OUTCOMES AND POLICY IMPLICATIONS OF BIORESOURCES AND BIODIVERSITY OF PHASE I FOR PHASE 2: INDONESIA AND ASEAN’s PERSPECTIVE

Prof. Dr. Enny Sudarmonowati
enny003@lipi.go.id; e.sudarmonowati@gmail.com

Side event in the 11th ASEAN STI Week, Bangkok, 14-17 June 2021
Research Topics in WP3: 3 clusters

1. Biodiversity: focuses on the biodiversity exploration/prospection, monitoring, and conservation.
2. Biomaterials: focuses on the development of innovative utilization of biomaterials and biodiversity.
3. Dissemination: focuses on the utilization and diffusion of innovative technology to the society.

Joint Labs:
LIPI: 1) RC Biomaterials; 2) RC Biology, 3) Center for Utilization of Science and Technology and Innovation (former: Center for Innovation)

Kyoto University: GSA, RISH

(modified from Watanabe & Kanzaki, 2019)
Biodiversity & Bioprospecting

- Strengthening the biological diversity information database and depository
- Biological resource research based on ownership of the bio-diversity and Access and Benefit Sharing (ABS)

Bioresource Utilization

- Creation of maximum values from the assembled structures of biomass
- Developing various biological processing for waste management to bio-energy

Research & Dissemination

- Sustainable use of peatland
- Stingless Bee: Taxonomy & Ecology to Value Chain
A. Improving from only focusing in each WP to become interlink with other WPs and involving more ASEAN members, more institutions/universities, more countries outside ASEAN (RoK, China, UK, USA, Australia)

B. Although certain activities have not been completed due to the nature of the research (to be continued in the 2nd Phase), all selected activities are useful as they tackled major problems faced in Indonesia and ASEAN countries such as:
- impact of forest fire on regeneration based on monitoring several years → need long time regeneration
- bioprospecting for high value products → bioeconomy
- utilization natural resources by local community in peat swamp area → the importance of local community and traditional knowledge
- utilization of biodiversity for trading and waste management using bioresources such as microorganism especially fungi → tackling environmental issue using bioresources
- utilization of biomass
Some of them have been informed to policy makers and have been adapted to the policy of local government, some which have not completed yet but the issues need to be informed to policy makers based on Phase I results combined with other results should be done asap → never too late as long as still relevant and timely.

Maximized the results by counterpart funding from other sources e.g. government DIPA project to LIPI, Government special project such as IBSAP, private sectors such as Jababeka, UNESCO funding through MAB YSA (Man and Biosphere Young Scientist Award) 2019 winner on White rot fungi exploration in Berbak Sembilang Biosphere Reserve (South Sumatra Province) for waste water treatment

Supported with projects of JASTIP-Net, small amount of funding but it has connected ASEAN countries and as seed money to search other funding sources from each government and partners.
• Enormous publications, but still lacking: the use of research results for the basis of policy!
• On its way to contribute to SDGs achievement, bioeconomy, green economy, circular economy.
WP 3: Bioresources and Biodiversity

Green Economy
Circular Economy
Low Carbon Society
Biodiversity-based Value Chain
Sustainable Future
Human Security
Research groups:
1. R03: Isolation, purification and characterization of laccase produced by newly isolated Indonesian fungi
2. R04: Searching and Characterization of Economically Potential Utilizations of Tropical Wood and Bamboo Species
3. R05: High Durable Wood Structure and Low Cost Wooden House
4. R06: Development of plants and wood decayed fungi for bio-attractants in wood-attacking insect
5. R07: Evaluation of termite biodiversity in urban conservation areas (UCAs) in Indonesia: Batam Island, Kuningan (West Java), and Baturaden (Central Java)
6. R08: Development of Particleboard Using Bamboo and Waste of Corn and Natural Adhesives
7. R09: Functionalization of Lignin Isolated from Acacia mangium Black Liquor by Polymer Blending and Grafting
8. R10: Development of energy storage device from biomass
10. R12: Development of ECO-house Concepts for A Traditional-Modern Combination Design of Wooden House Construction

JASTIP Net 2018/2019
Research groups:
1. Bioremediation of synthetic dyes, polycyclic aromatic hydrocarbons (PAHs) and crude oil by tropical fungi from Indonesia and Thailand

(D.H.Y. Yanto, 2019)
Some 2018 Activities
(D.H.Y. Yanto, 2019)

Isolation, purification and characterization of laccase produced by newly isolated Indonesian fungi (R03) (Dr. Dede Heri Yuli Yanto (RC Biomaterials LIPI), Prof. Takashi Watanabe (RISH Kyoto Univ))

Exploration of WRF in Toba supported by IBSAP Program, LIPI

Searching and Characterization of Economically Potential Utilization of Tropical Wood and Bamboo Species (R04) (Dr. Wahyu Dwianto – RC Biomaterials, Prof. Junji Sugiyama (RISH Kyoto Univ))
Some 2018 Activities
(D.H.Y. Yanto, 2019)

High Durable Wood Structure and Low Cost Wooden House (R05)
Agung Sumarno (RC Biomaterials LIPI), Dr. Akihisa Kitamori (RISH Kyoto Univ)

Development of particleboard using bamboo and waste of corn and natural adhesives (Prof. Subyakto (RC Biomaterials), Dr. Kenji Umemura (RISH Kyoto Univ))

Partly supported by DIPA LIPI program
2019 - 2020:

1. R03: Production of laccase enzyme from tropical fungi and their application into textile wastes.
2. R04: Exploration and utilization of bioresources, development of fast growing plantinum teak wood
3. R05: Publication
4. R06: quantification of potential compound in fungal extract and to develop the potential compound for bioattractant of fungi
5. R07: Identification of termite samples in species
6. R08: Particleboard from corn stalk and sembilang bamboo with compositions (bamboo : corn stalk = 100:0, 75:25, 50:50, 25:75, 0:100) using citric acid adhesive will be made. The physical and mechanical properties will be tested in accordance with the JIS A5908 standard
7. R09: Characterization of grafting lignin and PVA, enzymatic hydrolysis of pulp kraft bagasse sorghum with addition of grafted PVA-lignin
8. R10: Production of supercapacitor from activated carbon of oil palm empty fruit bunch in the nano size particles. The result will be compared with that of micro size particles
9. R11: Analysis of lignocellulose components, NMR analysis, and neutral sugar analysis
10. R12: wood densification for flooring, CLT and LVL for walls, fast growing teak for wooden structural, and bamboo lamination for door and windows' frame

JASTIP net:

1. To continue research for wastewater treatment application in textile home industry or in river/lake. Moreover, optimization of other tropical fungi for bio-decolorization and biodegradation process will be conducted.
Biodiversity & Bioprospecting

Bioprospecting: Discovery of (+)-2,2’-epicytoskyrin as an antibiotic candidate: oral toxicity test and inhibition of abscess formation:

Preliminary Screening for Antibiotic and Antioxidant Substance

More than 800 microbial isolates have been screened for their antimicrobial and antioxidant activities (2006 – 2015)

1. Rennellia eliptica
2. Rennellia speciosa
3. Uncaria gambier
4. Tinospora crispa
5. Archangelisias flavus
6. Garcinia mangostana
7. Curcuma aeruginosa
8. Camellia cinensis
9. Cinnamomum burmannii, etc.

Medicinal plant

(Agusta, 2018)
Isolation, Screening, and Assessment of White-rot Fungi in Berbak Sembilang Biosphere Reserve for Their Potency in Wastewater Treatment

Berbak – Sembilang Biosphere Reserve

1. Indonesia is home to the largest peat swamp and mangrove forest (49%) in Asia which the largest is located in Berbak National Park within Berbak and Sembilang Biosphere Reserve. One of the newest designated biosphere reserve by UNESCO in 2018 within the Man and Biosphere (MAB) Program.
2. It is located on the south-east coast of Sumatera, Jambi and South Sumatra Province, Indonesia which includes Berbak and Sembilang national parks and two wildlife reserves.
3. The total area of Berbak and Sembilang biosphere reserve is 3,819,837 ha which is dominated by peat swamp forest, freshwater swamp forest and mangroves around 350,000 ha.
4. These areas have an important role for biodiversity conservation as it has diverse and wide range of rare and endangered species as well as undisturbed peat swamp forest ecosystems.
5. However, this biosphere reserve is threatened by extensive agricultural development, illegal logging, draining and burning of many adjacent swamp forests.

(D.H.Y. Yanto, 2019)
Isolation, Screening, and Assessment of White-rot Fungi in Berbak Sembilang Biosphere Reserve for Their Potency in Wastewater Treatment (2)

Sample collection (175)

Control Decolorization and lignin degradation after treated by fungi

Isolation and Screening in Lab

More than 23 Isolates showed the potency for lignin-degrading and textile dyes-decolorizing fungi

(Example of other source of funding: UNESCO, MAB YSA Award, 2019)

(D.H.Y. Yanto, 2019)
Real Textile Wastewater Application

Supported by Center of Excellent for Lignocellulose (RC Biomaterials), JASTIP, IBSAP LIPI, and PT Jababeka Infrastructure (Company). This July 2021: pilot scale in Pekalongan City and Central Java Province

Bioremediation of synthetic dyes, polycyclic aromatic hydrocarbons (PAHs) and crude oil by tropical fungi from Indonesia and Thailand (JASTIP-NET)
LIPI (Indonesia), RISH – Kyoto Univ (Japan), Chulalongkorn Univ (Thailand), USM (Malaysia)

(Example of counterpart funding)

Dr. Dede and Team when applied RDBC

A = Pump Station
B = Grit Chamber
C = Primary Settling Tank
D = Oxidation Ditch
E = Collecting Box
F = Secondary Settling Tank
G = Sludge (Alternative Material)
H = Belt Filter Press
I = Return Sludge

Biological Treatment = RDBC

www.lipi.go.id
Bioremediation of real wastewater from textile and batik industries in Indonesia by white rot fungi: LIPI, RISH-KU, USM Malaysia, KNU RoK
Published in:

a) *Journal of Hazardous Materials* (2021): 405: 124176 (IF 9.038) and collaborating with RISH Kyoto Univ, Japan and KNU RoK
b) *Biomass Conversion and Biorefinery* (2020): 1-10. (IF. 2.602)

Characterization and conversion of tropical plant resources to functional materials: LIPI, Nanjing Forestry University, UPM Malaysia, Univ.of Melbourne, UK, NACE (USA)
Published in

a) *Journal of Adhesive and adhesion* (IF 2.671) collaborating with RISH Kyoto Univ.
b) *Journal of Material Science and Engineering* (IF 0.98)

(D.H.Y. Yanto, 2019)
OUTPUTS: Some Publications + broadened networking (outcomes) Bioresources

Biology and management of wood attacking insects important for global economy
BY: LIPI, IPB Univ, RISH KU, GSA KU, KUAS, Nara National Museum, USM Malaysia
Published in:
   a) Insects (2021) (IF: 2.220) and collaborating with RISH-Kyoto Univ. and Kyoto Gakuen Univ.
   b) Biodiversitas (2020) (IF 1.017) and collaborating with IPB University.

Development of highly durable low cost-house and novel wood composites using tropical plant resources
BY: LIPI, RISH, KU, Osaka Sangyo Univ., Hiroshima Univ., LERMAB, Lorraine Univ, France

Published in:

(D.H.Y. Yanto, 2019)
Some Publications: BIODIVERSITY: WILDLIFE AND FOREST MONITORING:

- Plant Diversity of Kalimantan: profiling and mapping of habitat loss → monitoring permanent plot forest fire in Kalimantan (Bukit Bangkirai)
- Genome Resource Bank Center as the Backbone of future Indonesian wildlife

On Skeletochronology of Asian grass frog

Fejervarya limnocharis (Gravenhorst, 1829) from Java to support management conservation

Ni Luh Putu Rischa Phadmacanty, Amir Hamidy, Gono Semiadi

| Abstract views: 558 | PDF views: 345 |

Abstract

Asian grass frog Fejervarya limnocharis is being utilized as pets, for laboratory experiments, for a mixture of traditional medicine and for cuisine. The harvest of F. limnocharis in high volume can threat its population. Biological data such as the age when the specimens are harvested is valuable information to manage the harvesting system in sustainable way. We conducted the skeletochronology technique using paraffin methods and hematoxylin staining from 69 samples (46 males, 21 females, 2 juveniles).

+ Poster presentation in 6th JASTIP International Symposium held in Jakarta on 1st November 2018.
+ data base and research results of biodiversity monitoring: on going

(Susanti, 2018)


(Susanti, LIPI, 2018)
OUTPUTS AND OUTCOMES: AMONG OTHERS...

End-products of JASTIP R-04 for FY 2015-2020: Bicycles with LVL Curve Frames: utilized by users, more to collaborate (planned: FOR RENT in Botanic Gardens)

**Fixie**
Made in 2015
Certificate No.
IDD000053321: 2018

**Licensed by:**
PT. Panel Agro Lestari
March 5, 2020

**Mountain Bike**
Made in 2016-2017
Certificate No.
IDD000048963: 2017
IDD000050073: 2017

**Fixie**
Road Bike Style
Made in 2020
Industrial design:
IDD000053321: 2018

(Dwianto, 2020)
This system is capable of producing approximately 4.5 KWH of energy stored in a battery of 4.8 KWH. This energy can be used to: (1) 6 Lighting of 20 Watt LED lights for 12 hours = 1440 WH, (2) 5 units of 18 Watt for HP and laptop chargers with an average of 10 hours = 1800 WH, (3) 15 Watt WIFI for 24 hours = 360 WH. The total used of energy is 3600 WH, and the remaining 1200 WH can be used for other purposes, such as LCD projector, LED monitors, and others.

(Dwianto, 2020)
OUTPUTS AND OUTCOMES: AMONG OTHERS…

To be offered to the government

• Development of Eco-house Concepts for Earthquake-resistant
• Wooden House Construction (JASTIP S-06)

(Dwianto, 2020)
Supporting the Achievement of SDGs

Outline

- WRF from a tropical region
- Ligninolytic enzymes (LE)
- Fungal cell
- Profile of LE activities
- Degradation mechanisms
- Purification of LE
- Degradation mechanisms
- Toxicity and final product analysis
- Effect of mediators
- Selected strains

Outline

- LE
- Fungal cell
- Immobilization
- Scale up
- Optimization
- Application

Purposes (Yanto et al., 2020)

This project integrates the scientific activities of three organizations and establish strong international network on the studies on tropical microorganisms useful for bioremediation and biodegradation of toxic compounds, leading to further exploration and applications of tropical microbial resources in ASEAN regions for sustainable society.

(Yanto, 2019; RC Biomaterial LIPI)
IMPLICATIONS ON POLICY: Gap: research to policy

Gap among decision makers and researchers:
- the culture within which decision makers act,
- lack of support for policy makers to acquire the skills required or to use research evidence,
- organizational, political and strategic, financial and resource limitations;
- personal experience;
- common sense;
- expert opinion,
- dissemination problems,
- access to research evidence.

Reasons why policy makers reluctant to use scientific results as the basis of policy:
- an inadequate approach,
- too much scientific uncertainty,
- poor local applicability,
- lack of focus on the social determinants,
- lack of integrated or multiple components,
3 crucial enabling factors that underpin modern conceptions of evidence-based policy (EBP):
1. high-quality information bases on relevant topic areas,
2. cohorts of professionals with skills in data analysis and policy evaluation,
3. political incentives for utilising evidence-based analysis and advice in governmental decision-making processes.

Include:
1. the importance of personal relationships and contacts between decision-makers and researchers,
2. the need for research to be clearly and accessibly presented.
3. cultural and practical barriers to the use of evidence by policy-makers.
4. policymakers’ definitions of evidence do not match academic constructions of ‘evidence’.
5. much about policy-makers’ attitudes to research evidence remains unclear.
EBP requires good data, analytical skills and political support. The politics of decision making inherently involves a mixing of science, value preferences, and practical judgments about feasibility and legitimacy. Factors that limit the use of research evidence: is the perception of lack of research evidence among decision makers and the negative perceptions of the research evidence available.

Obstacles can be solved by: improving communication between researchers and users, as well as trust between researchers and policy formulators. One of key solutions: must increase the capacity of researchers to produce and effectively disseminate evidence to decision makers and bring about changes in their culture to add value to the use of research evidence in decision-making.
Research results of Phase I as the base of policy, but not yet as a formal policy \(\rightarrow\) need to be written in a form of a Policy Brief

Could be written as a set of Policy Brief with tentative titles:

1. Bio-waste water management using selected fungi species is an environmentally friendly and powerful biodiversity-based approach: by the Govt. of Pekalongan District and to be by Central Java Province
2. Wind turbin using biodiversity resources from fast growing woods for its propeller is a choice for new and renewable energy \(\rightarrow\) by West Sumatra, Bengkulu, Bali, Lombok Provinces, will be by West Java Province
3. Other potential Policy Brief titles for policy makers \(\rightarrow\) should include problem solving:
   - Understanding termite behaviour and distribution in relation to climate change to reduce termite attack
   - Conservation and sustainable use of Rennelia sp producing anti-microbial and anti-virus active compounds
   - Bioprospecting of endophytic microbes for potential drugs to reduce raw material import
   - Strengthening bioprospecting research to produce added value commercial products and increase traditionally and involve them in developing high value products
   - Protect the forest from fire as it causes halting regeneration for long period, or: Speeding up the regeneration of heavy impacted forest fire (combining with other previous results)
Potential Phase I Research Eesults for the basis of Policy → as Policy Brief, academic paper (2)

- Managing stingless bee for curing diseases
- Managing agriculture crops, farms and pesticide regulations for sustainable pollinators types and population to support food security: effective pesticide regulation, control of the trade and movement of managed pollinators; implementation of pollinator-friendly practices in farms and urban areas; conservation, management and restoration of pollinator habitats.
- Increasing added value of genetic resources through support of users and increase access of technology in implementing Nagoya Protocol
- Developing a better network and collaboration in national and international levels in managing genetic resources.
- Developing and integration of data and information of genetic resources among institutions through national bigdata
Policy brief on Bioprospecting: example

2020: Direction of Development of Bioprospecting in Indonesia (a bit too long: 84 pages) → we can establish: …for ASEAN and more specific issues of Bioprospecting
Academic paper for a Presidential Decree on Microorganism Management: example

Implemented already:
Presidential Decree No. 1 Year 2021 on Microorganism Management
PHASE II: WP 3 (2020-2025)

BIODIVERSITY GROUP: GSA- Kyoto Univ & RC Biology- LIPI:
1. Bioprospecting:
   A. Extracts from Rubiaceae and Pteridophyte in SEA mainly for antibacterial and antivirus substances
   B. Modification of artemisinine, an anti-malarial substance by endophytic fungi of Artemisia plants
2. Stable isotope application to wildlife environmental forensic for the protection of CITES species (involving BATAN Indonesia)

BIORESOURCES GROUP: RISH- Kyoto Univ & RC Biomaterials- LIPI
1. Development of highly durable low-cost-house and novel wood composites using tropical plant species
2. Characterization and conversion of tropical plant resources to functional materials
3. Bioremediation of textile dye effluents using tropical microbes
4. Biology and management of wood attacking insects important for global economy
Recommendations: for resulting PHASE II EBP (1)

- Keep informing scientific results of the best available, robust results, the most relevant to policy makers to keep them on track as it is difficult to follow from publications which increasing exponentially
- Ensure communication of the results in an accessible language to the non-specialists
- Accessible communication tools such as Policy briefs: to translate research outputs or practices into a format that can support policy decision making
- Require: Effective, interdisciplinary SPI’s and timely and relevant inputs for policy makers
- SPI (Science-Policy Interface) need to be strengthened: by improving knowledge exchange and communication of scientific results by bringing the most recent and relevant scientific outputs to the attention of decision makers → need capacity building training courses for researchers!
- Criteria: Credibility, relevance, legitimacy
- Establish groups to formulate recommendations for the basis of policy: involves person experience in communication and formulating sets of Policy Brief for at least Minister’s Decree or academic paper for Presidential Decrees or Acts (NOT JUST relevant researchers !)
Recommendations: Policy Implications for Phase II (2)

A. To push govt to finalize the Draft of Act of Conservation and Utilization of Genetic Resources (for Indonesia), to put all relevant institutions in synergy and assign institutions as leading sectors in each specific issues related to Biodiversity and utilization of bioresources and specific minister regulating investment related to access and benefit sharing, to form national commission on biodiversity and bioprospecting

B. Strengthening local community in managing genetic resources

C. Strengthening national research on bioprospecting involving industries and community

D. Urge private sectors to develop products from bioprospecting by giving fair benefit to community

E. Law enforcement related to bioprospecting and biopiracy

F. Enhancement better communication with policy makers and provide updated results regularly of Phase I that have not been informed properly and involve them from early stage of the implementation of Phase II programs
A. In order research results to be used as the basis of policy by policy makers, key factors affecting among others, are: building good communication and trust, involve from the beginning and keep updating the results regularly, packaging the results in the policy maker “language”, and meeting the criteria (credibility, relevance, legitimate, timely).

B. Form for the basis of policy such as: recommendation for CITES, policy brief (4-6 pages the most) for the level of at least Ministers, academic or urgency paper for Act/Law/Presidential Decree.

C. The need to establish a group for translating research results to evidence-based policy
ACKNOWLEDGEMENTS

1. Dr. Dede Heri Yuli Yanto, RC Biomaterials LIPI
2. Prof. Wahyu Dwianto, RC Biomaterials LIPI
3. Prof. Sulaeman Yusuf, RC Biomaterials LIPI
4. Dr. Iman Hidayat, RC Biomaterials LIPI
5. Dr. Atit Kanti, RC Biology LIPI
6. Dr. Ruliyana Susanti, RC Biology LIPI
7. Prof. Andria Agusta, RC Biology LIPI

TERIMA KASIH, KOB KHUN KA, ARIGATOU GOZAIMASU