



Shelter belt in Inner Mongolia, China (HAI Chunxing (Beijing China))

Shelterbelts for farmland in sandy areas (中国)

Farmland shelter belt

描述

Belts of trees, planted in a rectangular grid pattern or in strips within, and on the periphery of, farmland to act as windbreaks.

Shelterbelts to protect cropland are a specific type of agroforestry system comprising certain tall growing tree species. Such shelterbelts around farmland help reduce natural hazards including sandstorms, wind erosion, shifting sand, droughts and frost. They also improve the microclimate (reduced temperature, wind speed, soil water loss and excessive wind-induced transpiration) and create more favourable conditions for crop production. Thus the establishment of shelterbelts plays a crucial role in the sandy drylands that are affected by wind and resultant desertification especially during winter and spring. Where there is irrigation, the shelterbelts protect the infrastructure from silting-up with wind-borne sediment.

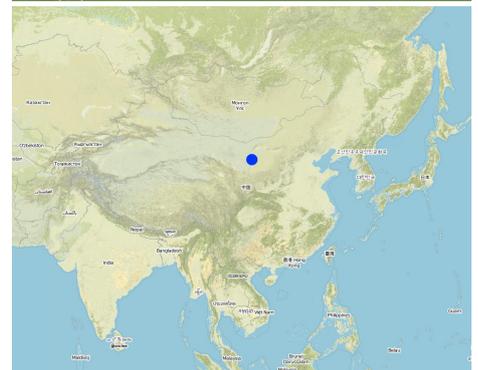
Strips of tall growing species (15-25 m) of poplar (*Populus* spp.) or willow (*Salix* spp.) were originally (from 1960s onwards) planted in a 400 by 600 m rectangular grid pattern within extensive areas of cropland, with an extra belt of windbreaks on the windward side (against the prevailing wind). Generally, the distance effectively protected is 15-25 times the tree height. Strips are of variable width, consisting of 2-5 tree lines (1-3 m apart) with trees planted every 1-2 m within the lines. Selective felling is used to maintain adequate growing space and the protective effect of the trees.

The impact of the shelterbelts depends on the planting pattern of the trees (the format of strips and grids), the orientation of the shelterbelts in relation to the wind, the spacing between, and the width of each strip and the type of trees planted. The specific design is primarily based on preventing the negative effects of wind, but depends also on local conditions such as the layout of the land, the location of the roads, farm boundaries and irrigation canals. Ideally the tree strips are perpendicular to the prevailing wind direction, and the angle between the strip and the prevailing wind is never less than 45 degrees. The structure of the strips determines the way the wind is controlled, ranging from blocking the wind

to letting it diffuse through semi-permeable shelterbelts. The best effect is achieved if the wind is not blocked entirely, as this can cause turbulence.

The ownership of the land and the shelterbelts still rests with the state, but management has been more and more transferred to individual households. On condition that the impact of the shelterbelt is not affected, the local forestry agencies now allow some felling of mature trees - on a rotational and selective basis, for timber and firewood. Pine trees (*Pinus sylvestris* var. *mongolica* and *P. tabulaeformis*), which command high value as timber for construction, and fruit (and cash) trees like the apricot tree (*Prunus armeniaca*) are increasingly used.

地点



地点: Inner Mongolia Autonomous Region, 中国

分析的技术场所数量:

选定地点的地理参考
• 106.114, 39.226

技术传播: 均匀地分布在一个区域 (500.0 km²)

在永久保护区? :

实施日期: 50多年前 (传统)

介绍类型

- 通过土地使用者的创新
- 作为传统系统的一部分 (> 50 年)
- 在实验/研究期间
- 通过项目/外部干预



Bird's-eye view of the rectangular grid of shelterbelts established over wide expanses of cropland to reduce natural hazards and protect crops. (Lingqin Meng)



Detailed view of a shelterbelt established in the early 1960s. A road and an irrigation channel run between the tree rows. (anonymous)

技术分类

主要目的

- 改良生产
- 减少、预防、恢复土地退化
- 保护生态系统
- 结合其他技术保护流域/下游区域
- 保持/提高生物多样性
- 降低灾害风险
- 适应气候变化/极端天气及其影响
- 减缓气候变化及其影响
- 创造有益的经济影响
- 创造有益的社会影响

土地利用

同一土地单元内混合使用的土地：是 - 农林业



农田

- 一年一作: 谷物类 - 玉米, wheat
- 每年的生长季节数: 1



森林/林地

- (半天然) 天然森林/林地, 管理: 选伐
- 植树造林

Tree types: 松树属, 山杨, Salix spp
产品和服务: 木材, 薪材, 水果和坚果, 自然灾害防护

供水

- 雨养
- 混合雨水灌溉
- 充分灌溉

土地退化相关的目的

- 防止土地退化
- 减少土地退化
- 修复/恢复严重退化的土地
- 适应土地退化
- 不适用

解决的退化问题



土壤风蚀 - Et : 表土流失, Eo : 场外劣化效应



水质恶化 - Ha : 干旱化

SLM组

- 农业林学
- 防风林/防护林带

SLM措施



植物措施 - V1 : 乔木和灌木覆盖层



管理措施 - M1 : 改变土地使用类型

技术图纸

技术规范

Overview of the shelterbelt layout.

Insert 1: Planting scheme: shelterbelts comprise 2-5 tree lines forming the windbreak about 5-15 m wide and 15-25 m high.

Insert 2: Rectangle grid layout of shelterbelts. Spacing of the rows is denser against the prevailing wind.

Technical knowledge required for field staff / advisors: moderate

Technical knowledge required for land users: low

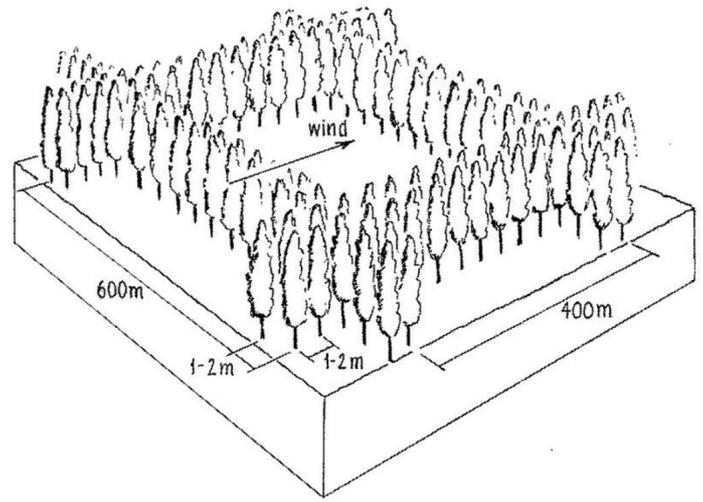
Main technical functions: increase / maintain water stored in soil, reduction in wind speed, protection from wind erosion, protection from sand encroachment, protection of crops from mechanical damage, reduction in evaporation loss

Secondary technical functions: increase in organic matter

Aligned: -against wind

Vegetative material: T : trees / shrubs

Trees/ shrubs species: Poplars (*Populus* spp.), willows (*Salix* spp.), increasingly also pine (*Pinus sylvestris* var. *Mongolic*)



Author: Mats Gurtner

技术建立与维护：活动、投入和费用

投入和成本的计算

- 计算的成本为：每个技术区域（尺寸和面积单位：ha）
- 成本计算使用的货币：美元
- 汇率（换算为美元）：1 美元 = 不适用
- 雇用劳工的每日平均工资成本：1.20

影响成本的最重要因素

The most important factors to affect the costs are seedlings (No.) and machine.

技术建立活动

1. Planning / designing of shelterbelt. (时间/频率: None)
2. Selection and collection of trees seedlings. (时间/频率: None)
3. Clearing and preparing land for planting of shelterbelt in (时间/频率: late autumn and spring)
4. Clearing and preparing land for planting of shelterbelt in (时间/频率: None)
5. Pits for planting the seedlings are dug (时间/频率: 4 Pits for planting the seedlings are dug)
6. Tree seedlings are planted (时间/频率: late spring)
7. 6 After planting each seedling is watered for up to two years. (时间/频率: None)

技术建立的投入和成本 (per ha)

对投入进行具体说明	单位	数量	单位成本 (美元)	每项投入的总成本 (美元)	土地使用者承担的成本%
劳动力					
Mainly collection and planting	ha	79.0	1.2	94.8	
设备					
tools	ha	1.0	5.0	5.0	100.0
植物材料					
tree seedlings	ha	1.0	25.0	25.0	
技术建立所需总成本				124.8	
<i>技术建立总成本, 美元</i>				<i>124.8</i>	

技术维护活动

1. Watering (时间/频率: after planting /timely)
2. Pruning of trees. (时间/频率: None)
3. Pest and disease control within shelterbelt. (时间/频率: None)
4. Intermediate/ selective tree felling. (时间/频率: None)

技术维护的投入和成本 (per ha)

对投入进行具体说明	单位	数量	单位成本 (美元)	每项投入的总成本 (美元)	土地使用者承担的成本%
劳动力					
Watering and Pruning	ha	7.0	1.2	8.4	100.0
植物材料					
tree seedling	ha	1.0	3.0	3.0	100.0
技术维护所需总成本				11.4	
<i>技术维护总成本, 美元</i>				<i>11.4</i>	

自然环境

年平均降雨量

- ✓ < 250毫米
- ✓ 251-500毫米
- 501-750毫米

农业气候带

- 潮湿的
- 半湿润
- 半干旱

关于气候的规范

以毫米为单位计算的年平均降雨量：430.0

- 751-1,000毫米
- 1,001-1,500毫米
- 1,501-2,000毫米
- 2,001-3,000毫米
- 3,001-4,000毫米
- > 4,000毫米

干旱

斜坡

- 水平 (0-2%)
- 缓降 (3-5%)
- 平缓 (6-10%)
- 滚坡 (11-15%)
- 崎岖 (16-30%)
- 陡峭 (31-60%)
- 非常陡峭 (>60%)

地形

- 高原/平原
- 山脊
- 山坡
- 山地斜坡
- 麓坡
- 谷底

海拔

- 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
- 凹陷情况
- 不相关

土壤深度

- 非常浅 (0-20厘米)
- 浅 (21-50厘米)
- 中等深度 (51-80厘米)
- 深 (81-120厘米)
- 非常深 (> 120厘米)

土壤质地 (表土)

- 粗粒/轻 (砂质)
- 中粒 (壤土、粉土)
- 细粒/重质 (粘土)

土壤质地 (地表以下>20厘米)

- 粗粒/轻 (砂质)
- 中粒 (壤土、粉土)
- 细粒/重质 (粘土)

表土有机质含量

- 高 (>3%)
- 中 (1-3%)
- 低 (<1%)

地下水水位

- 表面上
- < 5米
- 5-50米
- > 50米

地表水的可用性

- 过量
- 好
- 中等
- 匮乏/没有

水质 (未处理)

- 良好饮用水
- 不良饮用水 (需要处理)
- 仅供农业使用 (灌溉)
- 不可用

盐度是个问题吗?

- 是
- 否

洪水发生

- 是
- 否

物种多样性

- 高
- 中等
- 低

栖息地多样性

- 高
- 中等
- 低

应用该技术的土地使用者的特征

市场定位

- 生计 (自给)
- 混合 (生计/商业)
- 商业/市场

非农收入

- 低于全部收入的10%
- 收入的10-50%
- > 收入的50%

相对财富水平

- 非常贫瘠
- 贫瘠
- 平均水平
- 丰富
- 非常丰富

机械化水平

- 手工作业
- 畜力牵引
- 机械化/电动

定栖或游牧

- 定栖的
- 半游牧的
- 游牧的

个人或集体

- 个人/家庭
- 团体/社区
- 合作社
- 员工 (公司、政府)

性别

- 女人
- 男人

年龄

- 儿童
- 青年人
- 中年人
- 老年人

每户使用面积

- < 0.5 公顷
- 0.5-1 公顷
- 1-2 公顷
- 2-5公顷
- 5-15公顷
- 15-50公顷
- 50-100公顷
- 100-500公顷
- 500-1,000公顷
- 1,000-10,000公顷
- > 10,000公顷

规模

- 小规模
- 中等规模的
- 大规模的

土地所有权

- 州
- 公司
- 社区/村庄
- 团体
- 个人, 未命名
- 个人, 有命名
- communal/state

土地使用权

- 自由进入 (无组织)
- 社区 (有组织)
- 租赁
- 个人
- individual (see Annex T3 for remark)

用水权

- 自由进入 (无组织)
- 社区 (有组织)
- 租赁
- 个人
- individual (see Annex T3 for remark)

进入服务和基础设施的通道

影响

社会经济影响

作物生产
木材生产

降低 增加
降低 增加

生产区域 (耕种/使用中的新土地)



width of the shelterbelt

农业收入
off-farm income



extra timber and firewood

Crop production



Trees in competition with crops for solar radiation, fertilizer, and water



社会文化影响

冲突缓解
Loss of Food per agricultural land



shelterbelts of trees are not a direct source of food



生态影响

地表径流



SLM之前的数量: 8
SLM之后的数量: 0

土壤水分



土壤覆盖层



土壤流失



SLM之前的数量: 4
SLM之后的数量: 2

风速



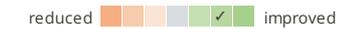
sand encroachment
microclimate for crops



regulating temperature, increasing humidity



conservation/maintenance of soil
fertility



场外影响

成本效益分析

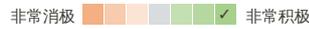
与技术建立成本相比的效益

与技术维护成本相比的效益

短期回报



长期回报



气候变化

采用和适应

采用该技术的地区内土地使用者的百分比



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?



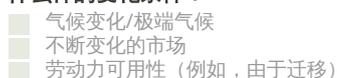
户数和/或覆盖面积

40 households in an area of 100-1000km² (10-50 persons/km²)

最近是否对该技术进行了修改以适应不断变化的条件?



什么样的变化条件?



结论和吸取的教训

长处: 土地使用者的观点

弱点/缺点/风险: 土地使用者的观点如何克服

长处: 编制者或其他关键资源人员的观点

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

- Reduced wind speed and trapped wind-blown sand particle

- Loss of land due to area used for the shelterbelts In this wind-prone part of Inner Mongolia, overall gains from the protected zones compensate for the reduced area under crops, especially if economically valuable species are planted in the shelterbelt, such

How can they be sustained / enhanced? Combine deciduous and

evergreen trees to maintain shelterbelt's protective function throughout the year.

- Increased crop yield

How can they be sustained / enhanced? Extend shelterbelt technology to unprotected croplands.

- Increased cash income

How can they be sustained / enhanced? Improve rotational felling regimes that maximise quantity and quality of tree products (timber; fruit etc) without reducing the shelterbelt's protective function. In Inner Mongolia apricot (*Prunus armeniaca*) and sea buckthorn (*Hippophae rhamnoides*) and in Gansu Province the Chinese dates (*Ziziphus jujuba*) are increasingly used.

- Apart from their effect on the wind, the overall benefits of the shelterbelts - for timber, firewood, fruits and fodder for animals - outweigh the loss of cropland occupied by trees

How can they be sustained / enhanced? Experience over 40 years has demonstrated that narrower trees strips and smaller grid size (100 by 200 m) would increase ecological efficiency, but due to higher costs and potential competition with crops, the spacing of the shelterbelts has mostly remained as it was originally.

- From 1960 onwards, approximately 22 million hectares – of vulnerable cropland have been protected in eastern Inner Mongolia

Editors' comments: In China, a total of 1.84 million km² suffer from desertification related to sand storms, shifting sands and wind erosion, making up 19% of the total land area. In those dry and desertified zones, farmland is barely productive, even with irrigation. The construction of shelterbelts in this northeastern part of China has had multiple benefits that outweigh the loss of cropland. However, maintenance has become an important issue with the changes in China's land use laws. This is one of two examples of windbreaks amongst the case studies in this book. Remark: In the 1960s, all land ownership and land use rights in China were communal and cropland was farmed collectively by village communes. After reform and open policy was put into practice in 1978, land use rights were transferred to the villages, to groups and individuals. Land itself and the shelterbelts however still belonged to the state. Nowadays the rights to cultivate specific parcels of land, within protected blocks, are generally granted to individual farm households. In some cases, in recent years, the shelterbelts too have been redistributed to individuals to look after. Inevitably maintenance has become an issue. But most of the shelterbelts are managed well. 3.2.8: If farmer cuts mature timber (for example a 40 year-old poplar), he/she can sell it for US\$ 20–25 per tree. With maturity of shelterbelts, the timber production increases, which brings increasing economic benefits; meanwhile, the effect of protection from wind erosion also improves.

as *Caragana korshinskii*, which can be used as forage, for 'green fertilizer' through leaf mulch and for firewood.

- Competition for sunshine, fertilizer and water Pruning of branches and digging of ditches to prevent roots penetrating the adjacent cropland
- Farmers lost the right to crop the tree-occupied land (since the shelterbelts belonged to the state). Originally, farmers were not allowed to fell trees Nowadays the local forestry department permits farmers to occasionally cut trees, which is a source of income. If land users were allowed to cut trees on a more systematic basis, it would help them to better appreciate the benefits.
- High cost (labour and money) for establishment Government support required.
- Shelterbelts comprised of single tree species are less resistant to pests and diseases

Shelterbelts consume more water Combine trees and shrubs/ different species, which improves both resistance and also the protective effect.

But they also help in drainage (where this is a problem) through lowering the ground water table and simultaneously reducing salinity. Appropriate tree species need to be selected and bred.

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WOCAT数据库中的完整描述

https://qcat.wocat.net/zh/wocat/technologies/view/technologies_1366/

链接的SLM数据

Approaches: Shelter Belt https://qcat.wocat.net/zh/wocat/approaches/view/approaches_2396/

文件编制者

机构

- GEF/OP12 Gansu Project (GEF/OP12 Gansu Project) - 中国

项目

- Book project: where the land is greener - Case Studies and Analysis of Soil and Water Conservation Initiatives Worldwide (where the land is greener)

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