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

Shelterbelts for farmland in sandy areas ( )

Farmland shelter belt

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 armeniace) are increasingly used.

: Inner Mongolia Autonomous Region,

:

- 106.114, 39.226

: (500.0 km²)

?:

: 50
( )

(> 50)

/

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)

, ,

/

/

✓

✓

/

/ -

• : - , wheat
: 1

/

• ( ) / .

•

Tree types: , Populus species, Salix spp
: , ,
,

✓

✓

/

- Et: , Eo:

- Ha:

SLM

•

•

SLM

- V1:

- M1:

Overview of the shelterbelt layout.
Insert 1: Planting scheme: shelterbelts compromise 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

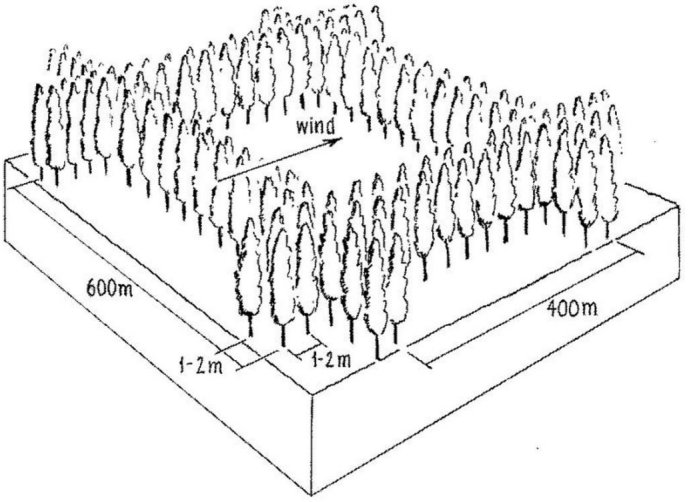
Technical knowledge required for land users: low

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

- (**ha**)
- ( ) 1 USD =
- 1.20

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

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

			( )	( )	%
Mainly collection and planting	ha	79,0	1,2	94,8	
tools	ha	1,0	5,0	5,0	100,0
tree seedlings	ha	1,0	25,0	25,0	
				124.8	
				124.8	

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

			( )	( )	%
Watering and Pruning	ha	7,0	1,2	8,4	100,0
tree seedling	ha	1,0	3,0	3,0	100,0
				11.4	
				11.4	

430.0

- [x] < 250
- [x] 251-500
- [ ] 501-750
- [ ] 751-1,000
- [ ] 1,001-1,500
- [ ] 1,501-2,000
- [ ] 2,001-3,000
- [ ] 3,001-4,000
- [ ] > 4,000

- [x] (0-2%)
- [x] (3-5%)
- [ ] (6-10%)
- [ ] (11-15%)
- [ ] (16-30%)
- [ ] (31-60%)
- [ ] (>60%)

- [x]
- [ ] 0-100
- [ ] 101-500
- [x] 501-1,000
- [x] 1,001-1,500
- [ ] 1,501-2,000
- [ ] 2,001-2,500
- [ ] 2,501-3,000
- [ ] 3,001-4,000
- [ ] > 4,000

- [ ] (0-20)
- [x] (21-50)
- [x] (51-80)
- [ ] (81-120)
- [ ] (> 120)

- [x] ( ) / ( ) (,) / ( )

- [ ] ( ) / ( ) (,) / ( )

- [ ] (>3%)
- [x] (1-3%)
- [ ] (<1%)

- [ ] < 5
- [ ] 5-50
- [ ] > 50

- [ ] /

- [ ] ( ) ( ) ( ) ?
- [ ] /
- [ ] /

SLM

- [ ] ( )
- [x] (/)
- [ ] /

- [ ] 10%
- [x] 10-50%
- [ ] 50%

- [x]

- [x] /

- [ ] /
- [ ] / (,)

- [ ] < 0.5
- [x] 0.5-1
- [x] 1-2
- [ ] 2-5
- [ ] 5-15
- [ ] 15-50
- [ ] 50-100
- [ ] 100-500
- [ ] 500-1,000
- [ ] 1,000-10,000

- [x] communal/state

- [ ] ( ) ( )
- [x] individual (see Annex T3 for remark)
- [ ] ( ) ( )

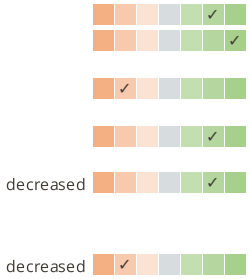
> 10,000

individual (see Annex T3 for remark)

(
/)

off-farm income

Crop production

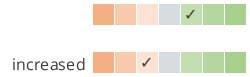


width of the shelterbelt

extra timber and firewood

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

Loss of Food per agricultural land



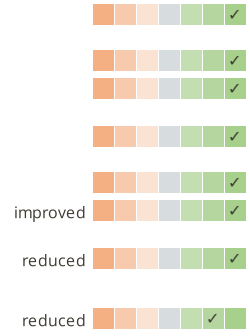
shelterbelts of trees are not a direct source of food

SLM: 8
SLM: 0

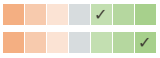
SLM: 4
SLM: 2

sand encroachment
microclimate for crops

conservation/maintenance of soil fertility



regulating temperature, increasing humidity



-

/

1-10%
11-50%
> 50%

?

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

/

40 households in an area of 100-1000km^2 (10-50 persons/km^2)

?

/

?

/

( )

:

:

/ / :

/ / :

- Reduced wind speed and trapped wind-blown sand particle

  How can they be sustained / enhanced? Combine deciduous and evergreen trees to maintain shelterbelt's protective function throughtout 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.

- 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 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.

Editors

Meili WEN

David Streiff
Deborah Niggli
Alexandra Gavilano

: 15 2010 : 13 2019

Yaolin Wang - SLM
Dogmei Wang - SLM

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

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

- GEF/OP12 Gansu Project (GEF/OP12 Gansu Project) -
- Book project: where the land is greener - Case Studies and Analysis of Soil and Water Conservation Initiatives Worldwide (where the land is greener)

- China atlas. China atlas publishing house, P 52.. 1999.: library of Department of Resource and Environmental Science, BNU.
- Zhao Yu, Jing Zhengping, Shi Peijun, Hao Yunchong et al. Inner Mongolia soil erosion research remote sensing was used in Inner Mongolia soil erosion research, Science publishing house, P25.. 1989.: library of Department of Resource and Environmental Science, BNU.
- Inner Mongolia forest department, Forest work manual,12, P33-34, P67.. 1998.: library of Department of Resource and Environmental Science, BNU.
- Synthesized investigate team in Inner Mongolia-Ningxia, CAS. West of northeast Forest in Inner Mongolia autonomy region, Science publishing house, P82-101.. 1981.: library of Department of Resource and Environmental Science, BNU.
- Sun Jinzhu. Natural condition and reconstruct in Hetao plain, Inner Mongolia people' s publishing house, P188-189.. 1976.: library of Department of Resource and Environmental Science, BNU.
- Inner Mongolia forest Department. Inner Mongolia autonomy region forest statistic data,P75.. 1987.: library of Department of Resource and Environmental Science, BNU.
- Hu Chun(chief editor). Inner Mongolia autonomy region climate resources about agriculture, forest and animal husbandry, Inner Mongolia people's publishing house, P45-47.. 1984.: library of Department of Resource and Environmental Science, BNU.
- Water and soil conservation bureau, Yellow River irrigation works committee of Department of water and electricity. Water and soil conservation economy benefit thesis collecting, P45-47.. 1987.: library of Department of Resource and Environmental Science, BNU.
- Zhang Pangchuen, A study on the benefit of shelter belt in the south part of Kerqin sand to agriculture increase in production. Journal of arid land resource and environment. Vol.4, no.1, P11-87.. 1990.: library of Department of Resource and Environmental Science, BNU.
- Sun Jinzhu,Chen Shan(chief editor). Inner Mongolia environment alarm beforehand and repair countermeasure. Inner Mongolia people's publishing house, P132.. 1994.: library of Department of Resource and Environmental Science, BNU.
- Compilation Committee of Inner Mongolia Forest Inner Mongolia Forest, Beijing: China Forestry Publishing House, 1989,299–319. 1989.: