Possible contributions of sericulture to the solution of the world's most vexing problems

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Abstract

This paper introduces a new type of sericulture and discusses the possibility of transforming the silk industry into a large worldwide industry the equal of the cotton or wool industry. The challenge for this new industry is to foster sericulture as well as sericulture-related industries such as spinning mills, textile and sewing factories in developing regions. This could create a vast number of jobs especially appropriate for women. First, an equation showing the various relationships among population, life-style and global environmental impact is introduced. Then, a consideration is given as to why the social status of women in developing regions is low and how this affects children. Because hunger is the most serious disaster facing mankind, a huge number of children suffer from malnutrition, and starvation. This paper concludes that this new type of sericulture, practiced successfully in Brazil and in Southeast Asia, promises job opportunities especially for women that could eliminate poverty in developing regions. In addition, it may also contribute to population control, increased food production, and global environmental benefits such as aforestation.

Introduction

Suppose 'population' is represented by Pi and the 'average impact on environment per person' by Ci, then we have the following equation to define the total impact human beings make on the global environment:

$$I = \sum_{i=1}^{N} Pi * Ci \qquad \text{.....(1)}$$

where N represents "the number of nations or races." Paul Ehrlich has warned us about the irrevocable global destruction which would result if "the Impact (I)" continues to increase at the present rate.

Today, however, the finite permissible destruction of the global environment is widely understood. We should discuss this problem based on the "dynamic differential quantity (dI/dt)" rather than on the impact quantity (I), since it is logically more accurate to think that if human beings continue to increase the Impact (dI/dt), that the accumulated Impact will some day exceed the finite quantity of permissible destruction and so render the earth no more habitable for us.

$$\frac{dI}{dt} = \sum_{i=1}^{N} \frac{dPi}{dt} * Ci + \sum_{i=1}^{N} Pi * \frac{dCi}{dt} \quad \text{.....(2)}$$

The necessary condition for the continuation of the human species requires us to curb the growth of dI/dt and change the value >0 to =0. Ideally, we should bring it to <0 as quickly as possible. The growth of the Impact (dI/dt) is the sum of the contribution by population growth (dPi/dt) and the sum by life-style (dCi/dt). 95% of our population growth (dPi/dt) comes from developing regions. On the other hand, two groups (affluent developed regions as well as poor developing regions) contribute to dCi/dt. The environments of both populations have been seriously undermined by the consumption of huge amounts of energy in the developed regions and reckless deforestation to procure wood fuel and develop cropland to sustain growing populations in poor developing regions.

In order to curb the growth of the Impact (dI/dt) in the long-term, people in developing regions must control their population growth as rapidly as possible, while in developed regions, the Impact should be decreased by changing to life-styles less burdensome on the environment. Nevertheless, even if population growth in developing regions is successfully controled and the life-styles in developed regions become less burdensome on the environment, that human life will continue on earth is not guaranteed. Why? Because getting rid of poverty is everybody's wish. If poverty were eliminated in developing regions, the improved standard of living would increase dCi/dt. With regard to the growth in Impact, the population of developing regions is already four time larger than that of developed regions. The second term (Pi*dCi/dt) which is the product of a large quantity of Pi multiplied by the increased quantity of dCi/dt would become an enormously large quantity.

Food and energy consumption contribute to Ci. Especially when foods are applied, we can locate the problem very clearly. In this case, dI/dt represents the increase in food consumption by all human beings, and the first term of Equation 2 represents the contribution of population growth, which was an increase indicated by Malthus. On the other hand, the second term depends on changes in life-style conditional upon economic growth and so on, which is irrelevant to population growth. What we must be careful about is that when compared with the first term, increases in the second term could occur extremely fast. While population growth usually does not exceed 3 % , it is not unusual for it to exceed 10 % when the economy grows very fast. Like population growth, economic growth multiplies exponentially. Unlike linear increases, differences in the growth rate expand over time. Increases in populations due to this non-Malthusian factor have already become

a reality in Southeast Asian regions. Population growth has already erased the effects of the increased food production caused by the green revolution, and huge food shortages have developed in this region.

In sum, the conditions necessary for mankind to continue to live on earth are: (1) to curb population growth in developing regions, and (2) to change the life-styles in developed regions into ones less demanding on the global environment. In addition to these, it is necessary to eliminate poverty in developing regions. This, of course, requires a development-oriented economy, but in this case, however, such development must be less detrimental to local environments.

Disasters and Poverty

Ideally, societies are peaceful. But natural disasters severely threaten peace, especially in impoverished societies.

Let me illustrate this situation using Japan as an example. Historically Japan has been vulnerable to frequent natural disasters such as earthquakes, typhoons, torrential rains, heavy snow falls and tidal waves. Of these, the most representative natural disaster is the typhoon. Three or four large-scale typhoons hit Japan every year. Each typhoon causes disasters, but the scale or effects of such disasters change depending on the social conditions of the time. We can see this difference by comparing two different 20-year periods: one just after WWII (1945-1965) and the other, the last 20 years (1975-1995).

Just after WWII, Japanese society was impoverished. Its rapid population growth provoked severe food shortage. The population growth rate during the three year period from 1947 to 1949 was especially high (the highest was 3.5%), even higher than that of Central African regions today. In order to increase the production of food, wood and coal demanded by the rapidly growing population, huge mountainous areas and forests, which had already been devastated by the war, were destroyed. As a result, the mountainous regions which are essentially vulnerable to natural disasters become even more vulnerable because of this social situation. Except for the years 1946, 1950 and 1952, the average death toll from natural disasters during the fifteen years just after WWII (1945-1960) exceeded 1,000 people a year.

With regard to the rapidly growing population, the whole country wrestled with the task based on a national policy to curb population growth through the practice of family planning and the enforcement of the Eugenic Protection Act. Such efforts began to bear fruit in 1949 and after ten years, the growth rate which was 3% in 1949 decreased by half.

After 1965, the effects of typhoon disasters began to show a distinctive difference. First, the yearly typhoon death toll, which used to be 1,000, people decreased by 90 percent even though smaller-scale typhoons which used to kill no one began to generate fatalities. Of course, death tolls as a whole have had a tendency to decrease. What was happening was that many people had begun to live in the outskirts of big cities such as Tokyo. Many of these areas, because of inferior land development, were dangerous to live in. Such developments were an outgrowth of Japan's improving economy which caused serious housing shortages in big cities. Such disasters decreased after 1975 and rarely happen today.

Earthquake is common in Japan and the biggest natural disaster after WWII was the Great Hanshin Earthquake. The death toll directly due to the

if we take 25 % of the leaves of the cassava, the harvest is not influenced at all. We have proven that promoting sericulture is compatible with growing the cassava as a staple food. Additionally, silkworm pupae have been used as an important source of protein in Vietnam. Pupae which were not eaten would lay about 400-500 eggs after leaving the cocoon (eclosion). If we raise these eggs, we need not procure eggs from elsewhere, unlike the sericulture which produces raw silk. The Eri silkworm grows all year round if the temperature remains over 15 C. It lives for 60 days and leaves a cocoon. In tropical and sub-tropical zones, we can expect harvests several times a year if we could invent some means to make it possible.

A mass of dead silk moths (imagoes) of the wild silkworm can be used as an important feed for the poultry. Poultry and eggs are, of course, important cash products in developing regions, and chicken droppings can be used as manure for the cassava field. The Eri silkworm can be fed the leaves of the castor-oil plant as well. The leaves of this plant can be harvested in 2-3 months, while it takes three years for mulberry trees to grow enough leaves to be useful. The fruit of the castor-oil plant is used to make castor oil, which can also be a cash crop.

Because it is easy to care for and allows for multiple harvests each year, sericulture based on the Eri silkworm can considerably lower the production cost of silk. The total production of cotton and wool in the world (1993) is 14.51 million tons and 1.62 tons respectively, while that of silk is only 105,000 tons. The most important reason the silk market is so small is that it is expensive. When we take into consideration the excellent features of silk, there is a great possibility that its market could make a huge expansion if the price were to go down. If this is realized, female employment in the sericultural industry will rise all over the world.

Japanese Experience and a Feasibility Study

The early stage of Japan's successful industrialization was supported by the textile industry which was based on sericulture and the spinning industry. The Japanese sericultural industry was in its prime around 1930, when 40-50 % of Japan's entire export was shared by silk export. The cocoon production at that time amounted to 400,000 tons and that of raw silk 43,000. Silkworm farmers numbered 2.2 million and about 5.5 million people were engaged in the sericultural industry. Including their families, the industry supported a total of 12 million people. The cropland required to grow mulberry trees reached 710,000 hectares.

The Japanese silk industry has been concentrating on raw silk. However, if you are not particular about raw silk, it is possible to use other species of the silkworm which are fed on trees that grow in tropical rain forests and mangrove swamps. That is, reforestation to allow for sustainable use of forestlands becomes possible. Easy raising of the silkworm would greatly contribute to the lower cost. Since short-fiber silk can replace all kinds of cotton or wool products, the silk market could expand remarkably if products making the best use of the merits of silk are sold at reasonable prices. In addition, as their economies grow rapidly, demand for textiles in India and China have increased. If we could satisfy such demand with silk products, the impact on the global environment would become smaller than if this demand were satisfied with cotton or wool products.

on these occasions. However, by making it possible to harvest continuously throughout the year, we have leveled the work force demand throughout the year. Unlike other labor in the primary industries, 90 % of the labor required by grape cultivation using vine trellis can be done by female workers. By expanding the scale of the vineyard, we have been able to employ masses of female workers. (Reference 3)

People used to be very poor in this region. The annual income of half these people was below $150 while the population was growing extremely rapidly during 1980s. Job opportunities for women were very scarce. We employed a large number of female workers and guaranteed them an annual income of about $600 which was the minimum wage stipulated by the government. After several years, we began to notice a considerable difference in the consciousness and living attitudes of those women who worked for us and other local women without such jobs. Those changes included:

1) The marriage age for single women increased by 3 or 4 years.
2) The number of children of our working women rarely exceeded four, while local women without jobs had an average of 6 or 7 children.
3) The infant death rate was much lower for children of working mothers than for the local average.
4) Women with jobs were more concerned about their children attending school. (In these regions, two thirds of elementary school children didn't finish school.)
5) The divorce rate for women with jobs decreased considerably. (Reference 2)

Job Opportunities for Women in a New Type of Sericulture

Sericulture is a labor-intensive primary industry but offers a great many jobs suitable to women. Enchanted by the qualities of silk, we took the time to improve a wild breed of silkworm and develop a better species. Raw silk is the twisted silk thread of a cocoon. A good cocoon is defined as one which produces as long a thread as possible. The intensive care required of the silkworm has raised the cost of raw silk and limited the size of its market. It has also made it difficult to transfer sericultural know-how to developing regions.

Besides longer fibers, raw silk and silk in general has many advantageous features which neither cotton nor wool has possesses. Paradoxically speaking, if we can produce short fibered silk, silk could replace all wool or cotton products and the market for silk would grow. The silkworm from which we get short threads requires little intensive care. There is no more need to cultivate mulberry trees which has limited silk production for generations.

There are many species of silkworm. If the sericultural industry is based on a species which fits the local ecology were to be introduced, it could create jobs and also promote afforestation. In this respect, we noticed the Eri silkworm. This species of silkworm can eat the leaves of the cassava, the castor-oil plant, the tree of heaven and the Chinese tallow tree. The cassava is an important staple food in developing regions and a total of 160 million tons of the cassava is produced worldwide; 50 % is produced in Africa, 30 % in Asia and 20 % in South America.

The experimental cultivation of the cassava in our fields proved that even

earthquake was almost 6,000. The biggest natural disaster in Japan in the 20th century was the Great Kanto Earthquake (1923). A total of 104,000 people were killed or missing as a result of this earthquake. Still such natural disasters are not nearly as lethal as social disasters such as WWII during which 6.5 million people died in Japan and 56 million people worldwide. This war is usually considered to be the greatest disaster of this century.

Today, the starving population on this planet numbers over 800 million. Every year, almost 20 million children under five years old die of malnutrition. The death toll of WWII may appear bigger, but the figure is the accumulation of deaths over six years of war. Therefore, from the viewpoint of death toll, we can say that hunger is the world's biggest disaster. Hunger is related to extreme poverty, and such poverty may also be the greatest cause of war. While in developed regions, people can enjoy peace if there are no wars, in extremely poor developing regions, people are not at peace even if there are no wars because they are still under the threat of annihilation.

During the lifetime of the great Russian novelist Tolstoy, world population was much smaller and starvation of large populations rarely a problem. That is why the title of Tolstoy's great masterpiece can so simply juxtapose war with peace. Today, this antithesis no longer makes such a simple point because there are so many people who cannot live in peace despite the fact they are not at war. Today, real peace requires that we solve the problem of poverty which will inevitably provoke real war. For us "Poverty and Peace" has superseded "War and Peace."

Women and Poverty

Primary industries such as agriculture are the main industries in developing regions. Available jobs in these regions mainly require physical labor which in large part accounts for the male chauvinism that characterizes the societies of these regions. The labor of women which is almost entirely domestic in these regions is not regarded as important, and the result is that social independence is difficult for women, and their social status is low. In good societies these days the status of men and women should be equal--even if those societies are poor economically.

The status gap between men and women is particularly distinct in the Islamic and Hindu cultural spheres as well as throughout Africa. The case of Nepal is particularly instructive. Here the life expectancy of women at the time of birth is 3 years shorter than that of men. In Nepal and Bhutan and in no other place in the world, is a woman's average life expectancy at birth shorter than that of men. For the world, life expectancy of men at birth is 64 years, and women, 68. In developed regions these figures rise to 70 for men and 78 for women, while in developing regions the figure is 62 for men and 65 for women. The gap between men and women is 8 years in developed regions but only 3 years in developing regions. Because the status of women is higher in developed regions than in developing regions it may be reasonable to use this mortality gap as a social index representing the status differentials between men and women.

The average life expectancy at birth in Mid-southern Asian regions is 59 years for men and 60 for women, a gap of only one year, smaller than the average difference of 3 years in developing regions. In Afghanistan, life expectancy at birth is the shortest in the world, men 43 years and women 44

years. Since the average life expectancy at birth is influenced by the death rate of children, we can assume that war has claimed the lives of a large number of children. (Reference 1)

A woman's life expectancy at birth in this region as a whole is only one year longer than that of a man--a very small gap. However, a more detailed look at the gap shows that in some regions such as Iran or Uzbekistan, a woman's life expectancy at birth is more than three years longer than men. These regions are within the Islamic cultural sphere where Hindu influence is not so strong. All the regions where a woman's life expectancy at birth is not much longer or even shorter than that of a man are in the Hindu cultural sphere. From these facts, we can conclude that discrimination against women tends to be more distinctive in the Hindu cultural sphere than the Islamic cultural sphere.

Hinduism still observes a strict dowry system, which has imposed a heavy burden on women. In order to be prepared for the cost of their marriage, women must labor from childhood. In Nepal where 90 % of the population are farmers, very young girls in the mountainous regions are forced to engage in harsh physical labor, which probably has a bad effect on their health before marriage. The gap in the rate of school attendance between boys and girls is very distinctive. That the rate of girls' dropping out of school is high suggests they have been forced into domestic labor while they are growing up. (Reference 2)

The Hindu cultural sphere is a region of severe poverty, in which the social status of women is very low. In addition, traditional ways drive women to even harsher situations. In Nepal where such social elements are added to harsh natural elements, the circumstances of a woman's life are much grimmer than those of a man. Positive actions to improve the living environment of women in regions like Nepal are imperative, and the most effective means to this end is the alleviation of poverty and the construction of a road leading to the independence of women.

The Creation of New Jobs and the Independence of Women

In order to promote the social independence of women, it is necessary to create a vast number of new jobs. In the primary industries, however, it is extremely difficult to foster any industry which can create a large number of jobs suitable to women. In addition, the primary industries tend to be affected easily by natural elements such as climate or weather. These circumstances make it difficult to maintain a level demand for work or stable job opportunities. If a mass of jobs suitable to women were created, both the alleviation of poverty and the improvement of women's social status would become possible. This is a very difficult challenge to realize.

There is a successful instance of this kind of effort going on in Brazil. Since early 1970s, I have been working with a project to manage vineyards in the inland desert of the north-eastern Brazil. We use the water of the San Francisco River for irrigation. What is characteristic of this vineyard is its perpetual harvest of grapes. In the temperate zone, grapes are usually harvested seasonally, while we can harvest grapes continually several times a year. 60 % of the work involved in raising grapes is shared by picking blossoms, pruning extra branches and harvesting. The work force is concentrated only

If we develop a variety of functionally-designed silk products, making the best use of short fiber silk instead of expensive raw silk, and market them at reasonable prices, we believe that the silk market can take over one fourth of the present wool production and one fortieth of cotton production. As mentioned, demand for textiles has been growing rapidly. The above projection (400,000 tons) is equivalent to ten times the silk production by the Japanese silk industry in its prime. Naturally, the required work force will be ten times as many as Japanese sericultural farmers at that time (equivalent to 22 million farmers), and 55 million new jobs will be created. If we include their families, as many as 120 million people could get out of poverty. In addition, 7.1 million hectares of cropland could be afforested.

Since 1990, we (the Wild Silk Development Center and this writer) have developed an experimental project to introduce cassava-based sericulture to agricultural lands in the mountainous regions of Vietnam. The average income of cassava producers per hectare is around $200. Our experience has proven that we can produce 180 Kg of raw cocoons per hectare without causing any harm to the cassava production as a staple food. Of 180 Kg of raw cocoons, 30 Kg is shared by cocoons and 150 Kg by pupae. We buy those cocoons at $5/Kg. Therefore, a local producer can earn $150/ha. from the cocoon business. What is interesting is that raw pupae are also tradeable at the very lucrative price of $1.5/Kg. That is, their income from the by-products (the pupae) amounts to $225, which exceeds the income from the main products, cocoons. For the local people in this region whose average annual income is below $100, the extra income by means of sericulture will contribute greatly to mitigate their poverty. If they can harvest cocoons multiple times a year, their income would further increase. Therefore, the local enthusiasm for sericulture is extremely high. In 1994, we began serious production on a commercial basis. The year's production was 6 tons and production continued to increase steadily after that. In 1995 and 1996, production reached 17 tons and 50 tons respectively. The important thing is that we guarantee farmers the purchase of all their harvest. Without guarantee, the local people will not agree to produce the silk.

According to our feasibility study on this project, the production in 1998 in Vietnam is projected to be 150-200 tons. Our task in the future is how to guarantee the purchase of all of this harvest. To realize this, it is essential to secure a stable market. However, products made of short fiber silk have been regarded as the reuse of defective fibers. Therefore, it will be difficult for the market to accept the short-fiber silk products even if they were made of intentionally-produced short fiber silk. In order to expand the market, first we will have to change its perception.

Once the market has successfully expanded, however, we can establish several sericulture-related industries such as spinning mills, textile and sewing factories, which will present further job opportunities. What is characteristic to the jobs created by these industries is that all of them fit for women. In addition, these industries are appropriate for developing regions because they have a very small impact on the environment.

Conclusion

Poverty is the main problem in developing regions. Most of the environmental problems in developing regions could be solved if they could

eliminate poverty. Meanwhile, as economies grow, new environmental problems develop. But the new type of silk industry imposes very little burden on the environment. It is an ideal industry to introduce and encourage in developing regions. However, it is difficult for developing regions to establish the industry on their own, and therefore, cooperation from developed regions is indispensable. Japan is in the best position to provide such cooperation because it has all the necessary sericultural know-how. In addition, the rapid decline of the Japanese sericultural industry has made many excellent sericultural researchers redundant. Cooperation from these people is easily available. Japan is just in an ideal position to help developing regions establish the sericultural industry.

Environmental problems as well as poverty can be solved only when positive actions are taken. They will be never solved if we leave things as they are. Silk consumption is big in developed regions, in Japan in particular. Purchasing silk products from developing regions also contributes greatly to promote the new type of sericultural in developing regions. Japan accomplished its own industrialization through the sericultural industry. Japan is a country which solved the problems of poverty and excessive population growth at the same time in a very short period. Japan should positively introduce its traditional sericultural experience to developing regions. To briefly recapitulate, we see these vital environmental issues improved by promoting this new type of sericultural industry:

i) Eliminating poverty;
ii) Improving the social status of women;
iii) Curbing rapid population growth
iv) Lowering infant death rate significantly;
v) Increasing food and protein production;
vi) Promoting afforestation;
vii) Curbing slash-and-burn farming;
viii) Protecting wild species by reviving the forests; and
ix) Restraining urbanization by revitalizing rural areas.

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