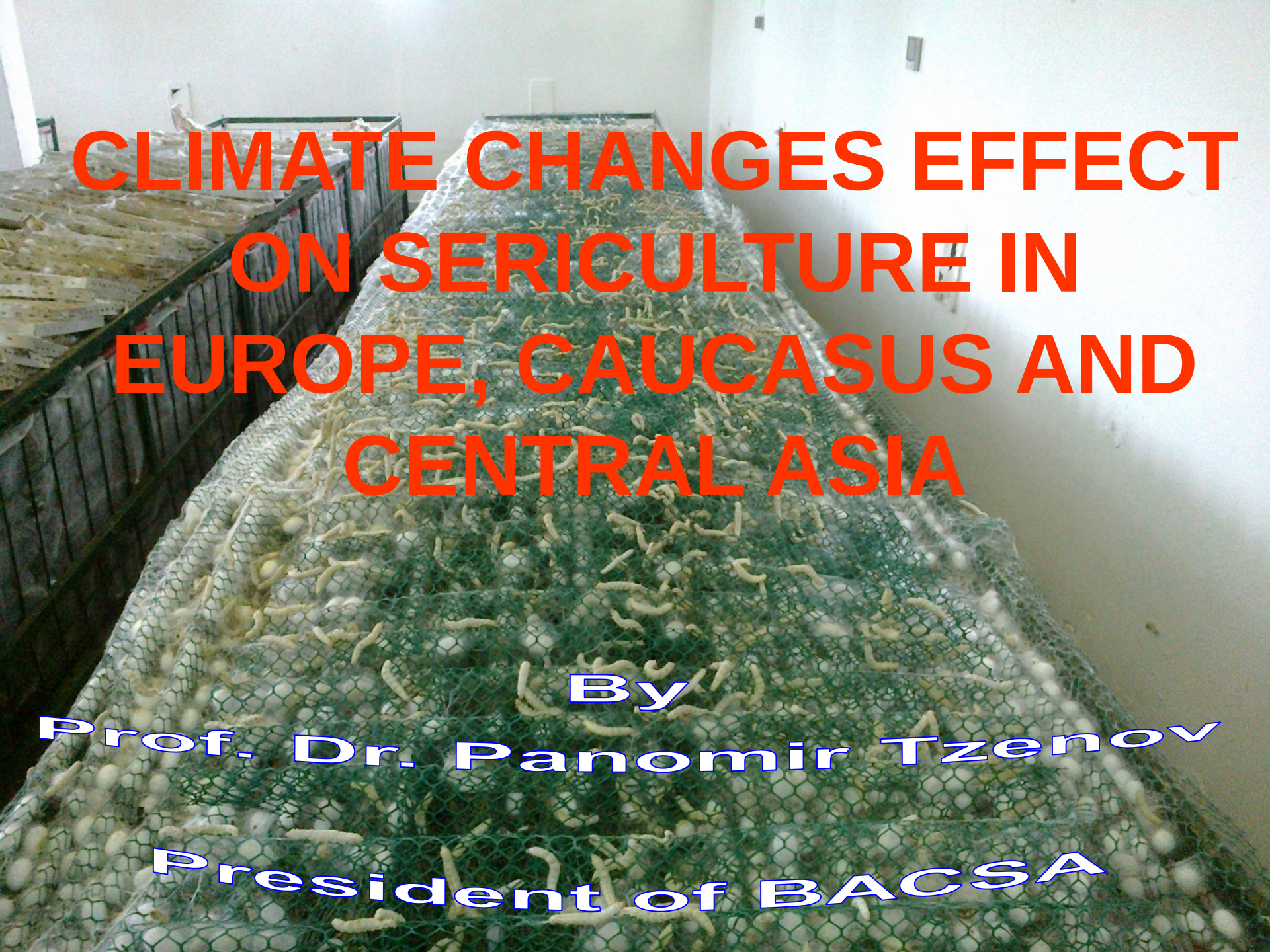

CLIMATE CHANGES EFFECT ON SERICULTURE IN EUROPE, CAUCASUS AND CENTRAL ASIA

By

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THE GLOBAL WARMING AND CLIMATE CHANGES

The main official conceptions about the **Global warming** are that:

- Global temperatures are rising at a rapid, unprecedented rate.
- The "hockey stick" graph proves that the earth has experienced a steady, very gradual temperature decrease for 1000 years, then recently began a sudden increase.
- Human produced carbon dioxide has increased over the last 100 years, adding to the Greenhouse effect, thus causing most of the earth's warming of the last 100 years.
- CO_2 is the most common greenhouse gas.
- Computer models verify that CO_2 increases will cause significant global warming.

THE GLOBAL WARMING AND CLIMATE CHANGES

- The United Nations' Intergovernmental Panel on Climate Change has proven that man–made CO_2 causes global warming.
- CO_2 is a pollutant.
- Global warming will cause more storms and other weather extremes.
- The earth’s poles are warming and the polar ice caps are breaking up and melting.

At the same time others consider that all these Global warming conceptions are just myths.

For example the Climate Research Unit of the University of East Anglia, shows warming to 1878, cooling to 1911, warming to 1941, cooling to 1964, warming to 1998 and cooling through 2011. The warming rate from 1964 to 1998 was the same as the previous warming from 1911 to 1941. Satellites, weather balloons and ground stations all show cooling since 2001. The mild warming of 0.6 to 0.8 º C over the 20th century is well within the natural variations recorded in the last millennium.

To the present day there is still no scientific proof that man-made CO2 causes significant global warming. Besides Carbon dioxide is no more a pollutant than nitrogen is. CO2 is essential to life on earth. It is necessary for plant growth since increased CO2 intake as a result of increased atmospheric concentration causes many trees and other plants to grow more vigorously.

Nevertheless whether there really is a "Global warming" or these are just cyclic climatic changes it is obvious that there are some climate changes which may badly influence the sericulture development.

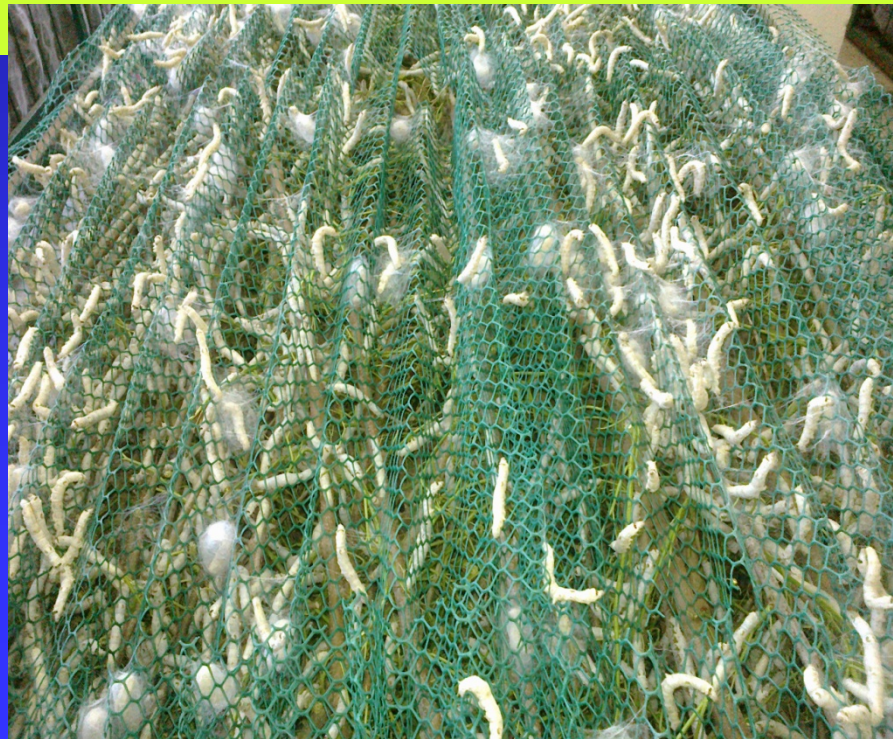
CLIMATE CHANGES AND SERICULTURE

Through changes in temperature, water regimes and carbon dioxide levels, global climate change may directly affect mulberry, soil, pests, and the silkworm.

Besides there are some specificities of the climate in European and Central Asian sericulture countries. Even though these countries are located in the temperate and sub-tropical belt like Japan, Korea and parts of China, the climatic conditions are quite different.

Most of European and Central Asian sericulture countries with temperate climate have comparatively cold winter and hot, but dry summer.

The peak of rains during mulberry vegetation period is in May and June, but July and August are the driest months. On contrary in Japan and Korea July and August are the most rainy months during the mulberry vegetation period due to monsoons. Even though June is considered as a late spring, usually the weather is very hot during the 5th larval instar. Due to very hot weather in June the mulberry leaves get coarse quickly.



There is also a big temperature fluctuation during the spring rearing season in May and June, namely the night temperature could be half of the day temperature. In early spring (March and April) hot weather with high temperatures like 25 – 30 ^{o} C is quickly changed with abnormally cold weather, even temperatures below zero which may very badly affect the already sprouted mulberry trees.

All these specific climatic conditions require mulberry to have high cold and drought tolerance and the silkworm breeds and hybrids to possess a good tolerance to adverse rearing conditions like high temperature, daily temperature fluctuations and coarse mulberry leaves feeding. It is not occasional that the bush type of mulberry plantations are not popular in any European and Central Asian sericulture country, mainly because their roots are situated too shallow in the soil, compared with low/medium/high stem mulberry trees.

Unlike in the past when the temperate countries use to be the major silk producers, there is a Paradigm shift of silk production towards tropical and sub-tropical countries namely South China, India, Vietnam, Thailand in Asia who are the major silk producers in nowadays.

However what will be the situation in the medium and long term future?

The silk produced was comparatively cheap, providing income resources to many poor farmers from the developing countries. In nowadays there are two main cocoon producers – China and India, providing more than 97 % of the Global cocoon production. In both two countries the local silk market plays a very important role, especially in India, thus presently China exports more than 98 % of the raw silk in the world market. Therefore the fresh cocoon purchasing prices in all the other countries are considered with the Chinese raw silk price. The fresh cocoon purchasing prices in China and India have increased almost triple during the last 10 years, reaching around 7 – 10 US$/kg now. In fact, judging from the previous experience, there is no any chance these prices to go down back, on the contrary they increase year by year so far.

Here I am not going to discuss the reasons of raw silk prices increase, but this situation will lead in a medium – term future to higher cocoon and raw silk prices and as a main result in the long-term future – big increase of the silk fabrics and garment and other sericultural products prices. I believe that it will no more be possible to produce cheap silk like in 90's of 20th century and early 2000's.

Then the question is whether the more expensive silk and other sericulture products may be sold at the similar quantities like now?

It seems that at too high final products prices there will not be possible anymore to produce so comparatively big amount of cocoons and raw silk as now, so my vision about the sericulture long-term future is that it will gradually become a boutique-like industry, producing very high value product in restricted amount. This is valid also for the sericulture products use for non-textile purposes.

In the long-term future may be there will be a much smaller than now sericulture products market, but of high value products.

That means the sericulture may change from an industry for the poorest farmers, to an agribusiness, requiring more investments and productional costs, but having high revenues by high market price of the products.

If this scenario will come true some of the climate changes problems, especially the drought and high temperature during the silkworm rearing will be solved by more investments in mulberry irrigation and suitable rearing houses with good insulation and air conditioned.

CLIMATE CHANGE AND MULBERRY CULTIVATION

Mulberry, a perennial species is physiologically classified as C 3 plant. Plants that survive solely on C_3 fixation (C_3 plants) tend to thrive in areas where sunlight intensity is moderate, temperatures are moderate, carbon dioxide concentrations are around 200 ppm or higher, and ground water is plentiful.

Therefore the increase in quantum of Carbon Dioxide is reported to be beneficial to mulberry which is C_3 plant. The increase in temperature may accelerate the faster growth of mulberry. Hence enabling more leaf harvests and a good biomass. However, this is possible only when there is enough moisture available in the soil.

How to adjust the mulberry varieties and agrotechnics to cold winters, sudden temperature changes, higher temperatures and drought?

The most important way of course is the mulberry varieties improvement.

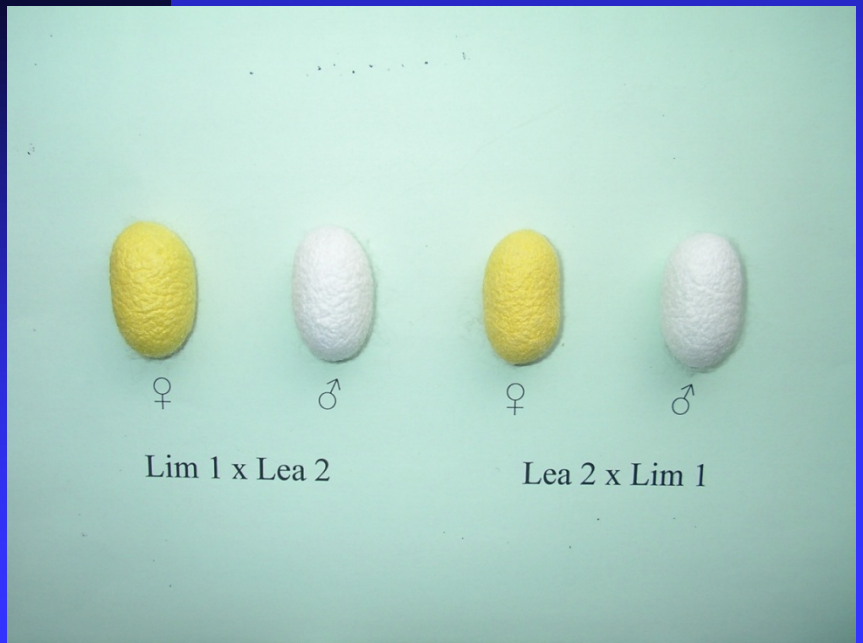
An ideal genotype of mulberry for cold and drought resistance should have following features:

- High cold tolerance, one of its most important component is the capability of variety to ripe well the shoots in order not to be damaged by the low temperatures during the winter.

- The variety to have medium term sprouting in the spring because the early sprouting varieties may be damaged by early spring frosts.

- Deep root system (for water mining from deep layers).

- High branch number.
- Can produce more biomass in stress.
- Continues to grow during stress period.
- High leaf thickness (high moisture retention, more photosynthetic efficiency).



Capable of responding to rains immediately whereas varieties with ceased growth response takes more time.

High cell membrane stability (can withstand high temperatures), high epicuticular wax (more water use efficiency).

Less post-harvest water losses and increase the reflection of light).

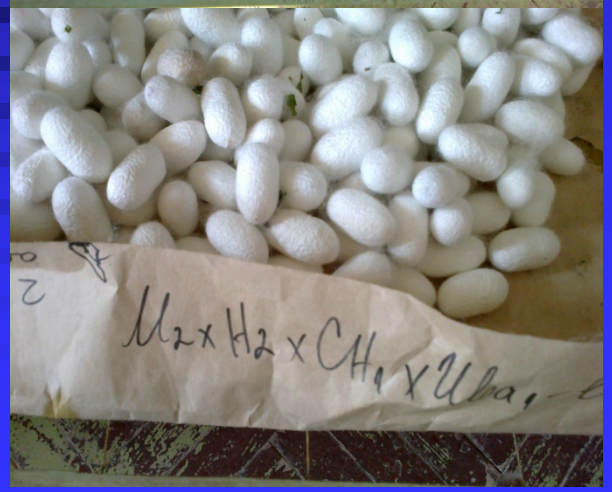
The other important factor is a suitable mulberry agrotechnics. We could recommend the following type of plantations:

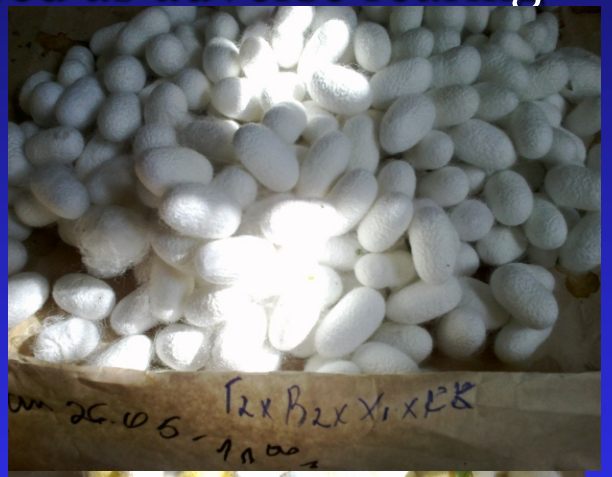
A planting inter-row distance of 1.8 – 3 meter and 0.6 – 1 m between the trees in the row. In this planting scheme the number of trees per 1 ha is 9250 – 3330. The stem height is 0.50 – 0.60 m (low – cut).

CLIMATE CHANGE AND SILKWORM REARING

Majority of the insects like the silkworm are cold blooded organisms, whose body temperature is approximately similar to that of environment, hence, the change in temperature influence insect behavior, distribution, development, survival, growth, and reproduction.

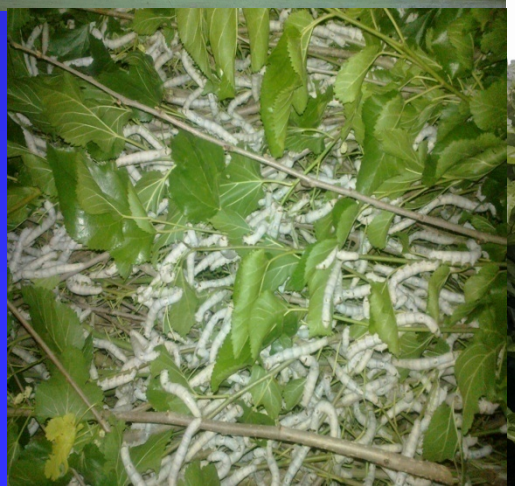
For the uni-bivoltine highly productive silkworm races high temperature (over 26 ^{o} C), high humidity (over 75 %) during the 5th larval instar and cocoon spinning, high rearing density, malnutrition caused by low mulberry leaf quality, high density or too low feeding amounts provided, not sufficient ventilation during the 4th and 5th instars and cocoon spinning may be considered as adverse rearing conditions.





The high air temperature during the 4th and 5th larval instars is the most harmful climatic factor that may influence badly the silkworm and cocoon crop.

In fact the problems caused by all these adverse conditions can be solved easily by keeping strictly the optimal silkworm rearing technology recommended



The problem however is that keeping the optimal technology requires more labor and capital investments, which most of the sericulture farmers do not want or are not able to make due mainly to the too low economical interest.

Therefore presently, when the sericulture farmers are still one of the poorest people from the society and the cocoon purchasing prices can not allow them to make big capital investments, the only solution to solve partly the problem of adverse silkworm rearing conditions is breeding of silkworm races and F_1 hybrids, having higher tolerance to such a conditions.

The main methods in the silkworm hardy varieties breeding are:

- **Selection of silkworm breeds under adverse rearing conditions.**
- **Crosses between bivoltine and polyvoltine races for use as breeding material.**
- **F1 hybrids between polyvoltine and bivoltine parents.**
- **F1 hybrids between hardy and highly productive silkworm breeds.**

The main problem in this type of silkworm breeding is the negative correlation between the larval sturdiness and the cocoon weight, silk shell weight and the shell ratio.

Nevertheless in some countries like for example India, Japan, China, Bulgaria etc. some hardy silkworm breeds and F1 hybrids have been created during the last 20 years.

The breeding target is to create races and hybrids having high tolerance to adverse rearing conditions and medium productivity so that when providing optimal rearing conditions the farmer to obtain a normal fresh cocoon yield per box of eggs with sufficiently high silk shell ratio and reelability.

SUGGESTIONS TO MITIGATE THE EFFECTS OF CLIMATE CHANGE

- Develop new cold and drought tolerant mulberry varieties.
- Develop silkworm races to adopt for increased temperature coupled with high moisture situations.

Develop effective management system for silkworm disease prevention/control as high temperature and moisture promote faster growth of pathogens.

Develop suitable methods to manage high humidity and CO2 both during rearing and cocoon spinning.

Creating economical conditions the farmers to be interested and able to make more capital investments in improving the mulberry cultivation and silkworm rearing facilities.


Europe
Mediterranean Sea
Egypt
Persia
China
Arabia
India
Somalia
Indian Ocean
Java
THANK YOU!