

PASSIVE SOLAR GREENHOUSES IN CHINA TO GROW VEGETABLES AND FRUITS IN WINTER SEASON

In China, fully [passive solar greenhouses](#) for the cultivation of fruits and vegetables in winter season have been successfully implemented since the 1980s.

The main feature of the passive solar greenhouse designed and adopted in China is its ability to retain as much warmth as possible, allowing to grow fruits and vegetables out of season throughout the year, using only the energy of the sun, without auxiliary heating during the winter.

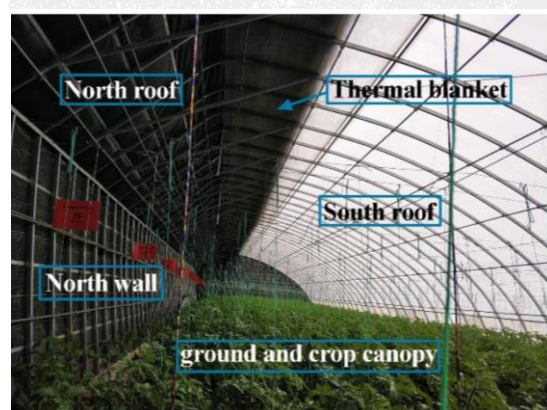
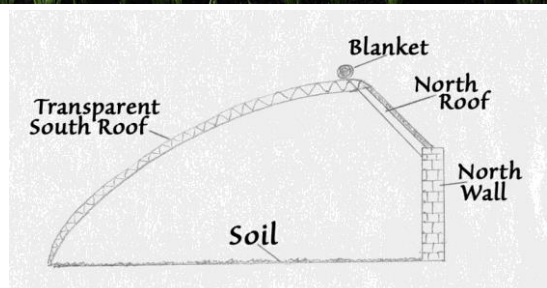
To achieve this result, the structure of the passive solar greenhouse is designed facing south, with three walls of brick or clay and partial roof on the north side. On the southern side arched struts extend from the peak of the roof to the soil surface, covered with transparent plastic material to capture the heat of the sun. An insulating blanket is also rolled over the plastic to retain heat increasing the insulation capacity of the structure. During the day the greenhouse captures heat from the sun in the thermal mass of the walls, which is released at night.

From these basic characteristics, it exists a wide variety of designs, from very low technology versions, constructed with simple local materials, to very high technological ones. The performance of the Chinese greenhouse depends on its design, the latitude, and the local climate.

The article [Reinventing the Greenhouse](#) published in 2015 by the [Low Tech Magazine](#), which presents its characteristics and applications, reports that 800,000 hectares of passive solar greenhouses were built in China during the last decades. The incentive policy of the Chinese government has made the solar greenhouse a cornerstone of food production in central and northern China. One fifth of the total area of greenhouses in China is now a solar greenhouse and by 2020, they are expected to take up at least 1.5 million hectares.

Passive solar greenhouses, compared to other current solutions, present advantages of great interest to allow food production when temperatures are very low. In particular:

- They do not require auxiliary heating and save energy costs for crops in winter. The indoor temperature of the structure can be up to 25°C higher than the outdoor temperature.
- They allow to supply local communities with fresh food



throughout the year, reducing the import of products and their related economic and environmental costs;

- They can be built with different materials adapted to the local context and do not require large maintenance investments by farmers;
- The design of the structure can be adapted to the climatic context of the area, for example increasing the slope of the roof in colder climates to maximize the absorption of solar energy;
- The level of technology adopted may vary depending on the economic capacities of the farmers, the requirements and the size of the farms.



The design of the passive solar greenhouses has evolved continuously in China and the [Low Tech Magazine](#) provides extensive and interesting information on improvements made by farmers, professionals and companies to adapt the structure to different contexts and functions. For example:

- the structure can be deeper and taller, allowing sunlight to be better distributed and ensuring that temperature fluctuations are decreased. In the northern territories the slope of the roof can be angled to be perpendicular to the sun's rays when it's lowest on the horizon.
- more modern materials for insulation of the walls and the plastic sheet are being chosen, to improve the heat absorption. In some recent greenhouses, the insulation blankets are rolled up and down automatically, and more sophisticated ventilation systems are used. Some greenhouses have a double roof or reflecting insulation installed.
- to achieve an adequate level of CO₂, in some greenhouses vegetable crops are combined with animal husbandry. Pigs, chickens and fish produce CO₂ that is absorbed by plants, while plants produce oxygen (and green waste) for animals. To improve heating and CO₂ production, compost production systems are also installed in some greenhouses, which is used at the same time to increase soil fertility.



Passive solar greenhouses represent a valuable tool to support farmers by strengthening local economies, to reduce energy use, to grow fresh food typical of the territory, favoring a healthy diet for the population in winter seasons.



Within the framework of the more recent initiatives launched by the International Community to strengthen *Family Farming* and for *Climate Action*, they represent an innovative and effective solution that will surely attract the attention of local governments, environmental agencies, businesses and peasant organizations to promote their wider use in cold climates.



To know more

[Low Tech Magazine-reinventing the greenhouse](#)

[Low Tech Magazine in Spanish](#)

[Chinese Solar Greenhouse in appropedia.org](#)

[Article in mdpi.com](#)

[Solar Greenhouses Chinese Style in resilience.org website](#)

[Passive solar greenhouse in lowimpact.org website](#)

[Photos in china.org.cn](#)

[Article in energyfarms.wordpress.com](#)

[Article in earthbound.report website](#)

[Article in Zenong.en.made-in-china.com](#)

[Article in cacilm.org](#)

[Article in vegcropshotline.org](#)

[Article in motherearthnews.com](#)

[Article in greenhousescanada.com](#)

[Document in geysoco.es](#)

[Passive Solar Greenhouses in FAO website](#)

[Document in FAO website](#)

