiriennes en contexte de crise sanitaire : bilan de la mise en œuvre à l'Université Alassane Ouattara-Bouaké', EFUA-Editions, pp. 228-259. (2) KRA, G.L. & KOFFI, N. (2024) 'COVID 19 et instauration des cours en ligne à l'université Alassane Ouattara : de l'innovation aux difficultés', Actes des colloques n°2 « Crises sécuritaires en Afrique : Diagnostics, défis et stratégies pour des solutions durables », PASRES Colloque FONSTI et PASRES 28 novembre à 1er décembre 2023 à Korhogo. (3) Gbougnon, M., KRA, G.L. & Niamkey, J.L. (2024) 'modèle de socialisation scolaire et normes locales d'apprentissage dans trois villages à économie cacaoyères', in Denis Pryen '(sous dir), Dynamique de la protection sociales de l'enfance au Cameroun et en Afrique, L'Harmattan, Paris, pp. 351-363. (4) KOUASSI, K.E., KRA, G.L. & MAZOU, G.H. (2023) 'Analyse sociologique des formes d'expression syndicale à l'Université Alassane Ouattara (UAO)', Revue sociologie et de sciences sociales 1, N°12, pp. 71-85.

Natural Scientist: LIU, Haifei (ID: 50329)

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Funding Type:	Subaward
Funding Source:	National Natural Science Foundation of China (NSFC)
Operating Capacity:	Natural Scientist
Role in the Project:	Undertake the ecological modelling of forest and river ecosystem, aiming to provide scientific evidences of deforestation and support relative policy making.
Primary Org.:	Beijing Normal University (ID: 50323)
Department:	School of Environment
Unit / Laboratory:	State Key Laboratory of Environmental Simulation and Pollution Control
Position:	Professor
Location(s):	CHN
Research Area(s):	[Ecology, Hydrography, Environmental sciences]
Career Level:	midCareer
Highest Academic Level:	Doctoral or equivalent level
Year Academic Level Obtained:	2009
Areas of Knowledge:	Environmental Simulation; ecological modelling; habitat suitability study
Partner Details:	Prof. Haifei Liu, obtained his doctorate degree from the School of Engineering, the University of Liverpool in the UK. He has presided over or participated in more than ten national-level scientific research projects, including the National Natural Science Foundation of China, the National Key Basic Research and Development Program, the National Science and Technology Support Program, and the National Key Research and Development Program, etc. He has published more than 60 related papers in well-known journals and has published 3 monographs and textbooks. He also serves as an editorial board member of several international academic journals, chairman of the organizing committee of the 1st International Symposium on Water Simulation (iSymWater), a senior member of the Chinese Hydraulic Engineering Society and the Chinese Society for Environmental Sciences, and a member of the International Association for Hydraulic Research (IAHR), and the Chartered Institution of Water and Environmental Management (CIWEM) in the UK.

Publications: (1) Ru, Z., Liu, H., Tu, G. and Huang, W. (2023) 'Water-balanced inlet and outlet boundary conditions of the lattice Boltzmann method for shallow water equations', Computers & Fluids, 256: 105860. (2) Xing, L., Bolster, D., Liu, H., Sherman, T., Richter, D., Rochal Brownell, K. and Ru, Z. (2022) 'Markovian Models for Microplastic Transport in Open Channel Flows', Water Resources Research, 58(8): e2021WR031746. (3) Ding, Y. and Liu, H. (2022) 'Lattice Boltzmann simulation of channel flow with unsteady lateral overland inflow', River Research and Applications, 38: 917-925. (4) Ding, Y., Liu, H., Yu, D., Song, J. and Duan, G. (2022) 'The migration of viscous fish eggs in artificial reefs', Ecologcial Modelling, 469: 109985. (5) Wang, H. and Liu, H. (2020) 'A mesoscopic coupling scheme for solute transport in surface water using the lattice Boltzmann method', Journal of Hydrology, 588: 125062.

Social Scientist / Humanist: LIU, Yimeng (ID: 50343)

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Funding Type: Subaward
Funding Source: National Natural Science Foundation of China (NSFC)

Operating Capacity: Social Scientist / Humanist
Role in the Project: Focusing on the formulation and implementation of the sustainable economic - social development field survey plan, which encompasses the engagement of the societal parties/stakeholders, the evaluation on the benefits of the proposed activity to indigenous peoples and local communities in terms of economic perspective and policy development, and the recommendations relevant to public policy and local institutions.

Primary Org.: Beijing Normal University (ID: 50323)
Department: Business School
Unit / Laboratory: BNU-GATE Experimental Economics Laboratory
Position:

Location(s): CHN
Research Area(s): [Economics, Sustainability Science]

Career Level: midCareer
Highest Academic Level: Doctoral or equivalent level
Year Academic Level Obtained: 2011

Areas of Knowledge: Green economy and sustainable development; Economics of innovation and development; Applied econometric methodology

Partner Details: With a high knowledge of green economy and inclusive sustainable development since 2011. High experience of assessment tools and skills on green development, inclusiveness and economic-social welfare, represented by a series joint research e.g. annual measurements of China Green Development Index (2010-2016) and Human Green Development Index (2014, 2018). Joined in GGKP(Green Growth Knowledge Platform) Research Committee on Metrics and Indicators from 2014 and carried on multiple research projects such as Measuring Economic Opportunities with Policy Linkages: Employment, Innovation, Trade and Investment, which were submitted to GGKP council members including OECD, UNEP, UNIDO, etc.

Publications: (1) Yin, X., Yang, L., Gao, T. Liu YM (2024) 'Non-inferior solutions for virtual water strategies: Model development and a case study in northern China', Journal of Hydrology, 634. (2) Anish, S., S., Pei-Chun, H., Chris, C.et al. (2024) 'Nitrification Inhibitor Chlorate and Nitrogen Substrates Differentially Affect Comammox Nitrospira in a Grassland Soil', Frontiers in Microbiology, 15. (3) Liu Y.M. Exploring a new model of green ecological agriculture, China Reform, Jan. 2021. (4) Qin, D., Huellen, S.V., Elshafie, R. Liu YM (2020) 'New Model Framework for a Principled Assessment of Selection Bias: Case Study on Labour Supply', SSRN Electronic Journal. Measurement of Human Green Development Index, Social Sciences in China, 2014(6).

Natural Scientist: MAARIF, Faqih (ID: 50336)

Family Name: MAARIF
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Funding Type: Subaward
Funding Source: National Research and Innovation Agency from Indonesia (BRIN)

Operating Capacity: Natural Scientist
Role in the Project: Working on civil and environmental engineering.

Primary Org.: Yogyakarta State University (ID: 50333)
Department: Civil Engineering
Unit / Laboratory: Material Engineering, Structural Engineering
Position: Lecturer/Researcher

Location(s): IDN
Research Area(s): [Emergency and disaster management, Sustainability Science]

Career Level: midCareer
Highest Academic Level: Doctoral or equivalent level
Year Academic Level Obtained: 2021

Areas of Knowledge: Structural Engineering; Environment; Disaster

Partner Details: None

Publications: (1) Thermal conductivity and compressive strength of lightweight mortar utilizing pumice breccia as fine aggregate; (2) A review of institutional response and Covid-19 pandemic risk communication in regional autonomy system in Indonesia; (3) A review of the discrete element method application on concrete materials; (4) Prediction of Lighweight Concrete Panel Homogeneity by Ultrasonic Pulse Velocity (UPV); (5) Scheduling design of Jakarta-Cikampek II elevated toll road project (P. 186–P. 187); (6) Correlation of ultrasonic pulse velocity with porosity and compressive strength of mortar with limestone for building quality assessment; (7) The new analysis of discrete element method using ARM processor; (8) The modelling of compressive strength of concrete on discrete element method; (9) Investigation of concrete quality using Discrete Element Method (DEM); (10) Non-Linear Behavior of Reinforced Concrete Frame Structure with Vertical Irregularities; (11) Use of Ground Calcium Carbonate for Self-compacting Concrete Development based on Various Water Content and Binder Compositions; (12) Experiment Study of Ultrasonic Pulse Velocity Test of R/C Column Under Axial Load Variation.

Natural Scientist: SASAERILA, Hidayat Yorianta (ID: 50340)

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Title(s): Ph.D

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Funding Type: Subaward
Funding Source: National Research and Innovation Agency from Indonesia (BRIN)

Operating Capacity: Natural Scientist
Role in the Project: Working on biology.

Primary Org.: Al Azhar University of Indonesia (ID: 50342)
Department: Biology
Unit / Laboratory:
Position: Dean Faculty of Science and Technology

Location(s): IDN
Research Area(s): [Forestry and arboriculture, Economics, Sustainability Science]

Career Level:	midCareer
Highest Academic Level:	Doctoral or equivalent level
Year Academic Level Obtained:	2003
Areas of Knowledge:	Agroforestry; Forest Ecophysiology; Entomology
Partner Details:	Dean Faculty of Science and Technology, since 2018 to present; Lecture Exchange – Erasmus program to University of Benevento, Italy 2018; Special staff for the Indonesian National Innovation Committee (2010-2015).
Publications:	(1) Sasaerila, H. Y., Effendi, Y., Wijihastuti, R. S., Pambudi, A., & Nicola, F. D. (2024) 'Studies on the short- and long-term effects of Rubber-Canna agroforestry through soil analysis and a metagenomic approach', Biosaintifika: Journal of Biology & Biology Education, 16(1): 73-88. (2) Noriko, N., Sasaerila, H. Y., & Anisah, S. (2024) 'Morphology characteristic and tuber content of yard cultivated Canna indica (ganyong) in Cibinong, West Java, Indonesia', Biodiversitas, 25(6): 2586-2593. (3) Sasmita, H. I., Ernawan, B. et al. (2024) 'Rhodamine-B for the mark, release, and recapture experiments in gamma-irradiated male Aedes aegypti (Diptera: Culicidae): Persistence, dispersal, and its effect on survival', Veterinary World, 17(8) : 1872-1879. (4) Ilmi, A. R., Luthfi, M., Elfidasari, D., Sasaerila, H. Y., & Prawiradilaga, D. M. (2023) 'First report on daily activity and feeding behavior of Javan hawk-eagle (Nisaetus bartelsi) in the protected forest of Kondang Merak Beach, Malang, Indonesia', Biodiversitas, 24(12): 6770-6779. (5) Sasaerila, H. Y., Sakinah, S., et al. (2021) 'Effects of Light Environments on Leaf Traits and Phenotypic Plasticity of Canna indica', Journal of Biology & Biology Education, 13(2): 169-177.

Natural Scientist: SUBA, Rachmat Budiwijaya (ID: 50337)

Family Name:	SUBA
First Name(s):	Rachmat Budiwijaya
Title(s):	S.Hut., M.Sc., Dr.
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Funding Type:	Subaward
Funding Source:	National Research and Innovation Agency from Indonesia (BRIN)
Operating Capacity:	Natural Scientist
Role in the Project:	Working on ecology and biodiversity
Primary Org.:	Mulawarman University (ID: 50374)
Department:	Forestry
Unit / Laboratory:	Laboratory of Ecology and Conservation of Tropical Forest Biodiversity
Position:	
Location(s):	IDN
Research Area(s):	[Ecology, Climatology]
Career Level:	lateCareer
Highest Academic Level:	Doctoral or equivalent level
Year Academic Level Obtained:	2017
Areas of Knowledge:	Biodiversity; Conservation Biology; Landscape Ecology
Partner Details:	National Research and Innovation Agency, Tropical Forest Conservation Act), GIZ-ProPeat, Kitadin Co. Ltd., Yayasan Konservasi Alam Nusantara, Research and Development Agency, District of Kutai Kartanegara, Ministry of Environment and Forestry-United Nations Development Programme/UNDP, Kitadin Site Tandung Mayang Co. Ltd., Regional Development Planning Agency of East Kalimantan Province), Jembayan Muara Bara Co. Ltd., WWF-Indonesia Kalimantan Programme), Berau Coal Co. Ltd., Kelian Equatorial Mining Co. Ltd., Sumitomo Forestry Co. Ltd. Japan, Kaltim Prima Coal Co. Ltd., Environmental Agency of Samarinda City, Environmental Agency of Kutai Kartanegara District)

Publications: (1) Oktaviani, E., Rayadin, Y., Boer, C., Matius, P., Purwanti, E., & Suba, R.B. (2024) 'Study of the potential deer breeding (Rusa timorensis and Axis axis) tourism at West Java', AIP Conf. Proc., 3095: 020014. (2) Harsono, R., Suba, R.B., Kustiawan, K., Aipassa, M.I., Sukartiningsih, & Rayadin, R. (2024) 'Keanekaragaman vegetasi pada beberapa umur revegetasi di lahan reklamasi pascatambang batubara PT Indominco Mandiri, Kalimantan Timur', Jurnal Ilmu Lingkungan, 22(3): 589-599. (3) Nuryani, A., Suhardiman, A., Boer, C., Suba, R.B., Sulistioadi, Y.B., & Rayadin, Y. (2024) 'Studi penggunaan Maximum Entropy untuk pemodelan kesesuaian habitat Bekantan (Nasalis larvatus Wurmb, 1787) di kawasan Cagar Alam Teluk Adang', Jurnal Ilmu Lingkungan, 22(5): 1174-1183. (4) Diana, R., Sutedjo, Syilvianti, I., Suba, R.B., & Syoim, M. (2023) 'Stok karbon tumbuhan bawah dan iklim mikro ruang terbuka hijau', MAKILA: Jurnal Penelitian Kehutanan, 17(2): 82-92.

Societal Partner / Stakeholder Representative: SUPRAYOGI, Bambang (ID: 50799)

Family Name:	SUPRAYOGI
First Name(s):	Bambang
Title(s):	CEO
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Funding Type:	Subaward
Funding Source:	National Research and Innovation Agency from Indonesia (BRIN)
Operating Capacity:	Societal Partner / Stakeholder Representative
Role in the Project:	Working on the forest conservation and carbon market.
Primary Org.:	Sumatran Elephant Foundation (Yayasan Gajah Sumatera) (ID: 50796)
Department:	Head office
Unit / Laboratory:	
Position:	CEO
Location(s):	IDN
Research Area(s):	Forestry and arboriculture
Career Level:	midCareer
Highest Academic Level:	Doctoral or equivalent level
Year Academic Level Obtained:	2009
Areas of Knowledge:	Forestry; ecosystem resilience; habitat conservation
Partner Details:	As the founder/CEO of the YAGASU, he has built partnering networks with global scientists, government, and other local stakeholders on the field programs that are designed to tackle the local problem-solution issues in surrounding project areas and improve the health and welfare of local socio-cultural-economic growth.
Publications:	None

Social Scientist / Humanist: TARYONO, Siswantoyo Margo (ID: 50334)

Family Name:	TARYONO
First Name(s):	Siswantoyo Margo
Title(s):	Prof. Dr.
ORCID:	0000-0001-7846-7717
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Phone:	081553242442
Funding Type:	Award
Funding Source:	National Research and Innovation Agency from Indonesia (BRIN)
Operating Capacity:	Social Scientist / Humanist

Role in the Project:	Plan and organize projects by setting clear objectives, timelines, and budgets; Guide the team, ensure each member understands their role, and maintain open communication with stakeholders to provide updates and address issues; Keep the project on track and work toward its successful completion by identifying risks early and ensuring quality standards are met.
Primary Org.:	Yogyakarta State University (ID: 50333)
Department:	
Unit / Laboratory:	
Position:	Director of graduate school
Location(s):	IDN
Research Area(s):	[Economics, Socio-economics]
Career Level:	lateCareer
Highest Academic Level:	Doctoral or equivalent level
Year Academic Level Obtained:	2007
Areas of Knowledge:	Health; welfare; Science
Partner Details:	He was the former president of Yogyakarta State University and he is the current dean of the Graduate School.
Publications:	None

Natural Scientist: YAO, Kouassi Patrick (ID: 50519)

Family Name:	YAO
First Name(s):	Kouassi Patrick
Title(s):	Professor
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Phone:	ykpatrick@yahoo.fr
Funding Type:	Subaward
Funding Source:	Fund for Science, Technology, and Innovation (FONSTI - Côte d'Ivoire)
Operating Capacity:	Natural Scientist
Role in the Project:	Being co-investigator, responsible for all scientific work related to wildlife; Intend to directly intervene in the disciplines of entomology and the ecology of organisms in a forest; Supervise the research work of assistants in the disciplines of hydrobiology, ornithology and mammalogy.
Primary Org.:	Alassane Ouattara University (ID: 50344)
Department:	Animal Biology and Ecology
Unit / Laboratory:	Laboratory of animal biological sciences
Position:	
Location(s):	CIV
Research Area(s):	[Environmental biology, Ecology]
Career Level:	midCareer
Highest Academic Level:	Doctoral or equivalent level
Year Academic Level Obtained:	2007
Areas of Knowledge:	Entomology; parasitology; ecology
Partner Details:	He has been in higher education since 2007, and during his career as a teacher-researcher, he has supervised 7 Master's projects and 2 doctoral thesis works. His work is focused on arthropods responsible for diseases or damage in plants and animals. He was the main coordinator of an international research project (2014-2016) (PRT at CIRDES in Bobo Dioulasso/Burkina Faso) and co-investigator of a national (PAES project) with West African funding (2015-2017). He also participated in projects as a Data manager in the field of parasitology and human health.

Publications: (1) Aké-Bogni, G. R., Yao, K. P., Coulibaly, N. D., Achi, Y. L., Dosso, M. et al. (2023) 'Detection and distribution of Anaplasma marginale, Babesia bovis, and Theileria annulata in Côte d'Ivoire', J. Parasitol. Vector Biol., 15(1): 1-11. (2) Fofana, D., Yao, K. P., Ouattara, K. & Koné, S. (2023) 'Diagnosis of Cimicidae, ectoparasites linked to human habitat in Côte d'Ivoire', J. Parasitol. Vector Biol., 15(1): 21-25. (3) N'guessan Diobo, F., Kouamé Diaha, A. C. A., Sylla, Y., Bogni, G. R., Adjogoua, V. E., Faye, H. K., Dosso, M., & Yao, P. K. (2023) 'Molecular Diagnosis of Rickettsia aeschlimannii in Febrile Patients in Côte d'Ivoire', American Journal of BioScience, 11(6): 137-141. (3) Aké-Bogni, G. R., Yao, K. P. et al. (2022) 'Distribution of cattle tick-borne haemoparasites in 54 Departments of Côte d'Ivoire after the invasion of Rhipicephalus microplus', Journal international des biosciences (IJB), 20(1): 123-132. (4) DIOBO, F. N., YAO, P. K., KOUAMÉ DIAHA, A. C. A., ADJOGOUA, V. E., & FAYE, H. K. (2022) 'Detection of Rickettsia africae in ticks and cattle in Côte d'Ivoire by real-time PCR', Journal of Applied Biosciences, 166: 17242-17251.

Social Scientist / Humanist: YU, Jialin (ID: 50330)

Family Name: YU
First Name(s): Jialin
Title(s): Assistant researcher

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Phone: 18610572166

Funding Type: Subaward
Funding Source: National Natural Science Foundation of China (NSFC)

Operating Capacity: Social Scientist / Humanist
Role in the Project: project management

Primary Org.: Rural Development Institute, Chinese Academy of Social Sciences (ID: 50324)
Department:
Unit / Laboratory:
Position:

Location(s): CHN
Research Area(s): Socio-economics

Career Level: earlyCareer
Highest Academic Level: Doctoral or equivalent level
Year Academic Level Obtained: 2019

Areas of Knowledge: rural economic; social economic; rural development

Partner Details: He currently leads two vertical projects: one on risk assessment and governance of China's village-level debt (2025QNZX022) and another on rural collective operation risks (ZKJC240821).His academic outputs include sole first-author papers in Journal of Financial Research, Finance Research Letters, and Research on Financial and Economic Issues, a co-authored paper in China Soft Science, and a paper in Journal of Labor Research as co-first author and sole corresponding author.

Publications: (1) Da Gong; Andong Yan; Jialin Yu. The Costs of Zero-Covid: Effects of Anti-contagious Policy on Labor Market Outcomes in China. Journal of Labor Research, 2024; (2) Yu Jialin; Liu Ruiming. The Relaxation of Credit Supervision, Financing Leverage and Local Government Debt: An Investigation Based on Prefecture-Level City Panel Data. Journal of Financial Research, 2024, (5): 39-57(In Chinese); (3) Zheng Shilin; Yu Jialin. Project System Governance Model and China's Agricultural Development: A Case Study of the National Agricultural Comprehensive Development Project. China Soft Science, 2022, (11): 37-46(In Chinese); (4) Yu Jialin; Yang Mengjun; Fu Mingwei. Why Has China's Labor Force Participation Rate Declined? ——From the Perspective of Wealth Effect. Finance Research, 2022, (6): 94-108(In Chinese); (5) Yu Jialin; Tao Ran. "Replacing Business Tax with Value-Added Tax", Demand Shocks and Land Leasing. Research on Financial and Economic Issues, 2022, (5): 99-108(In Chinese)

Social Scientist / Humanist: YU, Yuanhe (ID: 50331)

Family Name: YU
First Name(s): Yuanhe
Title(s): Assistant researcher

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Phone: 13146486688

Funding Type:	Subaward
Funding Source:	National Natural Science Foundation of China (NSFC)
Operating Capacity:	Social Scientist / Humanist
Role in the Project:	project management
Primary Org.:	Rural Development Institute, Chinese Academy of Social Sciences (ID: 50324)
Department:	
Unit / Laboratory:	
Position:	
Location(s):	CHN
Research Area(s):	[Socio-economics, Social policy, Development studies]
Career Level:	earlyCareer
Highest Academic Level:	Doctoral or equivalent level
Year Academic Level Obtained:	2019
Areas of Knowledge:	resource and development; geography; rural development
Partner Details:	He is an assistant researcher at the Institute of Rural Development, Chinese Academy of Social Sciences, starting from September 2023.He leads two key projects: a provincial-level project (2025QNZX001) on poverty alleviation in ecologically fragile rural areas and a National Social Science Fund Youth Project (24CGL090) on policy evaluation for such areas. He also participates in international and major national projects, including a UNDP-GEF project on national park innovation.As the sole first author, he has published papers in journals like Sustainable Development, China Environmental Science, and Journal of Shandong University of Finance and Economics, focusing on natural reserve impacts, rural income, and ecological conservation.
Publications:	(1) Yuanhe Yu; Junwei Li; Zijun Li. The impact of an urban tourism boom on farmers' income in neighboring rural communities: Evidence from the Lijiang Ancient City, China. Sustainable Development, 2024, 9(11): 110-128; (2) Yu Yuanhe; Wu Jian; Yu Fawen. The Impact of Nature Reserves on the Income Gap among Farmers: A Case Study of Lashihai, Yunnan. Journal of Shandong University of Finance and Economics, 2025, 37(4): 85-100(In Chinese); (3) Yu Yuanhe; Yang Zihan. Review of Research on Protection and Development of Nature Reserves. China Land and Resources Economics, 2024, 37(10): 18-27(In Chinese); (4) Yu Yuanhe; Wu Jian. The Income-Increasing Effect of Returning Farmland to Wetland on Farmers in the Lashihai Watershed, Yunnan. China Environmental Science, 2022, 42(2): 982-992(In Chinese); (5) Wu Jian; Yu Yuanhe; Gong Yazhen; Zhou Jingbo; Wang Xiaoxia. Wetland Protection, Ecotourism and Farmers' Income Increase: A Case Study of Lashihai Wetland in Yunnan. Acta Ecologica Sinica, 2023, 43(7): 2663-2675(In Chinese)

Budget for Project

Total Time Requested for Proposal: 108.0 Mo.
Total Requested Funding for Proposal: 452.0 K€
Total External Funding for Proposal: 0.0 K€

Partners Funding Requests:

Funding Agency	Funding Request
National Natural Science Foundation of China (NSFC)	240.0
National Research and Innovation Agency from Indonesia (BRIN)	181.0
Fund for Science, Technology, and Innovation (FONSTI - Côte d'Ivoire)	31.0

Budget - KOUAME, N'Guessan François, Fund for Science, Technology, and Innovation (FONSTI - Côte d'Ivoire)

Category	Year 1	Year 2	Year 3	Year 4	Total
Time dedicated to this project (# months)	12	12	12	0	36 Mo
Salaries	4	3	3	0	10 K€
Travel	3	3	3	0	9 K€
Overheads	1	1	1	0	3 K€
Consumables	2	2	2	0	6 K€
Facilities and equipment	0	0	0	0	0 K€
Other (including sub-contract)	1	1	1	0	3 K€
Total requested funding	**11**	**10**	**10**	**0**	**31 K€**
External funding / support	0	0	0	0	0 K€

Budget - TARYONO, Siswantoyo Margo, National Research and Innovation Agency from Indonesia (BRIN)

Category	Year 1	Year 2	Year 3	Year 4	Total
Time dedicated to this project (# months)	12	12	12	0	36 Mo
Salaries	15	15	15	0	45 K€
Travel	15	15	15	0	45 K€
Overheads	1	1	1	0	3 K€
Consumables	16	16	16	0	48 K€
Facilities and equipment	0	0	0	0	0 K€
Other (including sub-contract)	13	13	14	0	40 K€
Total requested funding	**60**	**60**	**61**	**0**	**181 K€**
External funding / support	0	0	0	0	0 K€

Budget - YIN, Xinan, National Natural Science Foundation of China (NSFC)

Category	Year 1	Year 2	Year 3	Year 4	Total
Time dedicated to this project (# months)	12	12	12	0	36 Mo
Salaries	15	15	15	0	45 K€
Travel	27	27	27	0	81 K€
Overheads	1	1	1	0	3 K€
Consumables	26	26	26	0	78 K€
Facilities and equipment	4	4	4	0	12 K€
Other (including sub-contract)	7	7	7	0	21 K€
Total requested funding	**80**	**80**	**80**	**0**	**240 K€**
External funding / support	0	0	0	0	0 K€

Data Management

Expected Outputs:

In this research project, the following types of datasets and open-source models and codes with long-term value can be produced. 1. Datasets Produced by the Project (Original Datasets with Long-Term Value): (1) Ecological Baseline Datasets of Tropical Forest-River Ecosystems. The following ecological baseline datasets produced by this project can serve as a baseline for tracking ecological changes in tropical forest-river systems under climate change and human activities, supporting long-term ecosystem health assessments. They can also enable cross-regional comparisons with other tropical ecosystems, facilitating meta-analyses of global ecological trends. ①Forest structure parameters (tree species, density, biomass, canopy cover, etc.), collected via field surveys, drone LiDAR, or satellite remote sensing. ②River hydrological and water quality data (flow rate, water temperature, nutrient content, pollutant indices, etc.), including long-term monitoring records. ③Biodiversity data (species distribution, population dynamics, endangered species habitat maps, etc.), obtained through camera traps, or ecological modeling. ④Soil physicochemical properties (organic carbon content, nutrient profiles, erosion risk indices, etc.), measured via field sampling and laboratory analysis. (2) Socio-Economic and Stakeholder Datasets. The following socio-economic and stakeholder datasets produced by this project can help understand the socioeconomic drivers of ecosystem service demand, supporting the formulation of sustainable protection policies. They can also provide a historical reference for evaluating the social impact of conservation measures (e.g., changes in community livelihoods post-intervention). ①Local community livelihood data (dependence on forest/river resources, income sources, traditional ecological knowledge). ②Policy and governance data (national protection regulations, transnational cooperation agreements, land use policies). ③Stakeholder survey data (attitudes toward conservation, willingness to participate in protection projects, conflict-resolution cases). (3) Ecosystem Service Valuation Datasets. The following ecosystem service valuation datasets produced by this project can serve as a standard dataset for quantifying the economic value of tropical ecosystem services, supporting policy advocacy and international funding applications. They can also enable dynamic modeling of service value changes under different climate/land use scenarios (e.g., deforestation vs. reforestation impacts). ①Carbon sequestration and storage data (forest carbon stock changes, riverine carbon transport fluxes), calculated via process-based models (e.g., InVEST, ARCGIS). ②Water regulation services data (flood control capacity, water supply reliability, water quality purification efficiency). ③Biodiversity protection and cultural service data (recreational value, scientific research value, indigenous knowledge documentation). (4) Transnational Spatial-Temporal Big Data Integrations. The following transnational spatial-temporal big data integrations datasets produced by this project can support transnational ecological governance by providing unified spatial data frameworks for cross-border ecosystem management. They can also facilitate long-term climate-ecosystem interaction research (e.g., predicting forest-river responses to extreme weather events) ①Merged remote sensing imagery (e.g., Landsat, Sentinel, MODIS) for tracking forest-river landscape changes across national borders. ②Gridded climate data (precipitation, temperature, CO_2 concentration) integrated with ecological models. ③Cross-border hydrological simulation data (river basin water balance, pollutant diffusion trajectories). 2. Open-Source Models and Codes (Adapted for Project Needs): (1) Open-source models adapted for tropical river-forest complex ecosystems. The following models adapted for tropical river-forest complex ecosystems produced by this project can provide reusable modeling frameworks for other tropical ecosystem projects, reducing technical barriers to research. These models can also enable iterative improvement: the models can be updated with new data by subsequent studies, forming the basis for a "living" scientific tool. ①Customized ecosystem service assessment models (e.g., modified InVEST models for tropical river-forest interactions). ②Machine learning algorithms for predicting forest degradation risks (trained on project-collected data). ③Web-based decision support tools for transnational conservation planning (incorporating spatial analysis and cost-benefit models). (2) Open-source codes adapted for tropical river-forest complex ecosystems. The following codes produced by this project can ensure data reproducibility and interoperability, allowing other researchers to replicate or extend the project's methods. These codes can also serve as educational resources for training future scientists in tropical ecosystem data management. ①Data processing pipelines (e.g., scripts for remote sensing image preprocessing, field data quality control). ②Open-source code for ecosystem service valuation (e.g., Python/R packages with documented workflows).

Policy Conformance:

To ensure your project's data and digital outputs align with the Belmont Forum Open Data Policy and Principles and the FAIR principles, follow this structured approach, integrating requirements from the Belmont Forum's Data and Digital Outputs Management Annex and FAIR implementation guidelines. 1. Develop a Robust Data Management Plan (DMP): (1) Use the Belmont Forum's Template: Start with the Belmont Forum DMP template to outline: ①Data Types: Specify all data/products (e.g., ecosystem surveys, hydrological models, satellite imagery) and their formats. ②Storage Repositories: Identify FAIR-compliant repositories. ③Metadata Standards: Use community-recognized standards to ensure interoperability. (2) Address Transnational Governance: ①Include agreements with partner countries to harmonize data sharing rules (e.g., data sovereignty clauses). ②Leverage frameworks like the Global Open Science Cloud for cross-border data infrastructure . 2. Implement FAIR Principles: (1) Findability ①Persistent Identifiers: Assign DOIs or UUIDs to all datasets using services. ②Metadata Quality: Ensure metadata includes: Contextual details (study location, methodology); Keywords aligned with global standards; ③References to related datasets (e.g., satellite archives). (2) Accessibility ①Standardized Protocols: Use APIs for machine-readable access. ②Long-Term Preservation: Deposit data in repositories with sustainability guarantees (e.g., Open Science Framework). (3) Interoperability ①Vocabularies: Adopt FAIR-aligned ontologies for consistent data labeling. ②Data Formats: Use open formats and avoid proprietary tools like Excel macros. (4) Reusability ①Licensing: Apply clear licenses (e.g., CC0 for public domain, CC-BY for attribution-required data). ②Provenance Tracking: Document data origins, processing steps, and software versions using tools like DVC or FAIRsharing. ③Domain Compliance: Align with community standards (e.g., NASA's EOSDIS for remote sensing data). 3. Engage Stakeholders and Training: ①Local Communities: Collaborate with Indigenous groups to co-design data governance protocols, ensuring cultural sensitivities are addressed (e.g., avoiding publication of sacred site locations). ②Capacity Building: Use the Belmont Forum's Data Skills Curricula to train team members on FAIR practices and BFgo.org reporting. 4. Monitor Compliance: ①BFgo.org Reporting: Submit quarterly updates on data progress through the BFgo.org system, including: Repository URLs and identifiers; Metadata completeness metrics; Compliance with Open Data Principles (e.g., timeliness of data release). ②Self-Assessment: Use tools like F-UJI to audit FAIR compliance and address gaps (e.g., missing DOIs, non-machine-readable metadata).

Plan Personnel:

Xinan YIN; François Guessan KOUAME; Margo Taryono SISWANTOYO

Output Protection:

To ensure the long-term value of data and digital outputs for the "Transnational Tropical Forest-River Ecosystems" project, implement a structured data management framework that integrates technical, organizational, and policy-driven measures. Below is a comprehensive strategy aligned with FAIR principles and Belmont Forum requirements. 1. Data Storage and Infrastructure During the Project: (1) Hierarchical Data Repository System ①Project-Level Storage (Temporary): Use cloud-based collaboration platforms for team-internal data sharing during fieldwork and analysis. These platforms should support version control and enforce metadata standards (e.g., mandatory inclusion of collection dates, locations, and methods). ②Long-Term Repository (Permanent): Deposit final datasets in FAIR-compliant and domain-specific archives. Use federated repositories to navigate cross-border data sovereignty regulations. (2) Data Backup and Preservation Strategy ①Implement a 3-2-1 backup rule: 3 copies of data (original + 2 backups); 2 different storage media (cloud + on-premises servers); 1 off-site backup (e.g., regional data centers in partner countries). ②Regularly migrate data to enduring formats to avoid obsolescence. 2. Lifecycle Management for Long-Term Value: (1) Data Processing Workflows ①Standardize at collection: Use digital field notebooks to enforce metadata capture, and implement real-time quality control checks. ②Version control for models/code: Host code on GitHub or GitLab, with continuous integration tests to ensure reproducibility. (2) Ongoing Validation and Updating ①Annual data audits: Use tools to assess FAIR compliance, checking for missing DOIs or persistent identifiers and incomplete metadata (e.g., missing resource type or creator information). ②Dynamic metadata updates: Revise metadata as new insights emerge (e.g., updating species classifications with new taxonomic research). (3) Alignment with Belmont Forum Reporting ①BFgo.org integration: Quarterly report on data deposition progress (repository URLs, identifiers), access statistics (number of downloads, user demographics), and compliance with Open Data Principles (e.g., percentage of datasets released on time). ②Publicly share data management updates: publish semi-annual reports on the project website, highlighting lessons learned in cross-border data governance and examples of reusable outputs (e.g., updated models or datasets).

Post-Project Data Management:

To ensure the long-term accessibility of data and digital outputs after the project ends, implement a systematic post-project management framework that integrates technical, organizational, and legal measures. Below is a comprehensive strategy aligned with FAIR principles and transnational data governance requirements. 1. Permanent Repository Selection and Migration: Complete full dataset migration to permanent repositories within 6 months of project closure, with DOIs assigned to all datasets. Convert legacy formats to enduring standards[*not provided*]) Tabular data: CSV or Parquet (over Excel); 2)Spatial data: NetCDF or GeoTIFF (over proprietary GIS formats); 3)Code: Archive with containerization (Docker images) to preserve dependencies. 2. Accessibility and Interoperability Maintenance: Use DOI resolution services to ensure links to data remain active, even if repository URLs change. Implement OAI-PMH protocols for machine-readable metadata harvesting by other systems. Maintain clear licensing (e.g., CC-BY 4.0) and access controls (via ORCID-based authentication) even after project funding ends. 3. Post-Project Data Management Workflow: ①Month 0–6 (Project Closure): Migrate all datasets to permanent repositories; update BFgo.org with final repository URLs. execute MoU with custodian institution; train their staff on data management tools. ②Year 1–5: Annually, perform data integrity checks; update metadata with new citations/usage stats. For every 2 years, review access policies and cross-border agreements for legal changes. ③Year 5+: Decadal format migration; assess whether data should be merged into emerging global initiatives (e.g., a future "Tropical Ecosystem Data Commons").

Restrictions:

NONE

Preservation of Restrictions:

To ensure that data security, privacy, and intellectual property (IP) restrictions are honored in derivative products, the project will implement a comprehensive framework. Below is a structured approach tailored to the transnational tropical forest-river ecosystem context. 1. Legal and Policy Frameworks: (1) Compliance with International and Regional Laws ①Data Source Country Regulations: Adhere to local data protection laws when collecting/processing data involving human communities, indigenous knowledge, or sensitive ecological sites. ②Belmont Forum and FAIR Principles: Embed open data policies (e.g., CC-BY licenses for non-sensitive data) while respecting exceptions for restricted datasets (e.g., through FAIR Data Point annotations). ③IP Agreements: Draft clear contracts with project partners, local communities, and institutions to define ownership of derivative works (e.g., models, algorithms, visualizations), non-disclosure clauses for proprietary data (e.g., corporate forest management data), and terms for using indigenous knowledge (e.g., traditional ecological knowledge, TEK) with explicit consent. (2) Licensing of Derivative Products Mandate clear citation of original data sources and IP holders in all derivative products (e.g., "Data courtesy of [Institution], licensed under [License]"). 2. Technical Measures for Data Security and Privacy: (1) Data Protection During Derivative Product Development ①Sensitive Data Handling: For human-related data (e.g., community survey responses), remove personally identifiable information and use pseudonyms. For endangered species locations or vulnerable communities, aggregate data to coarse grid levels (e.g., 10km²) or use synthetic datasets for modeling. ②Encryption and Access Controls: Encrypt raw data and derivative files at rest and in transit. Implement role-based access control in data repositories, restricting access to derivative product developers based on need-to-know (e.g., only ecologists access species distribution models). (2) Technical Barriers in Derivative Products ①Metadata Tagging: Embed machine-readable metadata in all outputs to indicate data sensitivity levels (e.g., "Public", "Restricted", "Confidential"), and IP restrictions (e.g., "Contains third-party data; commercial use prohibited"). ②Watermarking and Digital Signatures: Apply visible/invisible watermarks to visualizations or reports to deter unauthorized use, and use digital signatures to verify authenticity.

Documentation and Metadata for Reuse:

To support the long-term reuse of data and digital outputs, the project should publicly share comprehensive supporting documentation and metadata that adhere to FAIR (Findable, Accessible, Interoperable, Reusable) principles.

Long-Term Support Costs:

To account for the costs of managing data and digital outputs for long-term accessibility and identify funding sources, implement a structured cost framework and explore diverse financial mechanisms. Below is a approach tailored to the transnational tropical forest ecosystem project. 1. Project-Phase Funding Sources: ①Belmont Forum Grant Allocation: Include a Data Legacy Line Item in the project budget. ②Co-Funding from Partner Institutions: Negotiate with host country universities or research centers to cover storage costs (e.g., in-kind server space). 2. Post-Project Funding Strategies: ①Institutional Commitments: Partner with a Custodian Institution (e.g., national library, research institute) that commits to a part of cost coverage via institutional budgets. ②Private Sector and Philanthropy: Engage with corporations with mandates and foundations for data sustainability grants.

Proposal Elements

Element	File
Executive Summary	application-4921-executiveSummary_1 Executive Summary.pdf
Project Description	application-4921-description_2 PROJECT DESCRIPTION.pdf
Management Plan	application-4921-managementPlan_3 MANAGEMENT PLAN.pdf
Impact, Engagmnt, and Diss. Plan	application-4921-communication_4 IMPACT ENGAGEMENT AND DISSEMINATION PLAN.pdf
External Funding	application-4921-externalFunding_5 External Funding.pdf
Funding Justification	application-4921-fundingJustification_6 FUNDING JUSTIFICATION.pdf
References Cited	application-4921-referencesCited_7 REFERENCES CITED.pdf
Supporting Letters	application-4921-supportingLetters_8 SUPPORTING LETTERS.pdf
Eligibility Annexes	application-4921-eligibilityAnnexes_9 Eligibility Annexes.pdf

PART 1: EXECUTIVE SUMMARY

1 Aim and Innovation

Tropical forests are degrading under the combined influence of global environmental change and human activities. Tropical forests are extensive in area and span several countries. The condition of these forests in neighboring countries markedly affects the health status of other forests. However, due to disparities in the interests and policy priorities of forest protection among countries, it is difficult to forge a united front when formulating transnational forest protection policies and implementing measures.

Within and around tropical forests, dense river networks are often distributed. The ecological processes of the forests and the rivers are intricately intertwined. For example, rivers are water sources for forest ecosystems and serve as vital conduits transporting seeds; forests provide essential nutrients to river ecosystems and affect the hydrological processes of the rivers. Consequently, forests and rivers constitute an interdependent complex ecosystem. Conducting research at the scale of the forest-river complex ecosystem can elucidate the ecological repercussions of forest degradation, fully unleash the ecological resilience of these complex systems, and formulate more scientifically sound ecological restoration measures.

The low income level of stakeholders is one of the key factors driving deforestation and forest degradation. Changes in the profits of stakeholders impinge on ecosystem protection and restoration. As forests and rivers are mutually dependent, when safeguarding and restoring forest ecosystems, precedence is accorded to exploring the internal economic potential of forest-river complex ecosystems while concomitantly augmenting the profits of stakeholders. Carbon sinks, hydropower, fisheries, and other elements yield substantial economic returns in forest-river complex ecosystems. Carbon sink trading enhances the benefits of forest stakeholders and propels the ecological restoration of forests. Tropical regions are endowed with well-developed water systems and are ecologically resilient. The moderate exploitation of hydropower (e.g., small green hydropower) and fisheries and other resources within the tolerable range of river ecosystems augments the income of governments, enterprises, and residents. This income could be channeled into subsidizing forest protection and restoration, thereby further augmenting forest carbon sinks. Enhancing the economic benefits of forests and rivers would enhance the feasibility of forest protection and restoration.

This project is oriented towards protecting and restoring tropical forests and rivers, with a focus on the correlation between forests and rivers and coordinating the measures implemented by different countries. Integrating the ecological service functions of forests and rivers reveals their interactions and benefits on a transnational scale and proposes a method for augmenting the interests of stakeholders. Further, a transnational cooperation mechanism is predicated on the multiple drivers of carbon sinks, hydropower, and fisheries. This project holds significant practical implications and policy guidance value.

Figure 1-1 Q&A for Aim and Innovation

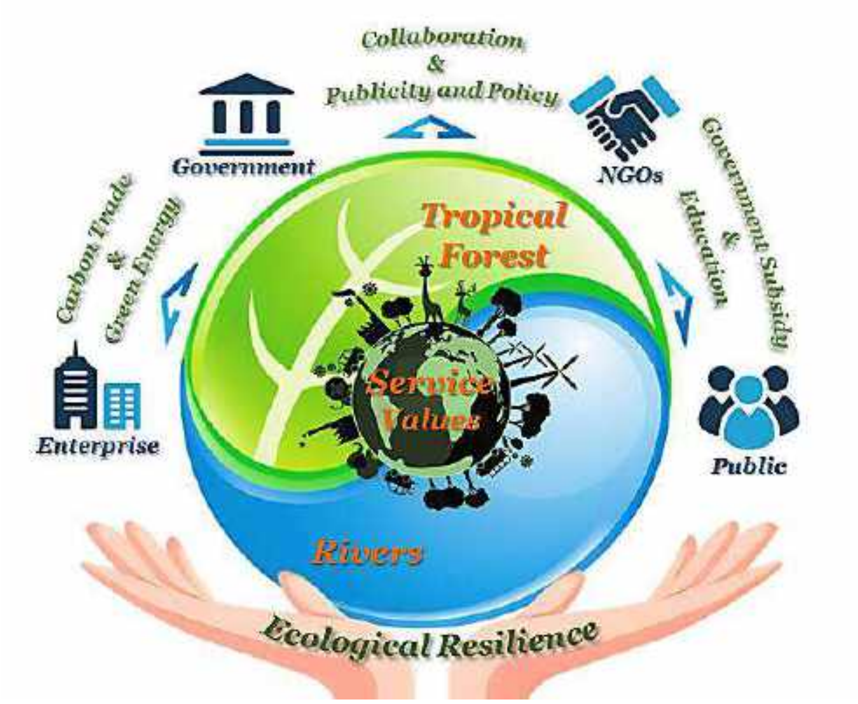

Figure 1-2 Concept Diagram

The specific aims include

(1) Explore the interaction of forest-river coupled system to release the potential of its ecological resilience;

(2) Integrate the ecological service functions of forests and rivers to reveal their benefits on a transnational scale;

(3) Predicate a comprehensive protection mechanism to augment the interests of stakeholders.

2 Research Contents

(1) **Evolution and correlation analysis of forest and river ecological resilience under climate change**

- Examine the spatial-temporal ecological connectivity and material exchanges between tropical forests and rivers under climate change. Define how riparian zones and structural complexity underpin the resilience of the coupled system.

- Analyze biotic adaptations to disturbances and their impact on ecosystem functions under climate change. Model the feedback loops to predict the system's resilience thresholds and tipping points under climate change.
- Construct a comprehensive assessment framework for gauging the resilience of forest-river coupled ecosystems. Evaluate the cumulative impacts of climate change, land-use transformations, and anthropogenic activities on the overall resilience of the coupled ecosystem.

(2) **Service value assessment for transnational tropical forest-river complex ecosystems**

- Establish accounting methodologies for the service value of a transnational tropical forest-river complex ecosystem. Determine the effect of each driving factor on ecosystem structure and function.
- Construct a conceptual model of the driving mechanism underlying ecological service function. Identify the key factors impacting the overall service value of the system.
- Quantify the effects of resource development activities (e.g., small green hydropower) and fisheries on riverine ecosystems. Determine the ecologically appropriate methods for augmenting river economic output.

(3) **Paths to enhance the interests of stakeholders in coupling transnational forest and river economic output**

- Analyze the effects of fluctuations in carbon trading prices on the behavior of stakeholders. Define the scope and magnitude of subsidies for forest protection and restoration.
- Combine the outputs of the forests (e.g., carbon trade) and rivers (e.g., hydropower generation and fisheries). Formulate an economic path for forest protection and restoration.
- Identify the key tasks and objectives for forest protection in each country, and analyze the agreement and potential conflicts. Develop international

cooperation routines (e.g., skills training and international investment) to enhance the economic distribution.

3 Research Team

Countries vary in terms of their economic development level and cultural traits, thus, the goals, requirements, and concerns regarding transnational forest protection and restoration differ. Individuals from different economic levels and cultural backgrounds must be jointly involved to facilitate the multinational protection of forests. Therefore, based on their economic development level and cultural characteristics, participants from three countries/regions will be included in this project. All of the countries/regions have a strong demand for tropical forest protection, including China (with a relatively high-income level and Confucianism-Taoism integrated culture), Indonesia (with a relatively low-income level and Islamic culture), and Cote d'Ivoire (with a relatively poor economic situation and tribal culture-modern civilization integrated culture).

Additionally, the consortium has a multidisciplinary background and expertise, including environmental science, ecology, economics, sociology, hydraulic engineering, and anthropology. Team members, from different types of organizations, such as universities, research institutes, NGOs and companies, can complement each other and conduct multidisciplinary integration in this project, thereby generating innovative scientific approaches.

4 Resources and Management

Each of the three participating countries will sponsor personnel from their country. The National Natural Science Foundation of China will provide 239.74 K€ (2 million CNY), the National Research and Innovation Agency of Indonesia will provide 181.00 K€ (3 billion IDR), and the Fund for Science, Technology, and Innovation of Côte d'Ivoire will provide 31.00 K€.

The consortium functions under the responsibility of the principal investigator. The leaders of the national groups are in charge of devising plans to drive the progress of the tasks within their respective groups.

PART 2: PROJECT DESCRIPTION

1 Background

Tropical forests worldwide are experiencing severe ecological degradation and over-logging. In many tropical forest regions, low income levels among local residents are a key driver of deforestation. The lack of stable economic opportunities and sustainable livelihood options forces many communities to rely on the direct exploitation of forest resources for survival. Activities such as illegal logging, timber sales, and land clearance for short-term agriculture provide immediate income but are typically short-sighted and destructive. These actions lead to large-scale vegetation loss and ecosystem fragmentation. Moreover, poverty limits the capacity of local populations to engage in sustainable development initiatives, as they lack the capital or technology to invest in forest conservation and restoration. This creates a vicious cycle of "poverty – over-exploitation – ecological degradation," further intensifying the threats faced by tropical forests. In many countries and regions, unlocking further economic value from forests remains challenging due not only to the complexity and fragility of these ecosystems, but also to constraints in technology, financing, and governance.

Tropical forests and their surrounding areas are often interlaced with dense river networks. These rivers serve as the lifelines of forest ecosystems, supplying water and habitats for diverse species, while also forming an interdependent forest–river complex. **As forests and rivers are mutually dependent, when safeguarding and restoring forest ecosystems, precedence is accorded to exploring the internal economic potential of forest-river complex ecosystems while concomitantly augmenting the profits of stakeholders.** Through the scientifically informed development of river resources, a virtuous cycle of "development – feedback – protection" can be established, creating a sustainable pathway for forest conservation. For instance, small-scale green hydropower development within ecological thresholds can generate economic benefits that are reinvested in forest protection efforts—such as corridor restoration and biodiversity monitoring. By establishing a "premium mechanism for river ecological products," revenues derived from sustainable uses like fisheries and water supply can be linked to forest conservation, providing local communities with stable income and reducing their reliance on forest resources (e.g., through destructive logging). Furthermore, forests act as green buffers for rivers, and their condition directly influences river health and productivity. **This interdependence can motivate stakeholders to engage actively in forest management, creating a synergistic effect in which "river development funds forest protection, and healthy forests enhance river output," ultimately achieving a win–win outcome for development and conservation.**

Many tropical forests and their surrounding rivers span multiple countries. For instance, the Amazon rainforest and the Amazon River, the Congo Basin forests and the Congo River, etc. Their ecological functions and resource distribution cross national borders, making it difficult for the governance actions of a single country to cover the whole. In this case, if the economic value of forests and rivers is developed only from the perspective of a single country, over-exploitation may occur due to the lack of unified standards, which will eventually backfire on the forest and river ecosystems. However, through international cooperation, it is possible to establish unified ecological protection standards, synergistically develop green economic formats such as shipping, sustainable fishery, and ecotourism under the premise of ensuring ecological carrying capacity. It can also integrate technical, financial and policy resources from multiple countries to jointly combat transnational illegal logging, coordinate forest protection and community livelihood improvement plans, fundamentally reduce forest destruction driven by economic interests, and realize the long-term protection of tropical forest and river ecosystems and the sustainable release of their economic value.

2 Literature review

(1) Ecological resilience of forest and river ecosystems

The ecological resilience of forests/rivers refers to the ability of forest/river ecosystems to maintain their structure, functions, and biodiversity, and to recover to their original state or reach a new stable state after being subjected to natural and anthropogenic disturbances (Yin et al., 2022). Based on the analysis of multi-source `satellite data and random forest regression model, Forzieri explored the patterns and driving factors of global forest resilience changes, indicating that about 23% of primitive forests have reached their critical resilience threshold (Forzieri et al., 2022). The Amazon rainforest is a potential 'critical element' of the Earth system. Bathiany used the dynamic global vegetation model to explore the resilience of the rainforest under different climatic conditions, trying to reveal the physiological and ecological processes that drive the observed changes in resilience (Bathiany et al., 2024). Understanding the ability of forests to adapt to climate change is essential for conservation science. Aguirre-Gutiérrez's study, based on a historical trait-climate relationship model, analyzed how the trait composition of tropical forests in the Americas has shifted in response to climate change in recent decade (Aguirre-Gutiérrez et al., 2025). They found that although the most species-rich forest system on Earth has initiated adaptive adjustment of functional trait composition, its adjustment rate is far from enough to match the rate of climate change (Aguirre-Gutiérrez et al., 2025). Low-resilient forests are more sensitive to anomalies in external drivers and may be more vulnerable to sudden and potentially irreversible changes (Seidl et al., 2014; Seidl et al., 2017). This is particularly important given that continued intensification of disturbance conditions may affect the provision of critical ecosystem services in the near future (Liu et al., 2019; Verbesselt et al., 2016). Forests in most parts of the Americas and Europe are increasingly susceptible to natural disturbances, and tree mortality increases, which provides independent evidence for the continuous decline of forest vegetation (Qin et al., 2021). However, anthropogenic disturbances, such as forest management and land use change, may directly affect tree species, age distribution, coverage density, rooting depth and primary productivity, thus affecting the ability of forest ecosystems to recover from disturbances (Villa et al., 2021; Gauthier et al., 2015). Complete forests have a higher ability to resist external disturbances due to their usually high structural complexity and species richness

(Schmitt et al., 2020; Zemp et al., 2017).

In terms of the ecological resilience of rivers, much research has been conducted. Ecological problems are considered to be the key constraints for the high-quality development of the Yellow River Basin. It is very important to accurately grasp and understand the spatial and temporal differentiation characteristics and driving factors of ecological resilience in the Yellow River Basin. Huang constructed a three-dimensional resilience evaluation index system composed of resistance, adaptability and resilience. The entropy method was used to calculate the resilience of 76 cities in the Yellow River Basin, and the spatial and temporal evolution characteristics were discussed (Huang et al., 2023). Jie et al. (2024) took the Taohe River Basin as the research object, and constructs an ecological resilience evaluation model based on the framework of ecosystem adaptability, ecosystem resistance and ecosystem resilience from the perspective of resilient ecosystem function. Xiong et al. (2024) took the Dongting Lake area as the research area. Firstly, remote sensing image interpretation, Fragstats landscape index, InVEST model and ArcGIS spatial analysis were used to calculate the D-C-R dimension index of Dongting Lake area, and a multi-temporal and spatial ecological resilience map library of Dongting Lake area was constructed for multi-temporal and spatial data integration.

Previous studies have mainly focused on the ecological resilience of forests and rivers respectively, and few studies have analyzed the correlation mechanism of the resilience of the two ecosystems from the perspective of composite ecosystems. It is urgent to study the main constraints, key processes and mutual feedback mechanism of forest-river complex ecosystem resilience. In addition, compared with forests and rivers in individual countries, transnational forests and rivers have greater spatial heterogeneity and stronger ecological resilience. How to give full play to the resilience of transnational forest-river composite ecosystems and effectively respond to environmental disturbances has become an urgent problem to be solved.

(2) Service value assessment for transnational tropical forest-river complex ecosystems

Ecological services include climate regulation (carbon sequestration and water cycle regulation), water conservation, soil and water conservation, purification of polluted environment, conservation of biodiversity, and provision of a good forest eco-tourism environment. Tropical forests play a roughly neutral role in the global carbon cycle, with intact and recovering forests absorbing carbon equivalent to the amount of carbon released from deforestation and forest degradation (Mitchard et al., 2018). Mitchard (2018) used forest inventory plots, satellite data, atmospheric inversion studies and dynamic vegetation models to estimate tropical forest carbon balance and carbon flux. Satdichanh et al. (2023) used vegetation and environmental data from two large-scale surveys with a total landscape area of 20,000 hectares in Southeast Asia to study the effects of plant species diversity, functional trait diversity, phylogenetic diversity, aboveground biomass and environmental factors on soil organic carbon sequestration during forest succession. Water and nutrient stress are important for tropical arid forests. Vargas Gutiérrez et al. (2023) explored the effects of water and nutrient stress on ecosystem processes in tropical arid forests based on large-scale control experiments. Guo et al. (2021) presented that the ecosystem function and stability of tropical forests in southwestern China are mainly driven by stand structure attributes and biodiversity. They used mixed effect models and variation partitioning to test the effects of stand structure attributes and biodiversity on biomass, productivity and stability. Finally, they found that adjusting the stand structure through forest management is an effective way to rapidly increase forest carbon storage. Human disturbance has an impact on the ecosystem services of tropical forests. In order to clarify how tropical forest deforestation and conversion change biodiversity and ecosystem functions, Marsh et al. (2025) evaluated the effects of selective logging and oil palm plantation conversion on the structure, biodiversity and function of tropical forest ecosystems through a comprehensive analysis of various ecological variables in Borneo.

Ecosystems provide a variety of services, called ecosystem services, which are essential for human survival and progress (Costanza et al., 2017). River ecosystems receive and process large amounts of terrestrial organic carbon, and their fate depends largely on organism's activity (Yin and Yang, 2013). Tiegs et al. (2019) found that the biological communities of rivers on Earth have different carbon treatment characteristics. The slow treatment is obvious at all latitudes, while the rapid treatment is limited to low latitudes. Both the mean rate and variability decrease with latitude, indicating that the temperature limit at the poles and other environmental drivers (such as nutrient load) at the equator play a greater role. The unique mountain-oasis-desert ecosystem of the Tarim River in China has long provided important regional ecosystem services, such as water cycle, climate regulation, carbon sequestration and biodiversity, which are essential for maintaining regional ecological stability (Liu et al., 2022). Yang et al. (2024) used InVEST to assess water yield, carbon sequestration, soil conservation, and habitat quality in the Tarim River, and explored the overall and local trade-offs / synergies between different ecosystem service.

Previous studies have focused on the separate evaluation of the ecological service value of forests and rivers, and few studies have evaluated the overall ecological service function value of the forest-river composite ecosystem. The overall ecological service function value of the forest-river composite ecosystem is not a simple sum of the ecological service value of the two systems. It is not possible to directly use the parameter values of the river or forest ecological service value when they are evaluated separately (Yin et al., 2018). Instead, the correlation mechanism and mutual influence between forests and rivers should be considered to adjust the parameter values. How to consider the correlation mechanism and mutual influence between forests and rivers, and construct the evaluation method of ecological service function value of forest-river composite ecosystem has become an urgent problem to be solved.

(3) Paths to enhance the interests of stakeholders in coupling transnational forest and river economic output

The relationship between ecosystem functions and human well-being is complex. Due to imperfect functional information, inaccurate measurements, or incomplete understanding of the relationship between man and nature, many benefits of ecosystems are difficult to identify, measure, and evaluate (Costanza et al., 2017).

Brazil's Amazon forest is the most popular tropical forest. Strand estimated the spatially explicit economic value of a series of ecosystem services provided by Brazil's Amazon forest, including food production (Brazil nuts), raw material supply (rubber and wood), greenhouse gas emission reduction (carbon dioxide emissions) and climate regulation (rent loss from soybean, beef and hydropower production due to reduced rainfall) (Strand et al., 2018). Torras (2000) systematically assessed the total economic value of deforestation in the Amazon. Strand et al. (2017) used the dynamic value function method to simulate the marginal value of rainforest loss. Ribeiro et al. (2018) is very concerned about whether multifunctional livelihoods, including leisure ecosystem services and non-timber forest products, can maintain biodiversity forests in the Brazilian Amazon. In addition, some scholars have established conservation models in the Amazon River Basin (Soares-Filho et al., 2006) to study the sources of water vapor and the impact of deforestation in economically related areas of the Amazon River Basin (Sumila et al., 2017), as well as the economic valuation of forest changes (Oliveira et al., 2017). Kreier et al. (2022) study found that trees reduce the earth 's temperature by one-third through biophysical mechanisms (such as wetting the air). Tropical forests absorb CO_2 from the air and play a vital role in cooling the earth 's surface.

Healthy and well-functioning rivers provide people with great economic, cultural, aesthetic, scientific and educational contributions (Lynch et al., 2023). However, freshwater biodiversity declines faster than other environments, and habitats degrade, including the shrinkage of floodplain rivers (Dudgeon et al., 2006). Current river management practices must focus on mitigating the risks of floods to population and infrastructure, whether by strengthening flood control infrastructure or providing space for rivers to flow (Yin et al., 2024). McCabe et al. (2025) comprehensively explored the ecological benefits of giving rivers more flow space, the basic role of free migration of rivers in the landscape on ecosystem resilience, including hydrological and super-ecosystem connectivity. River management practices designed to benefit humans and nature are likely to provide a wide range of ecological co-benefits, including laying the foundation for ecosystem resilience (Van et al., 2024;

Knox et al., 2022). The physical processes associated with river boundary retreat have been well documented (Dierauer et al., 2012; Heine et al., 2012; Curran et al., 2025; Cluer et al., 2014). As climate-driven extreme events continue to escalate, giving rivers more flow space can become a mutually beneficial solution for freshwater biodiversity crisis and flood disaster management (McCabe et al., 2025).

In the past, the increase of stakeholder benefits was usually based on two paths, namely: forest economic output → stakeholder → forest ecological protection, river economic output → stakeholder → river ecological protection. When considering the relevance and mutual feedback of forests and rivers, two new paths can be added: river economic output → stakeholder → forest ecological protection, forest economic output → stakeholder → river ecological protection. The scientific and technological level of forest development and river development in different countries is different. Through mutual scientific and technological learning and financial support, countries can improve the level of development and protection of rivers and forests, thus making the path of forest protection more feasible and more effective.

(4) Research progress summary

In summary, tropical forests and rivers are widely distributed across many countries. The status of forests and rivers in neighboring countries will significantly affect the health of forests and rivers in other countries. Forest ecosystem and river ecosystem are closely related to each other, forming a forest-river composite ecosystem. In the past, scientific research focused on the separate study of forest and river ecosystems, and less on the operation mechanism and value assessment of forest-river composite ecosystems.

In addition, **since the management of rivers and forests is usually the responsibility of different departments, previous international cooperation has typically been conducted within the river sector or within the forest sector. Carrying out cooperation between transnational rivers and transnational forests can enhance mutual constraints between the two countries. For example, if only transnational rivers are considered, downstream countries cannot constrain upstream countries; however, with the inclusion of transnational forests, forest**

pests, diseases, and fires in downstream countries can affect upstream countries. It can also increase feasible paths for cooperation. For instance, if upstream countries guarantee ecological flows and hydrological processes for downstream countries, it can boost the hydropower and fishery benefits of downstream countries, which in turn can allocate the increased benefits to the prevention and control of forest pests, diseases, and fires.

To this end, there is an urgent need to focus on the linkages between forests and rivers, and to coordinate measures implemented in different countries with the protection and restoration of tropical forests and rivers as the guide. By integrating the ecological service functions of forests and rivers, it reveals their interaction and benefits at the transnational scale, proposes methods to enhance the rights and interests of stakeholders, and builds a transnational cooperation mechanism. The project has important practical significance and policy guidance value.

3 Research Plan

The technical route of this study is illustrated in Fig. 3-1, which can be broken down in detail as follows.

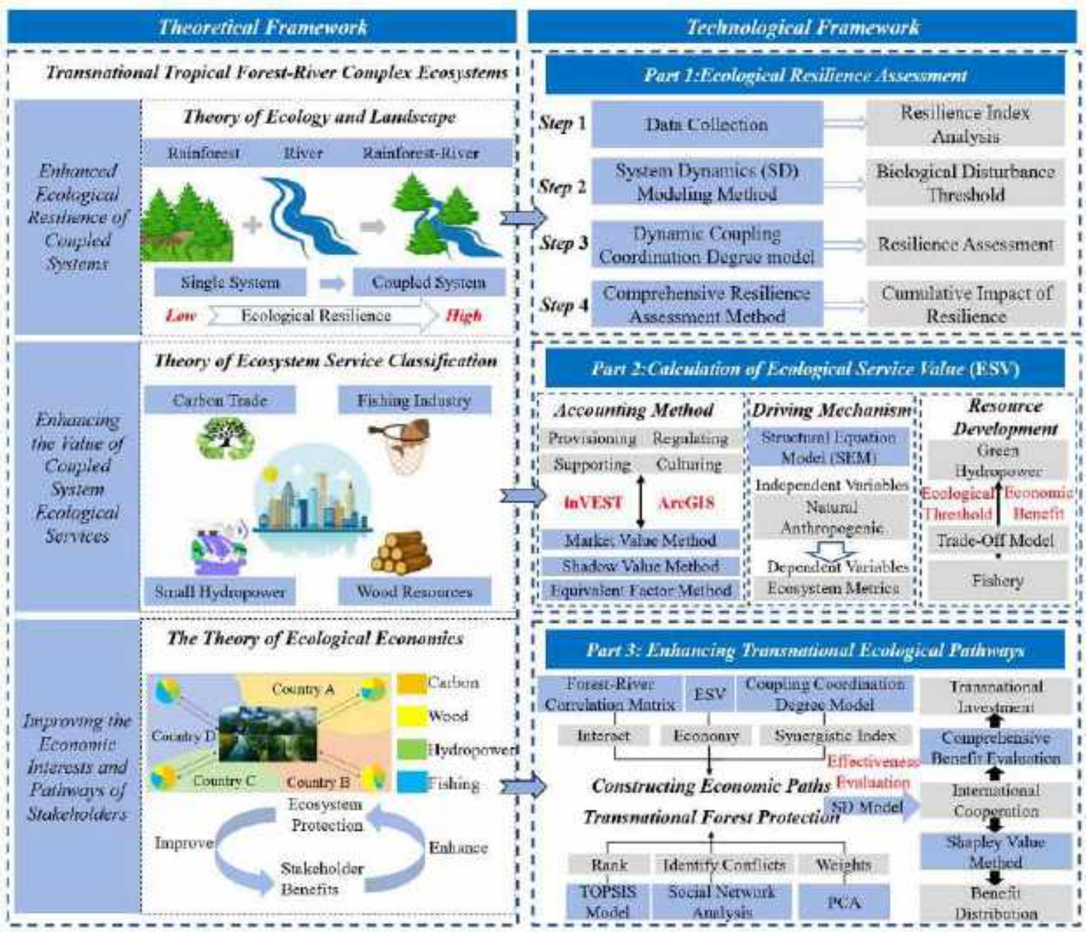

Figure 3-1 Technical route

(1) Evolution and correlation analysis of forest and river ecological resilience under climate change

①Analysis of the support of tropical forest river coupling system for ecological resilience

Resilience is a comprehensive attribute of ecosystems, and its quantification typically requires multiple indicators. This study adopts resistance, recovery, and adaptability as guiding principles for indicator selection. For assessing the resilience of tropical forest-river coupled systems, key indicators such as vegetation coverage, vegetation diversity, temperature, precipitation, soil organic matter content, soil water content, water quality, and slope are selected from vegetation, soil, river, climate, and topography perspectives. These indicators are used to evaluate variations across riparian zones, forests, and river areas under different seasonal climates, providing a basis for enhancing the coupled system's resilience.

- **Zone delineation and data collection**

To distinguish interactive zones among rivers, forests, and riparian areas, spatial delineation is performed along the river flow direction based on riparian zone width in tropical rainforests. Observation points are established at 100-meter intervals of increasing riparian width to collect relevant data. Rivers: Water quality parameters (*N*, *P*, dissolved oxygen), input of leaf litter and woody debris, and species richness via eDNA analysis. Riparian zones and forests: Vegetation metrics (coverage, height, diameter), soil properties (*P*, *K* concentrations, water-holding capacity, sediment carbon sequestration potential), and biodiversity indices. Temporal data collection is conducted monthly, alongside hydrological and climatic records (temperature, humidity, rainfall) over a year.

- **Data processing and indicator analysis**

Hydrological indicators: simulated and validated using the SWAT (Soil and Water Assessment Tool) model for runoff and water quality (N, P, dissolved oxygen). Topographic data: slope and aspect derived from DEM data; and GIS-based spatial analysis to generate riparian buffers and compute topographic wetness indices (TWI), followed by overlay analysis with ecological indicators. Soil-vegetation system: spatial distribution models for soil properties via Kriging interpolation; and mantel tests to examine soil-vegetation correlations. Biodiversity: α-diversity (Shannon-Wiener, Simpson indices) and β-diversity (Bray-Curtis dissimilarity) analyses; food web construction using eDNA data and network analysis to assess connectivity and keystone species' topological roles.

②Biological interference and threshold analysis under climate change

This study intends to adopt the System Dynamics (SD) modeling method. SD modelling is a computer simulation modelling technique focused on the understanding of the effects of feedback loop relationships and delays (Richardson, 2011) in the observable behavior of complex systems. In the context of resilience, SD modelling can be used to simulate system responses to disturbances and as a tool for analyzing the causal structures driving those responses.

Alternatively, ecological resilience literature assumes that a system can exist in alternative self-organized states. The approach to assessing resilience using the ecological paradigm is to estimate the potential drivers and disturbances that can change the behavior of the system from being driven by one set of structures and processes to another set. This study proposes the following two measures to assess ecological resilience: (i) the amount of disturbance needed to move the behavior of the system from one stable state to a different one and (ii) the likelihood of this to happen. These two measures of ecological resilience can be described as follows:

Elasticity (σ_E): the ability of the system to withstand a disturbance σ without changing to a different steady state. The more elastic the system, the larger the disturbance it can absorb.

Index of resilience (I_R): the probability of keeping the current steady state or regime. The higher the I_R, the smaller is the probability that the system will change from one state to a different one.

Furthermore, in order to estimate these metrics using the behavior of *F(x)* simulated by the SD model. The following are the main parameters required for quantifying resilience: δ is magnitude of disturbance; t_c is time when the disturbance starts to affect the system; t_d is time when the disturbance stops; t_f is time when the system fully recovers. These parameters can be measured from the simulated behavior of the outcome *F(x)* as illustrated in Fig. 3-2a, where Elasticity and Index of Resilience can be calculated in the following way:

$$Elasticity(\sigma_E) = \delta_E \times (t_d - t_c) \quad (1)$$

$$Resilience\ Index(I_R) = P(\sigma < \sigma_E) \quad (2)$$

The probability of the disturbance being smaller than σ_E, $P(\sigma \leq \sigma_E)$ can be obtained from the PDF resulting from the Monte Carlo simulations by calculating the areas underneath the curve (i.e. the shaded area in Fig. 3-2b). If the disturbance σ was adjusted manually, the probability of the disturbance being smaller than σ_E, $P(\sigma \leq \sigma_E)$ can be calculated as the proportion disturbance σ that is smaller than σ_E out of the total of plausible disturbances.

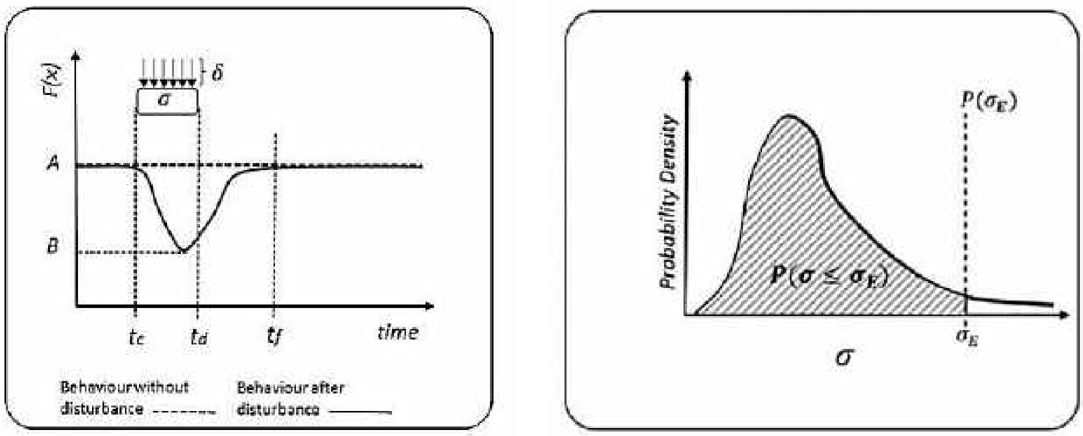

Figure 3-2. (a) Hypothetical response of the system to a disturbance σ with magnitude δ and duration (t_d t_c). (b) Probability density of the disturbance σ produced using Monte Carlo simulations.

The measures of resilience are calculated using the behavior by a previously calibrated and validated SD model. The model allows simulating the system response to different disturbances. To test different disturbances affecting the system, Monte Carlo simulations can be used to test a range of plausible disturbance magnitudes (δ) and durations (t_d t_c) following a particular probability density function (PDF). In addition, these parameters in the model can be changed manually. In cases where the parameters are changed manually, it is assumed there is the same probability of occurrence for all disturbance parameters tested. Independent of the method used to adjust the parameters, the measures can be calculated as follows: (1) Identify the outcome function F(x) and disturbance σ affecting it; (2) Start with the model representing the current behavior of the outcome function F(x); (3) Adjust the disturbance σ manually by increasing its magnitude δ while keeping td and tc constant or use Monte Carlo simulations with appropriate PDFs for δ, t_d and t_c. Calculate the disturbance σ_E that produces F(x) and Index of resilience I_R; and (4) Determine the system resilience threshold and critical point through Index of Resilience IR

③ A comprehensive evaluation framework and cumulative effects for the resilience of coupled systems

For the resilience assessment of tropical forest-river coupled systems, a multi-factor comprehensive evaluation method is adopted to extract relevant influencing factors and indicators from three dimensions: resistance, recovery, and adaptability. The entropy method is employed to assign weights to each indicator, followed by normalization processing to conduct further weighted summation and aggregation steps, ultimately obtaining a comprehensive resilience index to holistically evaluate the coupled ecosystem's resilience.

Regarding the cumulative effects on resilience, a dynamic coupling coordination degree model is utilized to analyze the cumulative impacts of climate change, land-use transformations, and anthropogenic activities on the overall resilience of the coupled system. The calculation model is as follows:

$$\frac{dx(t)}{dt} = a_1 x_1 + a_2 x_2 + \cdots + a_n x_n \tag{3}$$

where, a_i is a linear approximation parameter. The ecological resilience system is regarded as a composite system composed of three subsystems: resistance, adaptability, and resilience, represented by R, A, and C. Its evolution can be obtained through nonlinear fitting methods, and the corresponding change curve equation is as follows:

$$\begin{cases} R = \dfrac{dF(R)}{dt} = a_1 f(R) + a_2 f(A) + a_3 f(C), V_R = \dfrac{dR}{dt} \\ A = \dfrac{dF(A)}{dt} = b_1 f(R) + b_2 f(A) + b_3 f(C), V_R = \dfrac{dA}{dt} \\ C = \dfrac{dF(C)}{dt} = c_1 f(R) + c_2 f(A) + c_3 f(C), V_R = \dfrac{dC}{dt} \end{cases} \tag{4}$$

in which, V_R, V_A, and V_C respectively represent the evolution speed of the subsystem, and their symbols indicate the evolution direction of the corresponding subsystem. The evolution speed of the entire system is determined by the evolution speed of these three subsystems, denoted as $V=(V_R, V_A, V_C)$. Determining the coupling development stage of the composite evolution of each subsystem is based on the sign of subsystem evolution speed.

When considering a three-dimensional Cartesian coordinate system with R, A, and C as the coordinate axes, and the system develops in perfect coordination, $R=A=C$.

At this point, the direction vector of the vector formed by the evolution state of the system and the origin is (1, 1, 1). In the process of system evolution, the angle α between the system evolution state and the fully coordinated development at any moment satisfies:

$$a = \arccos(\frac{U \cdot U_0}{|U||U_0|}) \tag{5}$$

The angle α is called the deviation coordination degree, with a value range of 0°~55°, reflecting the degree to which the subsystem deviates from the optimal coordination development. The smaller the value, the closer the subsystem is to the equilibrium development state.

(2) Service value assessment for transnational tropical forest-river complex ecosystems

In transnational tropical forest-river complex ecosystems, the ecological processes of forests and rivers are intricately intertwined. However, current assessments of ecosystem service values remain confined to individual ecosystems, with a notable paucity of systematic methodologies applicable at the transnational scale. This study introduces a service value accounting framework tailored for transnational complex systems, employing structural equation modeling to quantify the effects of driving factors on ecological structures and functions. By constructing a driving mechanism framework to identify key determinants, the research ultimately explores evidence-based strategies for resource development, aiming to provide scientific underpinnings for transnational ecological conservation and sustainable development. The detailed research design and methodologies are outlined as follows:

①Data collection and integration

To characterize the ecosystem service values of transnational tropical forest-river complex ecosystems, this study has systematically collected multi-source data across transboundary regions, including high-resolution remote sensing data (for deriving vegetation coverage, river network distribution, land use data, etc.), long-term meteorological data (precipitation, temperature, wind speed, etc.), and real-time hydrological monitoring data (inflow rate, water level, water quality indicators, etc.). Social and economic data such as forest resource management policies, carbon trading data, hydropower development plans, and fishery statistics of various countries were collected and integrated. A multidisciplinary research team is organized to carry out field research to obtain field data such as riparian vegetation structure (vegetation type, community composition, coverage, etc.), key species distribution (rare habitats of rare flora and fauna, etc.), and local community economic dependence (dependence on forest and fishery resources for livelihoods).

② Establishment of accounting method for service value of transnational complex ecosystems

To address the inadequacy of the accounting methodology system for the service value of transnational tropical forest-river complex ecosystems, this study, grounded in the theory of ecosystem service classification, systematically organizes four categories of its services: provisioning, regulating, supporting, and culturing. By fully accounting for the cross-border transmission and compensation characteristics of ecological processes at the transnational scale, it constructs an accounting framework that reflects spatial heterogeneity and temporal dynamics. The market value method, shadow value method, equivalent factor method, and other approaches are comprehensively employed. By integrating tools such as the InVEST model and ArcGIS, an accounting model is established, forming a complete system of service value accounting methods for transnational complex ecosystems. It provides theoretical and methodological support for the assessment of transnational ecosystem service values and international cooperation in ecological protection.

Table 3-1 Establishment of service value accounting method system for transnational tropical forest-river complex ecosystems

Service category	Functional category	Functional definition	Accounting method
Supply service	Water resource supply	Total amount of available fresh water provided by the tropical forest-river complex ecosystem to the surrounding areas	Market value method
	Material production	Annual economic output of forest products such as timber, wild fruits, and medicinal materials from the tropical forest system	Market value method
	Fishery products	Yield of fishery resources sustainably harvested from rivers	Market value method
	Hydropower generation	Electricity generation service enabled by hydropower stations, leveraging river - derived water level differentials and flow kinetic energy within the transnational tropical forest-river complex ecosystem	Market value method
Regulation service	Water conservation	Capacity of tropical forest ecosystems to intercept precipitation, facilitate soil water storage, and mediate river regulation, thereby mitigating surface runoff and delaying flood peaks	InVEST model
	Climate regulation	Regulatory effects of carbon sequestration, oxygen release by tropical forest ecosystems, and river	Market value method

		evaporation on regional temperature and humidity dynamics	
	Water purification	Capacity of tropical forest ecosystems to filter pollutants, coupled with the degradation of nutrients (e.g., nitrogen, phosphorus) by river ecosystems	InVEST model
	Carbon sequestration and oxygen release	Carbon dioxide uptake and oxygen release via photosynthesis in tropical forest vegetation, alongside carbon sequestration and oxygen release processes mediated by aquatic plants and algae within river ecosystems	InVEST model
	Flood regulation	Capacity of river ecosystems to store floodwaters during the flood season, mitigating flood inundation risks	Market value method
Support service	Biodiversity maintenance	Capacity of tropical forest-river complex ecosystems to furnish habitats, facilitating survival and reproduction of flora and fauna	InVEST model
	Erosion - mediated biodiversity maintenance	Capacity of tropical forest vegetation and root systems to mitigate soil erosion and intercept riverine sediment, thereby sustaining biodiversity	InVEST model
Cultural service	Ecotourism	Socio - economic and cultural benefits derived from tropical forest landscapes, riverine scenery, and associated cultural heritages in	Travel cost method

		attracting ecotourism	
	Scientific research and education	Value of tropical forest-river complex ecosystems as ecological research bases and environmental education venues	Equivalent factor method

③Construction of conceptual model for driving mechanism of ecological service functions

Structural equation modeling (SEM) is a statistical approach employed to elucidate intricate causal relationships among variables. When applied to analyze the influence of driving factors on transnational tropical forest-river complex ecosystems, SEM enables the systematic integration of the causal pathways linking driving factors, ecological processes, and service outputs. This facilitates the construction of a conceptual model depicting a chain reaction framework of "driving factors-ecosystem structure-service functions", thereby offering a comprehensive understanding of the system's underlying mechanisms. This approach enables the simultaneous handling of multiple dependent and independent variables. Based on a pre-established theoretical framework, it incorporates natural driving factors (such as climatic conditions and topographical features) as well as anthropogenic driving factors (including population density, GDP growth rate, industrial structure, and transnational policies) as independent variables. Conversely, ecosystem metrics, such as forest cover percentage and river water quality indices, are designated as dependent variables. In this study, a comprehensive SEM framework, encompassing both a measurement model and a structural model, is constructed. Employing techniques such as maximum likelihood estimation, the model parameters are estimated and rigorously tested to validate and refine the theoretical model. This process aims to elucidate the causal pathways among diverse driving factors and ecosystem metrics, thereby providing in-depth insights into the underlying mechanisms governing the transnational tropical forest-river complex ecosystem. The mathematical formulation of the SEM measurement model is presented below:

$$y = \wedge_y \eta + \varepsilon$$
$$x = \wedge_x \zeta + \delta \quad (6)$$

where η and ζ are latent variables, y and x are manifest variables, matrices Λ_y and Λ_x are coefficient matrices reflecting the strength of the relationship between y and η, and x and ζ respectively, and ε and δ represent the measurement errors of y and x. The formula of the structural model is as follows:

$$\eta = B\eta + \Gamma\zeta + \zeta \quad (7)$$

In this model, the endogenous latent variables and exogenous latent variables are connected through the B and Γ coefficient matrices and the error vector ζ, where Γ is the impact of exogenous latent variables on endogenous latent variables, and B is the impact between endogenous latent variables.

④Quantification of ecological impact and economic optimization of resource development activities

For green hydropower development, this study integrates hydraulic models, ecological monitoring datasets and remote sensing imagery to evaluate the impacts of reservoir construction on river flow velocity, water temperature and sediment transport, analyzes the damage of these physical environment changes to fish habitats and the interference to forest water supply, so as to quantify its ecological cost. Regarding fishery activities, it employs fish population dynamics monitoring, biodiversity surveys, and fishery yield statistics to quantify the effects of overfishing on aquatic biodiversity. Furthermore, the research examines the feedback mechanism through which riverine ecological degradation influences fishery yields, ultimately establishing a dynamic relational model that elucidates the interplay between these two factors.

To identify ecologically appropriate development strategies, an "ecological threshold-economic benefit" trade-off model is established. This model integrates ecological protection objectives and economic development needs to determine the minimum ecological flow threshold for hydropower development, which is critical for maintaining the fundamental functions of river ecosystems. Additionally, it formulates sustainable fishing quotas to maximize fishery economic benefits while ensuring the sustainable development of fish populations. By treating ecological thresholds as constraint conditions and economic benefits as the objective function, the model quantifies the functional relationship between these two variables to derive optimal development plans. Ultimately, this provides a scientific decision-making basis for the sustainable development of transnational regions.

Table 3-2 "Ecological threshold - economic benefit" trade-off model

Application scenario	Ecological threshold index	Economic benefit index	Trade-off result
Hydropower development	Minimum ecological flow	Annual power generation and benefits	Optimal benefit realization at defined flow (meeting ecological standards)
Fishery activities	Minimum number of fish populations	Annual fishing output value	Optimal output value at balanced fishing quota (ensuring population stability)

(3) Paths to enhance the interests of stakeholders in coupling transnational forest and river economic output

To enhance the interests of stakeholders in coupling transnational forest and river output, this study develops a "forest-river" output correlation matrix and quantifies their associated values, and establishes the economic path of "carbon sink trading feedback+ecological product premium". We establish a multi-dimensional indicator system to delineate forest conservation tasks and targets across participating nations, and analyzes consensus and conflicts. For consensus and conflicts, corresponding international cooperation mechanisms are designed: transnational investment allocation and benefit distribution are optimized through the "green investment-benefit sharing" model, investment priority allocation matrix, and Shapley value method. Additionally, a coupled "forest-river-socioeconomic" system dynamics model is constructed, and the analytic hierarchy process (AHP) is employed to evaluate mechanism effectiveness, ensuring behavioral alignment among stakeholders.

①Method for constructing economic paths for the synergy of forest and river output

Construct a "forest-river" output correlation matrix to identify the interaction effects between carbon sink trading, hydropower generation and fisheries. Employing the ecosystem service value accounting method, forest carbon sinks, hydropower generation, and fishery outputs are uniformly converted into economic values. The coupling coordination degree model is applied to calculate the synergistic development index of these three components, thereby quantifying the output correlation intensity across different regions. Based on the correlation analysis results, an economic path incorporating "carbon sink trading feedback+ecological product premiumization" is designed. The cost-benefit analysis method is utilized to assess the feasibility of this path, ensuring that the income growth of each stakeholder is no less than 5%. The value quantification formula is as follows:

$$\begin{aligned} Vc &= C \times P \\ Vh &= E \times Ph \\ Vf &= F \times Pf \\ D &= \sqrt{(M \times T)/(M + T/2)} \end{aligned} \tag{8}$$

where V_c is economic value of forest carbon sink, C is carbon sink amount, P is carbon trading price, V_h is economic value of hydropower, E is power generation, P_h is on-grid electricity price, V_f is economic value of fishery, F is fishery output, P_f is market price, D is coupling coordination degree, M is the coupling degree and T is the coordinated development degree. The cost-benefit analysis formula is as follows:

$$NR = R - Q \tag{9}$$

where NR is Net revenue, R is total revenue, Q is total cost. The NR of each stakeholder is ≥0 and the revenue growth rate $((R_1\text{-}R_0)/R_0)\times100\%\geq5\%$, where R_0 is the revenue before implementing the path and R_1 is the revenue after implementation.

Table 3-3 "Forest-river" output correlation matrix

Output type	Carbon sink trading	Hydropower generation	Fishery output
Carbon sink trading		Hydropower carbon emissions need to be offset by carbon sinks (+)	Forests improve water quality and increase fishery output (+)
Hydropower generation	Reservoir impoundment may affect forest carbon sinks (-)		Hydropower regulation of water flow affects fish habitats (±)
Fishery output	Overfishing damages aquatic carbon cycle (-)	Hydropower stations hinder fish migration	

Note: "+" indicates a positive impact, "-" indicates a negative impact, and "±" indicates an uncertain impact.

Table 3-4 Economic path of "carbon sink trading feedback + ecological product premium".

Path component	Core content	Specific measures	Key points
Carbon sink trading feedback	Fund extraction and distribution	15% of forest carbon sink is extracted (80% for forest protection, 20% for river compensation), and 20% of river is extracted (50% each for riparian restoration and fishermen's transfer); the share is based on "40% area + 60% carbon increase"	Differentiated proportion, taking into account area and benefit
Ecological product	Certification mark	Three-level certification: ecological compliance (5%-10%), carbon sink	Graded premium

premium		related (15%-20%), pure ecological products (25%-30%); blockchain traceability	
	Channel distribution	Online special zone charges 5% service fee (30% returned to the production end); offline counter revenue: 60% for producers, 20% for carbon sink, 20% for channels	Dual channels, inclined to producers
Synergy mechanism	Capital closed-loop	"Trading-feedback-improvement-premium-re-investment", 40% of new revenue is reverted	Benign cycle
	Risk hedging	When the carbon price is low, 10% premium is extracted to supplement feedback; when unsalable, carbon sink pledge financing	Stable feedback continuity
Benefit evaluation and adjustment	Core indicators	Ecology: carbon increase ≥5%, water quality improvement ≥10%; economy: revenue increase ≥8%; society: employment stability ≥90%, satisfaction ≥80 points	Multi-dimensional compliance
	Dynamic adjustment	Evaluate every 2 years, if not up to standard, increase feedback by 2%	Optimize according to results

②Construction of multi-dimensional index system for transnational forest protection

This study mainly establishes a transnational forest protection task index system encompassing three dimensions: ecology, economy and society. Principal component analysis is employed to determine the weight of each indicator, while the TOPSIS model is utilized to rank the protection status of individual countries, thereby identifying gap areas. Forest protection objectives outlined in national policy documents are collated, with core demands extracted via text analytics. By establishing a "goal-interest" correlation matrix, social network analysis (SNA) is applied to identify consensus domains and conflict points. This involves quantifying conflict intensity (e.g. annual number of conflict events × affected population size × impact duration), conflict core nodes, conflict connection strength, key conflict pathways, and potential mediation breakthroughs. An in-depth analysis of conflict causes is conducted, distinguishing between types such as uneven resource allocation, policy divergences, and heterogeneous interest demands, which provides a basis for formulating conflict resolution strategies.

Table 3-5 Transnational forest protection task index system

Dimension	First-level index	Second-level index	Third-level index	Quantification standard
Ecology	Forest status	Forest coverage	Natural forest coverage	The proportion of natural forests in the total forest area per unit area
			Plantation coverage	The proportion of plantations in the total forest area per unit area
		Forest degradation rate	Annual degradation area ratio	The ratio of annual forest degradation area to the total forest area at the beginning of the year
			Degradation intensity index	Comprehensive vegetation coverage decline, soil erosion degree, etc., divided into mild (1-3), moderate (4-6), severe (7-10)

	River status	Ecological flow compliance rate	Monthly compliance rate	The proportion of days in each month when the actual flow meets the ecological flow standard to the total days of the month
			Annual compliance rate	The average of monthly compliance rates throughout the year
		Water quality compliance rate	Compliance rate of major pollutants	The proportion of monitoring sections where indicators such as chemical oxygen demand (COD) and ammonia nitrogen meet the standards
			Water eutrophication index	Using Carlson index, divided into oligotrophic (<40), mesotrophic (40-50), eutrophic (>50)
Economy	Carbon sink income	Proportion of carbon sink income in GDP	Annual proportion	The ratio of annual carbon sink trading income to the total national production value
			Per capita carbon sink income	The ratio of annual carbon sink trading income to the total population
	Fishery income	Per capita fishery	Annual income of fishermen	The ratio of the total annual income of fishery

		income		practitioners to the number of practitioners
			Fishery income growth rate	The ratio of the difference between the current year's per capita fishery income and the previous year's to the previous year's
Society	Carbon sink income	Proportion of carbon sink income in GDP	Direct employment number	The number of people engaged in work directly related to forest harvesting, cultivation, carbon sink projects, etc.
			Indirect employment number	The number of people engaged in work indirectly related to forest product processing, transportation, etc.
	Fishery income	Per capita fishery income	Annual number of events	The number of conflict events caused by cross-border water resource allocation, pollution, etc. each year
			Conflict impact index	Comprehensive number of countries involved in the conflict, affected population size, etc., ranging from 0 to 100

③Optimization calculation of international investment and benefit distribution

For the optimization of international investment and benefit distribution, this study mainly uses the "green investment-benefit sharing" model to score the comprehensive benefits of the project, which comprehensively considers carbon sink, hydropower and fishery, with weights of 40%, 30% and 30% respectively. According to the comprehensive benefit score, combined with the investment allocation priority matrix, projects are classified into three categories: priority, sub-priority and alternative categories. The Shapley value method is utilized to analyze the marginal contribution of each country in different cooperation subsets (i.e., the increase in cooperation income after the country joins). We calculate the comprehensive contribution of each country combined with the ratio of the size of the cooperation subset to the total number of participating countries, and determines the benefit distribution ratio according to the proportion of contribution. If a country's contribution ratio is more than 30%, its benefit distribution ratio must be no less than 25%.

Table 3-6 Investment allocation priority matrix

Project type	Comprehensive benefit score	Investment proportion	Source of funds
Priority	≥80	50%	Joint investment by multinational enterprises
Sub-priority	60-79	30%	Loans from regional development banks
Alternative	<60	20%	Domestic supporting funds

The comprehensive benefit score can be calculated as follows:

$$S = S_c \times 0.4 + S_h \times 0.3 + S_f \times 0.3$$

where S_c is the carbon sink benefit, S_h is the hydropower benefit, S_f is the fishery benefit, and the ecological compensation coefficient is 0.1-0.3.

④Mechanism effectiveness evaluation

For the mechanism effectiveness evaluation, this study designs multi-level scenario simulations, setting three types of comparative scenarios: no cooperation, partial cooperation, and full cooperation, based on differences in the intensity of international cooperation. It constructs a "forest-river-social economy" coupled system dynamics model, adjusts parameters through the "historical data inversion + expert verification" dual calibration method, and outputs various ecological, economic, and social indicators. Subsequently, it quantifies and calculates effectiveness evaluation indicators, including core indicators such as carbon sink synergy gain rate, cross-border conflict resolution efficiency, and investment marginal benefit. The analytic hierarchy process is used to determine indicator weights (40% for ecology, 35% for economy, and 25% for society), and the comprehensive benefit scores of each scenario are calculated. The mechanism is judged to be effective when the score of the full cooperation scenario is 40% higher than that of the no cooperation scenario.

Table 3-7 Differential setting of scenario parameters

Variable Type	No Cooperation Scenario	Partial Cooperation Scenario	Full Cooperation Scenario
Technology transfer efficiency	0 (no technical exchange)	30% (only basic equipment transfer)	80% (including technical training and maintenance)
Investment synergy	0 (no investment cooperation)	50% (bilateral project cooperation)	100% (regional joint investment fund)
Data sharing rate	<20% (only basic statistical data disclosed)	60% (sharing hydrological and carbon sink data)	100% (real-time monitoring data interconnection)
Policy coordination frequency	0 times/year	2 times/year (bilateral meetings)	4 times/year (multilateral coordination committee)

Table 3-8 Construction of "forest-river-social economy" coupled system dynamics model

Link	Specific Content	Detailed Description
Model structure refinement	Construct a "forest-river-social economy" coupling model, including 5 subsystems	Forest carbon sink module: focuses on carbon stock dynamics; hydrological regulation module: involves runoff and water quality; fishery resources module: studies population growth and fishing; economic benefit module: covers carbon sink trading and hydropower output value; conflict mediation module: focuses on the number of conflict events and resolution efficiency. Each module is interconnected through feedback loops. For instance, an increase in forest coverage leads to a decrease in runoff, which in turn results in a reduction in hydropower generation, while improving water quality.
Parameter calibration method	Adopt the "historical data inversion + expert verification" dual calibration method	Historical data inversion: collects measured data of the study area in the past 20 years (such as forest coverage, fishery output), and adjusts model parameters; expert verification: invites 5 transnational ecologists and economists to score the rationality of parameters, with the error between simulated values and measured values ≤10% and the average expert score ≥8 points.
Model operation settings	The simulation period is 30 years, with a time step of 1 year	Simulates the model according to the time range and step to ensure the continuity and effectiveness of data, facilitating the observation of long-term change trends.
Model	Output three types	Ecological indicators: annual carbon sequestration

output results	of indicators: ecological, economic, and social	of forests, river ecological flow compliance rate, fishery population quantity; economic indicators: total carbon sink trading volume, total output value of hydropower and fishery, cross-border investment return rate; social indicators: number of forest-dependent employment, time-consuming for cross-border conflict resolution, implementation degree of cooperation policies

The relevant formulas for effectiveness evaluation indicators are as follows:

$$Gc = \frac{\Delta C_{Full-cooperation} - \Delta C_{No-cooperation}}{\Delta C_{No-cooperation}} \times 100\%$$

$$Ec = \frac{T_{Full-cooperation}}{T_{No-cooperation}} \times 100\% \tag{10}$$

$$Mr = \frac{B_{Full-cooperation} - B_{No-cooperation}}{C} \times 100\%$$

where G_c refers to the carbon sink synergy gain rate, which is used to measure the improvement amplitude of carbon sink increment in the full cooperation scenario relative to the no-cooperation scenario, and $\Delta C_{Full-cooperation}$ is the annual carbon sink increment in the full cooperation scenario; E_c is the cross-border conflict resolution efficiency, reflecting the optimization degree of conflict resolution time in the full cooperation scenario compared to the no cooperation scenario, with a lower value indicating higher efficiency; $T_{Full-cooperation}$ is total benefits in the full cooperation scenario; M_r is the investment marginal benefit, reflecting the additional benefits generated by cooperative investment. $B_{Full-cooperation}$ is total benefits in the full cooperation scenario; and C is additional cooperation costs.

(4) Research areas

① Transnational tropical forest region in Xishuangbanna, China and neighboring countries

Xishuangbanna is a region in the southwestern tip of the province Yunnan, China (Fig. 3-3) that constitutes one of the most ecologically important areas in the whole of

Southeast Asia because of the widespread distribution of tropical rainforest in the region and their strategic location in the upper reaches of Lancang-Mekong River Basin. The area is covered by humid evergreen forests which are important ecological corridor and high endemism and biotic diversity. These forest ecosystems offer vital regulating and supporting services such as hydrological regulation, carbon sequestration and habitat and these services are fundamental to environmental stability and livelihood in the area.

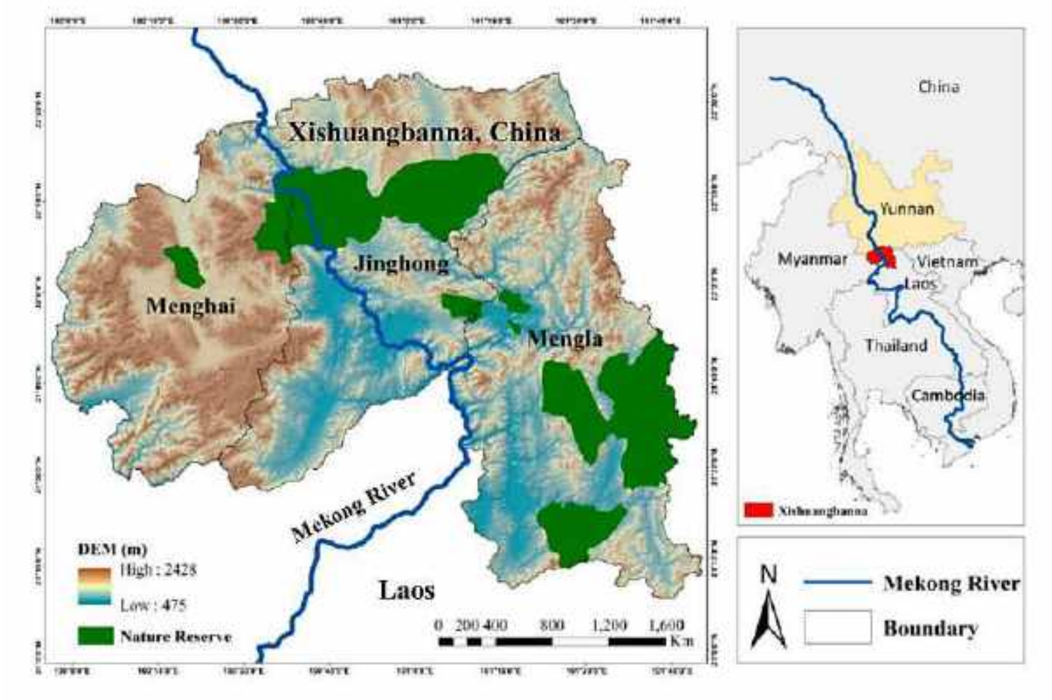

Figure 3-3 Location of Xishuangbanna, China (Cao et al., 2017)

The ecological functionality of the tropical forests as well as the Lancang River is deeply rooted in the agricultural production in Xishuangbanna. The principal crops are rice, rubber, and tropical fruits, and development of rubber monoculture increased substantially during recent decades. These land-use practices are justified by the disclosure of the essential ecosystem services like nutrients flow in soil, water resources, and pollination. Nonetheless, the expansion of hydropower development in the region has brought about ecological impacts, but on the other hand, offers more measures to balance the forest protection and local economy.

This study will evaluate ecosystem services (e.g., water purification, carbon sequestration, biodiversity support, and cultural services) of the tropical forest-river system in Xishuangbanna and the Lancang River downstream, with tropical forest protection as a core goal. A key focus is on ecological hydropower development as a critical tool to advance this goal particularly through its role in carbon trading to secure resources for forest conservation. Remote sensing (via MODIS and Landsat images) will monitor tropical evergreen forest health, distribution, and dynamic changes, analyzing how human activities (agriculture, hydropower) affect forest sustainability. It will specifically examine how ecological hydropower, through science-based design, mitigates development risks while directly reinforcing forest protection.

This study will also assess existing forest protection measures (e.g., transnational conservation, ecological corridors) and their synergies with ecological hydropower—for instance, using carbon trading revenues from hydropower projects to fund forest restoration and protection. Given the Lancang-Mekong Basin's transnational scope (China, Laos, etc.), it will explore cross-border governance, focusing on collaborative hydropower and carbon trading to strengthen transboundary forest protection and deliver local socio-environmental benefits.

Finally, it will examine how Xishuangbanna's local ecological knowledge, integrated with ecological hydropower practices, optimizes forest conservation strategies, especially leveraging carbon trading revenues to incentivize ethnic communities' participation in forest management, consolidating long-term forest sustainability.

②Transnational tropical forest region in Kalimantan Island, Indonesia and neighboring countries

This study intends to select a typical tropical forest river area on Kalimantan Island, Indonesia as the research area. Kalimantan Island is located near the equator in Southeast Asia (4°N to 4°S, 108°E to 119°E) and is the world's third-largest island, shared by Indonesia, Malaysia, and Brunei. The island is renowned for its vast tropical rainforests and dense river networks. Forest coverage once exceeded 80%, but due to long-term agricultural expansion, mining, and oil palm plantations, it has gradually declined. The Kapuas River is the longest river in Indonesia, stretching approximately 1,143 km with a drainage area of 98,000 km², accounting for about 13% of Borneo's total land area. Originating from the Müller Mountains, the river flows east to west across West Kalimantan Province before emptying into the South China Sea. Its basin features a distinct forest-river coupled system, including peat swamp forests, seasonal floodplains, and rich biodiversity, making it an ideal region for studying tropical hydro-ecological interactions.

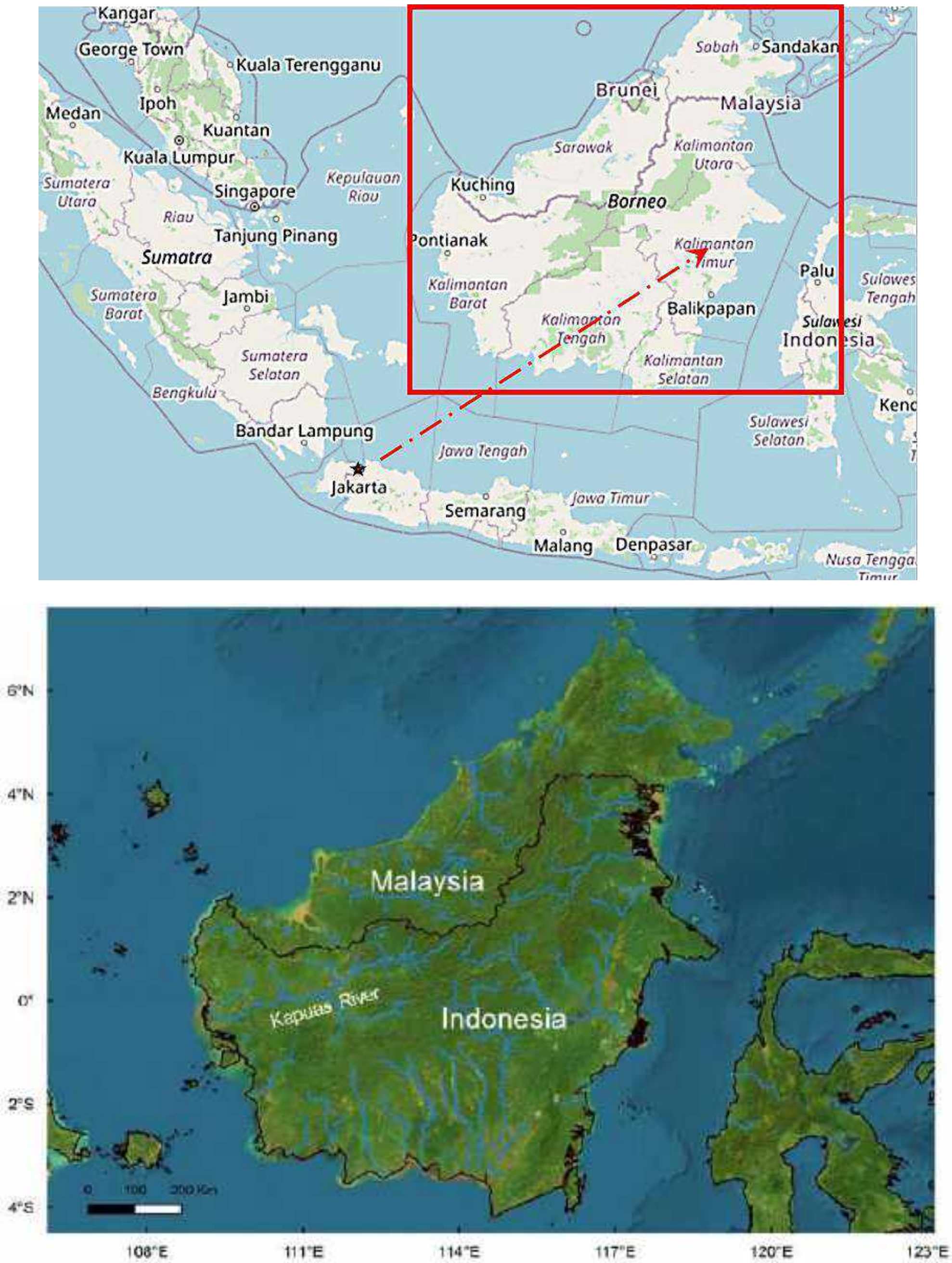

Figure 3-4 Location and river system of Kalimantan Island, Indonesia

In recent years, Borneo Island has faced significant land-use change pressures due to Indonesia's capital relocation plan (Nusantara Project). The Indonesian government plans to move the capital from Jakarta to East Kalimantan Province, requiring large-scale infrastructure development that may further fragment surrounding forests. Meanwhile, Malaysia has strengthened forest conservation policies in Sabah and Sarawak. The contrasting transboundary ecological governance approaches (e.g., carbon trading pilots, protected area coordination) provide a unique case for studying forest-river system responses to human disturbances.

This study will systematically investigate the enhancement of ecological resilience and the optimization of ecosystem service values in forest-river coupled systems, with a particular focus on innovative practices in transboundary collaborative conservation mechanisms and carbon trading markets. Based on landscape ecology and ecosystem service assessment frameworks, we will establish a multi-scale evaluation system to assess the ecological resilience of forest-river systems. By integrating remote sensing monitoring, field surveys, and model simulations, we will quantify the spatiotemporal variations of key ecosystem service indicators (including but not limited to hydrological regulation capacity, carbon sequestration intensity, and biodiversity maintenance capability), thereby revealing the threshold effects of system resilience under anthropogenic disturbances. Secondly, a multidimensional assessment framework will be constructed to quantify the value of critical ecosystem services under different development models (such as small hydropower development, deforestation, fisheries, and carbon trading). Using policy impact evaluation models, we will compare the effects of different governance approaches on ecosystem service flows. Finally, the market-based pathways for the Indonesia-Malaysia carbon trading pilot (e.g., Malaysia's increased investment in forest conservation and carbon trading with Indonesia) will be explored and we will design a transboundary compensation mechanism based on the "ecological protection-carbon value appreciation-benefit reinvestment" principle. By comparing ecosystem responses under differing national policies, a virtuous cycle of "ecological protection-carbon value appreciation-community benefits" will be established, providing actionable institutional design solutions for regional green development.

③Transnational tropical forest region in the Natural Reserve of Mabi-Yapa Complex, Cote d'Ivoire and neighboring countries

The target site of our project is the Natural Reserve of Mabi-Yapa Complex, located between 5°37'40-5°48'28 north latitude and 3°40'50-3°27'50 south longitudes, south-eastern Côte d'Ivoire (Fig. 3-5). Created recently by Decret N° 2019-897 of the Ivorian Ministries' Council of October 2019, the 30th, this Natural Reserve covers 61 282 hectares and results from the most preserved natural vegetation areas of both Mabi and Yaya classified forests created in 1929 for sustainable logging in Côte d'Ivoire. The degraded vegetation areas of these forests remain as classified forests surrounding of the Natural Reserve, which can offer biological and environmental exchanges with the Natural Reserve. The Natural Reserve of Mabi-Yaya complex consists of a lowland tropical forest with rivers and streams dominated by the Comoe and Kossa rivers, and surrounding by villages and camps.

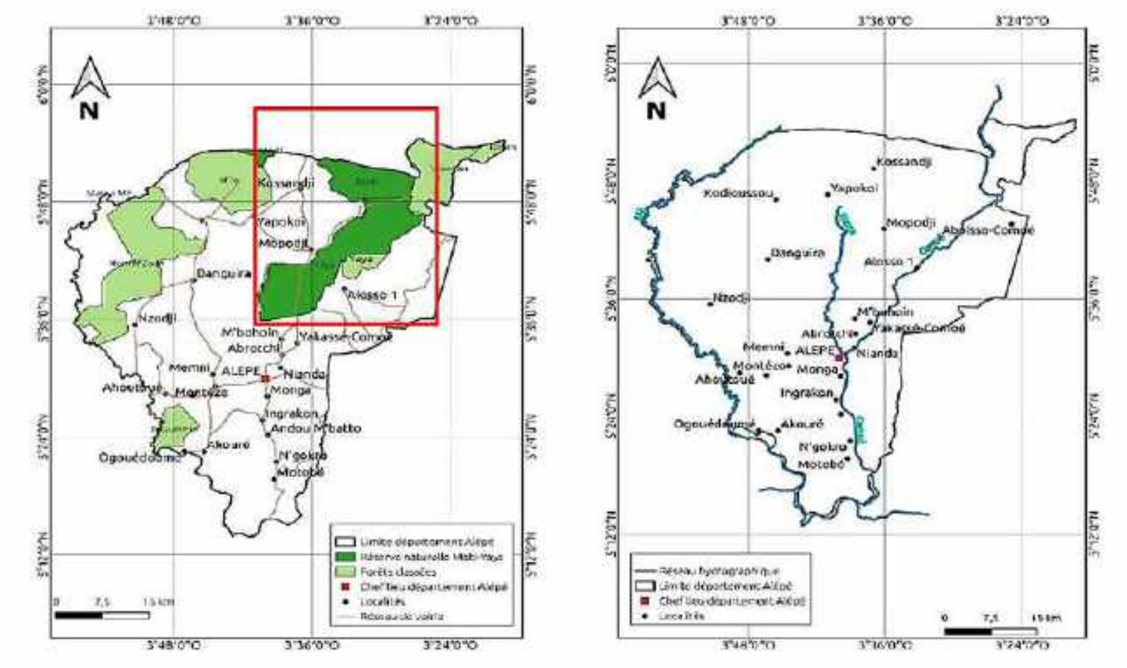

Figure 3-5 Location and river system of the Natural Reserve of Mabi-Yapa Complex, Cote d'Ivoire

Floristic inventories coupled with disturbance inventories have made it possible to identify anthropogenic disturbances as well as the flora. Finally, predictive modelling was carried out in IDRISI to generate future probabilities of these changes. The study revealed a decline in natural formations in favour of anthropized formations over 32 years. The spatial transformations underway are fragmentation, aggregation and the creation of vegetation classes. Four types of activities were identified as dominant anthropogenic disturbances in the protected area. These include land clearing (27.93%), cocoa plantations (20%), tracks (15%) and fallow land (10%). The dominant disturbances are linked to the development of cash-crop agriculture. The Mabi-Yaya forest complex is crossed by the Yaya River from West to East. It extends between the Comoé River and the Kossan or Tossan River. The banks of the Kossan River and the tributaries of the Comoé River within this forest massif, which covers an area of approximately 4,834 hectares, are considered a fragile ecosystem. They constitute essential habitats for the survival of certain plants and animals' species due to the microclimate favourable to their development.

As the selected site has been submitted to logging for long time, and some of its areas have been converted into crops plantations, the research questions are: a) What is the current state of the overall vegetation? b) What are the richness and diversity of the local flora and fauna in both the forest and rivers and, what is their correlation? What is the importance of both forest and water ecosystems to local population? What are the rights and future of the local population who had their crops plantations in the current natural reserve? What is the best mechanism to manage both the riverine population and the forest and rivers in the research site? What are the climate change local impacts and how to mitigate them?

The methodologies to test above questions are specific to the target science types: a) Plant sciences will combine plots inventory and in walking assessment methods to describe the vegetation and flora; and useful plants will be studied by ethnobotanical enquiries. Phytoplankton carbon stock, phytoplankton species will be sampled and catalogued using a 20 µm mesh plankton net and a Niskin bottle. The water environmental cycles will be studied from meteorological sites while water environmental indicators such as temperature, salinity, pH, dissolved oxygen, conductivity and TDS will be assessed in the field. Anthropogenic activities involving possible pollutants will be assessed and, water and sediment samples will be checked for the concentrations of persistent organic pollutants. b) Macroinvertebrates, Birds, Mammals, Herpetofauna, Fishes and Insects will be assessed through a specific method to each animal group and their uses will be studied by ethnozoological enquiries. c) Social Sciences will use qualitative and quantitative studies to check the relationships between population entities and forests, local knowledge, the bioeconomy, governance, and the recognition and protection of indigenous territories. d) Climate and local vegetation dynamics will be studied through GIS approach. e) Legal sciences will study the community and legal surveys on injustices related to land, water, and pollution will be organized with the surroundings population of the natural Reserve of Mab-Yaya complex. Community dialogues with local authorities and leaders, and interviews with elders, audio-visual collection of traditional knowledge will be organized in addition to the capacity-building workshops on sound forest management, training and legal support for monitoring committees. Some field surveys of customary territories will be applied in addition to information sessions on the legal framework for land tenure and the technical support for securing land tenure.

4 Consortium Composition

The Belmont Forum Guidelines stipulate that "a research consortium should have three or more participants representing at least three different countries, requesting support from at least three participating funding organizations, including academic and non-academic partners in the team". They also aim to "coordinate actions and projects with a transdisciplinary approach to develop innovative solutions to the challenges faced in tropical forest regions".

Since the economic development level and cultural characteristics of various countries will affect the implementation of policies, this project will involve China (with a relatively high-income level and Confucianism-Taoism integrated culture), Indonesia (with a relatively low-income level and Islamic culture), and

Cote d'Ivoire (with a relatively poor economic situation and tribal culture-modern civilization integrated culture) to enhance the practicality and promotability of the research results.

The composition of the research team of this project fully complies with the requirements of the Belmont Forum Guidelines, which is highly reasonable and scientific, and is expected to achieve good research results and extensive social impact. The team covers three participating countries: China, Indonesia, and Côte d'Ivoire (supported by three funding organizations), meeting the basic requirement of three different countries and three participating funding organizations. China, Indonesia and Côte d'Ivoire are all countries with tropical forests, and the in-depth participation of their experts ensures that the research accurately grasps the local characteristics of tropical forests. In terms of personnel composition, the team integrates talents from multiple fields: in the field of natural sciences, there are ecology experts from Beijing Normal University, tropical forest ecology experts from Yogyakarta State University, etc., who are deeply engaged in the mechanism research of forest-river ecosystems; in the field of social sciences, there are rural and environmental policy researchers from the Chinese Academy of Social Sciences, professors of social and economic surveys from Côte d'Ivoire, etc., focusing on governance mechanisms and stakeholder dynamic analysis; in terms of non-academic partners, engineers from PowerChina Group, senior engineers from African Tropical Timber Company, etc., provide practical experience in infrastructure evaluation, sustainable forestry practices, etc. **This diversified structure of "natural sciences + social sciences + non-academic partners" can not only realize in-depth interdisciplinary integration, closely linking scientific data with feasible strategies, but also gather the wisdom of the three countries through global partnerships, extract universal and regional protection methods from the case comparisons among China, Southeast Asia and West Africa, and significantly enhance the promotability and international influence of the research results.** At the same time, the team forms a strong synergistic effect relying on the advantages of all parties. China's theoretical framework and policy integration capabilities, Indonesia's tropical ecological field data and community experience, and Côte d'Ivoire's West African ecological research and economic dimension analysis complement each other. This not only can efficiently reveal the ecological resilience mechanism and service value of tropical forest-river composite ecosystems, but also construct a transnational protection mechanism that takes into account the interests of all parties, providing scientific support and practical examples for global tropical forest protection and sustainable development, and generating far-reaching academic influence and social value.

Experts from China, Indonesia, and Côte d'Ivoire jointly participate in this project, forming a high degree of complementarity in professional fields, regional experience, and role functions, and are expected to produce results with academic influence and social value and realize their promotion and application. **The academic institutions of the three countries form a theoretical support system, and enterprises and non-governmental organizations provide practical support to achieve resource sharing and result transformation. This multi-dimensional complementarity can not only promote academic breakthroughs in the protection of tropical forest-river ecosystems and propose scientific transnational protection mechanisms, but also the results can adapt to the actual needs of different regions, providing a promotable practical model for global tropical forest governance and sustainable development, with both academic influence and social application value**.

The consortium for the "Service Value Assessment and Comprehensive Protection Approaches for Transnational Tropical Forest-River Complex Ecosystems" project brings together a diverse team of experts from China, Indonesia, and Côte d’Ivoire, each contributing unique expertise to address the transdisciplinary challenges of tropical forest-river ecosystem conservation. The composition and roles of key partners are as follows:

(1) Chinese Partners: Leading Ecological Economics and Technical Implementation

①Beijing Normal University (BNU):

- Yin Xin'an (Professor): As the consortium lead, Professor Yin provides overall scientific leadership, leveraging expertise in ecosystem service valuation and transnational environmental governance. His work integrates ecological modeling with socioeconomic analysis, guiding the project's research framework.
- Liu Haifei (Professor): A specialist in landscape ecology, Professor Liu contributes to spatial analysis of forest-river interactions, focusing on habitat connectivity and fragmentation assessments.
- Liu Yimeng (Lecturer): With expertise in environmental economics, Dr. Liu leads the quantification of non-market ecosystem services (e.g., carbon sequestration, water purification) to support valuation methodologies.

②Chinese Academy of Social Sciences (CASS):

- Yu Yuanhe (Assistant Researcher) and Yu Jialin (Assistant Researcher): These scholars specialize in rural and environmental policy, analyzing governance mechanisms and stakeholder dynamics to inform policy-relevant protection strategies.

③Chinapower Construction Group:

- Chen Junhao (Engineer): Brings technical expertise in infrastructure impact assessment and sustainable development, ensuring the project addresses practical implementation challenges in tropical regions.

(2) Indonesian Partners: On-Ground Expertise in Tropical Ecosystems

①Yogyakarta State University:

- TARYONO Siswantoyo Margo (Professor) and AMINATUN Tien (Professor): Leading experts in tropical forest ecology, they contribute field-based research on biodiversity conservation and local ecological knowledge, particularly in Sumatra and Kalimantan.
- Faqih MAARIF (Lecturer) and KHOTIMAH Nurul (Associate Professor): Focus on community engagement, documenting indigenous practices for sustainable resource use and facilitating local participation in conservation.

- Putra HUTAMA Ponty Sya'banto (Doctor): Specializes in hydrological modeling of tropical rivers, supporting the assessment of water-related ecosystem services.

②Mulawarman University:

- KISWANTO Kiswanto (Professor Assistant) and Budiwijaya Rachmat SUBA (Doctor): Contribute expertise in peatland and mangrove ecosystems, critical components of Indonesia's forest-river complexes.

③Al Azhar University of Indonesia:

- SASAERILA Yorianta Hidayat (Dean): Leads institutional partnerships and capacity building, bridging academic research with local NGOs and government agencies.

④Yayasan Sumatra Elephant Gajah Sumatera:

- SUPRAYOGI Bambang (CEO): Provides on-the-ground conservation experience, particularly in mitigating human-elephant conflicts and restoring degraded forest corridors.

(3) Ivorian Partners: African Tropical Forest Governance and Technical Expertise

①Université Alassane Ouattara:

- KOUAME N'Guessan François (Professor) and Kouassi Patrick YAO (Professor): Experts in West African tropical forest ecology, they lead research on Guinean Forests of West Africa, focusing on biodiversity hotspots and climate resilience.
- Monnoin Frederic GUEYE (Lecturer): Contributes to socioeconomic surveys of forest-dependent communities, analyzing livelihood impacts of conservation policies.

②African Tropical Wood (Bois Tropicaux d'Afrique):

- KOUAKOU Gilbert (Senior Engineer): Provides insights into sustainable forestry practices and timber value chains, addressing economic dimensions of conservation.

③Centre De Recherche Pour Le Développement:

- Gérard Landry Konan KRA (Doctor): Specializes in agronomy and land-use change, supporting analysis of deforestation drivers (e.g., agriculture, logging) in Côte d'Ivoire.

④Société Ivoirienne de Réalisation, Production, Etudes et Conseil:

- Loukou Firmin KOUASSI (Senior Engineer): Offers technical expertise in environmental impact assessments for infrastructure projects, ensuring alignment with conservation goals.

⑤Université Polytechnique de San Pedro:

- Mory Latif KONATE (Lecturer): Focuses on coastal forest-river interactions, particularly in the San Pedro region, integrating marine and terrestrial ecosystem dynamics.

⑥Centre de Recherches Océanologiques:

- DIARRA Brahima (Associate Researcher): Contributes to marine-river interface studies, assessing estuarine ecosystem services and resilience.

(4) Synergy and Added Value of International Collaboration

This consortium fosters synergy through:

- Transdisciplinary Integration: Ecologists, economists, policymakers, and local practitioners collaborate to link scientific data with actionable strategies.
- Global Diversity: Case studies across Southeast Asia (Indonesia) and West Africa (Côte d'Ivoire) enable cross-regional comparisons, identifying context-specific and universal protection approaches.
- Capacity Building: Partnerships between academic institutions, NGOs, and industry (e.g., PowerChina, African Tropical Wood) strengthen local research capacity and ensure project outputs are scalable.
- Policy Relevance: By engaging researchers and stakeholders from three continents, the project generates globally applicable insights while addressing region-specific challenges, enhancing the impact of tropical forest-river conservation efforts worldwide.

PART 3: MANAGEMENT PLAN

The project implements a hierarchical management structure for coordination, monitoring, and control. The principal investigator (from Beijing Normal University) takes overall responsibility for the consortium, overseeing strategic direction, resource allocation, and cross-national alignment. National group leaders, representing institutions in China, Indonesia, and Côte d'Ivoire, manage task progress within their respective countries, ensuring local activities align with the project's global objectives.

Monitoring is conducted through regular progress tracking: national teams report on task completion, budget usage, and challenges, which are reviewed by the principal investigator to identify deviations. The project also leverages the multidisciplinary expertise of the team—spanning environmental science, economics, sociology, and more—to validate ecological and economic data, ensuring the accuracy of service value assessments and policy recommendations. Adjustments are made dynamically to address issues like delays in data collection or conflicting policy priorities between countries.

1 Management Processes

(1) Decision-Making and Coordination Mechanisms

- Steering Committee Meetings: These are held periodically (frequency not specified, but implied for cross-national alignment) involving the principal investigator, national group leaders, and key stakeholders (e.g., NGOs like the Sumatra Elephant Foundation from Indonesia). They resolve critical issues such as conflicting forest protection objectives between countries, approve methodologies for service value assessment, and endorse international cooperation routines like skills training or investment.
- Technical Workshops: Researchers from participating institutions (e.g., Beijing Normal University, Yogyakarta State University, Alassane Ouattara University) collaborate through workshops to share findings on forest-river interactions, carbon trade dynamics, and socioeconomic impacts. These workshops ensure

consistency in data collection and analysis across countries.

- Stakeholder Engagement: The project involves local communities, governments, enterprises, and NGOs to gather input on economic activities (e.g., hydropower, fisheries) and policy feasibility. This engagement is critical given the diverse cultural and economic contexts of China, Indonesia, and Côte d'Ivoire.

(2) Task Distribution Among Consortium Members

- Academic Institutions: Lead research on ecological service value assessment and model development. For example, Chinese institutions (Beijing Normal University) contribute expertise in high-income context policy analysis and Confucian cultural considerations; Indonesian universities (Yogyakarta State University) focus on low-income, Islamic cultural perspectives; and Ivorian institutions (Alassane Ouattara University) provide insights into tribal cultures and poor economic conditions.
- Research Institutes: Conduct on-the-ground studies on local policies, stakeholder behaviors, and ecological processes. China's Rural Development Institute and Côte d'Ivoire's Research Center for Development, for instance, analyze how cultural and economic factors influence forest protection measures.
- NGOs and Enterprises: Facilitate practical implementation, such as pilot projects for green hydropower (supported by Indonesia's Sumatra Elephant Foundation) and sustainable fisheries (involving Ivorian enterprises like African Tropical Wood). They also bridge gaps between research and local communities.
- Multidisciplinary Experts: Specialists in environmental science, ecology, economics, and hydraulic engineering collaborate to integrate ecological resilience analysis with economic potential (e.g., carbon sink trading, hydropower revenue models).

2 Milestones and Critical Path

(1) Key phases and dependencies

key phases and dependencies are as follows:

- Baseline Assessment (Months 1–6): Map transnational forest-river ecosystems, collect data on forest-river energy exchange, and survey stakeholder interests. A critical dependency is timely data sharing between countries; delays in tribal community surveys in Côte d'Ivoire could slow subsequent model development.
- Model Development (Months 7–12): Construct ecological service valuation models and economic pathways (e.g., combining carbon trade and hydropower). Validation by all three countries is a key decision point; failure to agree on model parameters may require revisions.
- Pilot Implementation (Months 13–24): Test small green hydropower and fisheries in Indonesia and Côte d'Ivoire, and carbon trade mechanisms between China and other countries. Success here depends on aligning local policies (e.g., Indonesian Islamic cultural norms around resource use) with project goals.
- Policy Formulation (Months 25–30): Draft transnational cooperation agreements and policy recommendations. Critical is resolving conflicts in forest protection priorities (e.g., economic development vs. conservation); delays here would push back final dissemination.
- Dissemination (Months 31–36): Publish results and train stakeholders. Dependencies include successful pilot outcomes and stakeholder buy-in.

(2) Information Flow and Communication

- Collaborative Platforms: A shared digital system allows real-time access to data on forest health, river hydrology, and economic projections, ensuring transparency across countries.
- Regular Communication: Virtual meetings and in-person workshops (hosted rotationally in China, Indonesia, and Côte d'Ivoire) facilitate knowledge exchange. For example, Chinese experts train Indonesian teams in carbon sink monitoring, while Ivorian engineers share tribal community engagement

strategies.

- Result Dissemination: Findings are shared through policy briefs, academic journals, and local outreach (e.g., community workshops in Indonesia and Côte d'Ivoire). This ensures that recommendations are tailored to cultural contexts and adopted by stakeholders.

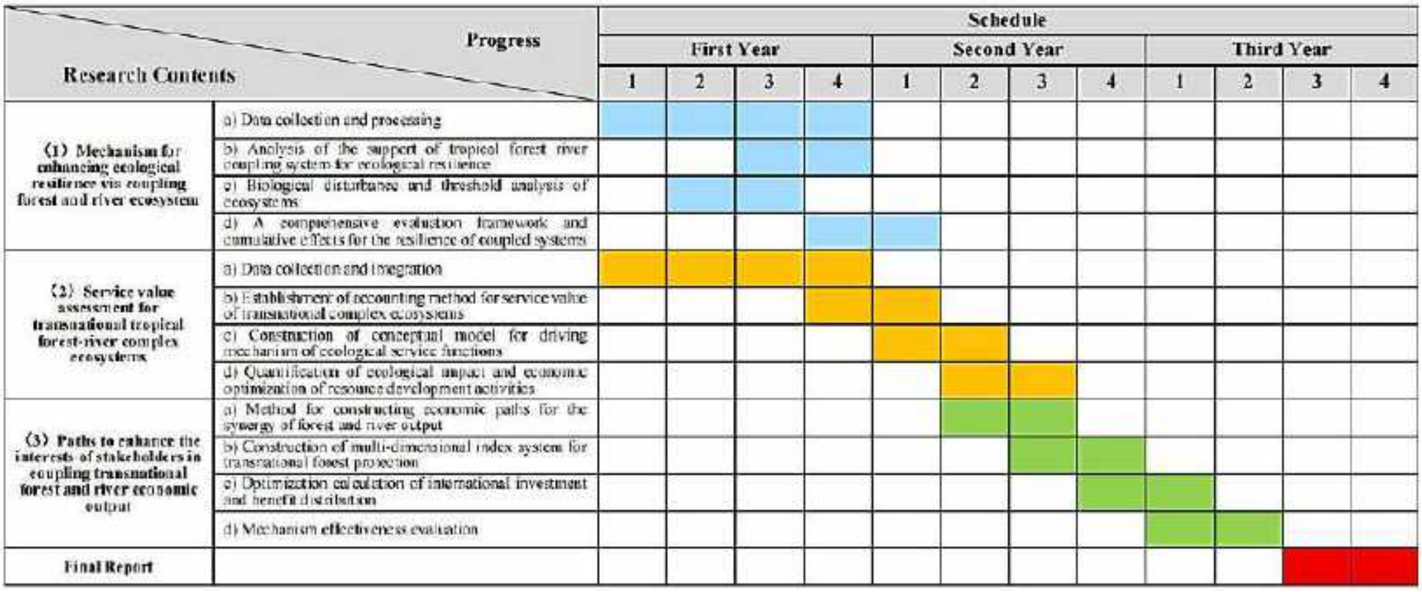

Figure 3-1 Gantt chart of the research plan

This structure ensures that coordination, monitoring, and communication adapt to diverse national contexts, enhancing the project's practicality and transnational impact.

PART 4: IMPACT, ENGAGEMENT, AND DISSEMINATION PLAN

1 Impact

(1) Governments and Policy Makers

- **Benefits**: The project provides transnational policy recommendations tailored to diverse economic and cultural contexts (e.g., balancing forest protection with hydropower development in Indonesia's low-income, Islamic setting; aligning tribal interests with conservation in Côte d'Ivoire). These recommendations help formulate coordinated cross-border protection policies, reducing conflicts between national priorities (e.g., differing forest protection interests) and enhancing the effectiveness of measures like carbon trading or green hydropower regulations.
- **Use Cases**: Governments can adopt the project's methodology for valuing transnational ecosystem services to allocate budgets, design subsidies for forest restoration, and negotiate international cooperation agreements (e.g., China's high-income, Confucian culture facilitating technical support for Indonesia and Côte d'Ivoire).

(2) Local Communities and Indigenous Groups

- **Benefits**: The project identifies sustainable economic pathways (e.g., moderate fisheries, small green hydropower) that increase income while preserving ecosystems. For example, tribal communities in Côte d'Ivoire can gain from fisheries managed within ecological limits, with revenues reinvested in forest protection.
- **Use Cases**: Communities receive training in sustainable resource use (e.g., carbon sink monitoring, eco-friendly fishing) to participate in income-generating activities tied to ecosystem health.

(3) Enterprises and NGOs

- **Benefits**: Enterprises (e.g., hydropower companies, carbon trading firms) gain insights into profitable yet sustainable practices (e.g., "small green hydropower" models). NGOs like Indonesia's Sumatra Elephant Foundation obtain tools to advocate for community-based protection and secure funding through carbon trade partnerships.

- **Use Cases**: Enterprises can adopt the project's economic models to optimize resource extraction (e.g., aligning hydropower output with river ecological resilience), while NGOs use research findings to design targeted outreach programs.

(4) Academic and Research Communities

- **Benefits**: Researchers gain access to novel data on transnational forest-river interactions, cross-cultural policy dynamics, and integrated ecological-economic modeling, advancing knowledge in ecology, economics, and sociology.
- **Use Cases**: Academic institutions (e.g., Beijing Normal University, Yogyakarta State University) can build on the project's conceptual models of ecosystem service drivers (carbon sinks, hydropower, fisheries) for further research.

2 Engagement

(1) Engagement Methods

- **Stakeholder Forums**: Annual in-person meetings in China, Indonesia, and Côte d'Ivoire bring together governments, communities, enterprises, and NGOs to review progress, provide feedback on pilot projects (e.g., hydropower trials), and co-design policy recommendations. These forums address cultural nuances (e.g., tribal decision-making processes in Côte d'Ivoire) to ensure relevance.
- **Training Workshops**: Technical training (e.g., carbon sink measurement, river health monitoring) is provided to local communities and enterprises, led by multidisciplinary team members (e.g., hydraulic engineers from PowerChina).
- **Public Outreach**: Localized campaigns (e.g., community workshops, cultural events) communicate the link between ecosystem health and livelihoods, leveraging Confucian, Islamic, and tribal cultural values to foster ownership.

(2) Capture and Storage

- **Data Sources**: Information includes ecological data (forest-river energy exchange, carbon sink levels), socioeconomic surveys (stakeholder behaviors, policy impacts), and cultural assessments (e.g., tribal vs. Islamic perspectives on resource use).

- **Storage Systems**: A centralized, secure digital platform (accessible to consortium members via role-based permissions) stores data. This platform is managed by the principal investigator's team to ensure consistency.

(3) Long-Term Archiving and Release

- **Data Governance**: National teams (e.g., Indonesian researchers from Yogyakarta State University, Ivorian teams from Alassane Ouattara University) validate local data for accuracy before integration. The project's multidisciplinary experts (environmental scientists, sociologists) review datasets to ensure alignment with research objectives (e.g., linking hydropower data to river resilience metrics).
- **Archiving**: Post-project, data is archived in institutional repositories of participating organizations (e.g., Beijing Normal University's library, Côte d'Ivoire's Research Center for Development databases) and international platforms (e.g., global forestry data portals) for long-term access.
- **Release Timeline**: Data is made publicly available after publication or proprietary use (e.g., policy drafting by governments). For publicly funded components, data is released within 1–2 years of project completion to comply with open-access mandates.

3 Dissemination plan

(1) Dissemination

- **Policy Briefs**: Tailored reports for governments, translated into local languages (e.g., Bahasa Indonesia, French for Côte d'Ivoire), highlighting actionable recommendations (e.g., transnational carbon trade frameworks, cultural-adapted protection incentives).
- **Academic Publications**: Peer-reviewed journals (e.g., *Ecological Indicators*, *Environmental Policy*) publish findings on ecosystem service valuation, cross-border cooperation mechanisms, and cultural impacts.
- **Public Outreach**: Media campaigns (e.g., videos, community posters) and

workshops communicate results to non-experts, emphasizing local benefits (e.g., “how sustainable fisheries support your village”).

(2) Publication and Data Protection

- **Intellectual Property**: Data and findings are protected during proprietary use (e.g., policy negotiations, enterprise pilot projects) to ensure stakeholders (e.g., governments, participating companies) can apply results without external interference.
- **Timely Release**: For publicly funded outputs, results are released within 6–12 months of publication to balance openness with the need for practical application. The consortium ensures compliance with funding mandates (e.g., China’s National Natural Science Foundation requirements) through a dedicated dissemination committee.

(3) Resourcing

- **Funding Allocation**: Resources from participating countries, e.g. 278,600 $ (239.74 K€) from China, 191,400 $ (181.00 K€) from Indonesia, 32,700 $ (31.00 K€) from Côte d’Ivoire, support data collection (fieldwork, surveys), platform development, training workshops, and archiving.
- **Personnel**: Multidisciplinary teams (including data managers, outreach specialists, and policy analysts) are dedicated to information management and dissemination, ensuring effective execution of engagement and archiving plans.

PART 5: EXTERNAL FUNDING

Not available.

PART 6: FUNDING JUSTIFICATION

Each of the three participating countries will sponsor personnel from their country. The National Natural Science Foundation of China will provide 239.74K€ (2 million RMB), the National Research and Innovation Agency of Indonesia will provide 181.00 K€ (3 billion IDR) and the Fund for Science, Technology, and Innovation of Côte d'Ivoire will provide 31.00 K€.

1 China

Total: 2 million￥, 239.740K€.

(1) Salaries (370,500￥, 44.419 K€)

The budget for Salaries required for the project is 370,500￥, 44.419 K€.

①Salaries for Students and Temporary Staff (298,500￥)

Salaries refer to the fees paid to graduate students without regular income and temporary staff involved in the project research, as well as social insurance subsidies for temporary staff. The budget standards for these costs are as follows: PhD 2500￥ per month, master's students 1000￥ per month, and temporary workers 600￥ per day. The total budget for salaries costs is 298,500￥.

a. Salaries for graduate students (210,000￥)

During the execution period of this project, two PhD and two master's students will participate. Each student's involvement in the project is estimated at 10 months per year, totaling 3 years. The total cost is calculated as follows: (2,500￥person/month × 2 persons + 1,000￥/person/month × 2 persons) × 10 months/year × 3 years = 210,000￥.

b. Salaries for GIS manual interpretation services (16,500￥)

The area of the transboundary tropical forest between China and Laos is approximately 3,000 km^2. According to the requirements of the nature reserve habitat quality study, Gaofen-2 satellite imagery with a resolution of 2m will be selected. Each scene covers an area of 1,000 km^2. The market price for manual interpretation per scene is 6,000￥. The total cost is calculated as follows: (3,000 km² / 1,000 km²/scene) × 6,000￥/scene = 16,500￥.

c. Salaries for temporary staff (72,000￥)

During the execution period of this project, field surveys and monitoring of the tropical forest are required. Due to the numerous monitoring points and remote locations of the sample areas, temporary personnel need to be hired to assist with field positioning and observation. Temporary recruitment of 4 local laborers is required to participate in the work, with each assignment lasting 5 days. The cost is calculated at 600￥ per person per day. The total cost for this item is: 4 persons × 5 days/assignment × 2 assignments/year × 3 years × 600￥/person/day = 72,000￥.

In summary, the total salaries for Students and Temporary Staff amount to 210,000 + 72,000 = 298,500￥

②Expert Consultation Fees (72,000￥)

Expert Consultation Fees are allocated for the payment of temporarily hired expert consultants The project primarily organizes consultations in the form of meetings. The expert consultation fee standards are as follows: for the first two days of the meeting, senior technical personnel 1,500￥ per day, and other professionals 1,000￥ per day. For the third day and beyond, senior technical personnel 1,000￥per day, and other professionals 400￥ per day. It is planned to hire experts for a total of 4 person-times, with a meeting duration of 3 days. During the project research period, 6 seminars will be organized. The budget for expert consultation fees is calculated as 4 person-times × (1,500￥/person/day × 2 days + 1,000￥/person/day × 1 day) × 6 times = 72,000￥.

In summary, the total budget for Salaries required for this research is 298,500 + 72,000 = 370,500￥, is equivalent to 44.419 K€.

(2)Travel（672,800￥, 80.642K€）

①Travel Expenses (334,800￥)

Travel expenses include out-of-town travel costs, local transportation fees, and other related expenditures incurred during the project research process for conducting scientific experiments (tests), scientific investigations, business research, academic exchanges, and similar activities. It will be reimbursed based on actual receipts, strictly adhering to the relevant provisions of the " Central and State Organs' Travel Expenses Administration Measures" (Finance[2013] No.531) and the "Notice on Adjusting Relevant Issues Regarding Travel Accommodation Fees for Organs of the Central Government and the State Council" (Finance[2015] No.497). Accommodation subsidies 380￥ per day per room, meal subsidies 100￥ per person per occurrence, and local transportation subsidies 80￥ per person per day. Local transportation subsidies will not be claimed if a vehicle is rented. Due to the research area being located in the the tropical forest between China and Laos, it is necessary to rent vehicles for researchers to collect samples and transport monitoring equipment. The daily vehicle rental cost is 500￥(excluding fuel costs). The total budget for travel expenses is 334,800￥ detailed as follows:

Each field monitoring and survey trip lasts 10 days, with vehicle rental for 9 days. Each trip involves 6 participants, and at least 2 such field surveys will be conducted annually.

a. Inter-city Transportation: 3,000￥/person (round trip) × 6 people × 2 trips/year × 3 years = 108,000￥;

b. Accommodation: 380￥/day/room × 6 rooms × 10 nights × 2 trips/year × 3 years = 136,800￥;

c. Meal Allowance: 100￥/person/day × 10 days × 6 people × 2 trips/year × 3 years = 36,000￥;

d. Vehicle Rental: 9 days/trip × 2 trips/year × 3 years × 500￥/day × 2 vehicles = 54,000￥.

The total for this item is 334,800￥.

②Conference Expenses (50,000￥)

In order to promptly refine achievements and clarify work priorities, as well as to summarize and exchange research progress and formulate the next work plan, two annual project summary meetings will be held. The participants will include the project leader and key personnel, totaling approximately 20 individuals, with an additional 5 external experts invited, whose research areas involve tropical forest ecological function services, energy-carbon coupling, etc. The calculation standard for conference expenses will be in accordance with the relevant provisions of the "The Central and National Government Meeting Expenses Management Method " (Finance[2016] No. 214). The scope of conference expenses includes accommodation, food, meeting room rental, transportation, document printing, etc., with a fixed standard of 500￥ per person per day. Each meeting lasts 2 days, calculated at 500 ￥ per person per day. The expense for this item is: (20 + 5) people/meeting × 2 meetings × 2 days × 500￥/person/day = 50,000￥.

③International Cooperation and Exchange Expenses (288,000￥)

International cooperation and exchange primarily include two aspects: international conferences and field visits to Indonesia. The budget for international cooperation and exchange expenses is 288,000￥, with the detailed breakdown as follows:

a. International Academic Conference Fees: 160,000￥

To enhance the international influence and research level of the project, key academic staff are planned to attend international conferences on forest ecosystem research. Expenses for overseas academic exchanges will strictly adhere to the "Provisions on the Management of Funds for Official Temporary Overseas Trips" (Finance[2013] No. 516). Travel expenses for personnel will be reimbursed based on actual standard rates for ordinary personnel. These costs mainly include conference registration fees, round-trip airfare, meals, accommodation, and miscellaneous expenses. Project team members will attend overseas conferences a total of 4 times. Registration fees are budgeted at 5,000￥ per person. Meal, accommodation, and transportation costs are budgeted at 3,000￥ per person per day, with each trip lasting 5 days. Thus, the cost for this item is (3,000￥/person/day × 5 days + 5,000￥/person) × 4 persons = 80,000￥. Round-trip airfare is budgeted at 20,000￥ per person.

Total: (80,000￥ + 20,000￥)× 4 persons = 160,000￥

b. Expenses for field visits to Indonesia and Cote d'Ivoire (128,000￥)

According to research requirements, the outbound exchange aims to learn advanced experiences and practices from foreign counterparts in tropical forest and river protection through methods such as field surveys, academic seminars, and collaborative research, providing strong support and references for this project. The Chinese outbound exchange will focus on core topics including river hydrology-water ecology simulation and prediction technologies, and multifunctionality of tropical forest ecosystem services.

Expenses for Chinese team members' visit (4 persons): 128,000￥

a. Round-trip airfare: 20,000￥/person × 4 persons = 80,000￥.

b. Accommodation costs: 900￥/person/night (125$) × 4 persons × 8 nights = 28,800￥.

c. Meal expenses: 350￥/person/day (50$) × 4 persons × 8 days = 11,200￥.

d. Miscellaneous expenses: 250￥/day (30$) × 4 persons × 8 days = 8,000￥.

In summary, the total international cooperation and exchange expenses amount to: 160,000 + 128,000 = 288,000￥.

3 Overhead（35,700￥, 4.280K€）

①Office Supplies

15 printer toner cartridges purchased at 200￥ each, totaling 3,000￥.

20 boxes of printing paper purchased, with 5 reams per box at 100￥ per ream, totaling 2,000￥.

20 folders purchased at 10￥ each, totaling 200￥.

2,000 labels purchased at 100￥ in total.

100 carbon ink pens purchased at 2￥ each, totaling 300￥.

20 notebooks purchased at 50￥ each, totaling 1,000￥.

5 file cabinets purchased at 400￥ each, totaling 2,000￥.

6 sets of office desks and chairs purchased at 1,000￥ per set, totaling 6,000￥.

The total cost for office supplies is: 3,000 + 2,000 + 200 + 300 + 1,000 + 2,000 + 6,000 =14,500￥.

②Field Survey Supplies

5 telescopes at 500￥ each, totaling 2,500￥.

5 compasses at 100￥ each, totaling 500￥.

5 soil samplers at 200￥ each, totaling 1,000￥.

2 tree growth borers at 2,000￥ each, totaling 4,000￥.

4 water samplers at 150￥ each, totaling 600￥.

5 waterproof flashlights at 200￥ each, totaling 1,000￥.

2 forestry survey toolkits at 2,000￥ each, totaling4,000￥.

5 temperature and humidity meters at 200￥ each, totaling 1,000￥.

Total cost for field survey supplies: 2,500 + 500 + 1,000 +4,000 + 600 + 1,000 + 4,000+ 1,000 =14,600￥.

③Safety Protection Supplies

5 mosquito repellents at 50￥ each, totaling 250￥.

5 safety helmets at 30￥ each, totaling 150￥.

10 pairs of gloves at 30￥ per pair, totaling 300￥.

5 first-aid kits at 100￥ each, totaling 500￥.

10 protective suits at 100￥ each, totaling 1,000￥.

Total cost for safety protection supplies: 250 + 150 + 300 + 500 + 1,000 = 2,200￥.

④Recording Devices

10 high-definition professional recording pens at 440￥ each, totaling 4,400￥.

In summary, the total material costs in this budget are: 14,500+ 14,600 + 2,200+ 4,400 = 35,700￥, is equivalent to 4.280K€.

(4)Consumables (645,000￥, 77.310K€)

Consumables are mainly used for data processing, analysis, and ecosystem sampling and testing expenses. The specific budget is as follows:

①Data Processing and Analysis

To increase computing resources and improve computational speed, it is planned to purchase a large server for program calculations, at a rate of 2,600￥ per day, for 300 days of use. The budget is 2,600￥/day ×300 days = 78,000 ￥.

②River Ecosystem Sampling and Testing Expenses

This includes water quality sampling and testing, aquatic biological sampling and identification, and habitat sampling and identification. During the project period, it is expected to conduct three times of river ecosystem sampling per year, with 15 sampling points set up for investigation and testing.

a. Water Quality Sampling and Testing: Each sample requires collection and testing of 8 water quality indicators at 800￥ per sample. Total cost: 15 samples × 800￥/sample = 10,500￥.

b. Aquatic Biological Sampling and Identification: Each sample undergoes 6 aquatic biological monitoring indicators at 1,500￥ per sample. Total cost: 15 samples ×1,500 ￥/sample = 22,500￥.

c. Habitat Sampling and Identification: 3 habitat indicators are identified per sample at 3,000￥.

The budget is calculated as follows: 3 rounds/year ×3 years ×(10,500 ￥ + 22,500￥ + 3,000￥) =324,000￥.

③Sampling and Testing Expenses for Tropical Forest Ecosystems

This component covers the costs associated with routine soil indicator testing and microbial analysis. During the project period, it is planned to conduct sampling of the forest ecosystem per year, with investigations and testing to be performed at 15 designated sites each time.

a. Routine Soil Indicator Testing: Each sample undergoes 7 indicators related to heavy metals and inorganic substances, at 800￥ per sample, totaling 12,000￥.

b. Microbial analysis: Each sample requires soil microbial testing, at 1,000 ￥ per sample, totaling 15,000￥.

The total budget for this item is calculated as follows: 3 times/year ×3 years × (15,000￥ + 12,000￥) = 243,000￥.

In summary, the total budget allocated for Consumables is calculated as follows: 78,000 + 324,000 + 243,000 = 645,000￥, is equivalent to 77.310K€.

(5) Facilities and Equipment (112,000￥, 13.428K€)

This category primarily covers the purchase of data collection and monitoring equipment. Based on the equipment required for this research and current market prices, the total equipment budget is 112,000￥, is equivalent to 13.428K€. The detailed breakdown is as follows:

①Portable Field Terminal Workstations

To facilitate real-time data processing and analysis during tropical forest ecosystem surveys, 2 portable field data processing workstations will be purchased (Core i7-6200U dual-core processor, 1TB SATA III hard drive, wireless card, 3-cell battery).

Unit price: 22,000￥ per workstation.

Total cost: 2 units ×22,000 ￥/unit = 44,000￥.

Okay, here are the official English translations for the two budget items:

②Portable Water Quality Monitor

To facilitate real-time detection during river sampling, 2 portable water quality monitors of the Hould brand will be purchased. These monitors are capable of detecting over 50 water quality indicators.

Unit price: 18,000￥ per monitor.

Total cost: 2 units ×18,000 ￥/unit = 36,000￥.

③Unmanned Aerial Vehicle (UAV)

In the investigation of the tropical forest ecosystem, UAVs are required to conduct aerial photography of the survey areas, including forests and rivers. Due to the large area of the study region, investigations need to be conducted in groups, necessitating the purchase of 2 UAVs.

Unit price: 6,000￥ per UAV.

Total cost: 2 units ×6,000 ￥/unit = 12,000￥.

④Differential GPS-DGPS

To facilitate precise location determination of sampling points during field trips undertaken by project team members, 2 differential GPS receivers will be purchased.

Unit price: 10,000￥ per DGPS.

Total cost: 2 units ×10,000 ￥/unit= 20,000￥.

(6) Other (including Sub-Award and/or Sub-Contract, 164,000￥, 19.662K€)

These expenses refer to the costs incurred during the project implementation, including publication fees, material costs, fees for purchasing specialized software, literature search fees, professional communication fees, patent application fees, and other intellectual property-related expenses. The total budget for this category is 164,000￥. The detailed budget breakdown is as follows:

①Chinese Journal Paper

The project plans to publish 6 papers in Chinese journals. The page charges are estimated 3,000￥ per article, resulting in a total budget of 6 articles × 3,000￥/article = 18,000￥.

②SCI Journal Paper

The project plans to publish 6 SCI-indexed papers in mainstream international journals. Given that most papers will include color figures, the page charges are estimated at 10,000￥ per paper, resulting in a budget of 6 papers ×10,000 ￥/paper = 60,000￥.

③Academic Monograph

The project plans to publish 1 academic monograph, with an estimated cost of 60,000￥.

④Invention Patent

The project plans to apply for 2 invention patents, with an estimated cost of 8,000￥ per patent, resulting in a total budget of 2 patents ×8,000 ￥/patent = 16,000￥.

⑤Literature Search

Due to the research needs of the project, various literature searches are required. The cost is estimated at 3,000￥ per year for 4 years, resulting in a total budget of 4 years ×3,000 ￥/year = 12,000￥.

In summary, the total budget for Publication/Literature/Information Dissemination/Intellectual Property Affairs within this project is calculated as follows: 18,000 + 60,000 + 60,000 + 16,000+ 12,000 = 164,000￥, is equivalent to 19.662K€.

2 Indonesia

Total: 3 billion IDR, 181K €

(1) Salaries

The budget for Salaries required for the project is 44,419 €.

Salaries refer to the fees paid to graduate students without regular income and temporary staff involved in the project research, as well as social insurance subsidies for temporary staff. The budget standards for these costs are as follows: PhD 299.76 € per month, master's students 119.90 € per month, and temporary workers 71.94 € per day. The total budget for salaries costs is 35,818 €.

a. Salaries for graduate students (25,180 €)

During the execution period of this project, two PhD and two master’s students will participate. Each student’s involvement in the project is estimated at 10 months per year, totaling 3 years. The total cost is calculated as follows: (299.76 €/person/month × 2 persons + 119.90 €/person/month × 2 persons) × 10 months/year × 3 years = 25,180 €.

b. Salaries for GIS manual interpretation services (19,239 €)

According to the requirements of the nature reserve habitat quality study, Satellite imagery with a resolution of 2m will be selected. Each scene covers an area of 500 km². The market price for manual interpretation per scene is 1,923.9 €. The total cost is calculated as follows: (5,000 km² / 500 km²/scene) × 1,923.9 €/scene = 19,239 €.

(2)Travel

The budget for Travel required for the project is 46,156 €.

①Travel Expenses (40,144 €)

The total budget for travel expenses is 40,144 € detailed as follows:

Each field monitoring and survey trip lasts 10 days, with vehicle rental for 9 days. Each trip involves 6 participants, and at least 2 such field surveys will be conducted annually.

a. Inter-city Transportation: 359.71 €/person (round trip) × 6 people × 2 trips/year × 3 years = 12,950 €;

b. Accommodation: 45.56 €/day/room × 6 rooms × 10 nights × 2 trips/year × 3 years = 16,403 €;

c. Meal Allowance: 11.99 €/person/day × 10 days × 6 people × 2 trips/year × 3 years = 4,317 €;

d. Vehicle Rental: 9 days/trip × 2 trips/year × 3 years × 59.95 €/day × 2 vehicles = 6,474 €.

The total for this item is 40,144 €.

②Conference Expenses (6,012 €)

In order to promptly refine achievements and clarify work priorities, as well as to summarize and exchange research progress and formulate the next work plan, two annual project summary meetings will be held. The participants will include the project leader and key personnel, totaling approximately 20 individuals, with an additional 5 external experts invited, whose research areas involve tropical forest ecological function services, energy-carbon coupling, etc. The scope of conference expenses includes accommodation, food, meeting room rental, transportation, document printing, etc., with a fixed standard of 59.95 € per person per day. Each meeting lasts 2 days, calculated at 59.95 € per person per day. The expense for this item is: (20 + 5) people/meeting × 2 meetings × 2 days × 59.95 €/person/day = 6,012 €.

(3)Overhead

The budget for Overhead required for the project is 3,489 €.

①Office Supplies (1,738 €)

10 printer toner cartridges purchased at 23.98 € each, totaling 239.8 € (reduced from 15 cartridges).

15 boxes of printing paper purchased, with 5 reams per box at 11.99 € per ream, totaling 899.25 € (reduced from 20 boxes).

15 folders purchased at 1.20 € each, totaling 18 € (reduced from 20 folders).

4 file cabinets purchased at 47.96 € each, totaling 191.84 € (reduced from 5 cabinets).

5 sets of office desks and chairs purchased at 119.90 € per set, totaling 599.5 € (reduced from 6 sets).

The total cost for office supplies is: 239.8 + 899.25 + 18 + 191.84 + 599.5 = 1,738 € (rounded).

②Field Survey Supplies (1,751 €)

4 telescopes at 59.95 € each, totaling 239.8 € (reduced from 5 telescopes).

4 compasses at 11.99 € each, totaling 47.96 € (reduced from 5 compasses).

4 soil samplers at 23.98 € each, totaling 95.92 € (reduced from 5 samplers).

1 tree growth borer at 239.81 € each, totaling 239.81 € (reduced from 2 borers).

3 water samplers at 17.99 € each, totaling 53.97 € (reduced from 4 samplers).

2 forestry survey toolkits at 239.81 € each, totaling 479.62 € (kept as original quantity).

4 temperature and humidity meters at 23.98 € each, totaling 95.92 € (reduced from 5 meters).

Total cost for field survey supplies: 239.8 + 47.96 + 95.92 + 239.81 + 53.97 + 479.62 + 95.92 = 1,751 €.

(4) Consumables

The budget for Consumables required for the project is 48,201 €.

①Data Processing and Analysis (9,352 €)

To increase computing resources and improve computational speed, it is planned to purchase a large server for program calculations, at a rate of 31.17 € per day, for 300 days of use. The budget is 31.17 €/day × 300 days = 9,351 € (rounded to 9,352 €).

②River Ecosystem Sampling and Testing Expenses (38,849 €)

This includes water quality sampling and testing, aquatic biological sampling and identification, and habitat sampling and identification. During the project period, it is expected to conduct three times of river ecosystem sampling per year, with 15 sampling points set up for investigation and testing.

a. Water Quality Sampling and Testing: Each sample requires collection and testing of 8 water quality indicators at 95.92 € per sample. Total cost for one round: 15 samples × 95.92 €/sample = 1,438.8 €.

b. Aquatic Biological Sampling and Identification: Each sample undergoes 6 aquatic biological monitoring indicators at 179.86 € per sample. Total cost for one round: 15 samples × 179.86 €/sample = 2,697.9 €.

c. Habitat Sampling and Identification: 3 habitat indicators are identified per sample at 359.71 €.

The budget is calculated as follows: 3 rounds/year × 3 years × (1,438.8 € + 2,697.9 € + 359.71 €) = 38,849 €.

(5) Facilities and Equipment

NA

(6) Other

The total budget for this category is 38,735 €.

①SCI Journal Paper (7,194 €)

The project plans to publish 6 SCI-indexed papers in mainstream international journals. Given that most papers will include color figures, the page charges are estimated at 1,199.03 € per paper, resulting in a budget of 6 papers × 1,199.03 €/paper = 7,194 €.

②Academic Monograph (16,267 €)

The project plans to publish 1 academic monograph, with an estimated cost of 16,267€.

③Invention Patent (2,918 €)

The project plans to apply for 2 invention patents, with an estimated cost of 1459.02 € per patent, resulting in a total budget of 2 patents × 1459.02 €/patent = 2,918 €.

④Literature Search (1,439 €)

Due to the research needs of the project, various literature searches are required. The cost is estimated at 359.71 € per year for 4 years, resulting in a total budget of 4 years × 359.71 €/year = 1,439 €.

3 Côte d'Ivoire

Total: 31K €

(1) Salaries

The total budget for salaries is 10,500 €.

a Salaries for graduate students (6,000 €)

During the project, 1 PhD student and 1 master’s student will participate for 8 months per year, totaling 2 years. The budget standards are as follows: PhD 250 € per month, master's students 125 € per month.

Calculation: (250 €/person/month × 1 person + 125 €/person/month × 1 person) × 8 months/year × 2 years = 6,000 €.

b Salaries for GIS manual interpretation services (4,500 €)

For the habitat quality study, 2m-resolution satellite imagery is used, with each scene covering 1,000 km^2. The market price for manual interpretation per scene is 900 €. The total study area is 5,000 km^2.

Calculation: (5,000 km^2 / 1,000 km^2/scene) × 900 €/scene = 4,500 €.

(2) Travel

The total budget for travel is 10,800 €.

①Travel Expenses (9,000 €)

Each field survey trip lasts 8 days, with vehicle rental for 7 days. Each trip involves 4 participants, and 1 such field survey is conducted annually for 3 years.

a. Inter-city Transportation: 300 €/person (round trip) × 4 people × 1 trip/year × 3 years = 3,600 €;

b. Accommodation: 40 €/day/room × 4 rooms × 8 nights × 1 trip/year × 3 years = 3,840 €;

c. Meal Allowance: 5.31 €/person/day × 8 days × 4 people × 1 trip/year ×3 years = 510 €;

d. Vehicle Rental: 7 days/trip × 1 trip/year × 3 years × 50 €/day × 1 vehicle = 1050 €.

The total for this item is 9,000 €.

②Conference Expenses (1,800 €)

One annual project summary meeting is held, with 10 project members and 2 external experts. The cost standard is 50 € per person per day, and each meeting lasts 2 days.

Calculation: (10 + 2) people/meeting × 1 meeting × 2 days × 50 €/person/day = 1,200 €.

Additional 600 € is allocated for meeting materials and on-site coordination.

(3) Overhead

The total budget for overhead is 2,700 €.

①Office Supplies (1,500 €)

5 printer toner cartridges at 30 € each, totaling 150 €;

10 boxes of printing paper (5 reams/box) at 10 € per ream, totaling 500 €;

3 sets of office desks and chairs at 250 € per set, totaling 750 €;

10 folders at 10 € in total;

1 printer at 90 €.

Total: 150 + 500 + 750 + 10 +90= 1,500 €.

②Field Survey Supplies (1,200 €)

2 telescopes at 100 € each, totaling 200 €;

3 soil samplers at 50 € each, totaling 150 €;

1 forestry survey toolkit at 600 €;

2 temperature and humidity meters at 125 € each, totaling 250 €.

Total: 200 + 150 + 600 + 250 = 1,200 €.

(4) Consumables

The total budget for consumables is 5,500 €.

①Data Processing and Analysis (2,000 €)

A server is rented for data processing at 20 €/day for 100 days.

Calculation: 20 €/day × 100 days = 2,000 €.

②Ecosystem Sampling and Testing Expenses (3,500 €)

1 round of sampling is conducted per year for 2 years, with 5 sampling points.

a. Water Quality Sampling and Testing: 5 samples × 100 €/sample = 500 € per round;

b. Aquatic Biological Sampling: 5 samples × 150 €/sample = 750 € per round.

Total for the project: 2 years × (500 € + 750 €) = 2,500 €.

Additional 1,000 € is allocated for habitat sampling materials.

(5) Facilities and Equipment

NA

(6) Other

The total budget for other expenses is 1,500 €.

①SCI Journal Paper (300 €)

1 SCI paper is planned to be published, with page charges estimated at 300 €.

②Literature Search (800 €)

Literature access fees are estimated at 200 € per year for 4 years.

Calculation: 4 years × 200 €/year = 800 €.

③Small Materials (400 €)

Covers minor expenses such as document printing and software subscriptions.

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PART 8: SUPPORTING LETTERS

Not available.

PART 9: ELIGIBILITY ANNEXES

Not available.