Greening Value Chains
For Sustainable Handicrafts Production in Viet Nam

UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

GREEN PRODUCTION AND TRADE
MDG ACHIEVEMENT FUND

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BAT	Best Available Technology
BEP	Best Environmental Practice
BOD	Biological Oxygen Demand
COD	Chemical Oxygen Demand
CSR	Corporate Social Responsibility
HRPC	Vietnam Handicraft Research and Promotion Centre
HUST	Hanoi University of Science and Technology
HRPC	Handicraft Research Promotion Centre
R&D	Research and Development
MARD	Ministry of Agricultural and Rural Development
MOIT	Ministry of Industry and Trade
MONRE	Ministry of Natural Resources and Environment
MPI	Ministry of Planning and Investment
MSMEs	Micro, Small and Medium-sized Enterprises
MSW	Municipal Solid Waste
NFTP	Non-timber Forest Product
POP	Persistent Organic Pollutants
RECP	Resource Efficient and Cleaner Production
RUDEC	Rural Development Centre, MARD
SCP	Sustainable Consumption and Production
SME	Small and Medium-sized Enterprises
TOE	Tonnes of Oil Equivalent
VIETCRAFT	Vietnam Handicraft Exporters Association
VIETRADE	Viet Nam Trade Promotion Agency
VIRI	Viet Nam Rural Industries Research and Development Institute
VNCPC	Viet Nam Cleaner Production Centre
VND	Vietnamese Dong
UP-POP	Un-intentionally Produced Persistent Organic Pollutants
VCCI	Vietnam Chamber of Commerce and Industry
VCA	Vietnam Cooperative Alliance

IV. On Green Industry and Greening Handicraft Value Chains

Handicrafts are uniquely placed to draw full advantage from a country's natural and cultural resources while transforming and adding value to non-timber forest products. By promoting crafts production we can reduce poverty and improve livelihoods in rural and remote areas and at the same time protect precious natural resources. Under this MDG-F Joint Programme, UNIDO worked with its sister agencies in Viet Nam to offer innovative and holistic solutions for the handicrafts sector from the cultivation and collection of raw materials to production and marketing through to the identification of "triple-bottom-line" development opportunities. It is imperative that developing countries fully explore the potential that can be unlocked from a value chain perspective.

At the same time, identifying and capturing resource efficiency opportunities is vitally important in promoting development. As we continue to move ever closer to ecological boundaries, the question of how to address the impacts of the unabated consumption of natural resources calls for immediate attention. By taking only the level of resources needed and extracting the maximum value-added from them, development can be made sustainable, resilient and inclusive. Not only is it no threat to growth, it actually helps achieve it.

Kandeh K. Yumkella, Director-General, UNIDO

Trade has been a key driver of economic growth in Viet Nam since the inception of the Doi Moi reforms. Faced with increased environmental degradation, the threat of climate change and the urgent constraints in the supply of natural resources, a new paradigm for development is needed and it must prioritise Green Growth. By launching its Green Growth Strategy in 2012 which emphasized the importance of green production and green technologies, the Socialist Republic of Viet Nam acknowledges that environmental sustainability cannot be a goal secondary to socio-economic development and that the two must be pursued in tandem.

In realizing this strategy, industry's role is absolutely vital and the handicrafts sector's should not be overlooked given the large amounts of precious natural resources it consumes and the informal and scattered nature of its operations. Upgrading and greening value chains ensures the continued competitiveness of the Vietnamese economy, that the well-being of future generations is not forsaken by the short-sightedness of the present and that, ultimately, growth does not have to be at the expense of environmental sustainability.

DO Thang Hai, General Director, VIETRADE, Ministry of Industry and Trade

Handicrafts stand out as an important part of a Vietnam's cultural heritage, the industry is a source of productive activities, incomes and livelihoods in rural areas throughout the country, with women and ethnic minorities among the greatest beneficiaries. Facing increased competition and saturation in global markets and with it, downward pressure on prices, handicraft producers need not only ensure that their products are attractive but also that their production methods are sustainable.

Resource efficient and cleaner production methods like those demonstrated under the Joint Programme not only protect natural resources but also improve bottom lines so that farmers, households and companies alike save money and producing more products from the same amount of raw materials they also make more money. Making such changes throughout the value chain would not only give Vietnamese crafts an edge over their competitors but would also have wider ripple effects on agriculture, industry and beyond.

DO Nhu Dinh, Chairman, VIETCRAFT

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Heinz LEUENBERGER
Director
Environmental Management Branch, UNIDO

Patrick GILABERT
Representative
UNIDO Country Office Vietnam

VI. Abstract

Bamboo, rattan, seagrass and other raw materials used in handicrafts production are an important part of Viet Nam's natural capital. These are valuable resources that need to be protected, harvested and utilized in a sustainable manner to ensure a vibrant crafts sector now and for future generations. The environmental impacts of crafts production by households and Micro, Small and Medium Enterprises (MSMEs) are often considered negligible given the scale of their operations, yet taking into account their sheer number, use of natural materials and limited capabilities, their production practices should also be appropriately addressed. Piecemeal interventions just at the production cultivation or stages, will only produce equally limited results. A comprehensive and integrated approach is needed to make green and clean-up the entire value chain, starting from raw materials collection, processing, crafts production and transportation, right up to final markets. Coordinated interventions to make green five value chains were supported in Viet Nam, respectively in the: bamboo and rattan, seagrass, sericulture and silk, lacquerware and handmade paper sectors.

Using simple equipment and techniques, significant amounts of waste generated in the production of bamboo, rattan and seagrass crafts can now be recovered as secondary resources to make new value-added products. With a view to reducing bamboo losses, a linseed-based preservation treatment has been developed, trialed and successfully demonstrated to industry. Collaboration with academia and industry in Japan and China has allowed for the transfer of the Kurome refining process so that lacquer can now be refined by local producers in Viet Nam. In the sericulture and silk sector, the development of which has suffered due to very high overheads, lack of know-how and underinvestment; optimisation of production processes in silk reeling, dyeing and weaving, etc. will help improve competitiveness throughout the sector.

Focused vocational skills-based training and hands-on guidance in cleaner production has contributed to new jobs and higher incomes for grassroots producers in all five sectors. With the concerted efforts and application of local and international knowledge, cleaner production techniques were made practical, applicable and cost-effective for crafts-producing households and MSMEs. Practical examples were developed of better product design, in harmony with the principles of sustainability and which proved to be attractive to the local market and international buyers. A further option lies in sustainability based branding and marketing, for which a practical assessment and labeling scheme have been developed.

In conclusion, a strategic focus on making the most out of Viet Nam's rich natural and cultural resources is required to ensure sustainable incomes and jobs in the handicrafts sector. Across the five value chains, this calls for sustainable management and cultivation of the natural resource base, better techniques for material preparation that avoid and reduce material losses and environmental impacts, enhancement of craft-making skills, and creative product designs that embrace cultural values and sustainability at large.

1. INTRODUCTION

1.1 Green Industry

In 2008, UNIDO launched the Green Industry initiative as an organization-wide strategic priority to foster sustainable industrial development in developing and transition countries. As rapid industrialization has proven to be a key driver for economic growth and poverty eradication in Viet Nam and throughout the developing world, sustainable industrial development is required to meet global aspirations for sustainable development, as reflected in the Agenda 21, adopted at the Rio Summit, and the Johannesburg Plan of Implementation, adopted at the World Summit on Sustainable Development.[1]

Green Industry is based on proven methods, strategies and tools and ultimately endeavours to decouple economic growth from increased use of natural resources (resource decoupling) and aggravated environmental impacts (impact decoupling). It provides a two-pronged approach for industrialization that is robust in the context of worsening environmental degradation, climate change and resource constraints:

- Firstly, Green Industry, through the 'greening of industries' achieves, on an ongoing basis, reductions in the use of natural resources and of the generation of waste and pollution in any business, including through such proven approaches as Resource Efficient and Cleaner Production (RECP) (see Figure 1), industrial energy efficiency, and chemicals management.

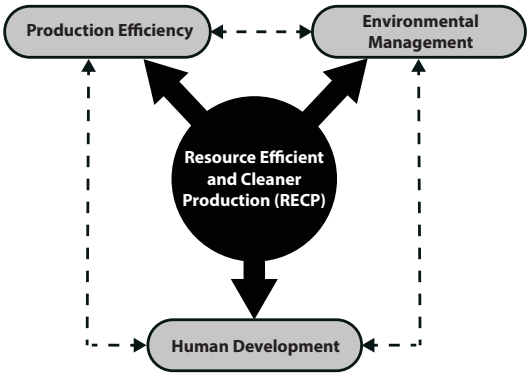
- Secondly, through the creation of 'green industries', Green Industry realizes the supply of high quality environmental goods and services in an effective and industrial manner, including, for example, for renewable energy, waste recycling and resource recovery, and environmental advisory services.

Green Industry is the sectoral strategy for achieving Green Economy and Green Growth in the manufacturing and related productive sectors. It assures the security of natural resources by alleviating the pressure on already scarce resources such as water, materials and fuels, contributes to mitigation of and adaptation to climate change by reducing greenhouse gas (GHG) emissions from energy and non-energy sources and at the enterprise-level, better environmental management and industrial and chemical safety. However, beyond this, achieving Green Industry is much more than just a question of environmental sustainability. It unlocks many more additional development opportunities, as a driver of competitiveness and sustainable business as enterprises improve their resource productivity and environmental performance. While also a catalyst for technological innovation, Green Industry is not just a new paradigm for industrial development, it also offers "triple bottom-line" benefits, serving as a clear strategy with defined pathways for achieving sustainable development.

UNIDO furthers the Green Industry agenda through action in three areas, as illustrated in Figure 2. Practical support is provided to scale-up both the greening of industries, through focused activities on resource productivity, pollution prevention and chemicals management, and the creation of green industries, by supporting the supply of goods and services for

FIGURE 1: Resource efficient and cleaner production

RECP refers to the application of preventive environmental management practices in industrial products, processes and services with the triple aim of improving resource productivity, environmental management and human development.
See: www.unido.org/cp



[1] UNIDO (2011). UNIDO Green Industry Initiative for Sustainable Development

renewable energy, materials recovery and pollution control. Both require an enabling framework, under which UNIDO is addressing policy and strategy, technology transfer, financial instruments and capacity building.

In specific, concrete terms, Green Industry is achieved through concerted actions that yield resource efficiency through the dematerialization of products and value chains; making use of materials with a longer service lifetime; recycling, reuse and recovery of materials, energy and water thereby reducing exploitation of virgin materials. Through improvements in process operations and application of advanced process technologies with higher efficiency and specificity, Green Industry minimizes the generation of waste and emissions. Employing of BEPs and BATs prevents the unintentional production of POPs and other hazardous pollutants while replacement of chemical by non-chemical processes translates into real reductions in risks associated with chemicals and (hazardous) wastes. Equally important in this strategy is the creation and expansion of (new) green industries, in which there are numerous opportunities to exploit from recycling and resource recovery to B2B support in promoting and deploying industrial energy efficiency and renewable energy solutions in addition to the collection, management and disposal of hazardous wastes.

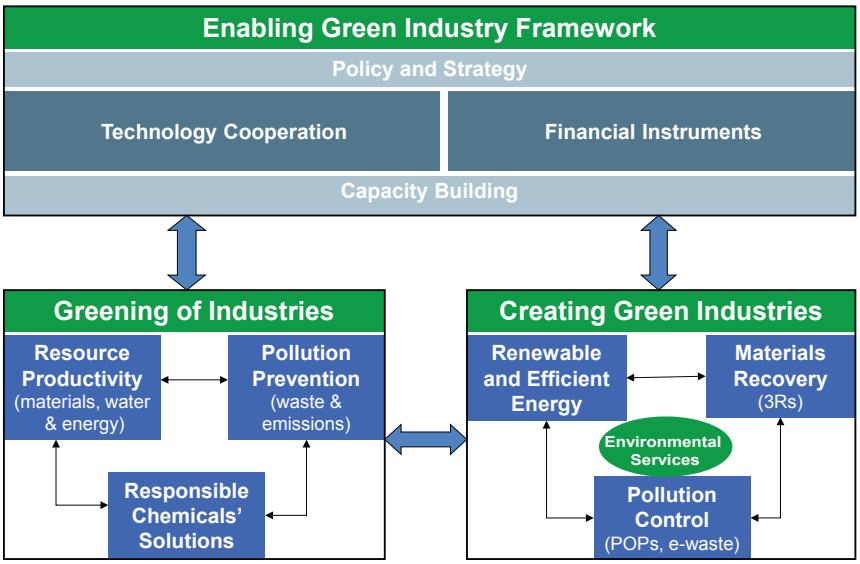
Green Industry cuts across the policy domains of competitiveness, innovation and trade. The use of fiscal policy, regulatory and market-based instruments to mainstream and embed Green Industry in industrial and related policies and strategies, along with the fostering of industry based initiatives, ensures that enterprises have access to affordable financing, that human and institutional capacity is developed in a systematic manner and that technology diffusion and deployment are supported at the enterprise level.

UNIDO, in cooperation with the United Nations Environment Programme, launched the Green Industry Platform during the United Nations Conference on Sustainable Development (also known as Rio+20). This multi-stakeholder platform will enable the scaling-up and mainstreaming of Green Industry policies and practices throughout the global manufacturing industry. In this regard, the Government of Viet Nam was one of the first countries to join the Green Industry Platform (www.greenindustry-platform.org), signing the Statement of Support on 16 June 2012.

1.2 UNIDO Achievements

UNIDO has undertaken environment and energy related projects in the manufacturing and related sectors in Viet Nam since the late 1990s. Their prime focus has been on the 'greening of industries', most of these falling under the umbrella of RECP (Figure 1).

FIGURE 2: UNIDO Green Industry Themes



A landmark has been the support for establishment and operation of the Viet Nam National Cleaner Production Centre (VNCPC) since 1998. The Centre has a strong record in delivery, as documented by the independent evaluation of its performance conducted on behalf of its founding donor (Government of Switzerland) and UNIDO. Published in February 2012, the report took stock of 340 consultancy projects implemented VNCPC in the form of Cleaner Production Assessments (CPAs), Technology Gap Assessments (GAPs), Clean Technology Assessments (CTAs), Cleaner Technology Implementation (CTI), Financial Engineering Proposals (FEPs) and Sustainable Product Innovation (SPIN). VNCPC's enterprise support had benefited numerous companies in diverse sectors from metals (19 per cent), food processing (18 per cent), textiles (14 per cent), handicrafts (11 per cent), pulp and paper (11 per cent), and construction materials (1 per cent). In addition, the Centre has trained many cleaner production specialists who have also continued to serve the local market. While it is difficult to quantify, in exact terms, the indirect beneficiaries, there are, according to the General Statistics Office, more than 2,000 manufacturing companies applying cleaner production and potentially many more in non-manufacturing sectors.

The project funded by the Global Environment Facility (GEF) on Introduction of BAT and BEP methodology to demonstrate reduction or elimination of releases of unintentional Produced Persistent Organic Pollutants from industry in Viet Nam (2009-2011), addressed the reduction of UP-POPs from the waste incineration, cement kiln (co-processing), pulp and paper, and iron and steel sectors through the introduction of best available techniques (BAT) and best environmental practices (BEP). The project also established the first database on dioxin emissions from industry in Viet Nam and built capacity for dioxin sampling and analysis in industrial emission samples.

As industry in Viet Nam contributes two-fifths of greenhouse gas emissions (GHG), industrial energy efficiency is all the more important. UNIDO is therefore implementing the GEF-financed project: Promoting Industrial Energy Efficiency through System Optimization and Energy Management Standards in Viet Nam (2010-2014). The project promotes industrial energy efficiency through system optimization and ISO energy management standards in food, textile, rubber and pulp and paper sectors.

The EU SWITCH-funded UNIDO project: Helping Vietnamese SMEs Adapt and Adopt Corporate Social Responsibility (CSR) for Improved Linkages with Global Supply Chains in Sustainable Production (2009-2013) targeted the textile/garment, leather/footwear, and electric/electronics sectors (www.csrvietnam.eu). It raised awareness and built a pool of experts who serve the local market as a source of CSR know-how and practice. At the same time, the project created an online platform and resource materials to facilitate information exchange, and experience on CSR implementation, among enterprises and CSR experts.

During 2011-2012, with support from the One UN Fund, UNIDO developed and proposed a policy framework and guiding quantitative goals for the improvement of resource productivity and environmental performance to facilitate wide-scale deployment of Green Industry (UNIDO, 2012).[2] In the first of three policy pilots, benchmarking against good international practices in the Electric Arc Furnace steel sector was combined with development of a sectoral voluntary agreement and a technology roadmap. Responding to the determination of the local government to develop an Eco-City in Hoi An by 2030 in the second policy pilot, a Green Industry Action Plan was devised to help improve environmental amenity and foster economic growth. Last but not least, Binh Yen Village in Nam Dinh Province was taken as a case in point for an in-depth investigation into micro-scale (aluminium) recycling in rural villages around Viet Nam with the aim of promoting replicable zero-emissions models.

1.3 Towards Green Growth in Viet Nam

Embarking on a sweeping series of market-oriented reforms (known collectively as the Doi Moi policy) in 1986, the Socialist Republic of Viet Nam has since witnessed remarkable progress. Annual growth rates have only been second to China in the Asia-Pacific region, industrial development driven by export-led growth and diversification achieved in its economic base. Absolute poverty fell drastically from 29 per cent in 2000 to 14 per cent in 2009 while during this

[2] UNIDO (2012). Towards Green Growth Through Green Industry Development

same period Viet Nam's population increased by 10.3 million. Joining the World Trade Organization in 2007, the country was also reclassified by the World Bank, moving into the "lower-middle income" bracket in 2010.

Key industries in Vietnam, at present, include food processing, garments and apparel, machinery, mining, coal, steel, cement, chemical fertilizers, glass, tires, oil and paper. However, while industry accounts for 40.7 per cent of GDP, it only contributes to 22.4 per cent of employment. Agriculture, at 21.5 per cent of GDP still accounts for some 48 per cent of jobs. Viet Nam has a large population – ranking 14th globally – and also one of the highest population densities in the world. The gaps between the rich and the poor, and between urban and rural areas persist. In remote and mountainous areas more pronounced inequalities along with pockets of absolute poverty remain, with an estimated 20.7 per cent of the population still living below the national poverty line (World Bank, 2010).

BOX 1: Viet Nam Country Profile

Capital City:	Ha Noi
Population:	90.5 million (14th most populous country in the world)
Area:	321,210 km^2
GDP per cap:	US$1,224/lower-middle income country (World Bank, 2010)
HDI:	0.593/ranked 125 of 187 (UNDP, 2011)

Handicrafts Industry in Viet Nam

The Vietnamese have traditionally produced a large variety of craft products which form a key part of cultural traditions and have also been widely used as household goods. Handicrafts production can play an important role in poverty alleviation and pro-poor growth, in particular, in rural and remote regions with relative abundance of natural materials for crafts production.

Many clusters of handicraft villages are located in proximity to the Red River Delta in Northern Viet Nam and Mekong Delta in the South-West. However, Central Viet Nam is also endowed with an abundant supply of natural materials. According to a survey by Japan International Cooperation Agency and Ministry of Agriculture and Rural Development (MARD) (2005), there are 2,017 villages that have engaged in handicraft production for more than 100 years. The handicraft industry is labour intensive, employing an estimated 1.4 million people, of which, more than 60 per cent of workers are women, increasing to 80 per cent in embroidery and fabric weaving. Crafts production can complement seasonal agricultural work to provide jobs that elevate living standards while also helping to preserve ancient traditions and skills. Many of the villages have leveraged their advantages in this area and become tourist destinations, bringing other additional benefits. Protection of cultural heritage aside, promoting the handicrafts industry in Viet Nam is part of the government's plan to foster economic development across all regions of the country, reducing unemployment especially in the rural areas and boosting exports.

BOX 2: About Handicrafts

Handicrafts are a cultural expression of the traditions, heritage and aesthetic values of a nation and represent an important engine for agrarian transformation and regional development. Such development has been rapid with the availability of resources: skilled labour, quality raw materials, designs and markets. The investment costs are also low, relative to other industrial sectors. Labour-intensive and often highly dispersed, handicrafts provide additional incomes in times of low labour demand in agriculture, exports of which can also be an important source of foreign earnings.

The International Labour Organization (ILO) describes the common characteristics of handicrafts specifically and of the informal sector, in general, as economic activities where there is a "reliance on locally available resources and skills, family ownership, small-scale operations, simple and traditional technology, intergenerational skills acquired outside the formal schooling system, informal organization of production and competitive markets."

Vietnamese-made handicrafts include wooden furniture, porcelain, lacquerware, silk, embroidery, candles, jewellery, artificial flowers and glass products. The economic value generated is relatively small compared to other such industries as textiles or mining, etc. Yet despite their small scale of operations, the value of total production is not insignificant. Export turnover of handicrafts was estimated at US$ 1.6 billion in 2012, with the USA, Japan and the EU comprising the top overseas markets.

Apart from the apparent bottlenecks in socio-economic development, progress towards environmental sustainability also faces critical hurdles. The National State of the Environment Report 2010 published by MONRE in 2011[3] highlighted sources of stress on the environment including: the number of industrial zones which increased from 131 in 2005 to 249 in 2009; municipal solid waste which increased by 150-200 per cent between 2003-2009 with collection rates reaching just 80 per cent in inner cities and lagging still at 70 per cent in industrial zones and 40-55 per cent in rural areas. Not separated at source, most solid waste is disposed of in the same landfills. Parts of Viet Nam are experiencing soil degradation (desertification, seawater intrusion and pollution by agricultural and industrial effluents). Land use changes also result in 74,000 hectares of losses in arable land each year. Overall, the World Bank estimates that the losses of up to 5.5 per cent of GDP a year could be incurred unless environmental pollution is appropriately addressed. Those most pressing issues identified in the report include: increasing environmental pollution, loss of biodiversity and environmental mismanagement.

Viet Nam's Green Growth Strategy

During the United Nation Conference on Sustainable Development in June 2012, governments agreed on the need to transition towards a green economy. Thereafter, on 25 September 2012, the Prime Minister of Viet Nam approved the Vietnam Green Growth Strategy, the Prime-Ministerial Decision noting that green growth has already become "a decisive tendency in sustainable economic development."

[3] According to Article No. 101 of the Environment Law (1993, amended in 2005), the State of the Environment Report is to published each five years in line with the government's national socio-economic development plans

The Vietnam Green Growth Strategy aligns well with UNIDO's Green Industry initiative as it focuses on three priorities: GHG mitigation, green production, and green lifestyle. Among the solutions identified, common themes can be found including the construction of necessary infrastructure, technological innovation and the creation of an enabling environment through the elaboration of appropriate policy mechanisms, standards, technical regulations and rational use of natural resources including fossil fuels. Moreover, citing the "Strategy on Cleaner Production in Industry Towards 2020" (Decision no.1419/QD-TTg) endorsed by the Prime Minister in 2009, the mainstreaming of cleaner production is explicitly mentioned as a solution.

Industrial clusters, by virtue of their size, possess a significant and recognized threat to the environment. On the other hand, household level production is not immediately seen as an environmental threat, yet should not be underestimated. The environmental sustainability of household-level production should be given its due consideration in light of the sheer number of actors and their general lack of knowledge on environmental techniques and practices relative to more formalized enterprises. Moreover, their limited resources, capacities and infrastructure, the vulnerability of local communities in which they operate and the natural environments from which they source raw materials also warrant concern.

1.4 Greening Handicraft Value Chains in Viet Nam

Handicrafts are an important sector for poverty alleviation and economic development. Yet its accelerated development also presents its challenges in terms of environmental and community impacts. Jointly with four UN sister agencies, UNIDO developed the Joint Programme entitled "Green Production and Trade to Increase Income and Employment Opportunities for the Rural Poor" (www.green-trade.org.vn). It was implemented during 2010-2013 with funding from the "Development and the Private Sector" Thematic Window of the Millennium Development Goals Achievement Fund (MDG-F) established by the Government of Spain. In the programme, UNIDO took responsibility for the greening of handicrafts production, addressing key determinants of

production techniques, handicraft skills, environmental techniques and practices, and product designs. In parallel, sister agencies supported respectively: the sustainable cultivation and harvest of raw materials (FAO); promotion of safe and sound work places and working relations (ILO); development of supply chains (ITC); and international market development (UNCTAD). The remainder of this report exclusively covers the UNIDO component, i.e. the greening of handicraft value chains.

BOX 3: The Pilot Provinces

Phu Tho – A mountainous midland province and one of the poorest, Phu Tho lies 80 kilometres North-West of Viet Nam's capital and is known as the Gateway to Hanoi. The trajectories of three great rivers (the Hong, Lo and Da Rivers) pass through the province and in addition, good land connections allow easy access to China and other South-East Asian countries.

Nghe An – Located at the heart of the Northern-Central region, on the North-South transport route and Asian East-West corridor, Nghe An lies 300 kilometres away from Hanoi and just 80 kilometres from the border with Laos. The Truong Son Mountain Range lies within its boundaries as does a dense system of rivers (with a total length of 9,828 kilometres) which cut through Nghe An, the largest of which is the Ca River (also known as the Lam River), originating in Laos.

Hoa Binh – Meaning "peace" in Sino-Vietnamese, the province shares a border with Hanoi and forms part of the Hanoi-Hai Phong-Quang Ninh economic hub, with well-developed connections by land and water (the Da and Boi Rivers). Hoa Binh's mountainous typography has made development more challenging, particularly in terms of infrastructure. Tourism has, however, thrived and local ethnic minorities and their cultural diversity and traditions have helped add to and enrich that of the region.

Thanh Hoa – 150 kilometres South of Hanoi, it is the second largest province in Viet Nam and to the West, it shares a border with of Laos. The province is diverse with many ethnic groups including the Kinh, Muong, Thai, Tho, Dao and Mong. Lam Son in Thanh Hoa Province is famous as the birthplace of various important figures in Vietnamese history including Ba Trieu, Le Loi and Dao Duy Tu.

Population size, poverty rate and GDP per capita in the four pilot provinces in 2010:

Province	Population	No. of households	GDP per capita	% of poor households
Phu Tho	1,364,522	274,908	8,842,097	18.41
Hoa Binh	788,274	174,198	13,090,660	19.34
Thanh Hoa	3,405,000	746,428	10,295,558	21.15
Nghe An	2,919,214	758,333	10,490,458	17.54

The programme targeted some 4,800 poor farming and craft-producing households in 25 communes located in four provinces in Northern Viet Nam: Thanh Hoa, Nghe An, Hoa Binh and Phu Tho. These communes were selected on basis of:

(i) A high incidence of poverty, particularly among ethnic minorities;
(ii) A high concentration of raw materials and local production of crafts; and,
(iii) The potential to create synergies with past and ongoing development activities.

Average GDP per capita in 2010 in all four targeted provinces fell below the national level of VND 17,180,000. Moreover, the percentage of poor households in the four provinces was higher than the national average of 13 per cent in 2010 (based on the national standard for poor households regulated by the Decision 179/2005/QD-TTg issued in 2005), in which households

living in rural areas with less than VND 200,000 per month are considered to be poor households). Of the four provinces, Phu Tho had the lowest GDP per capita.

With a focus on poverty alleviation, the programme targeted five important handicraft value chains relevant to the 25 target communes: (i) bamboo and rattan, (ii) sericulture and silk, (iii) seagrass, (iv) lacquerware, and (v) handmade paper. Twelve communes were involved in the bamboo and rattan value chain, eight in sericulture, two in seagrass, another two in lacquerware and one in handmade paper. In each of the targeted communes, the collection and processing of natural raw materials from forest areas into handicrafts constituted the most important source of additional income for rural households, without which they would not be able to lead a life above the poverty line.

To address the complex and interlinked challenges faced in the five sectors, a value chain methodology was adopted. The work of UNIDO (2009) and partner agencies confirms that value chain thinking and development is an effective strategy for sector and market development. It considers the relations (including procurement and sales, etc.) between each successive actor in the value chain, from raw material collection, to pre-processing, production, distribution and trade, all the way to the final consumer. While traditional value chain analysis has focused exclusively on value creation (and hence incomes and jobs) at each stage, it is now understood that a broader array of aspects needs to be considered, including environment, occupational health and safety and impacts on community development (UNIDO, 2011).

In view of this, UNIDO applied RECP principles and methodologies (as summarized in Figure 1) and to ensure a systematic and holistic approach these were extended beyond the scope of processing and production throughout the value chain. Capacity building and technology transfer enabled enterprises to fundamentally change their operations. Additional support in business management and branding were provided. However, over and above this, it was seen that the challenges the sector faced went beyond that of just marketing and the Design-for-Sustainability approach was adopted to redesign products that were sustainable.

In collaboration with ILO, UNIDO commissioned the Handicrafts Research and Promotion Centre (HRPC) to conduct surveys at the project inception and upon completion in regards to income, jobs, techniques, raw materials and environment and labour practices and work conditions. The needs for cleaner production and Design-for-Sustainability were then assessed by the Viet Nam Cleaner Production Centre (VNCPC) both at the level of grassroots household producers as well as SMEs. Next, VNCPC trained 65 trainers in household cleaner production techniques, who went on to deliver introductory hands-on training to 1,430 grassroots producers. Moreover, HRPC provided group based skills training to 261 household producers. In parallel, UNIDO focused on the specific technology needs for lacquer processing, silk dyeing and bamboo treatment, and through international cooperation new environmentally sound techniques were proposed and trialed. Moreover, UNIDO assisted with the provision of appropriate tools and equipment in communes and enterprises. In connection with the 2011 and 2012 Lifestyle Viet Nam Exhibitions organized by VIETCRAFT in collaboration with VIETRADE and at various trade fairs in China, UNIDO also supported 20 enterprises to redesign products using sustainability principles, and following thereon proposals were developed for the introduction of a green branding system for handicrafts.[4] As of January 2013, US$ 100,000 of sales revenues have been generated directly from products developed with UNIDO assistance under the Joint Programme. Technical and promotional documents were produced for the five sectors and disseminated at a national workshop.

This summary report complements the detailed technical reports by providing an overview of the progress made in the greening of each of the five value chains.

[4] UNIDO (2013). Achieving, Assessing and Communicating Sustainability – A Manual for the Vietnamese Handicraft Sector.

2. BAMBOO AND RATTAN

2.1 Introduction

Bamboo and rattan are commonly used together in the crafting of basketry and similar household items. Viet Nam has around 1.4 million hectares of bamboo forests (occupying 10.5 per cent of total forest area) and another 81,500 hectares of plantations. Total rattan resources including natural forests and cultivated rattan are estimated at 380,000 hectares. Locally grown resources are insufficient and some rattan and bamboo materials are imported to meet the gap in local supply. An estimated 723 or one third of the country's official 2,017 villages are engaged in bamboo and rattan craft in Viet Nam. Government statistics estimate the value of exports at around US$ 300 million in 2012.

Several varieties of bamboo and rattan are used for handicrafts in Viet Nam. UNIDO targeted lung bamboo (*Bamboosa sp.* or *Bamboosa longisima sp. Nov*) and garden rattan.[5]

BOX 4: About Bamboo and Rattan

Bamboo is a fast-growing grass which produces new shoots each season and can be harvested every few years. Its extensive rhizome root system protects against soil erosion and landslides, in particular on riverbanks. The composition of bamboo high in lignin and cellulose makes bamboo forests good carbon sinks. Bamboo is extremely versatile, apart from small household furnishings, it can also be made into, for example, plywood, paper, composite beams, whilst its shoots are also edible. Globally there are some 1,250 species belonging to 75 genera.

Superficially resembling bamboo, rattan is the generic name for approximately 600 varieties of climbing palms indigenous to tropical regions in Africa, Asia and Australasia. Vine-like, it does not grow free standing. Although rattan and bamboo are different species, both grow well in a variety of eco-systems. They are easy to harvest, transport and process together and in a similar way to make crafts products and also present similar concerns in terms of preservation and processing, etc.

[5] The other two main types of bamboo which are used in handicrafts production in Viet Nam are Luong (*Dendrocalamus membranaceus Munro*) and Nua (*Neohouzeau a Dulloa*).

Under the Joint Programme, UNIDO supported the bamboo and rattan sectors in Hoa Binh, Nghe An, Phu Tho and Thanh Hoa Provinces with:

- Cleaner production assessments in 23 SMEs and preparation of cleaner production guidelines;
- Training of trainers, including preparation of technical guidelines and information pamphlets for households;
- Introductory training of cleaner production methods to 690 grass-roots producers;
- Product design support to 17 SMEs;
- Skills training in 186 people from in seven communes in Hoa Binh, Nghe An, Phu Tho and Thanh Hoa Provinces;
- Provision of improved tools and equipment to three communes and six enterprises/cooperatives; and,
- Development of a natural linseed-based preservation process.

2.2 Greening the Value Chain

Raw Material Supply

The lung bamboo variety grows naturally in forests. Collection of bamboo by farmers is not regulated, and farmers lack information and training on sustainable collection of raw materials and bamboo resources are now becoming scarcer. The bamboo culms are cleaned in the forest and the waste is left behind. The stems are then transported to the enterprises for further processing.

An international review of bamboo processing identified several improvements in bamboo harvesting that reduce sugar and water content and hence improve bamboo raw materials by making them less susceptible to mould and insect attacks. Specifically:

- Harvest at the beginning of the dry season and at dawn, cutting above at least the first node taking care to avoid collateral damage, picking only those culms six to eight metres in height and leaving behind at least three culms per clump.
- Select only mature bamboo – bamboo

culms at three to five years of age are sufficiently lignified (hardened), have a lower water and pentose content and are yet more easily manipulated/ woven into products compared to younger or older bamboo.

- Allow for four weeks post-harvest transpiration, keeping culms upright without removing any leaves and avoiding contact with the ground (using, for example a rock) will help improve drying (Figure 3).

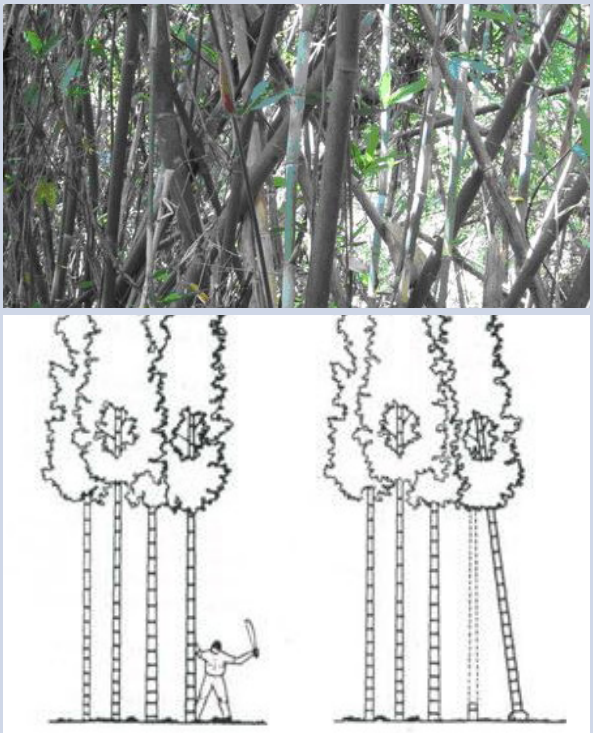


FIGURE 3: Lung bamboo (top) and post-harvest transpiration (trees shown in the example)

These practices have been promoted to collectors and have been successfully trialed. However, the unregulated collection of bamboo still stands in way of their effective and widespread implementation.

Materials Preparation

For lung bamboo, the most valuable part is the inner skin layer, which is used for weaving final products. On the basis of weight, most of the bamboo culm is therefore discarded as waste. Weight also factors in as an issue in transportation, as water content accounts for 20-40 per cent of the weight of green bamboo and 55-65 per cent of green rattan depending on the season and age.

It is a time-consuming process to extract the inner skin layer and split it into weavable strips. First the bamboo culms are split lengthways, either manually or with a mechanical press to leave behind the stem parts. The fine outer skin is then peeled away using a simple knife (Figure 4.). These stem parts are then allowed to dry, in the open and are commonly bleached and treated to prevent mould. The stem parts are then split again several times to remove the inner woody core, and leave strips of the inner skin layer. The inner skin layer is then ready for weaving, with as much as 70 per cent of the weight of the raw materials having already gone to waste. In some workshops, a part of the bamboo waste is used to fuel the boiler and/or for cooking in households, while the rest is discarded. Much more raw material goes to waste due to infestation by wood eaters, white ants and mould.

Productivity is low, taking on average four hours to split enough bamboo to get just 300 grams of skin layer which can then be used to weave the actual products. Productivity is low at 40-50 kilograms per day per worker, and yields variable, in particular in the case of manual splitting. Mechanical splitting offers productivity levels

FIGURE 4: Manual splitting of bamboo (top) and outer skin peeled from lung bamboo

BOX 5: Bamboo waste recovery in Dien Van Cooperative, Nghe An Province

The Dien Van Cooperative employs 30 people on-site and outsources the weaving of its products to nine households in the community. Under the Joint Programme, UNIDO provided them with two sets of splitting equipment (below left) and square and round tooth pick/joss stick makers (below right) to process waste bamboo materials. Splitting the bamboo and rattan in the company means that the households can focus on just weaving and they are more productive and able to make more products. They take home about 30 per cent more in commissions as a result. From bamboo waste, they are able to make some 120 kilograms of toothpicks and incense sticks a day and they also buy and reprocess waste bamboo for extra income.

The Joint Programme also helped connect them with collectors (via trainings) who they were able to buy directly from at VND 1,800 per kilogram instead of VND 2,000 per kilogram, thereby cutting out the middlemen. They also used to sell to exporters through an intermediary, but during the Lifestyle Viet Nam Exhibition in 2012, they made direct contact with an exporting company with whom they now trade directly.

that are 20 times higher, along with greater accuracy, which results in higher yields and materials more suitable for weaving (Box 5.).

Natural drying depends entirely on the weather, in case of insufficient space or during rainy periods, if the material is not adequately dried and stored, it grows mould easily. Unnecessary material loss occurs due to incomplete drying which is common in particular in the rainy season. Of greatest concern, however, is pre-treatment, which is needed to remove pentose and water and thereby protect against mould and infestation. The simplest form of preservation involves

FIGURE 5: Material drying outside the factory

submerging bamboo in waterways for an extended period of time (weeks) to leach out the sap, yet this process results in degradation and pollution of waterways. Chemical treatments are therefore most common, in particular sulphur fumigation and oil curing (i.e. boiling in diesel oil), which leaves workers exposed to chemicals, pollute the environment if not handled properly, and leaves undesired chemical residues on the otherwise natural materials.

The greening of materials preparation starts with proper sourcing of raw materials, which are relatively lower in pentose that is, mature bamboo harvested in right manner (as per the previous section on raw material collection). An international review pointed in direction of a natural linseed-based process. This was further developed and trialed with technical support of the Hanoi University of Science and Technology (HUST). The process proved itself, and turned out to be beneficial in terms of reduced shrinkage and linseed oil treatment offered protection against moisture re-entry (see Box 6.). Further work is ongoing to demonstrate the process to industry and get it accepted by buyers, to promote widespread uptake.

Weaving and Finishing of Products

The prepared bamboo slivers are then woven into final products, most commonly using split rattan as frames, as per customer specifications. Final products are shaped by hand (sometimes using steam) and transferred back to the companies where they might be finished with paint (by means of spray guns) or by carbonizing or dyeing. Thereafter products are inspected and packed for shipment to customers.

Craftsmanship and level of skill are key determinants in weaving. The more highly skilled,

the more complex (and higher priced) the products that can be produced and the lower the rates of rework and/or rejection. This was clearly demonstrated through the provision of advanced training (Box 7.) for household producers. In addition to improving weaving skills, household producers also learnt about best practice in pre-processing, materials preservation, good chemicals management and recovery of raw materials. Moreover, the weaving of new products was demonstrated, such as bags and purses, bowls, boxes, curtains, jewellery, lampshades, mats and pet houses, etc. some of which made use of bamboo and rattan waste and cores. Participants learnt also for the first time how to make products to specification from technical drawings which gave them a new inspiration and perspective on product design. They also shown how to calculate their costs (raw materials, electricity, water and labour, etc.) and thereby better price their products.

Waste Utilization

Typically the inner core – as much as 70 per cent of the bamboo material – becomes waste. Introduction of mechanized splitting produces more uniform pieces of bamboo waste, that can be recovered and used to make toothpicks, incense sticks and bamboo plywood.

Product Design

Product design is a key determinant for market development and acceptance. Seventeen SMEs therefore received design support from international and national experts to redevelop some product lines with sustainability in mind. Several collections were prepared and demonstrated at the Lifestyle Exhibitions in 2011 and 2012.

FIGURE 6: The "Interlocking" and "Lace" Collections, photos by Rebecca Reubens

BOX 6: Environmentally Sustainable Bamboo and Rattan Preservation

The Joint Programme aimed to find a suitable environmentally friendly method for treating bamboo, in general, and for lung variety, in particular. HUST laboratories looked for a solution that would be convenient, relied on locally available materials, was low cost, would be effective in the long-run, have low environmental impact and would yield a smooth and natural finish. Companies mostly handled splits and so boiling was therefore faster than soaking also giving better results.

With these criteria in mind, the use of two natural preservatives was explored:

- **Linseed oil**, which derived from flaxseed, is readily available in Viet Nam. High in fatty acids (58 per cent) and inedible for beetles and insects, it is a plasticizer and can make bamboo more flexible, prevent shrinkage, reduce weight loss by sap displacement. Hydrophobic, it can protect bamboo against re-entry of moisture and fungi during storage. Full oleo-thermal treatment would not be cost effective, but diluted with water, benefits were still apparent.

- **Neem** (*Azadirachta indica A. Juss*) extract is rich in essential oils (found in stems, branches, but most concentrated in seeds), possesses natural anti-bacterial and anti-fungal properties, and is valued in traditional medicine. One tree may give more than 50 kilograms of fruit, leaves and flowers, which are also edible. In rural areas, people burn dried neem leaves as a natural mosquito repellent or place leaves in rice storage houses to protect against pests.

Tests were run on each both separately and together and then compared to the results of treating in boiled water alone. It was found that curing in a linseed oil-neem extract solution gave the best results and could be used for both green and dried bamboo. Colour was preserved, and in addition, shrinkage and weight loss were reduced by means of sap displacement which also helped protect the bamboo against the re-entry of moisture. Moreover, antifungal and antibacterial effects were still apparent more than six months after curing.[6]

[6] Ta Thi, P. H. (2013). Cleaner Production Options for Improved Bamboo Treatment

The Interlocking Collection (Figure 6.), for example, made use of locally made laminated bamboo plywood. This plywood is more versatile and well suited for making higher value products, and the board itself can be made from lower quality bamboo cut-offs that would otherwise have gone to waste. The newly designed product can be assembled easily, without glue or other fixtures, and can be sold flat-packed for convenient storage and transportation.

BOX 7: Vocational Training of Grassroots Bamboo and Rattan Basket Weavers in Lang Thanh Commune, Nghe An Province

Training in Lang Thanh Commune, led by an expert from HRPC/VIRI, commenced at the beginning of August 2011 and ran for one month, a total of 30 trainees participated – 25 of whom were women. For all of them, it was the first time that they had been challenged to consider the concept of sustainability and asked to put into practice green production practices. The products they were taught to make were chosen based on the existing skills they possessed, with all materials and required hand tools provided. Participants were all enthusiastic about the course and about the opportunity to learn new skills and all were able to make the products demonstrated, successfully finishing 1,104 items on site which were sold to Ngoc Canh Company for VND 11.2 million (~US$ 550).

With the introduction provided via the Joint Programme, Lang Thanh Commune continues to produce and sell its products to Ngoc Canh Company. One year on, it still receives regular orders and incomes have improved from an average of VND 800,000 (~USD 40) a month before the training to VND 1.3-1.4 million (US$ 65-70) a month post-training.

Similar trainings were held for bamboo and rattan weavers in Quynh Thach also in Nghe An Province, Thang Binh and Tan Tho in Thanh Hoa Province, Lien Son in Hoa Binh Province and Yen Tap in Phu Tho Province.

The Lace Collection (Figure 6.) took the "lace doily" motif as an integral part of its design and used garden rattan cultivated by farmers in close proximity of the company increasing sustainability. Versatile and flexible, the variation in the natural colour of the garden rattan added to the uniqueness of each product, and avoided the use of chemicals for bleaching and/or curing. The lace doily design, the making of which was outsourced to local households, meant that no standardized lengths of rattan were required thereby greatly reducing the amount of materials wasted.

Companies have since worked on perfecting prototypes and expanding the collections. Products were showcased at Lifestyle Viet Nam Exhibitions in 2011 and 2012 and were well-received with many inquiries made by local and international buyers in each instance.[7]

2.3 Outlook

Specific areas of concern for the bamboo and rattan handicrafts were sustainable management of the resource base (in forests and plantations), collection and pre-processing, preservation techniques, cutting and processing wastes, and low value product designs.

The interventions demonstrated that it is possible to green the bamboo and rattan handicrafts sector through better coordination throughout the value chain. Firstly, quality should be maintained in raw material supply, by adopting the right harvesting and collection practices, and a natural process for bamboo preservation should be used. A second issue to be addressed is the bamboo and rattan waste, which can be reduced by mechanization and proper drying. This ensures that the bamboo waste can be recovered for production of plywood, toothpicks, incense sticks and chopsticks, etc. Thirdly, greater craftsmanship and skills combined with improved and unique designs offer significant potential for producing higher value-added products.

[7] Photos of collections from UNIDO (2011). "Final Report – Rattan and Bamboo Product Development".

3. SEAGRASS

3.1 Introduction

Due to favourable climate conditions, seagrass has been cultivated for many years in coastal areas in Viet Nam. There is a long local tradition of sedge grass weaving, for example, the Nga Son District which is well-known throughout Viet Nam for its hand-woven mats. In some places it represents the sole source of incomes and local livelihoods. Recently the industry is somewhat in decline and quality can vary from province to province, even for the same species. Production was at its highest during the 1980s-1990s, when split seagrass was exported to China, Japan and Korea at seven to eight-fold the value of rice cultivated in the same area.

Viet Nam has an estimated 12,523 hectares of seagrass meadows as of 2008. Yields average 8.7 tons per hectare. Processing takes place in close proximity to areas where there cultivation including in Thanh Hoa Province[8] which is the largest producer in Viet Nam with around 5,000 hectares of seagrass meadows. Seagrass can be woven into a variety of different products, including: mats, shoes, baskets and hammocks. These are sold both in domestic and international markets. Apart from handicrafts, seagrass is also used to make fertilizer and as fodder for animals. Low quality raw materials are sometimes used as roofing in the construction of traditional houses, paper powder making and also burnt as fuel.

Close to the sea in the North of Thanh Hoa Province, Nga Son District had approximately 1,570 hectares of seagrass meadows as of 2009, equivalent to 30 per cent of the total cultivated area in the Province. An estimated 30,400 tons of seagrass is processed in the district, 19,100 tons of which is grown locally and the remaining sourced from elsewhere. The seagrass growers in the two targeted communes Nga Tan and Nga Thai are specialized in and dependent solely on seagrass cultivation and sedge weaving.

Under the Joint Programme, UNIDO supported the seagrass sector in Nga Son District in Thanh Hoa province between 2010-2013 with:

- Cleaner production assessments in five SMEs and preparation of sector specific cleaner production guidelines;
- Training of trainers, including preparation of technical guidelines and information pamphlets for households;
- Introductory training on cleaner production methods to 50 grassroots producers;
- Product design support to three SMEs;
- Skills training provided to 35 grassroots producers Nga Tan Commune; and,
- Provision of improved tools and equipment to the commune and one other enterprise, respectively.

BOX 8: About Seagrass

Seagrass belongs to the *Cyperaceae* family which are known collectively as sedges. There are 5,500 species belonging to 109 genera. Often mistaken for algae (seaweed), they are actually a type of grass (producing flowers, fruits and seeds) which grow in shallow coastal marine areas, salt marshes and estuaries. They also produce food by photosynthesis and like terrestrial plants they have roots and their extensive rhizome root systems can help prevent against soil erosion.

3.2 Greening the Value Chain

Raw Material Supply

At present, overexploitation of seagrass resources and land degradation are already evident in places. Seawater intrusion has also adversely affected plantations and increased alluvial

[8] Other provinces with large amounts of seagrass resources include: Hai Phong, Thai Binh, Quang Ninh, Nam Ha and Ninh Binh.

FIGURE 7: Sedge mat weaving using a "Go" (top) and seagrass cord made with twisting equipment provided by UNIDO

deposits have lowered the water level. Irrigation or lowering of the land level are possible options to explore. However, both require significant capital investments and for irrigation also running costs and routine maintenance. Rehabilitation will be lengthy and costly. By comparison, preventive measures are cheaper in the long run, and sustainable management of seagrass meadows can allow for a sufficient supply of good quality raw materials for future years.

Seagrass matures quickly and can be harvested once mature, at three to four months. However, the right conditions must be met for good yields, in particular, the use of high quality seedlings, planting in the right season and at the right density (too low a density can result in more weeds) and with sufficient levels of water. A cultivated crop, its nutritional requirements are high (a mixture of both organic and inorganic fertilizers are recommended) and pests (mainly borers and locusts) pose problems and disease (in particular, black root disease) can also have a detrimental effect on quality.

Seagrass plants need to be replaced every five to eight years, when rhizomes become degenerated. In the intervening years, farmers need to then replant by ploughing to uncover new roots which have not yet become degenerated and which can be used as seedlings for the next season. Households are able to acquire fertilizers and pesticides, etc. but there are no specialized seedling sellers in the region.

Materials Preparation

Pre-processing is time-consuming and takes place immediately on site by farmers who will split the seagrass by hand into smaller strands which then need to be dried and stored and the fresh fibre will mellow from a greenish to a light-brown colour. High quality long-lengths of seagrass can then be used to weave mats. The productivity and accuracy of manual splitting is low and losses are high. To avoid this, semi-automatic splitting is recommended.

As the water content of seagrass is very high, proper drying is required to avoid mould, which can otherwise cause losses, sometimes as high as 50 per cent. Natural drying in sunlight normally takes three days, yet is often interrupted by rain and impaired by the high ambient humidity, and thus difficult to control. Many household producers simply cover materials with nylon bags, yet this does little to remove the moisture. Moreover, good storage practices are required to ensure that sufficient seagrass can be stored to allow for production all year around and for more seagrass to make it to market as finished products.

Only a few enterprises can afford purpose-built drying chambers, yet it was found that these often do not operate properly. The coal used is often not stored properly and moisture gets in. Due to the large variations in size and shape, the coal does not burn properly. Modifications such as a Z-shaped chamber can improve hot air contact with the seagrass. Temperature needs to be controlled and increased slowly so as not to adversely affect the colour of the seagrass and materials should be stored at least ten centimetres above ground to reduce mould forming. Other measures such as transparent roof panels make the most of natural light and airflow should be improved to remove moisture. However, doors and windows should be closed during rainy weather.

Seagrass is often dipped in a water-based glue, which is used to preserve the materials. However,

dipping results in excessive use of glue, and should ideally be replaced by spraying in a closed and controlled environment. Otherwise, options for recovery and reuse of glue waste should be considered.

Weaving and Finishing

Some 35 per cent of all households in the beneficiary communes are engaged in seagrass weaving. Mats are still most commonly woven by hand, using a traditional device known as a "Go" (Figure 7.). Two people can typically weave four mats a day. Most weavers are women from poor households, few are very skilled, and could in principle weave more complex products if demand existed. Household producers do not have a good knowledge of chemicals or dyeing. Most will dye without dispersants and stabilizers, etc., which takes a lot longer, results in a loss of dyeing chemicals and does not produce good colours. Production is also very ad-hoc, plans frequently change and materials then need to be re-dyed. Wastewater from the process is discharged directly into the environment without treatment.

FIGURE 8. A woman using seagrass drying equipment (top), and a drying chamber, both provided by UNIDO

Prices for mats range anywhere from VND 55,000 per piece to VND 250,000 per piece, depending on thickness, appearance and quality in general. Those made in Nga Son normally fetch between VND 120,000 -180,000 per piece. As the value chain is short and supply of raw materials limited, the price differences reflect the quality of the raw materials, the amount used and the craftsmanship. Making sure that cultivation and production are green through the above-mentioned measures can reduce costs and ensure that the quality of the materials and final products are the highest possible.

Due to lack of skill and innovation in the sector, and the unpredictable quality and supply of raw materials, only 30 per cent of Vietnamese seagrass is currently used for domestic craft and household goods production. The remaining 70 per cent is exported to neighbouring Asian countries, in particular, China for further processing. Training provided under the Joint Programme imparted practical skills, for example, weaving and knitting techniques originating from different regions, the use of a mixture of materials and a combination of different techniques in designing new products. Grassroots producers were shown how to make different shaped door stoppers and high quality mats for children from low quality seagrass which would otherwise end up as waste or be burned as fuel. Feedback was positive and trainees saw immediate benefits, including new

FIGURE 9: Mat made from "bundles" of seagrass waste (left) and stenciled yoga mat

designs and guidance in developing new products and those they made on site were also sold to a local company.

Waste Materials

Traditional sedge mat weaving makes use of the middle and more uniform, long sections of the seagrass reed. The top and bottom ends typically go to waste. There is, however, a great scope to recover and make good use of the ends and shorter lengths which together comprise 20-30 per cent of raw materials. Simple twisting equipment provided by UNIDO allowed producers to use lower quality materials previously disposed of as waste into seagrass cord (see Figure 7.). Coarse and rope-like in appearance, although much finer, seagrass cord can be used as string to pack goods or to make other new products, such as rugs and baskets, etc.

In facilitating Design-for-Sustainability, efforts focused on developing new products from this seagrass waste including this mat (Figure 9.) under the "Bundles" Collection and in addition higher value products including yoga mats which made use of the theme of health and wellbeing sector and traditional Vietnamese stenciling techniques (also Figure 9.).[9]

3.3 Outlook

A limited and somewhat unpredictable supply of raw materials and evidence of soil degradation, are key concerns to the development of seagrass sector. At the same time, this has had a knock-on effect on incomes and grassroots producers with limited cash have therefore tended to focus on immediate returns. The solution, as demonstrated in the simple comparison between the different quality seagrass mats (above), is to make green the value chain. This starts with sustainable agricultural practices and good preservation and storage of materials to keep them dry and mould free. Use of twisting equipment can recover off-specification seagrass lengths as cord, which can be used for a variety of new products.

This integrated greening solution is one which reflects the latest market trends, in particular, demand for higher quality products and those made in an environmentally sustainable manner. To its advantage, Nga Son District is already well-known in Viet Nam for its hand-woven sedge mats. Building on this reputation, good quality and well-branded products can provide additional revenues without further depleting seagrass resources.

[9] UNIDO (2012). Final Report – Design for Sustainability: Handicrafts Sector.

4. SERICULTURE AND SILK

4.1 Introduction

Global silk production is estimated at 80,000 tons a year. Although all major producing countries are located in Asia, sericulture is also well-established in other countries for example, Brazil, Egypt and Madagascar. Silk is a multi-billion dollar industry, mainly due to its high unit price (~20 times higher than that of cotton), yet it represents less than 0.2 per cent of the global textile market. Despite the continued growth in much cheaper synthetic fibres; less dense than cotton, wool or rayon, silk is soft, lustrous and absorbent, properties which make it still high in demand.

A good source of incomes, sericulture has spread from Northern to Southern Viet Nam and in some areas, production is concentrated, with cultivation at scale and higher levels of productivity such as Moc Chau, Yen Bai, some other Red River Delta area and Lam Dong. According to the Vietnamese Bureau of Statistics, as of December 2010, the mulberry tree is cultivated in 31 provinces, with orchards occupying some 25,046 hectares, equivalent to 0.21 per cent of total arable land. Most silk yarn is exported, with the potential added-value from textile processing lost.

Under the Joint Programme, UNIDO supported the sericulture and silk sector in Hoa Binh, Nghe An and Thanh Hoa Provinces with:

- Cleaner production assessments in 12 SMEs and preparation of sector specific cleaner production guidelines;
- Training of trainers, including preparation of technical guidelines and information pamphlets for households;
- Introductory training on cleaner production methods to 375 grassroots producers;
- Vocational training in natural dyeing, brocade-making and weaving for householders from four communes; and,
- Provision of improved tools and equipment to four communes and three enterprises/cooperatives.

4.2 Greening the Value Chain

The mulberry tree is usually planted close to river basins but can also be found in mountainous areas such as Son La Province (particularly in Moc Chau District) and Lam Dong Province. Productivity is low as is the quality of the leaves due as some 90 per cent of trees found in plantations are old varieties of mulberry. Yields are now a mere 10-15 tons per hectare compared to 15-20 tons per hectare in previous years. There is a lot of scope to improve yields. Leaves can be harvested six to eight times a year from mulberry trees for 10-15 years at which point they should be uprooted and new

BOX 9: About Sericulture and Silk

Silk is natural protein fibre produced by the silkworm or *Bombyx mori*, some forms of which can be woven into textiles. Mulberry leaves are the staple food of the silkworm which will eat every few hours for 20-35 days, in total consuming roughly 50,000 times its initial weight. The fully grown caterpillar will then attach itself to a twig and spin a cocoon from which the silk yarn can be extracted.

The cocoon is a continuous-filament fibre consisting of fibroin protein secreted from two salivary glands in the head of the larva which is cemented together by a gum-like substance, sericin (also known as “silk gum”). The cocoons are immersed in hot water or alternatively steam or fumigation is used to kill the silkworm before it emerges from its cocoon and breaks the filament. The sericin is then removed by boiling the raw silk in soap and water a process known as “degumming”. A single thread can measure up to 1,000 metres long, of which about 600-900 metres might be useful and the shorter lengths from broken or damaged cocoons can be made into lower quality “spun silk”.

saplings planted. Consideration should be given to new more disease resistant varieties of trees, and in cultivation, to suitable soil types, particularly those by river banks. Good soil preparation also improves yields.

Households procure both locally bred and also imported silkworm varieties. However, the latter often come via unofficial channels, the quality of which varies and without treatment, diseased larvae will die and sometimes losses may be as high as 50 per cent. The quality of silk produced can be attributed by a large part to the quality of silkworms. Costs are high and by introducing green techniques in sericulture, productivity can be improved (and hence incomes and jobs). Better quality control checks are needed in receiving deliveries. Different varieties of silkworm prefer different climates (the yellow variety thrives in warmer climes and the white fare better in cooler temperatures). Newborn, the silkworm larva responds well to strong light, yet when building its cocoon it does not and harsh lighting will adversely affect quality. Apart from this, a ready supply of mulberry leaves, regular cleaning of the bamboo trays in which they are reared, the right humidity and temperature and good ventilation, can help increase yields.

Silk Yarn Production

The silk is unwound from cocoons into skeins (Figure 10) known as “reeling”. Next it is degummed, using soap and hot water. For high quality silk (including colour-fast dyeing), all gum needs to be removed, which is not always the case due to poor control of the process. Multiple threads of silk are then wound onto bobbins, known as “throwing”.

One thread of silk yarn might have been derived from four to eight individual filaments of silk. However, the quality of the silk produced by silkworms reflects the conditions in which they are reared and the quantity of cocoons required to make one kilogram of silk thread can vary from anywhere between six to ten kilograms. Local expertise is limited and companies often do not possess the skill to remove all the silk from the cocoon, the remainder is shipped to China to be made into lower quality spun silk. The silkworm larvae, a by product of the process, are a good source of protein and sold to the local village as food.

FIGURE 10: Manual silk reeling (left) and weaving

Low quality cocoons are only suitable for semi-automated reeling which only produces a low quality thread, then only suitable for manual weaving. Efficiency and capacity are generally low. Due to high costs, obsolete equipment is commonly used which typically increases energy consumption. Efficiency and resource consumption however differ greatly from one company to the next. Water consumption varied between 35-240 litres per kilogram of silk, coal between 3-12.5 kilograms and firewood between 6-25 kilograms. Given the high costs throughout the process, applying cleaner production techniques would reduce energy costs and ensure optimal use of materials. Using an industrial boiler and then distributing water is more efficient than using separate coal-fired burners. In addition, it can help make the workplace safer and reduce the ambient temperature which can be stifling in summer and also reduce emissions thereby improving the working environment.

Silk used to be dyed with natural pigments. However, most young people today do not know how to make or use natural dyestuffs derived from berries, roots and leaves, etc., and many will use chemical dyes for quick results and a wider spectrum of colours. The dyeing techniques used were poor and many did not de-gum before dyeing which meant an excess consumption of dyes and colours which were not fast and would still fade over time.

Weaving

In communes, despite low levels of productivity, manual weaving is the norm and is sustained by the local market and also the demand for handmade products by tourists. However, the quality of silk yarn is poor and the supply can be intermittent. Although enterprises engaged in weaving have automated equipment, it is often obsolete (Figure 10). They frequently encounter problems in operations and energy consumption is high. Overall, designs tend to be basic and lack diversity.

Dyeing

The small-scale private sector has concentrated on pre-processing and due to a lack of know-how and equipment, many companies do not dye their silk yarn and typically sell it on to other overseas operators with more advanced technology for further processing. Those companies that engage in dyeing, typically do so in open vats without adequate process control. The resulting colour fastness is very low, and this indeed is one of the limiting factors for further development of the silk sector in Viet Nam.

Communes, on the other hand, dye both fabric and yarn. Good potential exists here for improving the dyeing process and achieving a better product quality whilst also reducing environmental impact. Better chemicals management can greatly help improve dyeing processes. Using a mild alkali, soda ash (sodium carbonate) also in dyeing silk, colours can be fixed faster,

BOX 10: Vocational Training in Natural Dyeing Techniques

Households in the four cooperatives, respectively, Pa Co Cooperative (Hoa Binh Province), Hoa Tien Cooperative (Nghe An Province), Van Phuc Cooperative (Ha Noi) and Nha Xa Village (Na Nam Province) are all engaged in dyeing.[10] Hoa Tien, Van Phuc and Nha Xa all use synthetic dyes and produce very small batches of silk items, although Hoa Tien has experience in using some natural dyes. Silk yarn is acquired by all three cooperatives from sources in and outside Viet Nam. The Pa Co Cooperative, on the other hand, uses Indigo powder to dye cotton which is a very complex process and fabric needs to be dyed several times and it can take anywhere between 10-20 days depending on the weather.

Overall, their dyeing techniques could be described as rudimentary. They processed only small batches of up to half a kilogram of yarn which was tedious and inefficient. The resulting colours were neither consistent nor fast and their management of chemicals was poor. Households from all four cooperatives were trained to use natural dyestuffs to replace synthetic dyes for different fabric mediums and how to control processes to dye effectively using both types of dyes. Through the training, they learnt to reduce dyeing times and chemical consumption and also ensure colour fastness. Tests conducted showed that the colours produced were indeed stable and would not fade.

Under the Joint Programme, households in the Pa Co Cooperative were provided by UNIDO with simple manually operated dyeing equipment which they were shown by an instructor how to use. The tanks can be heated with wood or coal, are easy to handle, allow for faster dyeing times, are more energy efficient and dyes can be easily recovered.

The Hoa Tien Cooperative were also provided with dyeing equipment, suitable for silk and cotton yarn and with a capacity of three to five kilograms of yarn per batch. The process is much faster taking just 30 minutes to dye one batch. Training was provided so that they could use equipment efficiently and safely. With the new equipment they can dye 10-15 kilograms of yarn each week, enough for 40-60 families to weave up to 200 scarves.

[10] Other households in the cooperatives are engaged in other parts of the sericulture and silk value chain including, mulberry tree cultivation, silkworm rearing, reeling and throwing, etc.

better and at lower temperatures. Hydrogen peroxide is much gentler and therefore preferred to liquid bleach (i.e. sodium hypochlorite) which can actually damage the fibroin protein threads. From an environmental perspective, it is also better, degrading naturally as it only produces water and oxygen as by products, however, silicate-based compounds are needed to stabilize and control quality). Optical brighteners (also known as fluorescent whitening agents) could also be used to reduce the need for harsher substances. Wastewater from dyeing and bleaching processes is high in BOD and COD, requiring treatment, which is still not practiced in the handicrafts enterprises.

UNIDO supported two pilots on improved dyeing. The first trial was aimed at promoting natural dyeing process in four communes (Box 10). Training and on-site guidance was provided on extracting dyestuffs from locally available fruits, barks and leaves, etc. In addition, small-scale dyeing equipment was piloted and all of the communes trained to dye under controlled conditions. Moreover, working with a national expert, the communes were able to produce a range of light colours with good colour fastness. The second trial supported Lam Giang Mulberry and Silkworm Company in chemical dyeing (Box 11). An integrated dyeing machine was provided to undertake dyeing under controlled conditions, a requirement to achieve replicable results and high colour fastness. Additional training and hands-on support was provided to develop standard operating procedures, and the company was able to greatly improve the quality of its

BOX 11: Lam Giang Mulberry and Silkworm Company, Nghe An Province

Mr. Ngyuen Kim Lung, a former army captain, retired several years ago and returned to his hometown wanting to make a contribution to its development. A nearby river basin and fertile soils ensure that there are good mulberry trees resources in close proximity and sericulture is well-established in the area.

His company, buying cocoons from local households, engages in semi-automated reeling and twisting. Directly employing 20 workers, many more jobs created outside the factory as a result through cultivation of mulberry trees and rearing of silkworms. In terms of efficiency, it takes 7-10 kilograms of cocoons to make one kilogram of yarn. He sells raw silk yarn for VND 950,000 per kilogram, almost all of which – more than 95 per cent – is exported to Laos for dyeing with just five per cent sold locally.

He wanted to move into dyeing and equipment provided by UNIDO enabled him to do so. Following training provided by instructors, he has since been working with staff to optimize processes. Dyeing by machine, it takes 1.5 hours to dye a batch of 4-5 kilograms. Once production is resumed, the company will have a capacity of 700 kilograms a month. He hopes to expand production in future and be able to buy more equipment. The gate at the Laotian border just 40 kilometres away will open soon and this should make access to Laos more easier in future.

Lam Giang is exploring new markets, new techniques and the use of natural dyes and other opportunities for by products made from mulberry leaves. They also hope in future to cooperate with the Dien Kim Commune nearby and also assisted under the Joint Programme.

dyed fabrics including their colour fastness and brightness, etc.

Product Development

Understanding consumer tastes and designing products which reflect market trends ensures marketability, yet remotely located cooperatives were found to lack access to market information and ideas for new products. This was particularly the case for Hoa Tien Cooperative in Nghe An Province, where women produced, in small scale, brocade and batik products, making use of locally grown/available guava leaves, jackfruit and woods to dye silk naturally. However, little attention was given to pattern choice, etc., resulting in low market interest and sales. In order to expand opportunities for this cooperative, a national expert worked with household producers, with the dual aim of improving both techniques (natural dyeing, batik and brocade making) and products (Box 12).

BOX 12: Advanced Vocational Training in Dyeing and Weaving

Through vocational training, grassroots producers in Hoa Tien Cooperative in Nghe An Province were demonstrated advanced skills in brocade and batik making. They learnt advanced dyeing techniques using natural pigments and chemical dyes, embroidery and weaving (the importance of separating the two steps) and how to get the maximum usage out of fabric (by making smaller items from scrap pieces). Demonstrations were given to participants – all women – of more sustainable techniques such as those used by ethnic minority groups in Thailand. They were introduced for the first time, to more complex patterns and techniques such as "Ikat" dyeing (also known as "resist-dyeing" which makes use of wax, stencils and stitching, etc., to selectively prevent parts of the fabric from being exposed to the dyes) to further add value to their products.

4.3 Outlook

Despite its long tradition of sericulture and being a one of the largest producers of silk yarn in the world, Viet Nam still imports finished silk (dyed and processed) for domestic consumption. The sector has suffered from underinvestment, lack of technology, know-how and imperfect information which have meant the loss of value-addition, with many enterprises simply selling low quality and raw silk yarn overseas for further processing. The crafts sector, on the other hand, although present in all stages of the value chain, operates with low levels of knowledge and techniques, resulting in both low productivity, as well as the low quality of finished silk.

This can be countered through a coordinated approach based on greening each of the steps in the value chain. Firstly, mulberry tree farming needs to improve, in terms of productivity and sustainability. Next, better management in silkworm rearing will improve silk quality, including through the reliable supply of good quality silkworms and a customized management regime reflecting the different stages of their life-cycle. In yarn production there are many options to minimize reeling losses and ensure proper degumming. For fabric dyeing, high colour fastness and good fabric qualities can be achieved both with natural dyes as well as synthetic dyes. Technology is part of the solution, but the equipment is only as good as those who operate it are skilled. Reducing the amounts of water consumed, improving energy efficiency and better chemicals management can all help bring down costs and improve the competitiveness of the handicrafts producers. In addition, better product development, as demonstrated, can also be achieved through hands-on vocational training.

5. Lacquerware

5.1 Introduction

First introduced by the Chinese, the art of lacquerware is a centuries-old tradition in Viet Nam. Lacquer painting is long and complex, requiring great skill and patience. It involves the application of many layers of lacquer onto a prepared wooden board, allowing each to dry in turn, detail can be created by painting or inlaying mother-of-pearl, gold and silver leaf and eggshell, etc. The surface of the lacquer is then carved to reveal the colours desired, which become deeper with age and more luminous. Vietnamese lacquer has a high-water content, is allergenic (causing induced contact dermatitis), cures only in high humidity and more slowly compared to the Chinese and Japanese varieties (Box 13), the latter of which dries even in less temperate conditions.

Tam Nong District in Phu Tho Province has around 494 hectares of plantations and total production is about 25.5 tons of lacquer sap per year. Current levels of yields and an average price of VND 95,000 per kilogram of sap make lacquer a key source of income and employment in the area (although prices can vary from anywhere between VND 85,000 – 160,000 per kilogram).

Under the Joint Programme, UNIDO supported the lacquerware sector in Phu Tho Province between 2010-2013 with:

- Cleaner production assessments in six SMEs producing lacquerware and preparation of cleaner production guidelines;
- Training of trainers, including preparation of technical guidelines and information pamphlets for households;
- Introductory training on cleaner production methods to 60 grassroots producers;
- Transfer and trial of new lacquer refining technology and measurement instruments through engagement of international experts from China and Japan to one enterprise and one cooperative.

BOX 13: About Lacquer

Lacquer is an organic viscous fluid, derived from the lacquer tree – belonging to *Anacardiaceae* family – of which there are approximately 600 species belonging to 70 genera. Three main varieties indigenous to Asia are the *Rhus vernicifera* which grows in China, Japan and Korea, *Melanorrhoea* usitata found in Myanmar, Laos, Cambodia and Thailand and the *Rhus succedanea* which grows in Vietnam and also Taiwan.

A deciduous, high latex plant, *Rhus succedanea* is mainly cultivated in mountainous areas in Viet Nam. Its active ingredient is the crystalline phenol, laccol.[11] Often confused with shellac which is derived from the lac beetle and unlike other natural resins (i.e. mastic and dammar) which cure through solvent evaporation, it sets rather by oxidation and polymerization. The resulting plastic-like coating is hard, durable and resistant to water, acid and heat. Sap is tapped from the lacquer tree much the same way latex is from a rubber tree, but instead using a mussel nailed into the bark.

Lacquer sap is used in different forms. Apart from mixing with turpentine, coloured powder and other inorganic minerals to form lacquer, as above, combined with elemi it can be used as a varnish, with sawdust as a glue for wooden furniture including rattan and bamboo. In industry, it is used to paint the shell of ships and boats, metallic lines for electrical isolation, in the food industry, to produce containers for liquids (i.e. fish sauce, liqueurs and beverages).

[11] Unlike Chinese and Japanese varieties, which are both urushiol-based lacquers.

5.2 Greening the Value Chain

Cultivation of Lacquer Trees

Propagation and selection of lacquer varieties is critical to improving quality and productivity. Yields in Tam Nong district average 230—320 kilograms per hectare a year compared to 550-600 kilograms per hectare a year reported in China and Korea. This would appear at least in part due to farming practices, including insufficient fertilization, irrigation and mono-cropping, yet comparison is difficult due to the differences in agro-ecological conditions.

Sap quality and yields can be unpredictable. Improving collection practices can increase productivity. First of all, tapping should start when the tree is mature at three years old. The tree can continue to produce high quality sap for another five to six years, after which it should be uprooted and new saplings planted. The quality of the sap is best during the dry season when laccol content is at its highest and collection should not be undertaken in wet weather. Scoring needs to be done with care, as scoring too deeply into the bark can kill the tree but not deeply enough will reduce productivity. The sap should not be exposed to direct sunlight to avoid oxidization and contamination by other impurities (dust and soot, etc.) should be avoided. Inter-cropping should be considered to help improve soil condition and while also providing additional income.

Different grades command different prices. Red lacquer trees are known to produce higher quality sap but in smaller quantities, whereas white lacquer trees produce poor quality sap (i.e. with a high water content) but in larger quantities. Sap from both varieties of trees is often collected and stored together, whereas separately storage of different lacquer grades would ensure the quality of the sap and make for more efficient processing.

Lacquer Processing

The raw lacquer sap needs to be processed (or refined) to produce a high quality lacquer "paint" that can be used in production of lacquerware. Unfortunately, there is little local expertise in lacquer sap processing. Most of the lacquer sap is therefore exported (at least around 80 per cent) and refined in China upon which small volumes of refined lacquer are re-imported by lacquerware producers.

Some sap is locally processed by ageing. The lacquer sap is stored in bamboo barrels for between three to five years, after which different layers form. The matured lacquer can then be extracted and graded. Yet this is a long process still with lower quality then lacquer refined in China.

Lacquer sap is priced by traders on the basis of its water content, for which a very crude measurement method was used (heating the sap to evaporate water and then weighing the remaining condensed sap). This puts local producers and collector at a disadvantage. Hence, simple electronic scales were provided by UNIDO to the beneficiaries. The lacquer sap is stored and traded in double-layered plain plastic bags which can be easily damaged in transit and make it difficult to trace their origin.

A technical seminar on lacquer chemistry and technology was organized with inputs from leading lacquer experts from Meji University in Japan. As a starting point, sap quality had to be better understood and entry of water and impurities into sap controlled. Vietnamese lacquer is different in terms of its chemical constituents and physical properties compared to Chinese and Japanese lacquer. Moreover, as in other areas of cultivation, sap chemistry and properties fluctuate through the different seasons. Collaborative research was initiated between HUST and Meji University in Japan, which pointed to the potential application of the so called "Kurome" process for lacquer refining (which is essentially based on the fine dispersion and mixing of the lacquer sap). Moreover a study tour was organized for lacquer industry experts to lacquer processing centres in China, under the guidance of Chinese Academy of Forestry. Thereafter national experts worked with Vietnamese equipment manufacturers to prepare a simple Kurome unit, which was then trialed and successfully transferred to Phu Tho Lacquerware Cooperative and two other companies.

Lacquerware Production

In lacquerware production, the wooden or bamboo substructure needs to be appropriately prepared before painting can begin. Materials must be properly treated first so they are not susceptible to infestation and proper drying of

panels will help avoid shrinkage, cracking and warping. It is then covered in cotton cloth and coated in lacquer paint. It can take three to five days to fully dry and harden depending on the environmental conditions in which it is dried and up to 10-15 coats are needed. Between each coating, the surface must be polished using whetsone and sandpaper which requires significant amounts of water.

Wastewater is high in pollutants (with BOD and COD levels are 2-8 times the levels permitted in technical regulations) and needs to be treated. Wet polishing (Figure 11) should be used in place of dry polishing which would avoid creating dust harmful to workers' health.

A few clusters of households in the suburbs of Hanoi are also known to process sap which is used for lacquer paintings locally, but production is only small-scale. Given the long drying times and inconsistent quality many companies import Chinese lacquer. However, many lacquerware producers have also

BOX 14: Improved Lacquer Sap Processing

Cooperation between HUST and Meiji University focused on analysing lacquer properties and variability therein over the duration of the collection season. Processing parameters were also studied, in particular, with a view to cutting down drying times. It was found that the addition of Chinese sap (which cures in less than nine hours compared to Vietnamese sap which takes more than 24 hours) or alternatively acetone or lactase were also effective in this regard. In addition, it was found that at the laboratory scale the Kurome process greatly improved the properties of the Vietnamese lacquer. The Kurome process finely disperses and mixes the sap under a slightly increased temperature to ensure that its chemical constituents are evenly distributed throughout and then dehydrated. Although the Kurome process is widely applied in Japan and China, its operating practices had to be customized to Vietnamese sap properties.

Analysis at the Meiji laboratories showed that the sap samples taken from lacquer trees in Di Nau and Tho Van Communes in Tam Nong District, Phu Tho Province, in September 2011, achieved after Kurome process an increased viscosity and three-fold reduction in water concentration.[12] Although the resulting difference in hardness in the lacquer samples was only negligible, drying times for both the Di Nau and Tho Van samples were faster, decreasing by 30 to 50 percent. The detected gloss values increased by a factor of two to four times.

Kurome equipment was not previously available in Viet Nam. Based on Chinese and Japanese experience, the former on current practice at the company level (observed during study tour), the latter garnered from laboratory models and small lacquerware workshops, HUST developed a customized version suitable for use at the commune level. A prototype was then built by Nam An Mechanical and Environment Company in Viet Nam and trialed and improved at laboratories of HUST. Given its good results it has since been transferred to the programme beneficiaries.

The equipment now retails at VND 25 million (around USD 1,250) and it is suitable for batches of three to five kilograms.

Kurome equipment used in Chinese company (top) and the prototype built in Viet Nam

[12] Bach, T. P. (2013). Results of the Study on Chemical, Physical Characterization and Processing, Refining of Vietnamese Lacquer Sap.

reverted to alternatives, including for example, cashew oil which offers a more consistent quality, dries quickly compared to lacquer, is more easily sourced and can be purchased in bulk. The products are then finished off with a coating of lacquer.

New Products

In the exchanges with Japanese and Chinese lacquer experts, it was found that income for farmers could be increased by developing additional products from the lacquer tree. It is in principle possible to produce soaps and candles and extract natural dyes, etc. Whilst it was not possible to pursue these opportunities so far, national support institutions have been made aware, including HRPC, and are considering the possibilities to support selected communes with the development of such new products.

5.3 Outlook

Farmers grow the lacquer trees and collect sap based on experience, without a good understanding of breeding, selection, propagation and farming practices that could improve yields and sap quality. Moreover grassroots producers had very little concept of sustainability, the bags in which saplings are packaged in, for example, are not disposed of properly and many can be seen discarded in the fields. Moreover as virtually no processing is taking place locally, most of the value addition is lost. The importing of processed lacquer also leaves local crafts workshops at the whim of traders and exchange rates while also stifling technical innovation as a result.

FIGURE 11: Wet sanding (top) and finishing of lacquer paintings

Yet despite these problems witnessed throughout the value chain, there is good potential for development of the lacquer sector. FAO supported farmers with improved farming practices, and once coupled with better sap processing practices, the household producers can see an improvement in their incomes. This could even be further enhanced with development of additional products from lacquer trees in future. Further development and widespread application of the Kurome process, can help reclaim the value addition from lacquer refining and could assist in re-establishing 'genuine' lacquerware production with Vietnamese lacquer.

The various interactions with China showed that Chinese enterprises collaborated closely with research institutes and universities in order to improve the quality of their products, integrate cleaner production techniques, overcome bottlenecks in production and achieve innovation in design. Needless to say, the Vietnamese lacquer sector could benefit from such support. There is a large scope for further research including: reducing induced-contact dermatitis, the production of lighter-coloured or UV-curable lacquer and alternative usages of lacquer sap, for example in anti-corrosive coatings and cosmetic applications, etc.

Apart from research institutes, opportunities for cooperation should also be explored with private companies. A visit by the Chinese delegation to Viet Nam, facilitated under the Joint Programme, allowed both sides to further explore mutually beneficial opportunities for trade and cooperation with Vietnamese partners in lacquer sap processing and lacquerware production in R&D. Continuous exchange helped cement relationships, with at least one partnership established between the Vietnamese L.V. Company, and its Chinese counterpart, an agreement on a joint-venture is being finalized between the two sides.

6. HANDMADE PAPER

6.1 Introduction

Handmade paper in Vietnam dates back to the 300AD and is used for drawing and calligraphy and other products include stationery, books and photo frames. In the North-West Vietnam, it has also traditionally been used in local festivals or religious rituals (for more details, see Box 15). An assessment by the Japan International Cooperation Agency in the Northwest of Viet Nam identified a high potential for paper production in the region which has, to date, grown as a traditional craft among ethnic minorities like such as the Hmong, Dzao and Muong.[13] Ethnic minority groups have used a variety of locally available materials for paper production. While Muong people make use of use of the bark of the “Duong” and “Do” trees, the Hmong people often use bamboo and the Dzao, rice straw.

The Suoi Co Village is located in Hop Hoa Commune in Thanh Hoa Province. They belong to the Muong group and they are amongst the poorest families in the area. In the village, some 15 households are engaged in the production of handmade paper.

Under the Joint Programme, UNIDO supported handmade paper producers in the Hop Hoa Commune, Hoa Binh Province between 2010-2013 with:

- Cleaner production assessments and introductory training of cleaner production methods in Hop Hoa Cooperative in addition to preparation of cleaner production guidelines;
- Training of trainers, including preparation of technical guidelines and information pamphlets for households;
- Introductory training on cleaner production methods to 30 grassroots producers;
- Product design support;
- Skills training in handmade paper making to 20 people; and,
- Provision of improved tools and equipment.

[13] In the Northwest, paper production mainly takes place in Son La (Bac Yen and Song Ma district – Hmong people), Dien Bien (Dien Bien Dong – Hmong people), Lai Chau (Tam Duong – Dzao people), Hoa Binh (Luong Son – Muong people), etc.

BOX 15: About Handmade Paper

"Giay Do", is a type of paper produced from the bark of the "Do" (*Rhamnoneuron balansae* (Drake) Gilg) or "Duong" (*Broussonetia papyrifera*) which is also known as the paper mulberry. In modern papermaking the body is used while traditional Giay Do paper makes uses of the bast (inner bark). A skill passed down through generations in traditional handicraft villages of Viet Nam, including, Nghia Do, Yen Thai, Phong Khe and An Coc villages, many have now disappeared or no longer keep this tradition.

Giay Do paper is used as the canvass for paintings in Vietnamese popular arts, especially to make Diep paper (also made from Do tree but using powdered seashells) for "Dong Ho" paintings originating from Dong Ho village in Bac Ninh Province. These paintings use paints made from natural pigments and depict different themes from good luck wishes, historical figures to everyday activities and folk allegories and were a traditional part of Tet Nguyen Dan (Vietnamese New Year) celebrations. In copper casting and statue making, craftsmen use Do to make statues, about 70 tons of Do paper were used to make a Buddha statue in NguXa Pagoda for example, a mould having first been constructed from soil and rice straw. Giay Do is also used to make votive paper and traditional toys.

The production of Do paper does not make use of acid, traces remaining of which in other types of handmade paper can make it brittle and more likely to disintegrate over time. Do paper has been known to last over 500 years and many official documents made from Do paper can still be found at pagodas and villages, etc.

6.2 Greening the Value Chain

Material Collection

Do trees grow naturally in a scattered manner in close proximity to the village, yet it is increasingly harder to gather sufficient materials for production. Paper-producing households might also grow a few trees in their gardens, but there is no specific land allocated for this purpose at present and so no cultivation at scale. As a consequence, fluctuations in the supply of raw materials constrain the total volume of paper production.

The Do bark typically contains 40-50 per cent cellulose although varying with the age of the tree. Fibres can measure up to 60-70 millimetres long and 10 millimetres wide and the ground powder around 92-93 per cent cellulose with a copper content of 1.13 per cent. Productivity is low and quality unpredictable.

Given the very scarce supply of Do trees and the reliance of the local people on papermaking as a complementary source of income (to farming), sustainable cultivation practices should be carefully observed. Bark should only be harvested from mature trees at three years of age and from then on, at intervals of two to three years to ensure a high cellulose content. It is then possible to collect bark from the same tree three to four times in this manner but at each successive interval, yields are lower. Careful pruning of smaller branches ensures the larger branches are stronger and will improve yields. Harvesting at the end of the rainy season will ensure that the outer bark is easier to remove from the bast fibres (inner bark).

Paper Making

The bark should be cleaned before being boiled to remove impurities and increase the quality of the paper. The darker outer layer is removed, leaving behind the bast fibres which are filtered and boiled in water to make the skin softer and easier to remove. A sufficient amount of raw material should be collected before boiling so as to not waste energy. Villagers use a very simple vat without insulation and most of the heat energy (from fuel wood) is lost in the process. An improved and insulated boiling vat can reduce fuel consumption and the boiling time. This was demonstrated with the new boiler, provided under the Joint Programme by UNIDO, which made it possible to complete the bark boiling process in one day instead of two.

The bast fibres are then soaked in lime water for three months to soften and extract the fibres to produce pulp. The pulping tank should be properly covered to prevent dust entering and reduce evaporation. Bleach is used to whiten the bast fibres which are then pounded. To ensure good quality paper and less waste, more care needs to be taken to use only the amount of bleach required and avoid spillage. Switching also from manual to automatic pounding would greatly improve productivity and consistency.

The remaining fibrous threads are mixed with a fermented hibiscus root solution to form the pulp paste, which is diluted in a large water-filled cement tank. A bamboo screen is then used to scoop up the pulp and distribute it evenly, drain water and form the actual sheets of paper. The cement tank (Figure 12) was difficult to clean and the water was dirty as a result. The new stainless steel tank (also Figure 12) provided by UNIDO is easier to clean, water is

FIGURE 12: The old cement (top) and new stainless steel tanks

easily discharged from the bottom of the tank and each subsequent batch of water is now cleaner and the paper not dirtied as a result. A mechanical press is then used to further reduce the water content. The pressure applied was low using the old press in the village, taking around 12 hours to drain one parcel of paper sheets. With the new press provided by UNIDO it takes just three hours.

The paper sheets are then stacked together and dried under sunlight or in drying cabinets. Rain often stalls drying and the quality of the paper is affected if drying is prolonged. A solar dryer could be used to improve both capacity and the quality of the final product.

Product Design

There was little innovation in design and most of the production was sold as loose sheet paper. Yet without having to substantively increase raw material supply in the short-run, shifting away from the production of low-value sheet paper and very simple stationery, to producing high quality and higher-value paper goods could increase incomes and jobs.

Learning from the experience of producing handmade paper in high value markets like Japan and Thailand, might lead to new products. Natural dyeing, using tea, saffron, shellac and cashew, etc. allows for diversity in design and also products that are still environmentally friendly. Training was provided by the HRPC in these areas and in addition in papier maché techniques using a combination of twenty different moulds to produce a variety of products, including bowls, vases and decorative animal figures.

Already an existing skill within the group, embroidered motifs were used to add value to paper products and the "Button-Up" Collection[14] included a selection of embroidered stationery and lampshades all of which fold flat and can be assembled together by use of button fastenings, allowing for easier transportation.

Products displayed at the Lifestyle Viet Nam 2012 exhibition attracted much interest and orders were placed by various local and overseas clients.

FIGURE 13: Lampshade (top) and stationery from the 'Button-Up' Collection

6.3 Outlook

Handmade paper is produced at the household level with very simple implements and is influenced by climatic conditions. Given the absolute constraints on capacity posed by local availability of raw bark material, it would not be possible to scale-up paper production without first expanding Do tree cultivation, which would itself be difficult due to the limited available arable land in the village. As demonstrated, cleaner production concepts resulted in practical solutions to the problems at hand, by ensuring that the paper produced is of the highest quality possible and without compromising environmental sustainability. Despite the difficult supply side constraints, it was shown that the village could move up the value chain and the solution by which to do so – redesigning products that are environmentally sustainable is one that pays.

Production is now more efficient, output higher and the paper produced of a superior quality. Making just VND 14 million before the Joint Programme started, incomes have increased to VND 17 million a year.

[14] UNIDO (2012). Final Report – Design for Sustainability: Handicrafts Sector.

7. TOWARDS SUSTAINABLE HANDICRAFTS PRODUCTION

Good final products require quality input materials, appropriate techniques in processing and production, etc., marketable designs and skilled labour. There are no quick-fix solutions. Applying and maintaining a consistent approach throughout the value chain will ensure that business is competitive, production is environmentally friendly and products find market success. Here, the cooperation and alignment of the activities of the different actors in the value chain is therefore key.

Of particular concern is the sustainable management of natural resources, in particular in cultivation and collection. A quota and/or fee based system could be the first step to helping avoid overexploitation and ensuring sustainable management of the resource base. Priority must then be given to the prevention of losses by appropriate storage and preservation of raw materials in the first place and to maximising the recovery of unavoidable waste as secondary resources for new products if this condition cannot be met. In this regard, RECP provides a lens through which to critically analyze and then optimize each processing step, from the perspective of reducing material losses (in quantity as well as in quality), minimizing the use of chemicals, water and energy, and recovering all waste. Doing so systematically, RECP realizes more and better products from less resources. For the five value chains, it was demonstrated that innovative cleaner production techniques can be downscaled and made applicable to handicrafts production in households, cooperatives and micro-enterprises. Examples include: the Kurome process for lacquer refining, best practice in natural silk dyeing and the preservation of bamboo using a natural linseed oil-based process.

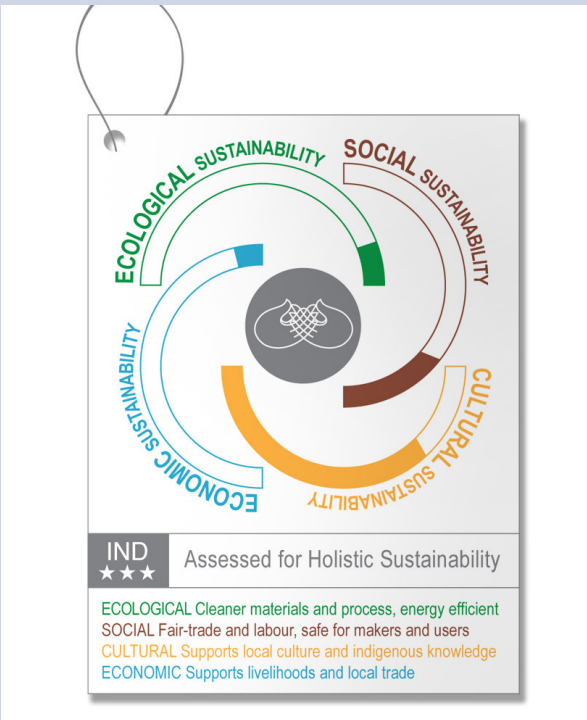
Existing constraints can present opportunities for innovation, equally for sectors faced with the very limited supply of raw materials (seagrass and handmade paper), as well as those contending with huge amounts of waste generation (bamboo and rattan weaving). Leveraging traditional skills, for example, embroidery in Suoi Co Village and traditional Vietnamese stenciling techniques in Nga Son District, value was added to handmade-paper and sedge-woven products. Giving consideration to reducing lifecycle impacts, the Interlocking Collection of laminated bamboo-board furniture which made use of waste bamboo cut-offs and required no glue or metal fixtures in assembly, allowed for easier storage and disposal at the end-of-life. Garnering appreciation for sustainability from consumers in far away markets remains a challenge. A trustworthy labeling scheme based on transparent and informative criteria provides an option to effectively position and ultimately brand sustainably produced handicrafts. A proposal for such a scheme was developed and trialed, showing good potential benefits (Box 16).

Overall, in searching for a solution to sustainable handicrafts production, an integrated methodology proves the most effective. Practicing cleaner production gives a cost advantage as does design which is both elegant and takes into consideration lifecycle impacts. As governments around the world continue to move to legislate in favour of environmental sustainability, greater consciousness and a first-mover advantage can therefore really pay off. The challenge still remains to scale up and mainstream those practices and techniques demonstrated throughout the crafts sector in Viet Nam.

BOX 16: Towards a Branding Scheme for Vietnamese Handicrafts

The consumer now faces a market saturated with products purporting to be environmentally friendly and/or more socially responsible, etc. While private standards exist for many types of goods on the market, few if any fully meet the needs of the handicrafts sector. Under the Joint Programme, UNIDO sought to develop a methodology in line with the government's own "Viet Nam Value" branding programme.[15] Whereas most labeling schemes tend to focus on single issues, given the special characteristics of crafts products, the brand was designed to be holistic, integrating social, ecological, economic and cultural aspects of sustainability. A checklist of 46 criteria grouped under five categories: materials, products, distribution, consumer use and end-of-life considerations was developed for this purpose which made use of Design-for-Sustainability principles, the Business for Social Compliance Code of Conduct of the Foreign Trade Association and the conventions of the ILO.

While making requisite minimum criteria including: user safety, no child labour and the meeting of statutory compliance measures, the scoring system allows for lower scores in particular aspects of sustainability to be compensated for by higher scores in others, so companies can monitor and improve their performance while also providing the consumer with more transparent information about how the product was produced.



15 *For full details please see:* UNIDO (2013). Achieving, Assessing and Communicating Sustainability – A Manual for the Vietnamese Handicraft Sector.

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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Telephone: +43 (0) 1 26026-0, Fax: +43 (0) 1 26926-69
Email: unido@unido.org, Internet: www.unido.org