Oil barrel where the husks are pyrolised, and the chimney of the burning chamber. (Stefan Graf)

Production and use of rice husk biochar in rice seed beds and vegetable production. (柬埔寨)

(Khmer)

描

Rice husks as well as empty seeds are pyrolised and used as a soil amendment in the rice seed beds and the vegetable gardens.

Biochar is the residue left after the pyrolysis of any organic matter and is used as a soil amendment. Pyrolysis occurs when the organic matter is heated in anaerobic conditions, which is usually done in specially designed kilns. Sometimes it is also made in a conventional fire, which is extinguished before the char turns to ash. Agricultural wastes like rice husks or unfilled grains are mainly used. Biochar can have many positive effects on the soil and plants:
-It buffers the pH, and has usually a high pH due to theash content.
-Due to its porous structure, it holds water and serves as refuge for microorganisms.
-It absorbs and adsorbs nutrients, both cations and anions. They are available for the plant roots.
-It can increase the resistance of plants to diseases.
Due to all these effects, the increased yields are higher than those that can be achieved only through the nutrients contained in the Biochar itself. Biochar is and was used in many parts of the world as soil amendment, with some benefits persisting for centuries. In Cambodia it was used during the Pol Pot regime to reduce the smell of the human faeces that were used on the fields due to a lack of other fertilizers. Today research in the Biochar domain is increasing, especially since the discovery of the man-made terra preta soils in South America.

Biochar is mainly used to increase the fertility, water holding capacity and carbon content of the soil. The fact that the benefits of Biochar addition to the soil remain for several years, unlike chemical fertilizers, makes it attractive to farmers. Other purposes, like the increased resistance of plants to diseases and buffering of nutrients are also of importance.

Biochar was introduced or reintroduced trough different NGOs, JICA (Japanese International Cooperation Agency) in this case study. Because of knowledge exchange between farmers, a rice husk char/ash mix, as residue from the pottery baking, was used already in 2011. In 2013 JICA borrowed a Biochar kiln to the local farmer self-help group with a training, so they could produce Biochar by themselves. The inner part of the kiln (cf. technical drawing) is filled with wood and lit. It is then put into an empty oil barrel, which is filled with rice husks. The heat pyrolyses the husks from the bottom to the top of the barrel, and the gases are burned in the inner part of the kiln and the chimney. Just before the upper part is pyrolysed, the husks are extinguished. There is a weight loss of about 50 to 60 % caused by this process. The Biochar is added to the fields after ploughing, and the fields are harrowed. In this case study, Biochar is used both in rice seed beds and in a vegetable patch. Concentrations of 0.5 kg/m2 are used in the rice seed bed, and 2.5 kg for the vegetables. Due to the little available quantities of husks, Biochar is not applied to the field yet. The use of Biochar is spreading quickly from farm to farm

The analysed area is flat (slope < 2%), with a tropical climate (dry season from November to May and wet season from June to October), and the soils are mostly sandy or loamy. The soil has a low fertility, contains little organic matter, and acidifies. The area has been deforested a long time ago, and the groundwater table is rather high (1-2 m during the dry season, on the surface during wet season).
Due to climate change, farmers notice more erratic rainfall, temperature rises and more recurrent droughts. Rice is the predominant crop grown in the area, since it serves as staple food (mix subsistence and commercial activities). Cattle are usually grazing on the fields after the harvest, without much control. Thus the cattle grazes too often and too much on the same spot, leading to degradation.
The increasing migration rate (the young generation leaves the villages to work in the cities, garment industry or abroad) results in a decrease of available labour force in the area which has detrimental effects on the agricultural activities. Furthermore, the civil war in the 1970s

地

地点: Kraing Leav, Kampong Chhnang, 柬埔寨

分析的技术场所数量:

选定地点的地理参考
- 104.60503, 12.24919

技术传播: 均匀地分布在一个区域 (approx. 0.1-1 平方千)

在永久保护区？:

实施日期: 不到10年前 最

介绍类型
- 土地使 创新
- 作为传 >=50 年分
- 在实 / 期
- ☑ 外 干

(Khmer Rouge) led to the loss of agricultural knowledge. Several NGOs are trying to re-establish the knowledge.

Oil barrel where the husks are pyrolised, and the chimney of the burning chamber. (Stefan Graf)

Burning chamber and part of the chimney. A wooden fire is started inside, and the burning chamber is then put into the oil barrel which is then filled with rice husks. (Stefan Graf)

技术分

主要目的

- [x] 改 产
- [ ] 减少、 、恢复土地 化
- [ ] 保护 态
- [ ] 合其他技术保护 /下域 区域
- [ ] 保持/提 多 性
- [ ] 低 害
- [ ] 应 候变化 天 及其影响
- [ ] 减 候变化及其影响
- [ ] 创 有 影响
- [ ] 创 有 会影响

土地利用

农田

- 一年一作: - 其他, - 叶 拉、卷心 、 他 , - 卜、 、南 、南 或ice, cucumber 年 : 季 数

供水

- [ ] 养
- [x] 合
- [ ] 充分

土地退化相关的目的

- [ ] 土地 化
- [x] 减少土地 化
- [ ] 修复/恢复严 化 土地
- [ ] 应土地 化
- [ ] 不

解决的退化问题

化学性土壤退化 - Cn 力下 和有机 含 下 , Ca 化

水质恶化 - Ha 干旱化

SLM组

- 土壤 力 合

SLM措施

农艺措施 - A2 有机/土壤 力

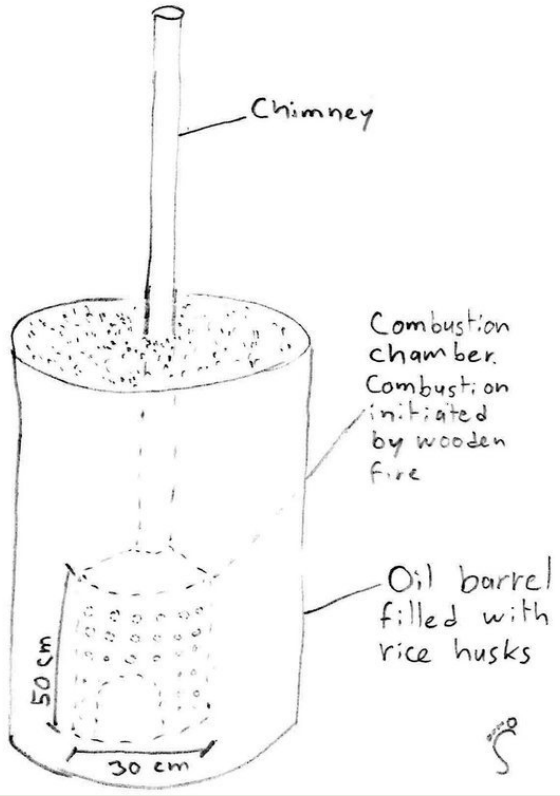
技术图

技术规范

Biochar kiln. In the inner part, the combustion chamber, a wooden fire is lit. The burning chamber is then placed in the oil barrel, which is filled with rice husks. The heat pyrolyses the husks, the gas burn in the chamber and chimney. When pyrolysis is almost completed, the char is extinguished.
Kampong Chhnang
Date: 2014

Technical knowledge required for field staff / advisors: high
Technical knowledge required for land users: moderate (When farmers only buy Biochar the required technical knowledge is low.)
Main technical functions: increase in organic matter, increase in nutrient availability (supply, recycling,...)
Secondary technical functions: improvement of surface structure (crusting, sealing), improvement of topsoil structure (compaction)

Manure / compost / residues
Material/ species: Rice husk Biochar (together with compost, which he already did before)
Quantity/ density: 0.5-2.5
Remarks: Entity: kg/m^2. Distributing on fields and harrowing.



Author: Stefan Graf, Switzerland

技术建□ 与□ 护□ □ 动、投入和□ □

投入和成本的计算

- □ □ □ 成本为□
- 成本□ □ 使□ □ **Riels** 币□
- □ □ □ 换□ 为1 □ 元兑 4000.0 Riels
- □ □ 劳工□ □ 日平均工5.00成本□

影响成本的最重要因素

The factors affecting the cost the most are the biochar kiln, and the amount of added Biochar.

技术建立活动

1. biochar kiln (时□ /□ □ None)

技术建立的投入和成本

对投入进行具体说明	单位	数量	单位成本 (Riels)	每项投入的总成本 (Riels)	土地使用者承担的成本%
设备					
kiln		1.0	50.0	50.0	
技术建立所需总成本				**50.0**	
技术建□ 总成本□ □ 元				*0.01*	

技术维护活动

1. Biochar making (时□ /□ □ Whenever there is time)
2. Adding Biochar to the fields after the compost was plowed in, and harrowing. (时□ /□ □ Yearly, before planting.)

技术维护的投入和成本

对投入进行具体说明	单位	数量	单位成本 (Riels)	每项投入的总成本 (Riels)	土地使用者承担的成本%
劳动力					
labour		1.0	20.0	20.0	100.0
设备					
machine use		1.0	0.25	0.25	100.0
植物材料					
rise husks		1.0	4.0	4.0	100.0
技术维护所需总成本				**24.25**	
技术□ 护总成本□ □ 元				*0.01*	

□ □ □ 境

年平均降雨量

- □ < 250□ □
- □ 251-500□ □
- □ 501-750□ □
- □ 751-1,000□ □

农业气候带

- □ □ □ □
- ☑ 半□ □
- □ 半干旱
- □ 干旱

关于气候的规范

1486.45 mm 2013 in Kampong Chhnang
Thermal climate class: tropics. 27° to 35°C

- [x] 1,001-1,500
- [ ] 1,501-2,000
- [ ] 2,001-3,000
- [ ] 3,001-4,000
- [ ] > 4,000

斜坡
- [x] 平0-2%
- [ ] 3-5%
- [ ] 6-10%
- [ ] 11-15%
- [ ] 16-30%
- [ ] 31-60%
- [ ] 60%

地形
- [x] 高原
- [ ] 山
- [ ] 山坡
- [ ] 山地斜坡
- [ ] 坡
- [ ] 底

海拔
- [x] 0-100 m a.s.l.
- [ ] 101-500 m a.s.l.
- [ ] 501-1,000 m a.s.l.
- [ ] 1,001-1,500 m a.s.l.
- [ ] 1,501-2,000 m a.s.l.
- [ ] 2,001-2,500 m a.s.l.
- [ ] 2,501-3,000 m a.s.l.
- [ ] 3,001-4,000 m a.s.l.
- [ ] > 4,000 m a.s.l.

.....应用的技术
- [ ] 凸形情况
- [ ] 凹 情况
- [ ] 不 关

土壤深度
- [ ] 常 0-20厘
- [x] 21-50厘
- [ ] 中 厚 30-80厘
- [ ] 81-120厘
- [ ] 常 > 120厘

土壤质地（表土）
- [ ] 中 壤土、 土

土壤质地（地表以下>20厘米）
- [ ] 中 壤土、 土

表土有机质含量
- [ ] 3%
- [x] 中 1-3%
- [x] 低 <1%

地下水位
- [ ] 上
- [x] < 5
- [ ] 5-50
- [ ] > 50

地表水的可用性
- [ ]
- [ ] 好
- [ ] 中
- [ ] 匮乏/ 有

水质（未处理）
- [ ] 好
- [x] 不 处
- [ ] 仅供农业使
- [ ] 不可

参

盐度是个问题吗？
- [ ] 是
- [ ] 否

洪水发生
- [ ] 是
- [ ] 否

物种多样性
- [ ]
- [ ] 中
- [x] 低

栖息地多样性
- [ ]
- [ ] 中
- [ ] 低

应 技术 土地使 征

市场定位
- [x]
- [x] 合 商业
- [ ] 商业/市场

非农收入
- [ ] 低于全 收入10%
- [x] 收入 10-50%
- [ ] > 收入 50%

相对财富水平
- [ ] 常
- [x]
- [x] 平均 平
- [ ] 丰富
- [ ] 常丰富

机械化水平
- [ ] 手工作业
- [ ] 力 引
- [ ] 机 化 动

定栖或游牧
- [ ] 定
- [ ] 半
- [ ]

个人或集体
- [x] 个人/家庭
- [ ] 团体/ 区
- [ ] 合作
- [ ] 员工 公司、政府

性别
- [x] 女人
- [x] 人

年龄
- [ ] 儿
- [ ] 年人
- [ ] 中年人
- [ ] 年人

每户使用面积
- [ ] < 0.5 公
- [x] 0.5-1 公
- [ ] 1-2 公
- [x] 2-5公
- [ ] 5-15公
- [ ] 15-50公
- [ ] 50-100公
- [ ] 100-500公
- [ ] 500-1,000公
- [ ] 1,000-10,000公
- [ ] > 10,000公

规模
- [ ] 小
- [x] 中
- [ ] 大

土地所有权
- [ ] 州
- [ ] 公司
- [x] 村庄
- [ ] 团体
- [x] 个人 未命名
- [ ] 个人 有命名

土地使用权
- [ ] 入 无
- [x] 区 有
- [ ]
- [x] 个人

用水权
- [x] 入 无
- [ ] 区 有
- [ ]
- [ ] 个人

进入服务和基础设施的通道

健康		✓		好
教			✓	好
技术援助		✓		好
就业 例如 农			✓	好
市场		✓		好
			✓	好
和交			✓	好
和卫 施		✓		好
服务			✓	好

影响

社会经济影响

作□ □ 产

□ 低 增加

农业投入□ □

增加 □ 低

工作□

增加 □ 低

According to the farmer, 50 to 70 % yield increase on his vegetable patches.

Rice husks become a demanded product instead of a waste. On the other hand, less pesticides are needed.

Biochar has to be made and added to the fields.

社会文化影响

□ 品安全 □ □ □

减少 改□

健康□ 况

恶化 改□

contribution to human well-being

decreased increased

Increased production, healthier plants/less pests.

Less pesticides needed.

Increased income, less expenses on pesticides.

生态影响

土壤□ 分

□ 低 增加

养分循□ /□ □

□ 低 增加

土壤有机□ /地下C

□ 低 增加

害□ /□ □ 控制

□ 低 增加

Plants can stand a short dry spell better if grown with Biochar.

A waste, rice husks, is returned to the soil. Biochar also adsorbs and absorbs nutrients.

The carbon from Biochar has a long half-life period in the soil .

Less pesticides needed.

场外影响

成本效□ 分析

与技术建立成本相比的效益

□ 期回报 □ 常□ □ 常□ 极

□ 期回报 □ 常□ □ 常□ 极

与技术维护成本相比的效益

□ 期回报 □ 常□ □ 常□ 极

The costs for the pyrolysis kiln were not borne by the land user. But as the farmer of this case study wants to build an own kiln as soon as the NGO needs it again, it is positive.

□ 候变化

渐变气候

年□ 蘼加 □ 常不好 □ 常好

气候有关的极端情况（灾害）

局地暴□ □ 常不好 □ 常好 □ □ □ 未□

局地□ 暴 □ 常不好 □ 常好 □ □ □ 未□

干旱 □ 常不好 □ 常好

□ □ 和□ □ □ □ □ □ □ □ □ 常不好 □ 常好

其他气候相关的后果

□ □ □ □ 期 □ 常不好 □ 常好

□ □ 和□ 应

采用该技术的地区内土地使用者的百分比

- 单例/实□
- 1-10%
- 11-50%
- > 50%

在所有采用这种技术的人当中，有多少人在没有获得物质奖励的情况下采用了这种技术?

- 0-10%
- 11-50%
- 51-90%
- 91-100%

最近是否对该技术进行了修改以适应不断变化的条件？

- 是

否

什么样的变化条件？

候变化极 候
不断变化 市场
劳动力可 性 例如 于

和吸取 教

长处: 土地使用者的观点

- Less insect damages where Biochar is applied.
- Good growth of vegetables, with increased yields especially for onions.
- The rice seedlings are stronger, and the roots break less while transplanting, and the plants recover quickly.
- The plants survive a short dry spell better.

长处: 编制者或其他关键资源人员的观点

- Soil amendment with long-term effect, as Biochar has a long half-life period.
- Buffering and raising of the pH, especially in sandy soils.
- Less washing out of nutrients.

弱点/缺点/风险: 土地使用者的观点如何克服

- Substrate to make Biochar (rice husks) is difficult to find in the area in big amounts, as only small rice mills are working there. Rice husks are wasted in other places. Networking with other villages.
  Use other (waste) sources of organic matter like leaves.
- Increased workload for the Biochar production (compensated by the increased yields). Use a bigger kiln to decrease the workload.

弱点/缺点/风险: 编制者或其他关键资源人员的观点如何克服

- The energy produced during the pyrolysis is wasted. Use it to power engines or as heating source. This would only be viable on large-scale kilns.

参 文

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WOCAT数据库中的完整描述
https://qcat.wocat.net/zh/wocat/technologies/view/technologies_1229/

链接的SLM数据
不

文件编制者

机构
- Local Agricultural Research and Extension Centre (LAREC) - 柬埔寨
- Society for Community Development in Cambodia (SOFDEC) - 柬埔寨

- 不

主要参考文献
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- Biochar foundation: www.britishbiocharfoundation.org