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Showcasing a profitability package for sericulture in the Philippine setting: The case of the Baroro sericulture demonstration farm

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Abstract

Both domestically and internationally, the silk market has enormous potential. There is a current need to expedite the development and popularization of sericulture through the establishment of demonstration farms in several key areas due to the rising demand of silk fabrics. With a total area of one hectare and a population of around 11,605 mulberries, the DMMMSU-SRDI Sericulture Demonstration Farm is situated in Barangay Baroro at the municipality of Bacnotan, La Union. The project featured a comprehensive production system and profitability package for growing mulberry saplings, raising silkworms to produce cocoons, integrating animals to crops, and composting sericulture wastes in addition to demonstrating the recommended sericulture technologies. Moreover, the demonstration farm was used as location for field trips, educational outings, research on land use management, as well as field testing and trials. Mulberry leaves were also supplied to sericulture site receiving SRDI support. Produced mulberry saplings were either supplied to recently opened areas or used for planting and replanting on sericulture sites. The Baroro farm's sericulture profitability package from 2011 to 2019 revealed a production of 730.9 kgs of fresh cocoons with a revenue of Php 255,797.00 and a total of 11,500 mulberry saplings produced amounted to Php28,750.00. An income of Php 21,100 was generated from animal-crop integration; 408 bundles of mulberry fuelwood derived an income Php12,600.00; and a total of 106 sacks of silkworm composts generated a revenue of Php10,600.00. When the recommended sericulture technologies are widely adopted and the farm is used effectively and efficiently for better output, the cumulative profits show that sericulture is a sustainable livelihood for rural people.

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Introduction

As evidenced by the high acceptability of farmers and business owners, sericulture is currently gaining wide popularity across the country. Raw silk has a huge supply and demand imbalance compared to other byproducts, making it impossible to meet both the demands of silk weavers and the general public.

The silk industry has great potential both locally and globally, thus a need to accelerate its development and popularization through the establishment of demonstration farms. Typically, researchers and/or extension workers set up demonstration farms to validate and show new farming methods and assist farmers in becoming aware of new opportunities for their productivity. An agriculture demonstration farm is an effective way to raise farmers' awareness about new options and for them to seek more information about a technology if they intend to adopt it. It further demonstrates the difference between the new practice and existing farmers' practice. A study conducted in Poland showed that demonstration farms represent the highest level of agricultural production and serve as venue for seminars, lectures, demonstrations and shows to facilitate the transfer of knowledge from science to practice (Kania and Kielbasa, 2015).

Demonstration farms have been practiced for a long time and have been proven to be an effective means of supporting farmers in solving problems on the farm and in providing new skills and knowledge for increased production and income.

It has been emphasized in the study of Aslam *et al.* (2020) that the role of the Research Extension Center in Haryana is effectively demonstrating the recommended technologies at the field level by ensuring effective percolation. This includes the popularization/demonstration of new silkworm hybrids: Raising and supply of saplings of improved mulberry varieties for field plantation; Demonstration of Technologies; Disinfection; Silkworm crop protection measures; Field supervision during late age silkworm rearing; Harvesting and sorting of cocoons before marketing; Compost Pit Making; and Vermi-Composting.

The importance of sericulture as a source of gainful income and employment and worthy of adoption can be seen in the study conducted by Savithri *et al.* (2023) which claimed that the pursuit of sericulture offers gainful employment to the rural masses. Being a labor-intensive rural-based industry, it offers a qualitative and quantitative change in poverty alleviation with a chain creation of employment from unskilled farm laborers to skilled artisans to all sections of rural folk.

To showcase the package of sericulture technologies, DMMMSU-SRDI created the Baroro Sericulture Demonstration Farm in Baroro, Bacnotan, La Union. This was organized to satisfy the mandates of RA 7359 which is the creation of the Sericulture Research and Development Institute (SRDI) in 1982. The Institute is mandated to conduct research, extend sericulture technologies, and educate and train sericulturists.

Farmers and entrepreneurs were able to gain an understanding of the benefits of sericulture at the Baroro sericulture demonstration farm by observing first-hand the finest practices and new technologies that might be used on their own farms. Hence the project was conceptualized to showcase the productivity and profitability of sericulture which may lead to higher adoption of demonstrated practices.

Specifically, the project aimed to establish a walk-in sericulture demonstration farm to showcase sericulture technologies as to: mulberry production; silkworm rearing for cocoon production; and farming systems (animal-crop integration, composting, Sloping Agricultural Land Technology); and to determine the productivity and profitability of sericulture technologies in the demonstration farm.

Materials and methods

Strategies of Implementation

Project description

The Don Mariano Marcos Memorial State University-Sericulture Research & Development Institute (DMMMSU-SRDI) established the Sericulture Demonstration Farm project at Barangay Baroro, Bacnotan, La Union, Philippines. It is situated along the

national highway on a flat to rolling terrain overlooking the surf destination beaches on San Juan, La Union. Some researchers and practitioners believe that for a demonstration farm to be efficient and effective, it should have good easy access to clients; and the area should be visible from the road and should have a signage indicating what is being done and who can be contacted for further information.

Development of the site started in year 2001 with the establishment of approximately one (1) hectare mulberry plantation and construction of the rearing house. Cocoon production started late 2002. The area was later abandoned for years until intense rehabilitation was carried out in 2007 and operation commence since then.

Pre-implementation phase

Project management and coordination between the project participants, including the SRDI management, the designated project-in-charge, researchers and extension workers, finance officers, and subject matter experts are included in the pre-implementation phase. To examine issues related to the demonstration farm's successful implementation, a preliminary meeting was called.

To demonstrate the various sericulture technologies and their productivity and profitability, the Baroro sericulture demonstration farm was constructed. Farmers and business owners were able to observe firsthand the finest techniques and new technologies that could be implemented to their own farm settings, which helped them, learn about the benefits of sericulture. Therefore, the project was designed to highlight the profitability and productivity of sericulture, which could encourage more people to follow the techniques that have been shown.

The project's goal is to meet the demand for the SRDI filature needed to produce silk and related goods that both domestic and international consumers want. Mulberry production, mulberry cutting and sapling production, silkworm rearing for cocoon production, agricultural methods to cover animal-crop integration, and composting are some of the sericulture technologies showcased in the area.

Implementation phase

Prior to mulberry establishment, soil analysis was undertaken. A farm can benefit greatly from soil analysis since it can identify the inputs needed for productive and profitable farming. A thorough soil test can assist and guarantee that the crop receives enough fertilizer to suit its needs while utilizing the nutrients already in the soil.

Mulberry plantation establishment and leaf production

The area was well prepared before the field was established, and in order to prevent disease, saplings were uprooted and submerged in fungicide solution for at least ten minutes. Planting was done following the row system with 1.5 m x 0.5 m between rows and hills respectively by dibbling, and pressing the soil near the base to prevent dehydration. A week later, or more often as needed, it was followed by gentle watering. Fertilization was conducted one month after planting and a second dose was applied after six months following the rate based on soil analysis. Those who were assigned to the task of mulberry establishment were assisted by some SRDI extension staff in demonstrating the Standard Operating Procedures (SOPs) related to fertilization, planting distance, and other farm activities.

Rearing house construction

Although the rearing house's layout and dimensions were based on the scale of the mulberry plantation, inexpensive or low cost local materials available in the area were utilized. Technical specialists in building construction were dispatched to oversee and support the construction of an ideal rearing house.

Late-age silkworm rearing

The Subject Matter Specialist (SMS) and Trainers closely monitored the trial silkworm rearing process. Feeding, cleaning the bed, monitoring molting, continuing feeding, spacing out till the mature silkworm larvae mount or spin, and harvesting and selling the cocoons are all part of the process. The project manager and the designated personnel adhered to the normal operating procedures and practices for raising silkworms which included providing the silkworms with plucked leaves during the third instar and branches during the fourth instar.

Moreover, the suggested feeding schedule-5 AM, 10 AM, 3 PM, and 7 PM—was adhered to. SMS has helped with silkworm rearing, particularly with the start of moulting, when to start feeding again after moulting, a process known as "resume feeding."

Farming systems

Animal-crop integration is one of the farming system approaches demonstrated in the Baroro farm. Integrated crop-livestock systems depend on synergistic relationships between the components of the plant and animal systems to support vital agroecosystem activities and possibly boost resistance to weather anomalies. This is an example of agriculture being intensified sustainably. The farming system approach offers a mitigation and adaptation strategy for climate change. Since the Baroro Farm is located in a flat to rolling terrain, intensive farming systems techniques must be used.

Furthermore, slope agricultural land technology (SALT) is utilized in the area. SALT is an easy-to-use, practical, affordable, and quick upland farming technique. This technology was created for Asian farmers who had little resources and few tools and equipment. Any farmer can learn how to create and utilize an A-frame transit, which is used to determine contour lines. In the SALT system, a farmer can plant common agricultural crops and apply traditional agricultural practices.

Value adding/by-product production

Excellent cocoons for use in the manufacture of raw silk for silk textiles are the demonstration farm's principal output. Moreover, the farm's production system generated wastes during operation, which were then converted into by-products with useful qualities like:

a. Composting from silkworm wastes- Wastes generated after silkworm rearing were segregated and were composted naturally in an improvised compartment until ready for use.
b. Unusable/leaf scraps as feed to animals. After silkworm rearing, unused leaves usually the leaf scraps were gathered to feed small ruminants to include range chickens, goats and rabbits.
c. Pruned branches/twigs – After pruning of mulberry plants, the stems not suited for sapling production were gathered and dried, and used as fuelwood.

Monitoring and evaluation

The University Extension Monitoring and Evaluation officials, led by the Extension Director, make up the Monitoring and Evaluation Team (MET). The project manager provides monthly, quarterly, and annual reports, and the team oversees the project on a quarterly basis.

The Institute also carried out monthly monitoring to assess the project's implementation progress and offer remedies for issues when they arose. An exit conference was planned to examine the findings of each monitoring and evaluation after it was completed.

Data gathering procedures

Documentation of the project

The project activities were documented with photographs and paperwork, and the Institute received progress updates on a regular basis. These reports contain monitoring and assessment reports, as well as annual and quarterly accomplishment reports. Every day, production data were captured for easier access when required.

Productivity and profitability analysis

A log book and a record book to record all operations, production inputs and outputs were kept. The project manager kept production records so they could be used for analysis. Yields of cocoons, byproducts, and mulberry saplings generated in the demofarm were used as productivity metrics, while return on investment and net income were used as profitability indicators to analyze costs and returns.

Results and discussion

Sericulture technologies showcased in the Baroro demonstration farm

Mulberry production and sapling production

Mulberry is widely recognized for its economic importance in producing the mori silk through feeding of leaf to silkworm (*Bombyx mori*) larvae (Vijayan *et al.*, 1998, 2004). Mulberry leaf foliage is also used as feeding material for domesticated animals (Datta *et al.*, 2002).

In the study conducted by Ghosh (2017), mulberry is a very hardy and fast growing perennial plant belonging to

the genus Morus of the family Moraceae. The leaf of mulberry is solely used for feeding and rearing of the silkworm, *Bombyx mori* for the production of silk yarn. It is estimated that mulberry silk contributes around 90 % of the total global raw silk production and it is a very attractive economic activities mostly to the rural people. In addition to the utilization of mulberry leaves as silkworm feed, it is being used for many other purposes.

The mulberry stand of the Baroro Sericulture Demofarm is a decade-old garden. It was established in year 2001 and 2002. It was abandoned for several years and intense rehabilitation was done in 2007. The mulberry plantation was utilized for silkworm rearing for cocoon production with an average of six rearing per year. The plantation was sub-divided into five (5) blocks for easier accounting, management and inventory of the existing mulberry stand. As a result, an inventory made on January, 2017 revealed a total of 11,605 mulberry plants.

Silkworm rearing for cocoon production

The Baroro demonstration farm produces cocoons year round with an average of 3 to 6 boxes per rearing with an average of 2 to 5 rearings per year. In this process, silkworms are reared at appropriate temperatures and humidity to get silk threads from cocoons. These cocoons are produced by the secretion of the liquid protein from the salivary glands of silkworm. It becomes the raw material used for the production of silk fabric once it is processed through reeling, re-reeling, doubling and twisting to produce raw silk.

Farming systems

The farming system concept is ideal for sericulture. This is because planting mulberries calls for a larger gap between hills and between rows. Therefore, adding cash crops to the plantation can help the farmers generate additional revenue.

a. Animal-Crop Integration

Aside from mulberry and cocoon production, the project has started animal-cash crop integration purposely for income augmentation. The demofarm maintained range chickens, rabbits, and goats and were fed with excess mulberry leaves. Vegetable crops were integrated in the mulberry plantation considering the wider spacing in between rows and hills. In the study conducted by Ssemugenze *et al.* (2021), it showed that sericulture industry has helped boost livestock production by improving the feeds sector. This has been achieved in two different ways namely feeding Mulberry leaves to animals and processing of silkworm secondary products like pupae to make livestock feeds. Mulberry leaves being easily digestible and palatable, fed as supplement to boost milk production from dairy animals.

Multiple land use approach which combines production of mulberry (as tree crops) and agricultural crops either simultaneously or sequentially on the same unit of land was implemented to increase the production and income per unit area. The integration of this scheme to sericulture farming can be a perfect alternative for additional income generation and contribute to the socio-economic upliftment of the farmers.

b. Composting

There is no better way of garbage, silkworm and mulberry waste disposal but through composting. A compost pile was organized to put mulberry and silkworm wastes. These scraps were chopped with a shovel prior to covering for speed decomposition. These will be used as mulch for the mulberry plants to increase soil fertility.

c. Sloping Agricultural Land Technology (SALT)

Contour planting on the rolling and sloping areas was done by utilizing mulberry as hedgerows. Various cash crops were planted in between rows of the mulberry plants. A total of 500 mulberry saplings were planted/replanted in the area. Sloping agricultural land technology (SALT), otherwise known as contour hedgerow intercropping (agroforestry) technology (CHIAT), is a system in which dense hedgerows of a fast growing perennial nitrogen-fixing tree or shrub species are planted along contour lines thus creating a living barrier that traps sediments and gradually transforms the sloping land to terraced land. The nitrogen-fixing hedgerows lining the terrace help improve soil fertility through nitrogen fixation at the roots and incorporation of the hedgerow trimmings into the soil. The hedgerows both markedly reduce soil erosion and contribute to improving and/or maintaining soil fertility.

The technology was developed by the Mindanao Baptist Rural Life Centre, internationally known by the name of its sister affiliate Asian Rural Life Development Foundation (ARLDF), on a marginal site in Kinua Kusan, Mindanao Island, in the Philippines.

Research-related activities

The site has conducted silkworm rearing for egg production (purelines). Silkworm rearing on sex-linked bivoltine was likewise conducted. It provided mulberry leaves to research-related activities and to individual farmer-clients.

Field visits

From January 2011 to December 2019, a total of 489 visitors were recorded. They were either students, businessmen, curious on-lookers, officials and employees form LGUs and farmers who want to gather information on Sericulture. Their visits were recorded for various purposes such as interview, field visits, field trips, "see me trips", and others. From 2011 to 2015, a total of 156 visitors were recorded which included students, families on vacation trips, politicians and other interested farmers in the locality. For year 2016, 45 persons visited the site for interview purposes and some for Bonsai venture. For 2017, 15 persons dropped in the area for educational interview and information gathering. For 2018, 58 students and teachers from Sta. Veronica College visited the area for education-related purposes. Fifty nine (59) visitors were likewise recorded in 2019 which included families from Ilocos Sur and Ilocos Norte, businessmen on bonsai selling, and students from the other provinces.

Productivity and profitability of sericulture technologies in the Baroro demonstration farm

Sapling production

Table 1 presents the productivity and profitability trend for sapling production in the demofarm. It could be gleaned from the table that the production of saplings was properly recorded from 2011 to 2019. A total of 4,500 mulberry saplings were reported as production for 2011 to 2015, while 5,500 pieces were produced from 2016-2018. In 2019, total of 1,500 mulberry saplings were distributed to farmer-clients from Ilocos Sur, Bangar and Balaoan, La Union. When sold at ₱2.50 per piece, a total sales of ₱28,750.00 can be generated with a production cost of ₱12,650.00 which can derive a total net income of ₱16,100.00.

Cocoon production

Table 2 shows the productivity trend of sericulture as to cocoon production from 2011 to 2019. Cocoon production from 2011 to 2013 has remarkably increased from 96.5 kgs. to 141.5 kgs. with 6 to 7 boxes of silkworm reared. Simultaneously, an increase in production was also incurred in 2014 with a total of 176.5 kgs. of fresh cocoons produced. It has also increased in the frequency of rearing and the number of boxes reared (7.75 boxes). This was attributed to the timely adjustment on the delivery system of silkworms, from 3rd instar 2nd day to 4th instar 2nd day. This scheme is an additional load to silkworm egg production but favorable to sericulture farmers. However, in 2015, cocoon production has decreased in yield. Only four (4) times rearing was done utilizing 3.75 boxes of silkworm and harvested 70 kgs. of fresh cocoons.

Moreover, cocoon production for 2016 showed a decrease in the number of boxes reared and the frequency of rearing with only 2.5 boxes for three (3) times rearing. This yielded only 53.85 kgs. of fresh cocoon. Records show that the cocoon production for CY 2016 is the lowest for the last five years.

Cocoon production for CY 2017 netted the lowest cocoon yield. Silkworm rearing was conducted only twice. Repair and rehabilitation of the rearing house was given priority in preparation for the establishment of the Bacnotan Trade and Tourism Center adjacent to the area of which sericulture products were included in the municipal plan of Bacnotan to be featured in the Center. Moreover, mulberry leaves in the area were utilized by farmer-beneficiaries from Bitalag and San Martin, Bacnotan and the Breeding and Egg Production Section of the Institute.

Table 1. Productivity and profitability of mulberry saplings

Year	Saplings produced	Total sales (₱2.50/pc.)	Production cost	Net income
2011-2015	4,500	11,250.00	4,950.00	6,300.00
2016-2018	5,500	13,730.00	6,050.00	7,700.00
2019	1,500	3,750.00	1,650.00	2,100.00
Total	11,500.00	28,750.00	12,650.00	16,100.00

Table 2. Productivity trend of sericulture as to cocoon production (2011-2019)

Year	SW breed	Number of boxes	Cocoon yield (kg.)	Average yield per box (kg.)
2011	346, 406	6	97	16.08
2012	406, 346, 100x115	6	79.3	13.22
2013	346, 102x103,101x115,406	6	141.5	23.58
2014	346, 408	7.75	176.5	22.77
2015	406, 346	3.75	70.00	18.67
2016	209, 102x107, PTRI breed	2.5	53.85	21.54
2017	209	1.5	24.5	16.33
2018	346, 408	2.25	51.2	22.76
2019	406, 346	3.5	37.1	10.6
Total		39.25	730.9	
Average				18.5

Table 3. Profitability trend of sericulture as to cocoon production (2011-2019)

Year	Cocoon yield	Gross income	Production cost	Net income
2011	97.0	33,950.00	14,938.00	19,012.00
2012	79.3	27737.00	11,372.00	16,365.00
2013	141.5	49525.00	25,257.75	24,267.00
2014	176.5	61,775.00	29,652.00	32,123.00
2015	70.0	24,500.00	12,740.00	11,760.00
2016	53.86	18,847.50	7,727.50	11,120.00
2017	24.5	8,575.00	3,430.00	5,145.00
2018	51.2	17,920.00	7,885.00	10,035.00
2019	37.1	12,967.50	5,122.00	7,845.00
Total	730.9	255,797.00	118,125.00	137,672.00

Table 4. Productivity and profitability of farming systems approaches and other sericulture by-products

Particulars	Production	Price/Unit	Gross income	Production cost	Net income
Animals raised in the farm (Range chickens)	21 range chickens	300.00/pc.	6,300.00	1,160.00	5,140.00
Vegetable crops (assorted)			14,800.00	1,370.00	13,430.00
Composts	106 sacks	100.00/sack	10,600.00	4,240.00	6,360.00
Fuelwood	408 bundles	30.00-32.00/bundle	12,600.00	1,512.00	11,088.00
Total					36,018.00

For year 2018, 2.25 boxes of silkworm were reared and netted 51.20 kgs. good cocoons. Unused mulberry leaves were utilized by seri-clients from various sites including Egg production unit and the 4th Instar Distribution Section of the Institute. Lowest production can be seen in year 2019 with only 37.1 kgs. of fresh cocoons were produced. It concentrated on producing cocoons for egg production apart from providing mulberry leaves for SRDI-assisted Seri-projects, egg production and 4th instar larvae production sections of the Institute.

The profitability trend of cocoon production is seen in Table 3. The total cocoon production of 730.9 kgs. with a total production cost of ₱118,125.00. This covers inputs like fertilizers, cost of silkworm larvae, rearing materials and supplies and other operating costs which may incurred during mulberry harvesting, disinfection of rearing house, bed cleaning, and other activities. When sold at a price of ₱350.00 per kg. of cocoons, a gross income of ₱255,795.00 is derived, hence, a total net income of ₱137,672.00 can be obtained.

Farming systems/other by-products

Table 4 shows the productivity and profitability trend for sericulture as to the farming systems approach and other by-products demonstrated in the area.

As to animal-crop integration, a total of 21 range chickens were raised and fed with mulberry leaves as left-overs from silkworm rearing. Other animals integrated in the demofarm include goats, and rabbits. There were variety of vegetables planted in the farm and produced plenty for consumption of some of the staff and the families of informal settlers nearby. These include bitter gourd, green beans, vegetable hummingbird, lady's finger, eggplant, purple yam, ginger, sponge gourd, banana, and other crops. The animal-crop integration when converted into income generation activity of the demofarm derived a net income of ₱5,140.00 and ₱13, 430.00 respectively.

With regards to composting, the project has produced 106 sacks of decomposed garbage/materials from 2011 to 2019 sold at ₱10,600.00 with a net income of ₱6,360.00. As to the productivity and profitability of fuelwood, From the pruned mulberries and other tree crops, a total 408 bundles of fuelwood were gathered and can generate a net income of ₱11,088.00 when sold at ₱30.00 to ₱32.00 per bundle. The farmer's family income would be increased by the extra revenue from the sericulture by-products. Additionally, because it promotes biodiversity protection, this farming systems approach will support farmers in improving their socioeconomic development and bringing sustainable livelihood security in the area.

Conclusion

The DMMMSU-SRDI Sericulture demo farm showcased a total production system to include among others mulberry sapling production, silkworm rearing for cocoon production, farming systems, animal-crop integration, sloping agricultural land technology (SALT), and composting of sericulture wastes. Likewise, the demo farm also served as venue for field visits and educational trips, and researches on land-use management, field testing and trials. The project generated income through the sales of saplings, cocoons produced, animals and crops, composts, and fuelwood. This reveals that the intensified extension efforts would bear fruitful results in popularizing the improved practices in sericulture. The demofarm provided mulberry leaves for regular extension projects, and also serves as experimental sites for researches and ultimately addressed Republic Act 9242 which requires government employees and officials to use tropical fabrics as uniforms by producing cocoons for silk yarn.

As a result, its nine years' worth of output serves as a showcase for the profitability and productivity of sericulture both locally and nationally. Additionally, it is recommended that for sustainability and income generation, farmers and other business owners should adopt the sericulture technologies used on the farm.

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