SUMMARY REPORT

Training on bamboo and utilization and the production of Bio-Char, an alternative for increasing value

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Summary Report

Rationale:

Bamboo is the fastest growing plant in the world. Its shoots are food that everyone knows well. The outstanding characteristics of bamboo make it suitable for various utilization. It is light weight, flexible, bendable, resistant to high tensile force, easy to propagate and affordable investment. Importantly, with the knowledge and technology available today, bamboo can be modified to be used more widely and have higher value, whether in construction, industry, pharmaceuticals, and new innovations. There are several advantages of bamboo over other trees such as tree requires many years to reach maturity while bamboo need only 3–4 years, after harvested, the root system of bamboo keeps growing and produce new shoot which can be harvested continuously every year and leads to sustainability. Bamboo is superior to wood in many ways, including strength, environmental friendliness, water resistance, cost, soil protection, and contribution to air quality. At present, due to its superior physical and mechanical properties, bamboo is often used instead of wood.

Biochar is a stable, carbon-rich material that can be used to improve soil health, sequester carbon, and enhance agricultural productivity. Producing Bio-Char involves a process called pyrolysis, which is the thermal conversion of biomass in the absence of oxygen. In general, biochar has an alkaline pH, has high porosity, contains fixed and available carbon, and contain some negligible nutrients for plant growth. The high cation exchange capacity also improves the effects of fertilizer applications. The most important characteristic for the improvement of soil properties (such as adsorption capacity and water retention) is biochar porosity and large surface area. Bamboo Bio-Char has the features such as highly aromatic, rich in carbon, porous, strong adsorption capacity and so on. The higher number of porosity area and big surface of bamboo Bio-Char help enhance the structure of the soil and housing the helpful microorganism, resulting in healthy soil. Because of its negative charge, it helps in boosting soil's exchange capacity, improving nutrient availability for plants. Bamboo biochar has a wide range of applications, including air purification, water purification and other fields.

In agriculture, bamboo biochar has the potential to improve plant growth or crop yield in term of increase water-holding capacity, prevent nutrient losses from fertilizers, provide structure for the build-up of beneficial soil microorganisms. Bamboo biochar can be used for land reclamation, and carbon sequestration since carbon in biochar is stable for a period of several to hundreds of years, offsetting its contribution as a greenhouse gas in the form of carbon dioxide.

In this training, bamboo was introduced as an alternative species to create revenues for livelihood improvement of the community. The training is focusing on bamboo Bio-Char and how to produce bamboo Bio-Char to be used in the community and to be sold as value added products.

Objectives:

1. To provide knowledge about bamboo, utilization and innovation in the modern world.

2. To provide knowledge about bamboo Bio-Char and its utilization.

3. To enable participants to gain knowledge in the Bio-Char production process and be able to produce

Bio-Char for their own use.

4. To enable communities to use Bio-Char to improve soil quality to increase agricultural productivity.

5. To enable the community to earn additional income from the use of bamboo and Bio-char.

Methodology:

1. Give lecture on bamboo and utilizations and new innovation to the participants via Power-Point presentation. (File attached)

2. Give lecture on Bio-Char and utilizations to the participants via Power-Point presentation.

3. Training on the production of Bio-Char from bamboo raw materials

Bamboo biochar is made by heating bamboo in a low-oxygen environment through a process called pyrolysis. This process breaks down the bamboo into a carbon-rich charcoal. The steps of preparing are as follows;

3.1 Preparation of bamboo feedstock:

- Ensure the bamboo is dry (10-30% moisture content) for efficient pyrolysis.

3.2 Prepare the Pyrolysis unit:

- Using Carbonization Pyrolysis system with production capacity 1 ton/300 cycle

3.3 Load the bamboo feed stock into the Pyrolysis unit

3.4 Initiate Pyrolysis introduce heat to the system.

- Control the oxygen supply to prevent combustion (burning) and ensure pyrolysis (thermal decomposition in low-oxygen conditions).

- The ideal temperature range for biochar production is 350–700°C. Dehydrate the bamboo feed stock by slowly heat the bamboo in the Pyrolysis from 20°C – 270 °C. Then, carbonize with the temperature range from 270 °C – 400 °C to convert bamboo into charcoal. Finally, turn charcoal into “biochar” by increasing the temperature by adjusting the air flow into the unit more, the temperature will gradually increase from 400 °C to 500 – 650 °C. Add steam

to quickly expel the tar that was in the charcoal and create large number of pores and a large surface area. Then reduce the temperature at the bottom of the unit to 500 °C.

3.5 Monitor the Process:

Watch for smoke and gases (syngas) being released. These gases can be combusted to provide additional heat for the process. The process typically takes 1–3 hours, depending on the scale and feedstock.

3.6 Cool and Collect the Biochar

Once pyrolysis is complete, extinguish the fire or stop the heat supply. Allow the bio-char to cool in an oxygen-free environment to prevent it from burning. Before open the unit, the temperature in the unit must be below 40 °C. Then, collect the bio-char from the pyrolysis unit. The Bio-Cha can be ground into the desired particle size for application to soil.

Program:

27 January 2025

Table 1 Training on bamboo and utilization and the production of Bio-Char, an alternative for increasing value

Time	Activities	Participants
8:30 - 10:30	Presentation on bamboo and utilizations	1. Project team 2. Team of lecturers 3. Community representatives under the project 4. Representatives from the Tor Pae Vitthaya Community School 5. Representatives from Ban Huai Sing School
10:30 - 10:45	Coffee break	
10:45 - 12:00	Presentation on bamboo and utilizations (Continue)	
12:00-13:00	Lunch	
13:00 -14:30	Presentation on Bio-Char	
14:30 - 14:45	Coffee break	
14:45 - 16:00	Demonstration on Bio-Char production	
16:00 - 16:30	Closing the training	

List of participants:

Table 2 List of Participated on bamboo and utilization and the production of Bio-Char, an alternative for increasing value Training

No.	Name	Affiliation	Position	Remark
1	Ms. Waankarn Saengsrichan	Ban Tor Pae Community Forest	Community Forest Committee	
2	Ms. Aunruen Klahiran		Community Forest Committee	
3	Ms. Thitapha Rangsrichan		Community Forest Committee	
4	Ms. Wichit Plianthongdeang		Community Forest Committee	
5	Ms. Laeng Phanbut		Community Forest Committee	
6	Ms. Suphalak Suriya	Tor Pae Wittaya Community School	Techer	
7	Master Phakhin Thongkham		Student	
8	Master Akdech Jai Nu		Student	
9	Miss Arisara (no surname)		Student	Holding an ID card for a person who is not a Thai national (a person from a highland area)
10	Master Thitichot Phanrit		Student	
11	Mr. Supachai Kwangthu	Pratu Muang Community Forest	Community Forest Committee	
12	Mr. Niyom Chailangka		Community Forest Committee	
13	Ms. Kotchakorn Prakongnit		Community Forest Committee	
14	Mr. Sombat Sriudomkarn		Community Forest Committee	
15	Ms. Wan (no last name)		Community Forest Committee	Holding an ID card for a person who is not a Thai national (a person from a highland area)
16	Mr. Worawet Kirimasaphudong	Lekoh Community Forest	Community Forest Committee	
17	Mr. Rapin Prapapiman		Community Forest Committee	
18	Ms. Narisara Hanpradit	Lekoh School	Techer	
19	Ms. Suda Praipanarak		Techer	
20	Ms. Chuthathip Bunyuang	Thung Pham Community Forest	Community Forest Committee	
21	Ms. Kesorn Jommani		Community Forest Committee	
22	Ms. Buaphan Nokkaew		Community Forest Committee	
23	Ms. Khampan Sunantha		Community Forest Committee	
24	Ms. Jai Phutthasen		Community Forest Committee	
25	Ms. Supattra Duangdee	Ban Huai Sing School	Techer	
26	Ms. Amporn Chengsa-ad		Techer	
27	Miss Tawan Phanaleewiman		Student	
28	Master Nadech (no last name)		Student	Holding an ID card for a person who is not a Thai national (a person from a highland area)
29	Master Chanwit Ngamdeandao		Student	

Results:

The results of training on the bamboo and utilization and the biochar and biochar production can be summarized as follows:

Result from bamboo and bamboo utilization training:

Participant know the bamboo more than they ever know since the presentation contained all in formation about bamboo and utilization from all over the world and including all innovation at present day. The training unlocks a "green economy", one of Thailand's important policies, that balances ecology and livelihoods. By leveraging bamboo's versatility, communities can combat climate change, reduce poverty, and preserve cultural heritage. Long-term success depends on continuous skill-building, market linkages, and supportive policies. This bamboo training led to the knowledge and idea on how to create income generation from bamboo material for better livelihood together with vision on transformative environmental, economic, and social benefits.

For environmental benefits such as;

- Sustainable resource management: Bamboo grows rapidly (1–2 feet/day) and regenerates without replanting, reducing pressure on forests.
- Carbon Sequestration: Bamboo absorbs more CO_2 than many trees, mitigating climate change.
- Soil Conservation: Its root system prevents erosion and improves soil health in degraded lands.
- Biodiversity Protection**: Bamboo forests provide habitats for wildlife and act as ecological corridors.

For Economic Empowerment such as;

- Income Generation: Communities can get profit from bamboo-based products (furniture, handicrafts, flooring) or raw materials.
- Job Creation: Training fosters roles in planting, harvesting, processing, and marketing bamboo productions.
- Cost Savings: Bamboo replaces expensive imported materials (e.g., timber, steel) in construction and crafts.
- Export Opportunities: High demand for bamboo in global markets (e.g., textiles, bioenergy, bio-char).

For Social and Cultural Impact such as;

- Skill Development: Training builds expertise in sustainable agroforestry, carpentry, and entrepreneurship.

- Poverty Alleviation: Low-cost bamboo enterprises uplift marginalized groups, including women and youth.

- Cultural Preservation: Revives traditional bamboo crafts and integrates them into modern economy.

- Community Resilience: Bamboo's versatility aids disaster-resilient housing and infrastructure.

For health and Infrastructure such as;

- Affordable Housing: Bamboo is a lightweight, durable, and earthquake-resistant building material.

- Clean Energy: Bamboo charcoal and biomass provide eco-friendly fuel alternatives, reducing indoor air pollution.

Result from Bio-Char training:

Participants gained new knowledge about the utilization of bamboo, namely biochar. Biochar training can catalyze a transition toward sustainable agriculture and circular economies which are the major policies of Thailand. It also enhancing community resilience. However, success depends on addressing logistical barriers, ensuring equitable participation, and providing continuous support. When effectively implemented, biochar initiatives can offer a holistic pathway to climate resilience, economic growth, and social. It can cover many aspects, affecting agriculture enhancement, the environmental benefit, the economic opportunity and social and health impacts as follows;

For agricultural enhancement such as;

- Improved soil health: Biochar increases soil fertility by enhancing nutrient retention, water-holding capacity, and microbial activity, leading to higher crop yields.

- Food security: Increased agricultural productivity can reduce reliance on external food sources and improve resilience against climate variability.

For environmental benefits such as,

- Carbon Sequestration: Biochar locks carbon into the soil, mitigating climate change by reducing atmospheric CO_2.

- Waste Management: The processes encourage converting agricultural/plant waste into biochar, reducing open burning and associated air pollution.

- Biodiversity Protection: Healthier soils support diverse ecosystems and reduce deforestation pressures from slash-and-burn practices.

For Economic Opportunities such as,

- Income generation: Communities can sell surplus biochar or biochar-enriched produce, creating new revenue streams.

- Job Creation: Local biochar production may spur small enterprises, involving roles in production, distribution, and marketing.

- Cost Savings: The need for chemical fertilizers is reduced and the plant's durability is increased, resulting in lower farming costs.

For Social and Health Impacts such as,

- Community Empowerment: Inclusive training fosters collaboration and skill-sharing, strengthening social cohesion.

- Health Improvements: The processes reduced air pollution from waste burning decreases respiratory illnesses.

Assessment results:

The assessment result of this activity, overall, found that more than 70% was scoring this training as excellent while 20% evaluated it as good. And also the participants expressed their opinions on this activity such as 1) They gained new knowledge, which they could introduce to their younger siblings and friends, 2) We were able to integrate the knowledge into teaching causes and learning system in school. 3) They gained knowledge in experimentation, which they could apply in the future. 4) They gained knowledge that was in line with the intended purpose of their participation, and they were able to apply it to their careers and communities. They also provided suggestions for promoting appropriate areas in addition to this by organizing of the diverse topic, and they wanted to learn about other professions.

Sustainability:

Since the project of producing biochar from bamboo can be applyed to the soil improvement in the agricultural areas of the villagers instead of using chemical fertilizers and can be produced for sale, generating additional income, many people participated interested in applying knowledges to further develop production in a tangible way. They requesting support in sending people to get additional deep training to increase production skills and create equipment for producing biochar by themselves. In addition, agencies such as school is interested in including bamboo and biochar in the school curriculum to make the new generation to have knowledge and become the leaders in biochar production, in order to turn the community and nearby areas into important sources of bamboo and biochar production in the northern region. However, there are challenges and considerations such as the limit number of pyrolysis equipment, bamboo materials, technical support and market linkages that may affected to the sustainability.


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