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Sustaining Biomaterials in Bioeconomy: Roles of Education and Learning in Mekong River Basin

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Abstract: The demands to improve the livelihood of small farmers require a systemic shift from fossil fuel-based and destructive approaches to sustainable renewable raw materials and non-destructive approaches. This should be accompanied by a fundamental reorganization of education and learning policies to create new bio-oriented value chains for biomaterials, food, wood, and energy, as well as in large parts of the health, manufacturing, and service industries. In the long run, the successful implementation of bio-oriented production depends on the systemic linking of both first- and second-hand learning in communities in rural as well as urban settings. The purpose of this paper is to present a concept for the co-design of a new curriculum to better equip new graduates with the ability to support the effort of the sustainable production of biomaterials that are non-destructive to the environment. To sustain biomaterials and enhance non-destructive ways of thinking, learning needs a community of practice in both online and onsite platforms—allowing students to better understand and support cascade use. Therefore, the use of by-products and recycling products after use will increase in importance. A community of practice, and institutions, must create education and learning platforms for improved actions regarding biomaterials across generations and experiences, which will subsequently be integrated into the circular value chains of the bioeconomy. The first- and second-hand learning to sustain these value chains depends on higher education and learning institutions with both legal mandates and systems approaches.

Keywords: rubber wood; systems approaches; first-hand learning and second-hand knowledge; higher education and learning institution; SDG's partnership

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1. Introduction

"The sustainability of natural and man-made systems rests on the principle that we, as a society, use available natural resources to meet our present needs without compromising the ability of the future generations to derive enough satisfaction from the same set of resources" [1,2]. In general, activity on a system is considered sustainable if it can be carried out indefinitely renewably, such as sunlight [3]. Futures studies indicate that agricultural systems and forestry must provide food, fiber, and biomaterials for both human systems as well as ecosystems [4–7]. Educational learning systems and platforms must be re-designed to equip instructors, students, and learners with an understanding of sustainability and the 21st Century skills and key alternatives to maintain the abilities of natural systems, as well as agroecosystems, to meet the needs of both systems sustainably [8]. The new non-destructive curriculum must be designed for personal development and the networking

of reform leaders [9] by systemically collaborating in planning, doing, studying, and acting [10].

Current knowledge on sustainable curricula in higher education institutions has been implemented in various fields to cope with changes [11], for example: in sustainability science hosted by Harvard's Kennedy School of Government [12]; in wood products industry dynamics, which also focuses on project-based learning (PBL) [13]; in pharmacy education [14]; in a transdisciplinary curriculum for sustainable businesses [15]; in agricultural systems at the Master and Doctoral degrees level by Chiang Mai University [16], in tourism education [17]; and in bioeconomy systems at the Master and Doctoral degrees level by an alliance of six universities in Europe [18]. The assessment of students can be standardized at the pre-university level [19] and evaluated based on developmental evaluation [20]. Ideally, these curricula and programs must be designed to fulfil multiple goals and the expectations of a range of internal and external stakeholders. These goals and expectations preferably go beyond the typical academic and professional skills to actively learn and engage with societal values, especially sustainability goals [21].

The Sustainable Development Goals (SDGs) are a collection of 17 global goals to be achieved by 2030, set by the United Nations in 2015. The goals were based on the Millennium Development Goals (MDGs), which ended in 2015 and applied to all countries and nations [22]. In particular, SDG 4 calls for inclusive and equitable quality education and the promotion of lifelong learning opportunities for all with ten targets and 31 indicators [23]. To achieve these ambitious goals and deal with high-level complexity, a bio-based economy is required to cross the boundaries of a single sector and integrate tools, language, and knowledge drawn from different disciplines and sub-disciplines [24]. Henceforth, these targets and indicators can be achieved and based on first-hand and second-hand knowledge.

While the number of people with direct experience in agriculture and forestry declines, student interest in agriculture and forestry and their related fields remains high. Due to many urban students having little to no practical experience with agriculture, educators have stressed the need for the inclusion of practical learning experiences that are integrated into the formal curriculum. This focus on practical education harkens back to the original intentions of the purposes of the regional universities. One significant step toward institutionalizing the field would be to develop undergraduate majors in sustainable agriculture. There are few published studies that document regional university progress towards the development of non-destructive sustainable agriculture and biomaterials curricula, especially one that focuses on sustainable biomaterial production systems.

The purpose of this paper is to present a concept for the co-design of a new curriculum to better equip new graduates with the ability to support the effort of non-destructive and sustainable production of biomaterial by combining both first- and second-hand knowledge. We focus on the Mekong River Basin (MRB) region, covering Southwest China PRC, Myanmar, Lao PDR, North and Northeast Thailand, Cambodia, and Vietnam. The MRB is home to approximately 65 million people with diverse cultures, agroecosystems, and political systems [25]. Our study is intended to provoke constructive discussion and stimulate interest among agricultural educators and higher education Ministries in the MRB to look at these biomaterials for the bioeconomy from a more holistic perspective whilst developing an educational curriculum to better equip graduates who are capable of addressing sustainability.

2. Materials and Methods

2.1. Study Area: A Common Source of Biomaterial Production in MRB

Based on the 2015 estimates, approximately 65 million people are living within the Lower Mekong Basin (LMB). Thailand and Vietnam each account for a little over a third of the population in the LMB, China and Cambodia a fifth, and Lao PDR the remainder [10]. The region has a large rural population that is predominantly employed in agriculture. The sector is therefore critical to maintaining food security and realizing poverty reduction

efforts. It is also organized and operated by small to medium-size farms growing both annual and perennial crops in diverse cultures and agroecosystems with elevation ranging from sea level to more than 4000 m above mean sea level [26]. Agriculture also provides important inputs for the manufacturing sector.

Plantations of natural rubber (*Hevea brasiliensis* (Willd. ex A.Juss.) Müll.Arg.) represent a major form of plantation. They are a source of biomaterials in MRB, recently promoted at the policy level and adopted by local communities and private processing and operation companies in the region. In 2018, the estimated size of the areas of rubber plantations within the MRB boundary was 0.43 million ha (mha) in Southwest China [27], 0.30 mha in Lao PDR [28], 1.16 mha in North and Northeast Thailand [29], and 0.41 mha in Cambodia [30].

Rubberwood and natural rubber latex (NRL) are two important sources of biomaterial from rubber plantations that can be produced sustainably as a result of the MRB region's sound policy, education, and learning programs [31]. There is a considerable and likely growing market demand for rubberwood products. Rubberwood can provide substantial income for rubber growers and an opportunity for domestic wood processors to add value to this resource. The gross economic value of annual timber production in the LMB is estimated to be US$1.4 billion [10].

2.2. Methods

The present study is based on a desk review of the key national green economy/green growth-related documents from Cambodia, China PRC, Lao PDR, Thailand, and Vietnam (Figure 1). In particular, with respect to higher education and learning about biomaterials in Thailand. During late 2019–early 2021, we conducted a series of panel discussions with focus groups consisting of government officers, growers, growers' organizations, and agricultural educators in higher education organizations (Supplementary Table S1). We used brainstorming [32] to address the main question of 'What should be the role of education and learning on sustaining biomaterials in the bioeconomy?' in the MRB. In addition, participants in the sessions brainstormed to provide ideas on three components of the curriculum: philosophy and objectives, a network of learners, and future models of sustainable bioeconomy education and learning.

Information regarding rubber plantations as a source of biomaterial, such as NRL, was provided to the participants, as well as data on relevant and established industries with important socio-economic contributions, both nationally and locally in areas where the sector operates as being the major source of biomaterials with various applications [33,34]. We have also provided information and materials on system approaches relevant to curriculum development [35] to improve the management of agriculture and resources [36], agroecosystem analysis [37], and developmental evaluation (DE) [38].

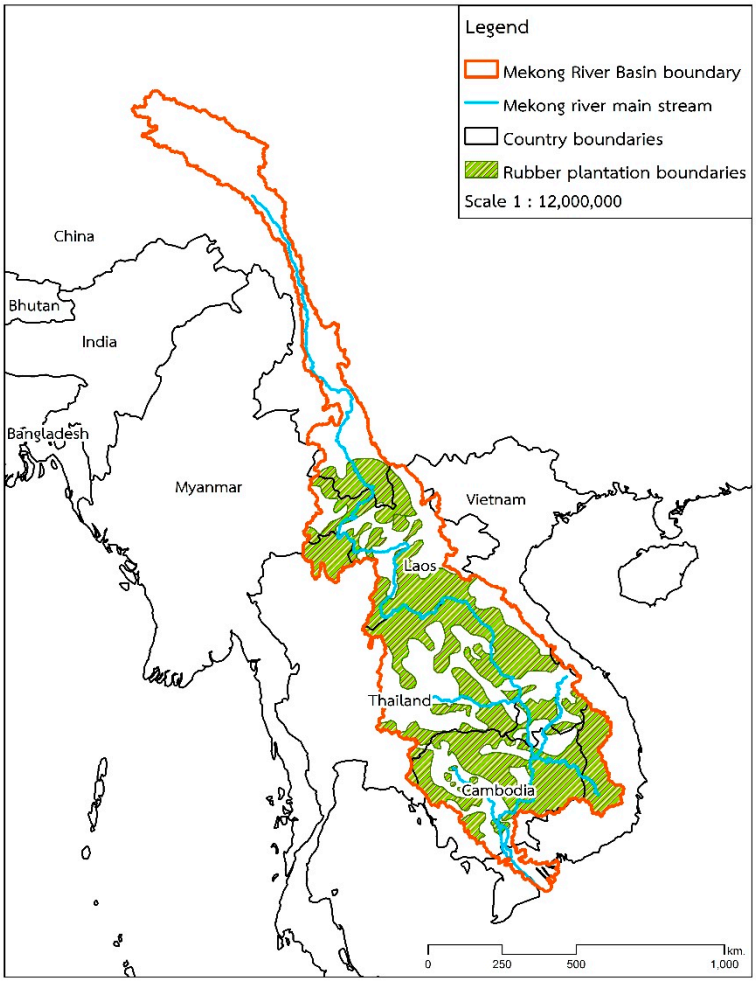

Figure 1. Rubber plantations in the Lower Mekong Basin (LMB) and Mekong River Basin (MRB) in the inlet map. Source: Rubber plantations redrawn from [39]; Country boundary redrawn from [40]; MRB boundary from redrawn [41].

3. Results

3.1. National's Policy Framework

In this section, we summarize key the messages of the Green Growth Policies and the strategies of five countries in MRB to provide a background of common directions by five governments. These common directions call for new generations of graduates with the skills and capacity to support sustainable biomaterials production in the region.

3.1.1. Cambodia's Green Growth Policy Framework

In Cambodia, the Green Growth Policy and Strategy were published in 2013. The strategy will be in effect up to 2030 and is coordinated by the National Council for Sustainable Development (NCSD). The policy and plan include the overall goal of "Ensuring the reduction of poverty, social inequality, gender roles, and improving people's quality of life". Its achievement is being monitored using poverty rates and GINI indices as well as several gender and education-related indicators. The NSPGG (National Strategic Plan on Green Growth) incorporated nine sectors, including human resource development and green education. However, education (second-hand knowledge) and learning (first-hand knowledge) of the potentials and opportunities of biomaterial production and utilization in higher education institutions need to be elaborated on, and various priority actions and intermediate goals must be clearly defined [42].

3.1.2. China's Rural Revitalization and Agricultural and Rural Modernization

On 4 January 2021, the Chinese government issued opinions on comprehensively promoting rural revitalization and accelerating agricultural and rural modernization [43]. Planned actions conclude that by 2025, the Chinese government will support the construction of national pilot zones for "green" agricultural development. Subsequently, the Yunnan provincial government released its fourteenth five-year plan for national economic and social development and outlined the long-term goals for 2035. The plan calls for building a world-class "Green Food Brand (GFB)", promoting the province's green food variety cultivation, quality improvement, brand building, standardized production, and a move towards a high-value chain [44]. Additional processes are needed to develop plans and procedures regarding the priority and actions on regional education and learning institutions regarding biomaterial production and utilization, particularly from rubber plantations.

3.1.3. Lao PDR

In January 2019, the first Lao PDR National Green Growth Strategy for 2030 was approved by the prime minister. To build long-term prosperity, Laos' growth pattern needs to continue shifting to be better managed, more diversified, and a sustainable "green growth" model by emphasizing the improvements of its macroeconomic fundamentals. The key challenges stem from, and are compounded by, weak human capital [45]. As of 2020, the Green Growth National Steering Committee (GGNSC) was mandated to lead and oversee the country's "green growth" agency. The government has established a "Green Growth Promotion Center" with the mandate to operationalize the strategy by incorporating its priorities in key planning and budgeting processes [46]. Similar to Cambodia and China PRC, more work is needed to formulate plans and projects regarding the priority and actions on education and learning about biomaterial production and utilization, in particular from plantations.

3.1.4. Thailand

On 19 January 2021, Thailand's cabinet approved the Bio-Circular-Green Economy (BCG) model concept and approach to further develop and transform the country into a high-income country (HIC) status with a strategic plan for 2021–2026 [47]. The BCG model arose on the national agenda, and the committee requested that all government agencies formulate BCG programs and projects, based on 4 + 1 strategies, namely: (a) agriculture and food, (b) health and medicine, (c) energy, biomaterial, and biochemicals, (d) tourism and creative economy, and e) biodiversity and cultural diversity [48]. The white paper on BCG in action also called for BCG talent and entrepreneur development in six major groups, namely (1) startups; (2) innovation-driven enterprises (IDEs); (3) smart farmers; (4) high-value service providers; (5) deep technology developers; and (6) creative entrepreneurs [49]. These programs and projects are likely to reflect the needs of the agencies to be part of the BCG model rather than the needs of the nation and with no priority on education and/or learning.

3.1.5. Vietnam

On 25 September 2012, the prime minister issued a decision approving the national strategy regarding "Green Growth No. 1393/QD-TTg" and on 20 March 2014, a national action plan regarding "green growth" in the period 2014–2020 according to decision No. 403/QD-TTg of the prime minister [50]. The basic concept was to shorten the development gap and to enhance access to a modern economy. The development of a "green economy" should be the first orientation; However, the development model and the industry structure matching with a "green economy" in the context of Vietnam's development needs to be continuously studied and perfected. Lessons must be learned from the nations which have previously implemented "green economies" for the appropriate steps. Similar to other nations in MRB, more work is needed to formulate plans and projects regarding

the priority and actions on education and learning regarding biomaterial production and utilization, particularly from plantations.

3.2. Bioeconomy Education and Learning Programs for MRB

In this section, we present the results of the brainstorming sessions, which focused on a new curriculum to educate a tailor-made new generation of graduates ready for implementing the Green Growth Policy and Strategy of the five countries in MRB. Figure 2 show the key components of a new learning program based on a symbiosis of various non-destructive sustainable biomaterial production systems in MRB.

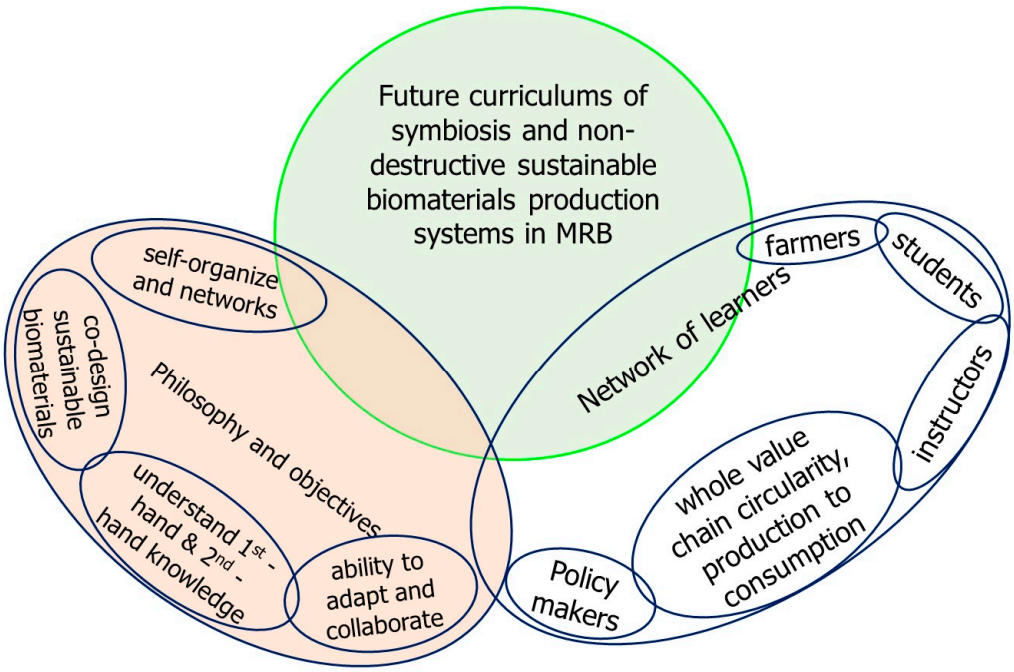

Figure 2. Key components of the symbiosis and non-destructive sustainable biomaterials production systems curriculum in MRB.

3.2.1. Philosophy and Objectives

The participants of the brainstorming sessions in Thailand agreed that new programs need to be introduced to produce future graduates and practitioners that understand the social, environmental, and economic issues of a given situation. This future workforce will be capable of self-organization with stakeholders, forming networks of learners to collaboratively co-design educated practices for non-destructive and sustainable biomaterials. Communities of practice for sustainable biomaterial in the bioeconomy is a key mechanism to co-design and co-implement the new programs. The new programs should share a common main objective to create high-quality graduates that are well-equipped with first- and second-hand knowledge. Both types of knowledge include selected contents on social sciences, agricultural sciences and technologies, information and communication technologies, and interdependent global communities with the ability to collaborate and adapt to climate change and deal with the complexity of pandemics.

3.2.2. Network of Learners

We found that the new education and learning philosophy for the sustainable production of biomaterials to support the BCG or 'green' policy must combine first-hand learning processes and second-hand knowledge-capturing instructional processes for a network of learners, including farmers, students, instructors, and policymakers. The philosophy can be facilitated by a network of learners and practitioners of the whole value chain from consumption back to production and the use of supply inputs, energy, retails, logistics,

waste management, and new knowledge generations through responsible research and innovation. Smallholder farm producers of raw materials must be included in the network right from the start, with fair benefits for primary farm products, as well as for the processing of secondary products and tertiary products by the network. Farm primary products must be processed into secondary products by small and medium enterprise processing in the region. Then, the final products can be manufactured and retailed for consumers in the market places in and outside the region.

The network becomes the learning space for firsthand knowledge or 'hands-on' for students and instructors. The students will better understand the interdependence of the components within the network and their contributions to the performance of the whole network. With data sets and evidence from the field and farm level, the students experience firsthand experience on how to plan, do, check, and take actions to obtain high-quality raw materials, reduce costs, and protect the environment. The instructors provide explanations based on second-hand knowledge and scientific theory with evidence from the data sets to each process. Thus, they strengthen and enhance the student's learning ability as well as their capability to be part of the wider learning network.

In the second-hand instructional process, the instructors introduce key theories, principles, and contents sufficient for students to self-direct their own firsthand learning process. Instructors introduce the fundamental properties of forest biomaterials and their optimal utilization, as well as a wide range of innovations to non-destructively evaluate important properties with the goal of the development and use of labor, equipment, and procedures for the assessment of forest and/or rubber biomaterials, from seedlings to historic rubberwood/timber structures. During the second-hand instructional process, it is important that the students understand the relationships of various components of biomaterials from rubber plantation value chains. The students will understand the instructions related to the non-destructive testing and evaluation of rubber structures, as well as key global and local technical authorities, principles, current research activities, and education. The instructors act as facilitators for students and at the same time learn from students' reflections on their firsthand learning process.

During the firsthand learning process, students must be fully engaged with their own interests and prepared to ask a series of questions related to biomaterials and the subject of bioeconomy. Subsequently, the students design their own methods and materials to gain a better understanding and solve questions with support from the instructors. Therefore, both the students and instructors benefit from the exchanges of first-hand and second-hand processes under the network. The network must be operated based on a combination of first- and second-hand knowledge program structures to achieve their philosophy and objectives. A common co-evaluation system for learning and understanding the students and learners was discussed and agreed to be based on DE. DE is focused on the co-development and co-support of an innovative and adaptive development of a new curriculum in diverse and dynamic environments such as MRB. The outcome of the brainstorming indicated that DE would allow students to be more responsive to culture and cultural context for sustainable and non-destructive biomaterial production systems.

3.2.3. Future Model of Sustainable Bioeconomy Education and Learning

With the objectives and network of learners, the higher education institutions of nations in the MRB region should co-design degree programs that take advantage of both first- and second-hand instructional self-learning domains for the sustainability of biomaterials within the bioeconomy. The first year covers second-hand knowledge of the fundamentals of sustainability science, natural sciences, mathematics, languages and communications, design engineering, and computer science together with the first-hand learning of social issues in biomaterial value chains, i.e., planning, production, processing, quality management, consumption, and entrepreneurship. In the second year, a number of sustainable self-employment courses with more emphasis on first-hand learning settings are experienced with the support of instructors and owners of biomaterials along the value

chain. Subsequently, the students and instructors co-design the remaining years of the education and learning courses and experiences based on students' abilities, opportunities, and challenges toward sustainable biomaterials.

The value chain for a sustainable biomaterial is a component of the learning space to provide first-hand knowledge for students and instructors, where future contributions and career paths can be identified, as well as jobs in the value chain. With the rubber plantation in MRB as a learning space, learners experience the day-to-day operations carried out by the owners and workers to trap, process and earn income from latex (NRL), a source of biomaterial. The learners also gain experiences and lessons from the latex collection centers, as cup lumps of rubber sheets and large dealers in each location within MRB.

4. Discussion

To address such demanding and complex issues as the production of sustainable biomaterials under the bioeconomy concept, nations in the MRB must co-organize a partnership and plan to bridge life and environmental, as well as social and economic sciences, which is required not only in terms of research but also education and learning [9]. More specifically, new programs of education and learning in higher education institutions must be offered and continuously updated at all levels in a complex body of agencies that cover from high-level professional specialization to activities designed for various actors. These institutions must combine first- and second-hand knowledge learning and sharing between learners and instructors. A network may be formulated, similar to EBU [18], to collaborate and establish the new curriculum. They must be deeply involved in the establishment of the new partnership and its academic programs [51], possibly starting at the high school level.

Finland achieved the highest scores in the Program for International Student Assessment (PISA) scores by organizing firsthand learning experiences for students to be exposed to experiential learning, or "learning by doing", from farm settings. It was concluded that the reason for this was that the subject to be learnt could be studied comprehensively and firsthand in its original surroundings, including processes and output–outcome impacts. On-farm learning has proven to be a versatile learning environment that encourages learning and supports learners who differ in their learning preferences [19].

At the higher education institution level, six major research and higher education and learning organizations collaborated to organize the European Bioeconomy University (EBU). The EBU aims at providing new governance models for an internationally unique and competitive theme-based, system and future-oriented university that focuses on inter- and transdisciplinarity, as well as sectoral and European collaboration. The EBU partners are best equipped for this task as, together, they cover the entire spectrum of bioeconomy dimensions [16]. Instructors understand the greatest need in providing a systems approach to learning and interdisciplinary classroom discussion. Also emphasized was the need to couple practical experience with theory and subject curriculum. Additionally, useful learning practices that were identified include guest lectures, senior projects that use community resources, and group projects.

With respect to rubber plantations in the MRB, both students and instructors can gain a better understanding of the potential contribution of more sustainable rubber production to climate change mitigation. Thus, it depends on what it replaces and on how it is conducted: (a) impact is generally negative when rubber replaces forest—be it primary or secondary; (b) impact is positive when rubber is implanted in severely degraded land; (c) impact can be neutral or slightly positive when rubber replaces swidden systems depending mainly on the length of the fallow period of the system replaced; (d) impact is negative when rubber displaces swidden systems, which as a consequence encroach into forest areas; (e) impact is positive if systems are diversified, integrating other trees which can be as efficient to store carbon as secondary forests [52].

Furthermore, in the MRB, instructors and students can gain real-time and real-life learning materials from on-farm and in-field experiences. These in situ conditions are

critically important for students to gain firsthand knowledge on the production of sustainable biomaterials from rubber plantations. This could be contrasted with the absence of practitioners' recommendations for on-campus experiences in conventional lectures, reading assignments, or in-lab exercises. With respect to life-long learning, on-farm internships, visits, and field trips are extremely important. Research experiences must be situated on-farm. Students need to engage in dynamic relationships between diverse components of the entire agri-food system. Students must be exposed to the overall complexity of the agri-food system, and teaching must include experiences with a variety of conventional and organic management settings, as well as differing scales of operation. Experience in agriculture is necessary but needs to extend well beyond classical agronomic production disciplines into environmental and social sciences.

Students and instructors must also learn how to co-investigate novel practices that address agricultural and environmental sustainability. Ideas for practical projects emphasize long-term implications of practices as well as on short-term production and profit goals. Economic considerations and management are also very important factors to be taken into account. Networking with stakeholders with divergent viewpoints must also be emphasized. Our study supports the current curriculum focusing on sustainability in various fields to cope with changes [12–17].

With this new setting that combines both first- and second-hand learning and knowledge, it is visualized that better understanding and high perceptions of biomaterials by sustainable agriculture can be captured and observed for both groups at higher education and learning institutions in the MRB. We do agree with Schweisfurth et al. [9] that higher education and learning institutions in the MRB have the potential to facilitate both the personal development and the networking of reform leaders, but not sufficient condition for promoting developmental leadership.

There are some limitations to this study, which can be summarized as follows:

(1) The concept of combining second-hand and first-hand knowledge for a new curriculum on biomaterial sustainability is rather new in the MRB region. Therefore, national policymakers and higher education institutions must collaborate into planning, doing, studying, and acting [10] to successfully implement the new policy and new curriculum. The collaboration will provide opportunities to co-design and co-transform beyond business as usual (BAU).

(2) We conducted a series of brainstorming sessions in China, Laos, and Thailand. Additional information from Cambodia, Myanmar, and Vietnam is needed to provide a complete picture of the current and new curriculum for the whole MRB region.

To eliminate these situations in the future, researchers should consider forming a regional network to gather and exchange information. This network would allow teams to collaborate and start the process of changes in terms of structure, procedure, and culture in higher education and policy institutions [21]. The focus of these new learning programs was on collaboration to take advantage of first-hand and second-hand knowledge and think systemically and reflexively about making the curriculum more responsible together. Therefore, the contribution of our work is to raise awareness and co-develop a network that could co-design a new curriculum by culturally shifting towards responsible symbiosis so that learning innovations that could successfully take place.

5. Conclusions

Higher education institutions in the MRB need to address elements of emerging needs for the bioeconomy by organizing partnerships to combine first- and second-hand learning and knowledge. The partnerships must aim to generate new generations of graduates ready for sustainable production, processing, and marketing and distribution systems of biomaterials in the MRB by symbiosis and non-destructive methods. Firsthand learning provides direct knowledge of the bioeconomy subject and knowledge of the student's own achievement and learning ability. The direct knowledge and the learning ability support the joint venture to collaborate in various bioeconomy activities. In addition, our study also

raises important questions for further discussion about facilitating administrator, faculty, and student internal engagement while directly bringing more firsthand learning space into the work of regional universities. By incorporating such diverse input into the design process, these universities are systemically in positions to better prepare students for the future. Most importantly, the partnership is a major shift to fully meet the spirit of the BCG plan of the MRB's nations to develop an educational curriculum to educate graduates capable of addressing sustainability issues of biomaterials.

Supplementary Materials: The following are available online at https://www.mdpi.com/article/10.3390/f12121670/s1, Table S1: The detail of participants in brainstorming sessions during 2018–2020 in MRB.

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References

1. Velenturf, A.P.M.; Purnell, P. Principles for a sustainable circular economy. *Sustain. Prod. Consum.* **2021**, *27*, 1437–1457. [CrossRef]
2. Fan, J.; Fan, X.; Jintrawet, A.; Weyerhaeuser, H. Sustainability Interventions on Agro-Ecosystems: An Experience from Yunnan Province, China. *Sustainability* **2021**, *13*, 5698. [CrossRef]
3. Gliessman, S.R. Agroecology and Agroecosystems. In *Agroecosystems Analysis*; Rickerl, D., Francis, D., Eds.; American Society of Agronomy: Madison, WI, USA, 2004; pp. 19–30.
4. HLPE. *Sustainable Agricultural Development for Food Security and Nutrition: What Roles for Livestock?* A Report by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security: Rome, Italy, 2016.
5. Lindahl, K.B.; Westholm, E. Food, Paper, Wood, or Energy? Global Trends and Future Swedish Forest Use. *Forests* **2011**, *2*, 51–65. [CrossRef]
6. FAO. *Forestry for a Low-Carbon Future: Integrating Forests and Wood Products in Climate Change Strategies*; FAO Forestry Paper 177; Food and Agriculture Organization of the United Nations: Rome, Italy, 2016; Available online: http://www.fao.org/3/i5857e/i5857e.pdf (accessed on 7 November 2021).
7. What Is 'Futures Studies' and How Can It Help Us Improve Our World? Available online: https://www.weforum.org/agenda/2021/10/what-is-futures-studies-and-how-can-it-improve-our-world/ (accessed on 7 November 2021).
8. World Development Report 2008: Agriculture for Development. Available online: https://openknowledge.worldbank.org/handle/10986/5990 (accessed on 25 July 2021).
9. Schweisfurth, M.; Davies, L.; Symaco, L.P.; Valiente, O. Higher education, bridging capital, and developmental leadership in the Philippines: Learning to be a crossover reformer. *Int. J. Educ. Dev.* **2018**, *59*, 1–8. [CrossRef]
10. The Deming Institute. Available online: https://deming.org/explore/pdsa/ (accessed on 6 November 2021).
11. Hakovirta, M.; Lucia, L. Informal STEM education will accelerate the bioeconomy. *Nat. Biotechnol.* **2019**, *37*, 103–104. [CrossRef]
12. Harvard Kennedy School. Degree Programs in Sustainability Science. Available online: https://www.hks.harvard.edu/centers/mrcbg/programs/sustsci/grants-fellowships/degree-programs-in-sustainability-science (accessed on 6 November 2021).
13. Tasdemir, C.; Gazo, R. Integrating sustainability into higher education curriculum through a transdisciplinary perspective. *J. Clean. Prod.* **2020**, *265*, 121759. [CrossRef]
14. Katajavuori, N.; Salminen, O.; Vuorensola, K.; Huhtala, H.; Vuornela, P.; Hirvonen, J. Competence-Based Pharmacy Education in the University of Helsinki. *Pharmacy* **2017**, *5*, 29. [CrossRef] [PubMed]
15. Marcos, E.; De Castro, V.; Martín-Peña, M.L.; Vara, J.M. Training new professionals in service engineering: Towards a transdisciplinary curriculum for sustainable businesses. *Sustainability* **2020**, *12*, 8289. [CrossRef]

16. MCC (Multiple Cropping Center). The Master's Program in Agricultural Systems (AGS). Available online: http://www.mcc.cmu.ac.th/mcceng/graduate/AGSprog.html (accessed on 7 November 2021).
17. Wilson, E.; von der Heidt, T. Business as Usual? Barriers to Education for Sustainability in the Tourism Curriculum. *J. Teach. Travel Tour.* **2013**, *13*, 130–147. [CrossRef]
18. Integrated Strategy. Available online: https://european-bioeconomy-university.eu/about/ (accessed on 15 July 2021).
19. Smeds, P.; Jeronen, E.; Kurppa, S. Farm Education and the Value of Learning in an Authentic Learning Environment. *Int. J. Environ. Sci. Educ.* **2015**, *10*, 381–404. Available online: https://files.eric.ed.gov/fulltext/EJ1069262.pdf (accessed on 17 July 2021).
20. Patton, M.Q. What is Essential in Developmental Evaluation? On Integrity, Fidelity, Adultery, Abstinence, Impotence, Long-Term Commitment, Integrity, and Sensitivity in Implementing Evaluation Models. *Am. J. Eval.* **2016**, *37*, 250–265. [CrossRef]
21. European University Association. Curriculum Design: Thematic Peer Group Report, Learning & Teaching Paper #8. Available online: https://eua.eu/downloads/publications/eua%20report%20curriculum%20design_web.pdf (accessed on 3 November 2021).
22. The 17 Goals. Available online: https://sdgs.un.org/goals (accessed on 14 July 2021).
23. Goal 4: Ensure Inclusive and Equitable Quality Education and Promote Lifelong Learning Opportunities for All. Available online: https://sdgs.un.org/goals/goal4 (accessed on 14 July 2021).
24. Sacchi, S.; Lotti, M.; Branduardi, P. Education for a biobased economy: Integrating life and social sciences in flexible short courses accessible from different backgrounds. *New Biotechnol.* **2021**, *60*, 72–75. [CrossRef] [PubMed]
25. Mekong River Commission. *State of the Basin Report 2018*; Mekong River Commission: Vientiane, Laos, 2019.
26. Thomas, D.E.; Ekasingh, B.; Ekasingh, M.; Lebel, L.; Ha, H.M.; Ediger, L.; Thongmanivong, S.; Jianchu, X.; Sangchyoswat, C.; Nyberg, Y. *Comparative Assessment of Resource and Market Access of the Poor in Upland Zones of the Greater Mekong Region*; World Agroforestry Center, ICRAF-Chiang Mai: Chiang Mai, Thailand, 2008; pp. 1–350.
27. Chen, H.; YI, Z.-F.; Schmidt-Vogt, D.; Ahrends, A.; Beckschäfer, P.; Kleinn, C.; Ranjitkar, S.; Xu, J. Pushing the Limits: The Pattern and Dynamics of Rubber Monoculture Expansion in Xishuangbanna, SW China. *PLoS ONE* **2016**, *11*, e0150062. [CrossRef]
28. Smith, H.; Lu, J.; To, P.X.; Mienmany, S.; Soukphaxay, K. *Rubber Plantation Value Chains in Laos: Opportunities and Constraints in Policy, Legality and Wood Processing*; A Report produced for ACIAR project FST/2016/151—Advancing enhanced wood manufacturing industries in Laos and Australia and Forest Trends; Melbourne, Australia, 2020; pp. 1–99. Available online: chrome-extension://bocbaocobfecmglnmeaeppambideimao/pdf/viewer.html?file=http%3A%2F%2Flaoplantation.org%2Fwp-content%2Fuploads%2F2020%2F07%2FRubber-Plantation-Value-Chains-in-Laos-30-June-.pdf (accessed on 14 July 2021).
29. Ministry of Agricultural and Cooperatives (MOAC). *Rubber Planted Areas in Thailand 2018*; MOAC: Bangkok, Thailand, 2018; pp. 1–84.
30. Avtar, R.; Suzuki, R.; Sawada, H. Natural Forest Biomass Estimation Based on Plantation. *PLoS ONE* **2014**, *9*, e86121. [CrossRef]
31. Otten, F.; Hein, J.; Bondy, H.; Faust, H. Deconstructing sustainable rubber production: Contesting narratives in rural Sumatra. *J. Land Use Sci.* **2020**, *15*, 306–326. [CrossRef]
32. FAO (Food and Agriculture Organization). *FAO Capacity Development. Learning Module 4: Organization Analysis and Development*; Food and Agriculture Organization of the United Nations: Rome, Italy, 2013; pp. 1–189.
33. Ige, O.O.; Umoru, L.E.; Aribo, S. Natural Products: A Minefield of Biomaterials. *ISRN Mater. Sci.* **2012**, *2012*, 983062. [CrossRef]
34. Kerche-Silva, L.E.; Cavalcante, D.G.S.M.; Job, A.E. Natural Rubber Latex Biomaterials in Bone Regenerative Medicine. In *Biomaterials in Regenerative Medicine*; Dobrzański, L.A., Ed.; IntechOpen: London, UK, 2017; pp. 303–317.
35. Bawden, R.J.; Macadam, R.D.; Packham, R.J.; Valentine, I. Systems thinking and practices in the education of agriculturalists. *Agric. Syst.* **1984**, *13*, 205–225. [CrossRef]
36. Wilson, K.; Morren, G.J., Jr. *Systems Approaches for Improvement in Agriculture and Resource Management*; Macmillan Publishing Co.: New York, NY, USA, 1990; pp. 1–361.
37. Conway, G.R. The properties of agroecosystems. *Agric. Syst.* **1987**, *24*, 95–117. [CrossRef]
38. Patton, M.Q. *Developmental Evaluation. Applying Complexity Concepts to Enhance Innovation and Use*; Guilford Press: New York, NY, USA, 2010; pp. 1–375.
39. Chiarelli, D.D.; Passera, C.; Rulli, M.C.; Rosa, L.; Ciraolo, G.; D'Odorico, P. Hydrological consequences of natural rubber plantations in Southeast Asia. *Land Degrad. Dev.* **2020**, *31*, 2060–2071. [CrossRef]
40. CDC (Centers for Disease Control and Prevention). Epi Info™ Support and Resources. Available online: https://www.cdc.gov/epiinfo/support/downloads/shapefiles.html (accessed on 25 November 2021).
41. GRDC (Global Runoff Data Centre). ESRI File Shapefiles. Available online: https://www.bafg.de/SharedDocs/ExterneLinks/GRDC/mrb_shp_zip.html?nn=201762 (accessed on 25 November 2021).
42. Vuola, M.; Korkeakoski, M.; Vähäkari, N.; Dwyer, M.B.; Hogarth, N.J.; Kaivo-oja, J.; Luukkanen, J.; Chea, E.; Thuon, T.; Phonhalath, K. What is a Green Economy? Review of National-Level Green Economy Policies in Cambodia and Lao PDR. *Sustainability* **2020**, *12*, 6664. [CrossRef]
43. Policy on Organic Agriculture, Central Document No. 1. Available online: http://www.gov.cn/zhengce/2021-02/21/content_5588098.htm (accessed on 2 July 2021).
44. The Fourteenth Five-Year Plan for the National Economic and Social Development of Yunnan Province. Available online: http://www.yn.gov.cn/zwgk/zcwj/yzf/202102/t20210209_217052.html (accessed on 2 July 2021).
45. World Bank Group. Learning: To Realize Education's Promise; A World Bank Group Flagship Report; 1818 H Street NW, Washington, DC 20433. 2018. Available online: https://www.worldbank.org/en/publication/wdr2018 (accessed on 12 July 2021).

46. Secretariat for Formulation of National Green Growth Strategy of the Lao PDR. *National Green Growth Strategy of the Lao PDR till 2030*; Vientiane Capital 2018; Available online: https://data.opendevelopmentmekong.net/dataset/e7db2aa8-c294-47dc-a2da-aa6e41493a12/resource/861b9f4c-cf6c-413b-aeff-e4f6b9346fd7/download/final_version_of_national_green_growth_strategy_english_feb_2019_.pdf (accessed on 11 July 2021).
47. BCG Model Expected to Generate B1tn over Five Years. Available online: https://www.bangkokpost.com/business/2114811/bcg-model-expected-to-generate-b1tn-over-five-years (accessed on 14 July 2021).
48. The Prime Minister Promotes BCG Model to Add 1 Trillion Baht into National's GDP. Available online: https://spm.thaigov.go.th/CRTPRS/spm-sp-layout6.asp?i=51111%2E9221570211211312111311 (accessed on 14 July 2021).
49. MHESI. *BCG in Action: The New Sustainable Growth Engine*; Ministry of Higher Education, Science, Innovation: Bangkok, Thailand, 2019; pp. 1–66. Available online: https://www.nxpo.or.th/th/bcg-economy/ (accessed on 15 June 2021).
50. Nguyen, A.D.; Gang, C. Green growth in Vietnam: Policies and challenges. *E3S Web Conf.* **2020**, *164*, 11010. [CrossRef]
51. Knight, J. What is an International University? In *The State of Higher Education 2014*; Glass, A., Ed.; The OECD Higher Education Programme (IMHE): Paris, France, 2014; pp. 139–144. Available online: https://www.oecd.org/education/imhe/stateofhighereducation2014.htm (accessed on 14 November 2021).
52. Gitz, V.; Meyback, A.; Pinizzotto, S.; Nair, L.; Penot, E.; Baral, H.; Xu, J. *Sustainable Development of Rubber Plantations in a Context of Climate Change*; CIFOR: Bogor, Indonesia, 2020. [CrossRef]