

Reviving the Sericulture Industry In Indonesia

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Kind Regards

Peter D. McNair

Reviving Sericulture in Indonesia

The South East Asian Hub for Sericulture - Macro

Silk as we all know is a highly valued natural fibre which is increasing in demand around the world.

The opportunity for new/other products exists in Indonesia but first the industry must be re-established and made sustainable. This paper therefore looks at the background and the current silkworm practices in Indonesia, what is required to develop a sustainable industry which includes methods to enable year-round availability of silkworm seed and mulberry leaves, improved mulberry harvesting, creating an export culture for the sericulture products and potential funding for a coordinated integrated sericulture industry.

The worldwide demand for silk is increasing but production is decreasing and an opportunity exists for a number of countries and especially for Indonesia to use technical and commercial expertise to develop its own specialist silk industry.

Traditional silkworm rearing methods are manpower intensive and are considered a complementary activity of the traditional agricultural activities such as rice. Because of the traditional methods being employed - sericulture is mostly carried out in underdeveloped countries where manpower is cheap (China, India, Thailand, Vietnam). It is suggested that Indonesia falls into this category.

It has also been recognized by many world organizations including NGO's that sericulture is a means of poverty alleviation in under developed countries. Sericulture provides an income for small land holders and farmers (petani) as well as additional income for local people directly involved in the breeding, rearing and reeling associated with the sericulture industry. Sericulture is an excellent industry for local women to be involved.

Indonesia consists of approximately 17,500 islands (6000 inhabited) and is an agrarian based society - with sericulture being an agro-based industry – the two are complimentary.

Sericulture provides scope for quick sustainable economic growth, a poverty alleviation industry if managed correctly and using foresight the industry is sustainable. Being a labour-based intensive industry, it provides maximum employment opportunities especially for rural people and especially for women. The requirements for a sericulture industry and the outcomes make Indonesia one of – it not the – best placed country in the world to capitalize on an efficient, sustainable export oriented sericulture industry. In Indonesia, mulberry plants grow vigorously and labour costs are relatively low with labour plentiful – a plus for sericulture to be successful.



Figure 1 Republic of Indonesia

Silk was introduced to Java around 1720 by then governor general of the Dutch East Indies, Hendrick Zwaarddecroon, who also dabbled in coffee and spices.

Indonesia's early silk production was a failure. But traditional methods eventually overcame the failures and the industry has continued until the present day.

Many attempts to create a sustainable silk industry in Indonesia have failed due to lack of funds, poor leadership/management, poor mulberry stock, poor quality eggs, disease, lack of knowledge and the lack of desire to create a sustainable export industry. Indonesia like many countries finds sericulture to be a sideline industry that offers a means for people to increase income and provide work for women but only when they have other means of income. It is possible with the proper leadership and management for Indonesia to create a highly sophisticated sericultural industry – this is viable outcome.

China produces about 75% of the world's raw silk. India produces about 15% and Korea and Turkmenistan produce just fewer than 5% each. Approximately 30 other countries produce commercial silk. However, it is difficult to compete with China in the international silk market and it is suggested that Indonesia should aim at satisfying some of its own silk needs first and then produce silk to supply niche export markets.

Several countries have state sponsored sericultural research institutes and approximately 2000 strains of mulberry silkworm have been developed. Indonesia does not have this type of research facility.

Indonesia at the present only provides ad hoc interest to the industry and there is currently little appetite for a modern sericulture industry and its growth. Notwithstanding some areas within the Department of Planning are attempting to pull together a strategy for the future of the industry but it needs a "champion" to deliver change. It is hoped this paper will invigorate this appetite, produce the champion and lead to a sustainable modern industry. The future could include the production of amino acids for example from the cocoons to be used in cosmetics.

The Dutch as mentioned brought the technology for silk cultivation to Indonesia around 1720. Since that time sericulture has been carried out by petani in rural areas but very little has changed in the methodology employed. Over the years a number of programs and players have entered the industry but these have been short lived as the desire for a quick profit always overruled a strategy to create a sustainable industry where all the players are paid a fair price for their outputs.

Never the less, Indonesian environmental conditions are very suitable for the development of sericulture; this includes both silkworm rearing and mulberry plant cultivation.

Silkworms (*Bombyx mori*) and mulberry plants (*Morus spp.*) were widespread in Indonesia with little development work being undertaken on these resources until the present. As matter of interest the mulberry plants (8,066 Ha in 1999) has steadily decreased (less than 4,900 Ha in 2009) with only 600 Ha of mulberry available now in Java as petani (farmers) move into other value crops.

The first step in reviving sericulture in Indonesia is actually twofold –

- first - getting the interest of the petani again and demonstrating they can make a living in the industry and
- second - get Government to recognise the benefits and support the sericulture industry and have a strategy for growth and sustainability for the industry.

This second step must include the sourcing of suitable funding for downstream (rearing, reeling and twisting) and upstream (mulberry) activities. Funding one stream without the other will be futile. Once this second step has been implemented then it would be time to establish processes to increase production and create world best practice for the industry in Indonesia. Co operation and collaboration with Organisations such as **The Black, Caspian Seas and Central Asia Silk Association (BACSA)** and support from the FAO and IFC will assist in advancing the sericulture industry in Indonesia and lessons learned by others to promote sericulture production will assist the industry in Indonesia.

For mulberry production we need to determine the best conditions under which to grow mulberry plants and the most efficient and economical way to harvest them. In tropical areas such as Indonesia mulberry can be harvested up to 8 times per year (average 6 times per year) with mulberry plants having continued growth but if not managed the leaves become tough and dry in the dry season. Techniques¹ have been developed to overcome this dry season unavailability of suitable mulberry leaves such as:

- Refrigeration of fresh mulberry leaves in sealed plastic bags and
- Artificial diets. The artificial diets contain about 30% mulberry leaves to which can be added bean powder, yeast, sucrose, cellulose, agar and water. Blocks of this diet can be stored in less space than mulberry leaves and could be kept refrigerated until needed.

Both refrigerated leaves and the artificial diet have been used to successfully maintain larval development during autumn and winter in experiments in Australia.

Additionally for Indonesia the petani require training in cultivation, fertilizing and maintenance of mulberry plants. Modern horticulture methods can be employed with suitable training. With training mulberry leaf output will increase.

For example - Twenty kilograms of raw silk per hectare can be produced from rain fed unfertilised mulberry plants using inferior silkworms; whereas up to 120 – 130 kg of raw silk per hectare can be produced using a better variety of mulberry for the particular region using good cultivation techniques , fertilizers and a good silkworm breed.

¹ Silk Production in Australia - A report for the Rural Industries Research and Development Corporation RIRDC Publication No 05/145 Nov. 2005 Pg.vi

Harvesting in Indonesia is by picking leaves by hand or chopping branches using crude hand tools – the use of machinery is very rarely used and for mulberry leaf harvesting this is adequate as an abundance of labour is available. Efficient cultivation and maintenance of the plants though must be introduced and developed. Indonesia must introduce intensive cultural operations such as application of fertilisers, irrigation systems, breeding of mulberry and variety selection, training in pruning and regulation methods, and finally harvesting methods to ensure the right leaves are harvested for the correct instar.

The quality of the mulberry leaf fed to the instar is reflected in the quality of the silk produced. It is important to produce quality leaves to feed the silkworm. The quality of the leaf is a direct result of prudent agronomic management of the mulberry plant. A complete agronomic package of variety selection, planting techniques, nutrient management, water application, pest and disease control measures, and harvesting techniques ensures high yield and good quality mulberry leaf. Training and ongoing education and research is required for Indonesian conditions.

The current Indonesian silkworm seed produces poor quality cocoons and in turn low silk productivity and quality. The introduction of suitable silkworm seed for higher productivity is essential for a sustainable, viable commercial Indonesian sericulture industry. Extensive studies have been carried out over the years to review existing seed for commercial purposes, and to develop new races through a breeding program, for improved silk productivity, adaptability to local environments and disease resistance/tolerance capabilities. But such reviews have rarely been put into practice and have never been continued. The importation and improvement of silkworm eggs for higher productivity are necessary for running a profitable sericulture industry. Also the number of silkworm grainage should be increased and methods to improve egg quality must be achieved. Current silk seed comes from one major source and is of low quality.

For the Industry some specific objectives should be:

- Expanding and improving mulberry tree cultivation in the local environment,
- Introducing new techniques and methods in silkworm breeding to improve the production in quantity and quality terms,
- Reducing poverty among petani by improving the industry that makes additional income that leads to stabilization in the rural areas,
- Reduction in the use of chemicals (fertilizers-pesticides) as the mulberry tree doesn't need a lot of chemicals or introduce organic fertilizers that can be used instead.
- Improving and creating additional opportunities for women in rural areas since silkworm activities and the silk yarn industry offer employment to women.
- Introduce micro financing to support petani in the industry and
- Suitable financing to establish a sustainable private enterprise

Regarding the specific target groups:

- Increase the number of men and women silkworm breeders or willing breeders by making the industry cost effective and
- Educate both men and women willing to process silkworm products from cocoon through to weaving natural silk threads.

Over riding requisite

Everybody in the selected areas has the right to participate in the industry and gain access to the micro funding with priority being considered for those petani already working in silkworm breeding or in natural silk processing and willing to contribute to the overall objectives.

World Silk Production

The major silk-producing countries of the world today are, China, India, DPR Korea, Turkmenistan, Brazil, Uzbekistan, Thailand, Vietnam, Kyrgyzstan, Japan, Iran, Tajikistan, and Romania. Indonesia with all its potential does not rate among world silk producers and exporters.

Indonesian Resources

Indonesia has an ideal climate and topography for sericulture. For example a mulberry/sericulture plant can be located in Java at an altitude of 520 to 700 meters above sea level or more. Topographically, plains represents the most part of the area (43,73%), followed by slopes (about 23,75%), corrugated land (about 20%), and mountainous (21,82%). The land structure: brown latosol constitutes 40% of the total land, gray alluvial 35%, brown andosol 15%, and regosol 10% - ideal for mulberry.

The annual temperature ranges from 10⁰ to 27⁰ C. During the rainy season, rainfall ranges from 281 to 349 mm, reaching its peak in December and January. During the dry season, rainfall is between 86 to 219 mm reaching its lowest level in July and August.

In my example area, there are 78.153 people, 38.596 being males and 39.557 females, who inhabit the region. Most of the population (46.490 people) belong to the productive group (15 – 64 years old), 27946 pre-productive (below 15 years old), and 3.717 non-productive (over 65 years old).

The example area was selected for the research due to the altitude, range of the rainfall, air humidity, land condition and other aspects that have met the requirements for a sustainable sericulture industry. But it must be stressed that Indonesia has many such regions.

Another aspect considered when choosing an area for sericulture is the condition of supporting facilities such as roads, power, water and communications infrastructure and its relatively open access to other locations, and most importantly is the availability of human resources and high level of interest of the farmers (petani).

In my example the total potential area for natural silk development is approximately 20,712 Ha, and approximately 7,921 Ha of the area is available for mulberry cultivation. Some years back approximately 13,575 Ha had been cultivated, but interest has waned and the mulberry plants were replaced by other crops and the silk industry has continued to decline. All the pillars to revive the industry still exist. The prospect of natural silk development in the area is wide open for further development. Leadership and funding is required.

Java – The Potential Hub:

- There is sufficient land resource which is suitable for agribusiness development for natural silk. Most of the land is under the control of Perhutani ((Indonesian state forestry company).
- Mulberry cultivation and silk rearing is still traditional and semi intensive. This presents an excellent opportunity to develop;
- Small industry of textile and natural silk weaving exists;
- Textile industry of natural silk in Indonesia still lacks timely cocoon supply and the silk yarn is still imported at high cost but the desire to succeed is evident;
- The few existing silk farmers participate in a local cooperative and want to develop the agribusiness of natural silk;

Until now, the constraints faced by people to develop the silk business in Indonesia are as follows:

- There is no co-ordinated strategy for the industry addressing sericulture “end to end”
- There is minimum infrastructure
- Capital is limited
- The quality of natural silk eggs and small silk worms has to be obtained from other districts at high prices and are of poor quality and delivery is ad hoc;
- Cocoon supply for weaving industry is low; and
- Natural silk is not the main business in the region because of current lack of supply, high costs caused by middlemen and little infrastructure or support to grow the industry.

To improve the performance of a national natural silk industry (sutra alam) in Java Indonesia a collaboration/partnership between an entrepreneur(s), investor(s), local and federal government, NGO’s and local people is needed to develop the industry and with technology create a world ‘best of class’ industry that many countries would be proud of. The development of mulberry cultivation and silkworm rearing is an environmentally sound business as well as supporting water and air conservation, reforestation and rehabilitation and provides excellent employment opportunities for the local people especially women.

Mr Tobing (an Indonesian Businessman) and I commissioned a feasibility study to review the financial and economic benefits of the silk industry in Indonesia in 1998.

The result at that time showed excellent benefits not only for the proposed industry and company but for Indonesia as a Nation. Those benefits still stand as of today.

We have planned a winning formula to take advantage of exporting high quality raw silk products with the design of a fully integrated sericulture facility.

The feasibility analysis we commissioned confirmed that this business is feasible to implement. The feasibility analysis indicated that:

- A company will incur a loss at the beginning of investment year 1. On the first year after investment (year 2) and onwards, the company will gain a net profit.
- Pay back period should be 7 - 8 years. This means that the capital that is invested by a company or investor can be repaid in 7 - 8 years.
- The ROI exceeds 23%

According to our feasibility analysis, the empowerment of an integrated facility in cooperation with the petani utilizing a small business model (refer Appendix 2) will have excellent outcomes. Other Requirements needed are:

- Full support from Department of Planning, Industry and Forestry and Plantation to provide licensing and other requirements,
- Encouragement and support from the Government of Indonesia and local regions and from other institutions in order to participate actively to:
 - create Indonesia as a centre of natural silk agribusiness and agro industry in South East Asia;
 - increase the labour absorption; solve critical land and economic crisis.
 - increase the cocoon production to fill demand of raw material for the natural silk industry and decrease dependence of import supply.
 - increase export non gas and oil and
 - encourage the developing program of natural silk.

Our feasibility and research centred on central Java. The following map indicates this area used as an example in this paper.



Moriculture- Mulberry - Micro

The purpose of mulberry breeding is to develop a variety that is an efficient user of nutrients and water, has a high yield, high quality, adaptability to environment, is pest and disease resistant, and has a high return. These desirable traits are spread among many species and varieties and repeated hybridisation is done to evolve a variety featuring most of the desired traits. Such research is scarce in Indonesia. Indonesia needs to commence a horticulture program with the collection of as many local and exotic varieties as possible and evaluate

their characteristics to select those varieties suitable to the respective region and provide the best outcomes.

Rain fed or irrigation - Leaves from irrigated fields have more moisture, protein, and other nutrients than rain fed leaves. Silkworm reared on leaves from irrigated fields will show better health, and an increase in weight, cocoon weight, and shell weight. It is recognised that nitrogen is the most important element that contributes to the increase in leaf yield. Nitrogen increases vegetative growth and leaf number, size and weight.

A complete agronomic package of variety selection, planting techniques, nutrient management, water application, pest and disease control measures, and harvesting techniques ensures high yield and good quality mulberry leaf². Training and education of the petani will achieve this.

The leaf yield harvest is dependent very much on the soil, weather condition, and management practices. In tropical regions such as Java the leaves are available all year round whereas in temperate regions only 2 - 3 harvests are obtained.

Superior mulberry varieties have been developed through breeding processes, which are efficient users of nutrients and water with high yields of quality leaves and with traits of environment adaptability and pest and disease resistance. Collaboration and cooperation between Indonesian research facilities and other nations is encouraged including Australia.

Silkworm seed production

One of the areas that require urgent improvement in Indonesia is silkworm seed production. Indonesia has poor quality and timeliness of eggs. At the micro-level, petani cannot improve their output and silk quality while they receive poor quality eggs. The petani will increase their cocoon production with the introduction of better quality silkworm eggs and this will lead to increased yields.

Management of seed production which includes transportation and incubation play an important role in the success of the sericulture industry. To produce quality seed, it is very important to adopt an efficient scientific methodology of egg production. As there is no definitive research centre in Indonesia, silkworm seed sold to the rearers is arbitrary and silkworm breeds adapted to Indonesian conditions do not exist.

Silkworm rearing

Indonesia uses traditional silkworm rearing methods with few changes over decades. There is a distinct lack of technical advice whenever serious problems arise and there is a lack of guidance and supervision during rearing of silkworm for the petani. In nearly all instances the farmer is left to his/her own devices.

² Ming-FangFa *et al.* 1994

Rearing space plays an important role in the success of a silkworm crop and improvement of cocoon quality. Overcrowding leads to unequal and insufficient consumption of leaf, unequal growth of worms, susceptibility to diseases and low cocoon yield. The importance of a wider rearing space has been studied for multivoltine silkworm rearing. Such practices need to be implemented.

Low hatching percentage of silkworm eggs, high disease incidence of silkworms, low yield of quality cocoons, limited facilities for rearing, inadequate quantity of mulberry leaves and low quality mulberry leaves for rearing, are the problems faced by the petani in Indonesia. Lack of operational funds, rising costs of materials and labour, long time to recover investment, limited market of cocoons, low price and low grades of cocoons, are just some of the issues facing the industry.

The resultant outcomes produce poor quality cocoons and silk – what is needed is central control, an integrated facility, research facility and a sustainable strategy for the industry.

To enable petani to obtain high-quality raw silk (at least 3A grade) or better the following activities must be employed:

- Design rearing beds to meet the conditions for each rearing unit without overcrowding
- Identification of the best conditions for disinfection management of the rearing units
- Obtain high quality cocoons
- Training and ongoing education
- Increase the efficiency of rearing by 50 %
- Increase the number of annual cycles for up to 6 cycles by education with mulberry harvesting and leaf storage
- Establish a central research organization to disseminate data
- Establish an integrated sericulture facility to be used as a bench mark and produce good quality eggs.
- Increase employment (especially female employment), in cocoon rearing, reeling and within the raw silk processing fields. This is one of the main objectives for the Indonesian Government .
- Reduce poverty in the villages by introducing employment opportunities. This is also an Indonesian Government priority.

Marketing of cocoons / Marketing of raw silk

The success of the sericulture industry can come down to a proper and highly efficient marketing system which assures good prices to the petani. Efficient marketing helps in minimizing wide fluctuations in cocoon prices. It has been found that fluctuations are due to variations in cocoon quality, absence of quality control, intervention of middlemen and poor

marketing facilities³. Women in the industry are preferred because of their nature, patience and hard work and hence they are employed in the mulberry fields or in silkworm rearing or weaving centre. However, the women's work has not always been recognized or rewarded. The good work they do should be promoted and marketed. Though sericulture is lucrative by nature, it faces various problems in aspects of marketing. The problems faced by sericulturists in Indonesia mainly relate to insufficient financial support from government agencies, climatic hazards, wide fluctuations in cocoon prices and also, to some extent, inadequacy of extension services – research and training. Our research revealed problems like rearing sheds, stop start supply of cocoons, lack of awareness, low literacy level, poor infrastructure, etc. The availability of cocoons throughout the year can ensure the regular buyers in the market a better price. Training and education overcomes many of these problems. Various recommendations have been offered in this paper to pave the way for an improved sericulture industry, leading to an increase in foreign exchange earnings, and giving additional employment opportunities to the petani families, silk yarn reelers, silk weavers and others involved in the silk industry in Indonesia.

A proposed Silk Solution Centre (SSC) must be created and should establish then intensify its efforts to strengthen the marketing system in new areas to make the industry more viable. The SSC should establish standards and eliminate poor communication systems, establish a market infrastructure, agro-processing plants, marketing credit, a proper market organization, proper pricing, uniform grading and standardization of weights and measures.

Training

The Central Government, local government and NGO's have instituted many projects over the years which included training but still the problems within the industry exist. What is urgently needed is a central facility that can undertake specific research, produce and distribute silkworm news items and materials, conduct field trials, conduct training on all aspects of sericulture, transfer technology developed in the research facility to the field and improve the quality aspects of the sericulture industry

Such a facility could be run by private enterprise endorsed by the central government (Department of Planning or Forestry) on a "user pays" basis and subsidized to enable it to be sustainable and affordable to the petani. Training individuals, petani, reelers, etc in the technical and managerial aspects of sericulture is essential and a central facility can also be used for the production of disease-free seeds and for hybrid egg multiplication as well as for the required training.

Such a facility could be agreed and implemented immediately and seek support from such organizations as FAO / IFC.

Proposed Central Silk Organisation

For the development of silk industry in Indonesia a Silk Solution Centre (SSC), potentially a statutory body, should be established and functioning under the administrative control of the nominated Central Government Ministry.

The following are important functions the SSC should be accountable for:

³ Development Planning and Project Cycle Analysis for Sericulture in Central Java Dissertation - Djeimy Kusnaman 2004.

- Promoting the development of silk industry by such measures as it thinks fit.
- Undertaking, assisting and encouraging scientific, technological and economic research.
- Devising means for improved methods of mulberry cultivation, silkworm rearing, developing and distributing healthy silkworm seeds with the support of private industry, improving methods of silk reeling, improving the quality and production of raw silk.
- Collaborating with private enterprise to streamline processes including licences.
- Co-ordinating and supporting international collaboration with other international central sericulture centres.
- Improving the marketing of cocoons and raw silk.
- The collection and compilation of statistics.
- Advising the Govt. of Indonesia on all matters relating to the development of silk industry including import and export of raw silk and silk related products.

Conclusion

Global consumption for silk products is valued at over US \$ 20 billion. The US and Europe are the major consumers accounting for around two-thirds of the global trade of about US \$ 9 billion – US: 32%, Germany: 15% and UK: 11%. Improved global spending patterns coupled with wider variety of value added silk products are driving growth.

Manufacturing capacities for silk products are being shifted from Europe to destinations such as China and India. China being the largest producer (72%) of silk fabrics in the world is primarily focused on mass production. India is the second largest producer (17%), providing scope for an accelerated growth for the industry.

Indonesia stands to gain due to its lower cost of production, potentially skilled manpower, introduction of world class technology and increasing acceptance of its value added products. Sericulture is an important economic activity particularly for women, as women are most involved in the labour-intensive work of feeding silkworms, placing mature silkworms in frames and spinning yarn. Sericulture is also an income-generating activity for disadvantaged social groups, and a poverty alleviation strategy.

Indonesia must take action to establish a “world class” sericulture industry for export of silk products such as silk yarn, spun yarn, cocoons and related products such as amino acids. Such an industry should have world class, leading edge technology and expertise.

The recommendation is:

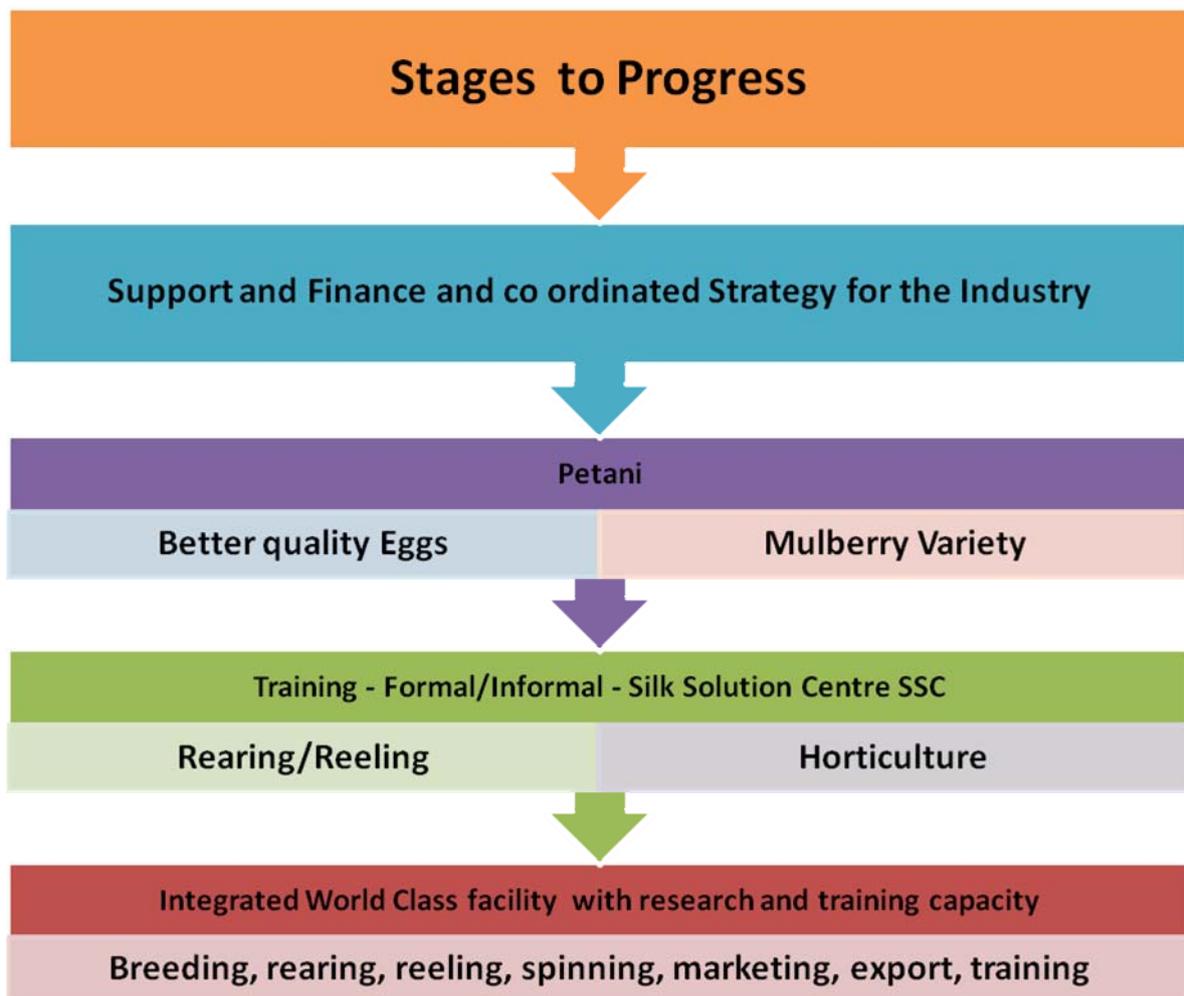
- To promote Java (Cianjur and/or Garut) as the hub of Indonesia’s natural silk business.
- To increase the production of export quality silk, and for Government to contribute to the promotion of national natural silk development.
- Revive the traditions and heritage in sericulture that are considered as a national and historical wealth, provide job opportunities for poor households and combating unemployment with a sustainable silk industry,
- With the support from regional and the central government, the success of the natural silk agribusiness model should be developed throughout Indonesia in all areas suitable for mulberry plants.

- A coordinated strategy to demonstrate Indonesia can produce sericulture products in an efficient and effective manner with minimal losses and good quality.

Quality and quantity of silkworms can be influenced from numerous variables, e.g. mulberry leaves, rearing shed, climate, and the petani themselves and to improve the industry in Indonesia means improving the environment for sericulture farming.

The final word: the most important thing is to improve the petani's human capital through training and support from a world class integrated facility.

Appendix 1. Strategy for way forward



SSC (providing technical advice, training, silkworm eggs, funding)

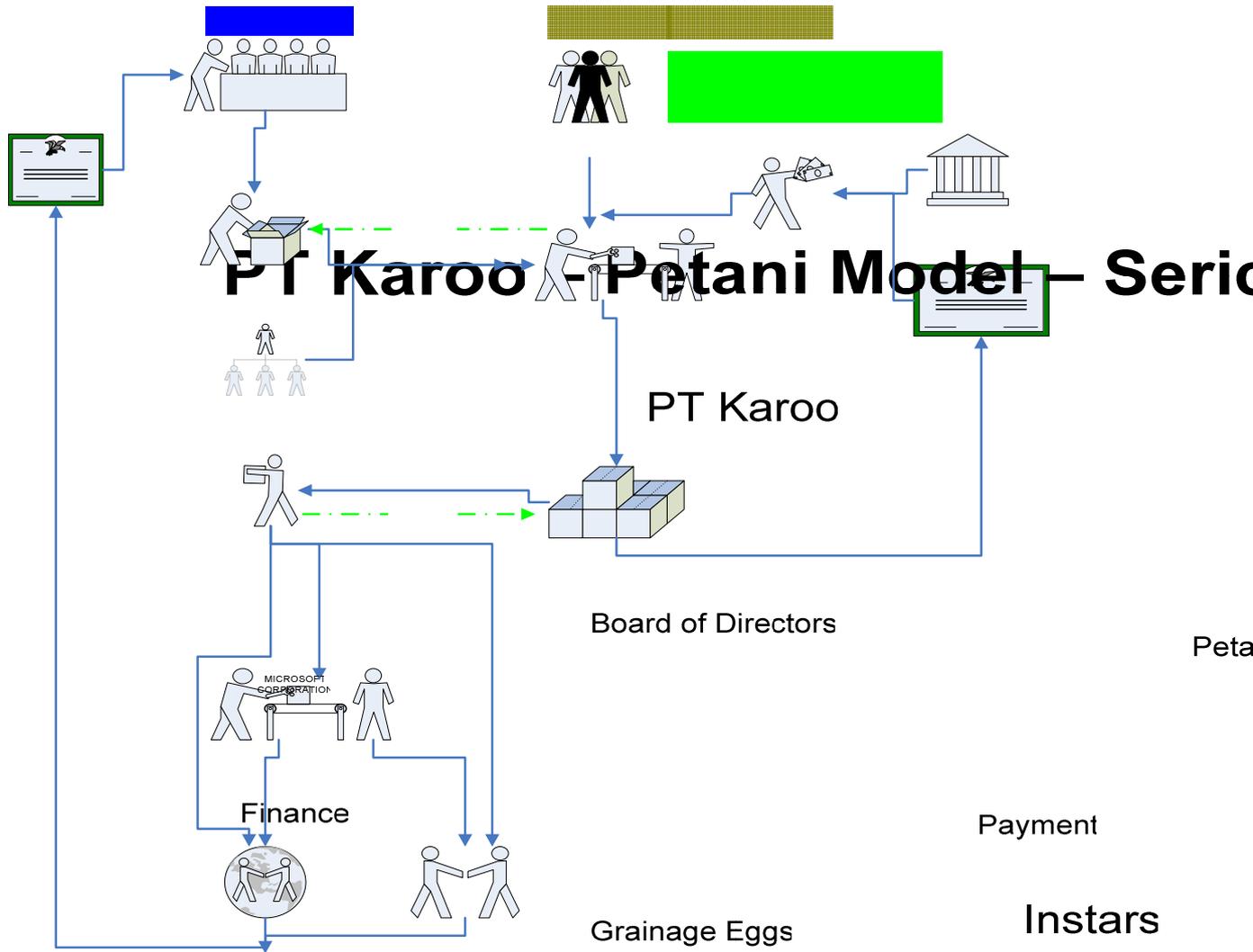
NGOs (organizing groups, providing credit, technical advice, funding research)

Grassroots groups (producing silk products, selling to markets and more widely to increase income)



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Appendix 2 - Suggested Model for Sustainability



Receiving Payment