Case Studies: Biodiversity Impact

Learning from the cases of Siam benzoin, organic chili, Indian prickly ash and jujube in Vietnam, Laos and Myanmar

Prepared for the Regional Biotrade Project In Southeast Asia

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Executive Summary

Determining the contributions of Helvetas' Regional Biotrade Project to the biodiversity of the countries in Southeast Asia is difficult. This is partly because biodiversity impacts in terms of its attributes towards complex and dynamic ecosystems is hard to measure, and partly because biodiversity impacts can take many years or even decades to materialise. To deal with this issue, case studies were prepared on four Biotrade products to derive a qualitative and forward-looking view of the project's impact on biodiversity. Product were deliberately chosen to include cases expecting to have positive impacts, as well as cases with minimal potential in contributing to biodiversity preservation.

The case study on pioneering the production of Siam Benzoin in Vietnam found that benzoin from natural stands of *S. tonkinensis* trees for gum extraction has a positive and beneficial impact on biodiversity. This tree specie faces the eventuality of being displaced by forest succession if there is no intervention. At the landscaping level, active planning and management is needed for its sustainable production and maintenance, but dealing with these issues will require new types of policy intervention, particularly on land-use management and forestry regulations.

Findings on organic chili in Vietnam were less positive. Organic chili production has indirect effects on biological diversity outside the production area, but without other interventions targeting biodiversity, organic chili production can still have negative consequence for overall biodiversity. Therefore, the potential benefits of organic chili production are lower than the other products in the case studies.

Indian prickly ash in Laos, like Siam benzoin, is a native specie that grows in early succession forests, in small-scale gardens and village grazing land. Although its production areas are less bio-diverse compared to the primary and mature secondary forests that surround them, Indian prickly ash can provide an alternative income to slash-and-burn upland rice and maize farming, and its cultivated grounds can provide natural habitat for birds and pollinators. Overall Indian prickly ash fits well with the forest management zoning around villages, taking pressure off protected conservation forests.

Jujube production in Myanmar was selected because it has not yet been successful in export markets. Despite this, jujube was found to have a very positive impact on biodiversity in the central dry zone of Myanmar. The key lesson learned from this case is that some native products have very high inherent conservation value, a quality that should be taken into account during product selection process.

Comparing the results from the studies, the project draws four main conclusions for the future. Conclusion one is that export potential analysis needs to be supplemented by biodiversity conservation potential analysis when selecting species to work with. Conclusion two is that biodiversity does not yet impact sourcing decisions, although it could be possible to influence this with new types of partnership and outreach. The third conclusion is that the project should partner with one or more conservation organizations to increase capacity to work on biodiversity issues. The final conclusion is that policy interventions, currently focused on economic and trade issues, should be diversified to better support biodiversity impacts. To achieve these goals, while continuing to improve export performance, a comprehensive market systems analysis is recommended to guide design of the next phase.

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Introduction

Project Context

The Regional Biotrade Project in South East Asia is a four-year project funded by the Government of Switzerland through the State Secretariat for Economic Affairs (SECO). The program began with a preparatory inception phase in September 2016, which was completed in April 2017 and is now in its third year of implementation. The agreed goal of the project is ***conservation of biodiversity through sustainable trade of natural ingredients in a manner that increases the competitiveness of local exporters/producers and the livelihood benefits (income and jobs) of rural women and men***. The project is being implemented in Vietnam, Laos and Myanmar by HELVETAS Swiss Intercooperation through its programs in the three countries. Southeast Asia was selected partly due to its status as a biodiversity hotspot, and partly due to the high economic and social potential of sustainable business in the region.

The project applies a *Market Systems Development* approach to analyse and develop interventions, facilitating the growth of the Biotrade business model and the sustainable local structures and support services it needs to flourish. To achieve this, the project works with a mix of private companies trading and exporting biodiversity products, public and private sector business support service providers, relevant levels of government and other stakeholders interested in sustainable use of biodiversity. The project's three main areas of intervention are: a) facilitating companies and their supplier networks to become "export ready"; b) enabling exporters and relevant business support organizations to promote exports of sustainably produced natural ingredients, and; c) encouraging a more supportive policy and enabling environment for export of biodiversity based natural ingredients.

Rationale for Case Studies

The Regional Biotrade Project has a strong business focus, and its impact logic posits that biodiversity will be protected through promotion of trade in sustainably produced ingredients derived from native species. While the project does not have a formally-stated Theory of Change, a suitable approximation would be:

<u>If</u> natural ingredients companies implement business models aligned with the Biotrade principles and criteria, are supported to reach new export markets independently and by competent BSOs, and improvements are made to the supporting frame conditions for Biotrade, <u>then</u> biodiversity will be conserved, companies and producers will be more competitive and rural women and men will benefit from increased income and employment.

Because the project's impact thesis focuses on the role of private sector exports, the project is not directly involved in biodiversity conservation. The project does not have an impact indicator directly measuring biodiversity conservation, which would anyway take many years to emerge and would be very difficult to measure its attributable impact. Nevertheless, project management and staff had an intuitive sense that some of its partnerships and products would (or will) have biodiversity benefits, while others may not.

To get a better understanding of the project's likely biodiversity impact, a decision was taken to conduct case studies examining four different products in Vietnam, Laos and Myanmar. Organic chili and Siam

benzoin were selected from Vietnam, Indian prickly ash was chosen from Laos, along with jujube in Myanmar. The products were selected partly to represent different country contexts, production systems[1] and natural environments[2], but also to include products with higher and lower likelihoods of significant biodiversity impacts[3].

Given the difficulty of measuring the biodiversity impacts of a specific product in complex and dynamic ecosystems and the fact that the full impacts will take many years to emerge, the case studies use a significant amount of qualitative observation to reach conclusions about each product. By comparing the impacts of the four products, the Regional Biotrade Project in Southeast Asia can learn valuable lessons about the effectiveness of its approach in the past, and can study options to improve its impacts in the future. These lessons learned are discussed in the final section of this document, after the presentation of the case studies.

Eggs from an unidentified ground nesting bird species, discovered during research into the biodiversity potential of Siam benzoin in northern Vietnam

[1] Annual cultivation versus permanent tree crops and wild collection
[2] This includes lowland cultivated land (organic chili), humid tropical and sub-tropical uplands (Indian prickly ash) and semi-arid lowlands (jujube)
[3] Whil

Case study: Siam benzoin in Vietnam

Objective of the study

The study is part of a review of Helvetas Regional BioTrade Project in South East Asia to suggest inputs for the design of a follow-up phase. In total, there are four case studies carried out on natural products in Laos, Vietnam and Myanmar with the purpose to:

- assess whether its production is making positive contributions to conservation of biodiversity or not (qualitative approach);
- draw conclusions about why or why not each product contributes to preservation of biodiversity, and why or why not sustainability criteria have been respected along the supply chain;
- what key lessons that can be learned about what characteristics of products or species can be used to describe a high potential in contributing to biodiversity.

This study analyzes the contribution to biodiversity conservation in Vietnam of two contrasting products: a) Siam Benzoin Gum, obtained from a native tree species (*Styrax tonkinensis*), and b) organic chili, a short life-cycle and non-native herbaceous plant. Helvetas Regional BioTrade Project has given support to selected companies of both value chains, mainly in export-related topics.

Methodical approach

The **Convention on Biological Diversity (1992) defines biodiversity** as: "*… the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems*". It refers therefore to: a) species diversity; b) genetic diversity, and c) ecosystem diversity with its complex interactions between biotic (flora and fauna) and abiotic components (soil, water, radiation).

The author is drawing up the assumption that contribution to biodiversity conservation through the use and management of natural products is determined by three factors:

(1) Firstly, it depends on the **inherent potential of the species** itself to contribute to biodiversity conservation. Key questions are e.g.: *Is the selected species rare or endangered? Is it native? Is it perennial? Is it a key species of an ecosystem?* These characteristics are internal factors, which cannot be changed. Further, the contribution to biodiversity depends on the **production system**: *Does production takes place in a natural ecosystem, or it is cultivated artificially? Is the whole species extracted, or just part of it? Are agro-chemicals or heavy machines used?* Although the production system can be changed, it is considered here as a given pre-established parameter, to allow comparison of different production systems (for e.g. plantation versus wild harvest, organic versus non-organic).

(2) Secondly, contribution to biodiversity conservation depends on the vulnerability and **protection needs of the affected ecosystem**. It requires a look on its **uniqueness** and its status quo of **alteration caused by human**. Key questions include: *Is the affected ecosystem abundant or rare? Is it home to endangered species? Is there already pressure on biodiversity by human activities? What level of fragility or resilience is the eco-system at? What impact can be expected from the production of the selected product on the ecosystem or on the endangered species?* The protection

needs of the affected ecosystem is determined primarily from damages caused by previous, long-term human interventions and therefore when protecting an affected ecosystem, addressing its vulnerability by past and on-going external factor (i.e. human activities) constitute the main consideration during the assessment of the potential of contribution to biodiversity conservation.

(3) Beside the internal and external potential of the product to contribute to biodiversity conservation, its real impact depends on the **performance of the actors involved in the supply chain**. These are influenced by **legal regulations and** national politics for the management of the species and/or natural resources, and the awareness of clients at upstream value chain to demand for sustainable production and biodiversity conservation. This factor is the intervention level of the Helvetas Regional BioTrade project, where a change in the behavior of actors in the supply chain can be made in order to achieve positive effects on biodiversity.

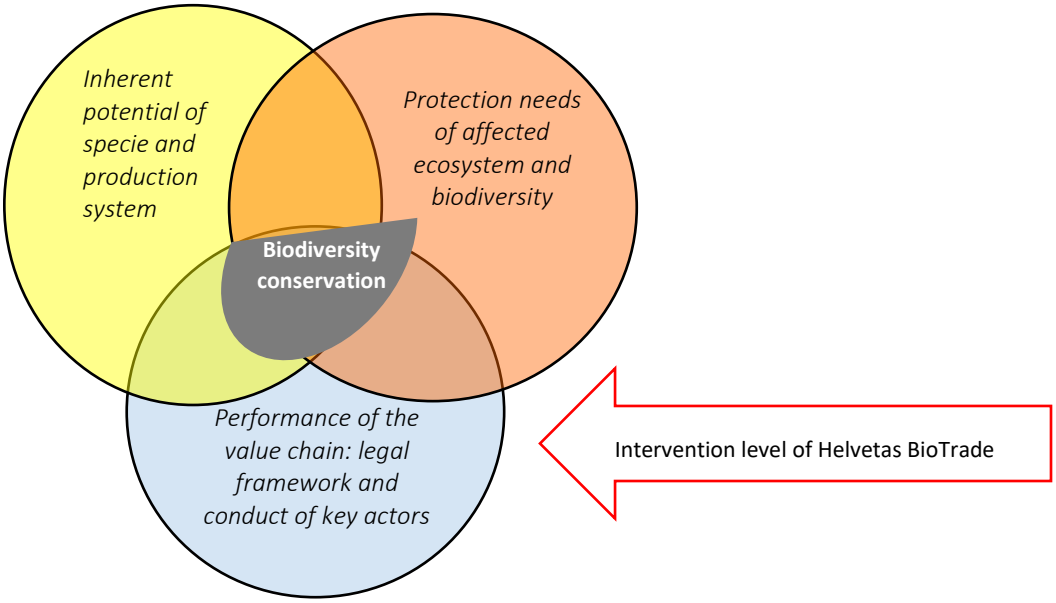


Fig. 1: *Decisive factors for biodiversity conservation by a production system and intervention level of Helvetas BioTrade (Author´s suggestion).*

The criteria applied in the study have been freely chosen according to the author's opinion and must not be understood as complete or unchangeable. Helvetas can adjust the criteria to suit its bio-conservation goals and may choose to have different specific focus for different products for eg. Helvetas may prioritize species protection or habitat conservation, or even climate change mitigation for different areas/products. Helvetas can select a priority criteria according to its main objective for that specific product, or valuate a set of criteria by doubling or tripling the weight-counting index of individual criteria.

Siam Benzoin

A 1. General information of the supply chain

Siam Benzoin Gum is a good smelling balsam obtained from the broad-leaf tree *Styrax tonkinensis*. The gum is mainly used by the international perfume industry, alongside a small local market for medical

purpose. Laos is presently the world's biggest production country. However, until the 1990s, Siam benzoin gum had been produced in Vietnam, too (Woda 2017).

Since 2013, Duc & Phu Agriculture Joint Venture Company (DPC) is promoting re-establishment of benzoin gum production in Vietnam in rural villages. Since 2017, DPC is supported by Helvetas BioTrade to export to neighboring countries and to Europe. At present, DPC is the main benzoin gum producer and trader in Vietnam. The tree-tapping work for gum production is carried out by individual rural households. Villagers either tap trees that grow wild in native forest on national land tenure, or tap trees on their own plantations that was initially grown for timber. To harvest the gum, intersections the size of a cigarette-box are cut into the bark along the tree stems once a year at start of rainy season. After a couple of month, gum is secreted and dried-up, and is then collected (Kashio & Johnson 2001). Trees are not cut for harvest. If intersections are well placed, trees can survive and keep being productive for many years.

For the study, information was collected in May 2019. The team visited production areas and its rural households in 3 areas:
a) native national forest site at Puong village, Quảng Hòa district, Thanh Hóa Provinve,
b) native national forest site at Nậm Tha commune, Văn Bàn-district, Lào Cai province, and
c) plantations at Xóm Sưng village, Đà Bắc-district, Hòa Bình province.
Additionally, openstructured interviews were held with representatives of the local district governments, with functionaries of the Forest Protection Board of Pu Hu Nature Reserve, of Van Ban district and of Nậm Tha commune. Experts from Flora and Fauna International, IUCN and WWF-Vietnam were consulted, as well as from German Development Bank Forestry Project "KfW 9".

A 2. Inherent potential of *Styrax tonkinensis* and gum production system for biodiversity conservation

To assess the inherent species potential to biodiversity conservation locally, a survey with 8 key questions were identified, which also allow for comparison to other species. Each question is answered with a rating according to its positive, neutral or negative impact to biodiversity conservation (2, 1, 0, -1 and -2). For the total of 8 questions and a maximal rating of "2" for each question, maximal total rating would be "16". *S. tonkinensis* achieves half the maximal score with 8 (Fig. 5). It is considered positively that *S. tonkinensis* is a native tree. As a perennial plant - it can reach up to 60 years – **the tree dominates the early succession phase of natural forests**, often mixed with bamboo.

Pollination of *S. tonkinensis* is not well documented. However, producers from Thanh Hóa report that pollination is done by insects, and Les (2017) describes that tree species of the *styrax*-genus are mostly pollinated by insects. Flowers have an attractive design for insects (Fig. 3), **so it can be assumed that the tree is insect pollinated,** contributing to biodiversity.

The small, **nut-like seeds seem to be an important food source for wildlife** (Fig. 2). Producers reported that the seeds are eaten by squirrels and other rodents, and by at least two birds. Rodents are an essential part of the food pyramid basis for wild animals, and prerequisite for existence of prey birds and carnivorous mammals. **A diverse landscape with *S. tonkinensis* trees forest stands, adjacent to older forests or in very close proximity probably contributes positively to wildlife conservation**. Producers in Thanh Hóa mentioned the existence of small **wild cats, dog-like species and small bears** in surrounding

forests which likely to have benefitted from the *Styrax* seeds providing food for rodents at the bottom of the wildlife's food pyramid.

Fig. 2 – 4*: Seeds and flowers of Styrax tonkinensis, and thin crown structure of Styrax plantation.*

Overall, there is no negative impact of *S. tonkinensis* to biodiversity. In some aspect, the tree is indifferent to biodiversity. It is neither a hosting species for epiphytes nor for birds, as the thin crowns are not preferred for nest building (Fig. 4).

Fig. 5: *Inherent potential of S. tonkinensis to contribute to biodiversity conservation. 2: high positive impact, 1: low positive impact, 0: neutral; -1: low negative impact, -2: high negative impact.*

Key questions	Description	Rating
1. It is a native species?	Yes, native to SE Asia	2
2. Is it a rare or endangered species?	Abundant	0
3. It is perennial species?	Yes, life circle up to 60 years	2
4. It is a key or dominant species of an ecosystem (e.g. forest stands)?	Yes, forms the early succession stage of native forest	2
5. Is the species shade-tolerant and part of an old growing ecosystem, or a pioneer species?	pioneer species, high light demanding	0
6. It is an important food source for wildlife?	Two birds are recorded by local people to eat fruits and seed. Seeds are also eaten by rodents, which constitute an important food source for other animals such as predator birds and carnivore mammals. Pollination is probably done by insects	2
7. It is an important host plant for nesting for animals?	Not reported	0
8. It is a host plant for other epiphytic plants	Not reported	0

Total	8

Regardless of the species, it is also the production system that affects biodiversity. Benzoin gum is produced in native forest as well as in mono-aged and -structured plantations, which have been established for timber. Impact on biodiversity highly differs for these two production systems (Fig. 6 below). According to the key questions, **production in native forest gets a total rating of 15 of the highest possible score of 26, whereas production in plantation gets even a negative rating with -11**.

Fig. 6: *Potential of S. tonkinensis production systems to contribute to biodiversity conservation. 2: high positive impact, 1: low positive impact, 0: neutral; -1: low negative impact, -2: high negative impact.*

Key questions	Production in native forest		Production in plantation	
	Description	rating	Description	rating
1. It is grown as monoculture?	No, natural ecosystem	2	Yes, but sometimes mixed with other commercial species	0
2. Is the whole species extracted, or just part of the plant?	Just part of the bark is cut. However, tree vitality can get affected	1	For gum, just the bark is cut. But after 6 to 12 years plantations area cleared for timber harvest.	-2
3. Does the production assume the function of green, biological corridor	Very suitable	2	Still suitable	1
4. Does the production system allow the natural vegetation succession?	No. To maintain shade-intolerant Styrax, periodical interventions are needed, cutting other trees	-1	Every few years, the whole - artifical - ecosystem (plantation) is cut, and remaining vegetation is burnt	-2
5. Are other species affected when product (gum) is harvested?	Shrubs are cut around the tree in native forest	-1	no	0
6. Any side-effects as constructions of roads/path, hunting etc?	Transportation is done by foot on small path. However, it attracts hunting in native forest	-1	Clearcut and burning avoids long-term establishment of native vegetation/ecosystem	-2
7. Use of chemical insecticides	absent	2	Attacks of defoliater *Fentonia* sp. (Lepidoptera) may require use of insecticides (Orwa et al. 2009)	-1
8. Use of chemical fertilizer	absent	2	Application of nitrogen fertilizer (60 g/tree) is recommended, but not always applied.	-1
9. Use of chemical herbicide	absent	2	Glyphosat is used in some cases	-1

10. Soil compacting	Absent	2	Occurs at timber harvest	-1
11. Soil fertility	Natural pedogenesis takes place	2	Erosion after clear cut	-1
12. Impact on water cycle	high	2	Water is kept during years, but affected when clear cut	1
13. Motivation to keep native forest	High, but under a management to artificially keep pioneer species	1	In competition to native forest	-2
Total		**15**		**-11**

Overall, benzoin gum production in native forests contributes positively to biodiversity conservation: The native ecosystem is used, which is home to wildlife. The productive *Styrax*- forest can assume the function of green, biological corridors, while linking high valuable "islands" of still intact forests. There is no use of chemicals, and soil fertility and water balance are not affected. There are some negative impacts to biodiversity, too, but at low intensity. For gum harvest, shrubs in the understory are cut around the tree. Further, there is a general risk of side effects when tappers got to forest, as they might hunt, fish and extract other plants for timber or medicinal purpose. High sensitive animals can be disturbed during tapping and harvest. However, there are only a few days a year when tappers go to the forest, so that the risk is manageable.

Trickier is the fact that *S. tonkinensis* is high light demanding and does not tolerate shade (Fig. 7). Natural succession will continuously reduce the number of the pioneer species *S. tonkinensis* trees. **Therefore, the forest must be kept artificially in an early succession phase, to avoid it becoming an old-growing forest**. Thinning and cuttings in the canopy and/or shrub layer must be done in order to regulate shade and maintain the tree species. Moreover, **doing the clearings on a small scale ("gap-management") can be beneficial in contributing to a richer pattern of habitats and biodiversity within the native forest.**

Fig. 7 – 9: *Styrax tonkinensis in native forest (early succession phase); 14-years old plantation; clear cut of Styrax plantation on steep slope.*

The negative score returned on the assessment on benzoin gum production in plantations is mainly attributed to the **periodical clear-cut activity**- which are carried out to harvest the timber - and the burning of the remaining vegetation left behind after the clearing. Clear cuts are done approximately every 7 to 15 years depending on how quickly the trees have grown and whether the extra income from selling the timber is needed. This practice destroys long-term establishment of a natural-like ecosystem that is crucial for biodiversity conservation. As plantations are often established in mountainous land to

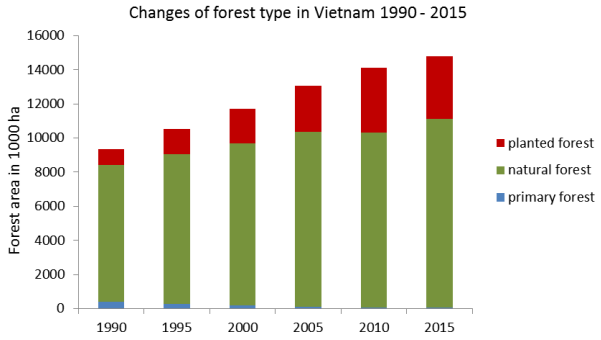
retain water ("protection forest"), **clear cuts are done often on very steep slopes** (Fig. 9), causing **extremely high erosion rates**, which severely threaten biodiversity and habitat conservation. Skidding is done by buffalo or by machines, and soil gets compacted. If the household has enough money, chemical fertilizer, herbicides (glyphosate) and insecticides to control defoliating butterfly-larva are utilized as well.

Nevertheless, *Styrax*-plantations are contributing to forest cover with a native tree, which is still ecologically better than the abundant plantations of non-native *Acacia mangium*. It also creates more positive impacts on water-level compared to agriculture crops. **There is high potential to increase biodiversity with *S. tonkinesis* plantations through the application of improved management techniques.** Those can be the **establishment of mixed plantations (introduction of fruit trees)** and **surrounding hedges**. A more desirable method would be the implementation of **selected tree harvest** to allow the establishment of **permanent forest cover**. Plantations would become **more structured and could assume the function of a buffer zone or of green corridor for high valuable and more biodiverse forests**. Feasibility of these techniques depends on gum productivity and related income.

A 3. Fragility of related ecosystems biodiversity: Native forests in Northern Vietnam

Between 1943 and 1993, Vietnam´s forest cover declined from 43 % to 28 % (FCPF 2011). According to FAO (2015), forest cover then recovered from 9.14 million hectare to more than 14 million hectare nowadays (41 % forest cover). This impressive achievement has been made possible through governmental forest protection and rehabilitation programs and legislative instruments (Braun et al. 2017; Cochard et al. 2017).

However, when looking at qualitative data, picture changes. **Forest cover had increased, but forest quality has decreased** (Fig. 10 and 11). The increase was mainly attributed to the planting of fast-growing trees, such as non-native eucalyptus, acacia and rubber; plantations today represent 25 % of forest cover. In contrast, natural forest is hardly re-established. The claim that 75 % is native forest is considered to be grossly overestimated, and moreover, the forest cover today is mostly in degraded conditions (Braun et al. 2017). Only less then 1 % is primary forest (FAO 2015).



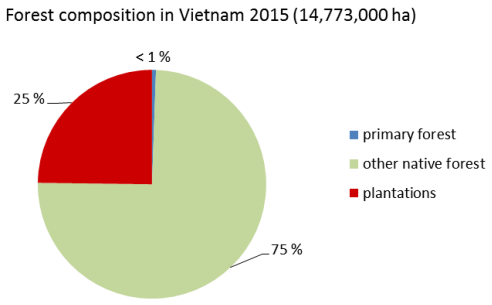


Fig. 10: *Changes of forest type in Vietnam 1990 – 2015.* ***Fig 11:*** *Forest composition of Vietnam in 2015. Source of both figures: FAO 2015.*

The biodiversity of Vietnam's forests is ranked as very high at global level. Vietnam is the convergence of three streams of fauna and flora migration from China, India-Himalaya and Malaysia-Indonesia. Fauna and

Flora includes many endemic species (Phung Ngoc Lan 2006), which still are not fully studied, as demonstrated by recent reports of newly discovered species. So far, there are nearly 20,000 plant species recorded (Nguyen Nghia Thin 2008). For fauna, there are 9,325 species recorded.

On the other side, pressure on biodiversity is extremely high. Vietnam is highly populated with 95,000,000 people, of which 40 % depend on agriculture (ILOSTAT database). To meet its agricultural needs, not only low land, but also mountainous land is today extensively used for agriculture or short-cycle forest-plantations. Only very rugged mountain terrain with extremely difficult access is left untouched for forest. The geological characteristic of karstic mountains elevating abruptly on flat landscape, which are like islands rising from an expansive sea agricultural land (Fig 12) has lead to a **high degree of fragmentation of wild life reserves**. The genetic flow between remaining wildlife population is curtailed by the cultivated flatland leading to increased risk of species extinction.

Fig 12 – 14: *Fragmented native forest in karstic landscapes; Young man with a hunted wild cock (Gallus gallus) on the way to market; Wild bird (Garrulax chinensis) trapped and kept as a pet at rural household.*

According to WWF-Vietnam, forest cover in protected areas is more or less stable due to high efforts of the Forest Protection Boards, but outside protected areas, **deforestation is ongoing**. Vietnam is known to be one of the "hot spots" for **illegal trade of wild life** on international level. According to "Education for Nature – Vietnam (EDV)", Vietnam's rhinos have been extinct just a couple of years before. There are only 5 tigers reported to be left, and less than 100 elephants. The population of 16 of 25 primate species is described as critical (Vietnam News, 25th of May 2019). According to WWF, direct causes of deforestation and biodiversity loss are hunting, collection of fuel wood, legal and illegal logging and shifting cultivation for agriculture. Root causes behind are growing population, poverty and current land tenure situation (Fig 15). Hunting is often done for own consumption, to generate income (Fig 13), or to keep wild life as pets (Fig. 14). **Overall, protection needs of native forest and wild life in Vietnam can be described as very high.**

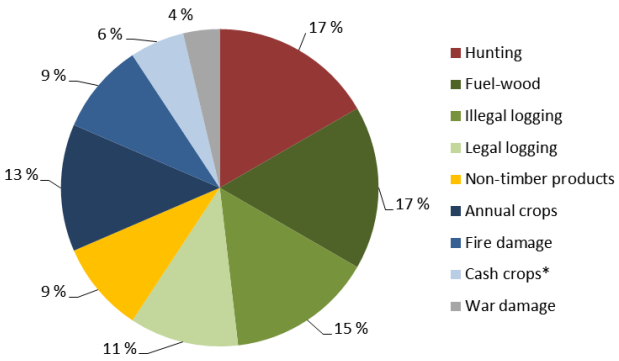


Fig. 15: *Own elaboration based on WWF (2000). *Coffee, pepper.*

Highest levels of biodiversity are found in the central highlands of Vietnam and the Mekong delta, whereas Styrax gum production takes place in the Northern provinces. To classify the potential impact on biodiversity conservation, it has to be understood which forest eco-type is related to styrax forests. Surprisingly, the Forest Protection Board could not provide any information about an ecological vegetation- classifying system of forests in Vietnam.

Due to non-existence of an official forest classification system, it is hereinafter referred to a study of FAO, UN-REDD Vietnam and Vietnam´s Research Centre for Forest Ecology and Environment of Forest Science Institute to stratify Vietnam´s territory into forest eco-regions (Vu Tan Phuong, 2011). In total, there are 8 forest eco-regions and 47 sub-regions identified based on climate, soils and geology conditions. The main styrax gum production sites of Duc and Phu Company (Thanh Hoa, Lao Cai and Hoa Binh provinces) are therefore located within the **eco-regions "North West" and "Middle North", and in 4 sub-regions** (Fig. 16). Related forest type **is mountainous evergreen mixed closed and broadleaved humid forest** with different sub-types according to the altitude above sea level.

Benzoin gum production takes place mainly in **middle range altitudes**, as lowland is used for agriculture, and the climate in high range altitudes is too humid and cold for gum production. In the nearby high mountains, including the highest mountain of Vietnam "Fanxipan", cloud forest and coniferous forest persist, including besides other endangered tree species such as *Cunninghamia konishii* and *Fokienia hodginsii*. **Well managed *S. tonkinensis* forests and plantations can assume the function of "buffer-zones" of these high value ecological forests**.

Fig 16: *Forest Sub-ecoregions of Benzoin gum production areas and its ecological characteristics according to Vu Tan Phoung (2011).*

Sub-Eco-region	**Dominant tree species and ecological characteristics according to Vu Tan Phoung 2011**
No. 3: Son La - Moc Chau plateau	18-22°C; 1400 - 1600 rain mm/year. Limestone inserted between mountains tops on different rocks.
	Low and medium mountainous evergreen mixed closed and broad leaved humid forests (500-1500 m) and coniferous forests: *Taxotrophis illicifolia, Excentrodendron tonkinense, Quercus acutissima, Q. serrata species, Carya tonkinensis, C. chinensis, Engelhardtia spp., Phoebe, Actinodaphne, Litsea species. Shrublayer: Prunus arborea, Gironiera subaequalis, Chukrasia tabularis, Castanopsis indica, C. chinensis, Mallotus phillipinensis*.
	Coniferous forests, and mixed broad-leaved on tops of rocky mountains: *Keteleria davidiana, Dacrycarpus imbricatus, Nageia spp., Pinus merkusii.* **High ecological value**.

No. 5: Hoang Lien Son mountain ange	11-23°C; 1600 - 3500 rain mm/year. Strongly-fragmented topography, steep slopes, many tops above > 2,000 m. Fanxipang is the country's highest mountain in Vietnam (3143 m). Low and medium mountainous evergreen mixed closed and broad leaved humid forests < 1500 m: *Lithocarpus, Quercus, Illicium, Eurya, Camelia, and Hartia; Acer; Alnus nepalensis; Magnolia, Diplopanax, Pentaphylax, Rhodoleia mix*ed with coniferous as *Fokienia hodginsii, Tsuga yunnanensis and Abies delavayi.* Shrub layer: *Ericaceae, including Rhododendron, Lyonia, Gaultheria.* High mountainous evergreen mixed closed and broad leaved humid forests > 1500m: **Cloud forests** with low temperature and 1800-3200 mm/year. *Ericaceae, Illiciaceae, Rosaceae, Theaceae, Tsuga yunnanensis, Abies delavayi* and bamboo.
No. 6: Hill land of Hoa Binh, Ninh Binh	22-24°C; 1600 - 2200 rain mm/year. Limestone mountains of 300 – 700 m. Lowland evergreen mixed closed and broad leaved humid forests < 700m, **strongly affected by human and most secondary forests** (after-cultivation). *Hopea odorata, Vatica fleuryana, Canarium album, Pelthophorum sp.* Also bamboo and mixed bamboo and timber forests as degraded ecosystems at drier sites: *Dendrocalamus sericeus, Indosasa amabilis, I. crassiflora, Ampelocalamus patellaris, Neohouzeana dulloa, G. subaequalis, Castanopsis indica, Cratoxylon, Engelhardtia, Ilex.* Plantations of *Acacia, Eucalyptus, Dendrocalamus*
No. 20: West mountain of Thanh Nghe Tinh	19-24°C; 1400 - 3000 rain mm/year. Massive mountainous blocks, strongly dissected, high steeps; 1000 - 1500m. Low and medium mountainous evergreen mixed closed and broad leaved humid forests **with very high biodiversity. At least 2,500 vascular plants, including 23 species listed in the Vietnamese Redbook 2007.** The area with the richest flora diversity is **Pu Ma National Park** where inventoried 2461 vascular plants, including new species. *Hopea, Dipterocarpus, Quercus, Lithocarpus, Castanopsis, Cinnamomum and Litsea.* < 1500 m: Fagaceae, Lauraceae and Myrtaceae, however, Dipterocarpaceae. > 1500 m: *Cunninghamia konishii, Fokienia hodginsii and Decussocarpus wallichianus*. **Some are still in quite good conditions with little impacts by human**. As consequence of forest degradation there are also bamboo and mixed bamboo forests.

To be more specific, current production of **Siam benzoin gum takes place in the surroundings of the following protected areas:**

Van Ban-District (Lao Cai Province):	• South of Hoang Lien National Park
Da Bac-District (Hoa Binh Province):	• South of Xuan Son National Park • very close / within Cultural Site Dao Ho Song Da

Districts of Quan Sơn, Mường Lát, Quanh Hoa (Thanh Hoa Province):	• South of Pu Hu Nature Reserve • South of Pu Long Nature Reserve • North of Xuan Lien Nature Reserve • North of Nam Xam National Biodiversity Conservation Area (Laos territory!)

Thanh Hoa is the province with the most protected areas, **and Benzoin gum production takes place right in the middle.** According to Mr. Le Khac Dong from Pu Hu Nature Reserve Forest Protection Board, **the region still provides home to extremely endangered species**, including the northern white-cheeked gibbon *Nomascus leucogenys,* wild dog *(Cuon alpinus),* gaur *(Bos gaurus),* Chinese pangolin *(Manis pentadactyla)* and apparently even the tiger *(Panthera tigris).*

Thanh Hoa province is at the same time the most productive area of benzoin gum, demonstrating the high **potential of *S. tonkinensis* forests in contribute to biodiversity conservation through aligning the production system within a concept of buffer zones or green corridor management for high value protected areas**.

A 4. Performance of supply chain actors in terms of biodiversity conservation

Beside the *potential* of the tree species to contribute to biodiversity conservation, the actual contribution depends on the performance of the value chain actors, its will and its motivation to implement actions to conserve biodiversity, and also depends on the legal regulations to manage the natural resources.

The raw material client's interest is mainly about **ensuring long-term availability** of raw material. He has actively promoted to establish practices to guarantee the compliance of BioTrade principles and the specific criteria of good practice designed for gum. The client is guided by the logic that a **sustainable management of natural resources and fair working conditions for producers**, within a model in which everybody wins, will lead to sustainable sourcing. The client is also in a key position to put some "positive pressure" to upstream value chain actors to take care about biodiversity. However, **the topic of biodiversity conservation remains in the background,** as it is not seen as part of the business. So far, DPC was not asked to carry out specific measurements to enhance biodiversity conservation. A different pricing could be used by the client, but as well by DPC as a guiding tool to increase producer´s motivation to contribute to biodiversity conservation.

The producer & export company DPC shows willingness to create fair working conditions for the households and has expressed its commitment to work under respect of BioTrade principles. So far, priorities have been set on fair payment, occupational safety, quality and traceability, which are the topics most closely related to the core production process. In contrast, actions to ensure long-term sustainability of *Styrax*-tree population are still under construction. **Ecological consciousness about the need and feasibility to further contribute to biodiversity conservation within Benzoin Gum production is very low and not put into practice so far**.

The gum producers have in-depth knowledge of local biodiversity, which is generally not documented nor considered in conservation strategies. Many households independently establish mixed – and more biodiverse - plantations instead of monocultures, to diversify their economies. Nonetheless, illegal hunting and over-harvesting of natural resources is widespread, since the priority is given to meet the economic needs of the mostly poor households. *Styrax*-plantations are clear cut for timber harvest, as

selected harvest (or thinning) is assumed not to be economically feasible. Overall, possible interventions to improve biodiversity conservation at household level by giving technical advice - ideally combined with economic incentives – seems to be high.

The forest administration (Forest Protection Board FPB) is trying to manage the balancing act between creation of income options for the poor and biodiversity protection. The district FPBs have little knowledge of biodiversity in the forests. Their work is clearly focused on timber production, and the value of a forest is assessed in terms of timber volumes. Only FPB-staff from protected areas who monitor flora and fauna know about biodiversity conservation. **As a result, knowledge about species biodiversity is limited to forest staff working in protected areas, while staff in unprotected native forests lack information on biodiversity**. This situation was found for *Styrax*-stands, too, where no staff working in the forest protection board could classify the ecologic value of the forest and its related fauna.

The **legal regulations for non-timber forest products such as benzoin gum are rather lax**. People can harvest it from native forests, even from protected forests, without having to comply with any administration or regulations. According to Circular 27 of the Forest Protection Boards (FPB), households should report extracted volumes of non-timber products, but so far no one has registered that for benzoin gum. FPB is **not carrying out any monitoring of harvest areas and of the remaining tree population**. It is reported that in the case of some other non-timber products such as medicinal plants, uncontrolled extraction has already led to extinction of the species at local level.

This is in contrast to timber extraction, where FPB is following a hard line on biodiversity protection. FPB has recently declared a national-wide logging ban for all native forests. Although the logging ban was established with good intentions, overall it seems to have more counterproductive impacts for livelihood of local communities and biodiversity (Braun et al. 2017). **The logging ban impedes sustainable management of the *S. tonkinensis* forests,** as the high light demanding tree requires regulation of shade and light through cutting of selected trees. Although these trees are not cut for its timber but for landscape management, cutting is not allowed under the current blanket logging ban. Without light regulation, *styrax* **trees will disappear with ongoing natural succession,** and forest stands will no longer offer an income source for local households. It is probable that **affected households will then switch to illegal activities causing negative impacts on biodiversity**.

The **strict rules for natural forest management are in contrast to plantations, which are practically free of any restrictions**. Plantations totally lack regulations and incentives to increase biodiversity and soil conservation which could otherwise bring many ecological benefits such as establishing biodiverse green strips and hedges, and regulating the size of clear cuts according to the slope's gradient

A 5. Impacts and recommendations

So far, the **contribution to biodiversity conservation in benzoin gum production has been quite low**. This is in contrast to the **high potential of Benzoin gum production to contribute to biodiversity conservation**:

- It is a native tree, and a dominant species of the early succession phase of native forests;
- Seeds are a food source for some birds, but mainly for rodents, forming the base of the food pyramid for prey birds and carnivorous mammals as e.g. civet cat, as long as there is nearby a rich structured habitat;

- Especially in native forest, benzoin gum production has a high potential to contribute to biodiversity conservation.

The **protection needs of related ecosystems are very high**:

- Benzoin gum production takes place in the eco-regions of "North-West" and "Middle North" of Vietnam, including Vietnam´s highest mountain with rare ecosystems;
- Related forest stands are mountainous evergreen mixed closed and broadleaved humid forests and in the upper part cloud and high mountains is coniferous forests;
- Benzoin gum production is done close to protected areas. Especially in Thanh Hoa there is a high concentration of protected areas, with productive *S. tonkinensis* forests are right in the middle of Pu Hu Nature Reserve, Pu Long Nature Reserve, Xuan Lien Nature Reserve and Nam Xam Conservation Area (the last one is in Laos territory)
- The protected areas still have a high biodiversity, including endangered species, but are subject to a strong spatial fragmentation due to agriculture activities in lowland;
- *S. tonkinensis* stands under gum production can contribute to forming green biological corridors, linking higher-grade mature protected forests to increase genetic flow and interchange of species.

Despite the high potential of *S. tonkinesis* to contribute to biodiversity conservation, **the effort of value chain actors and stakeholder to implement specific actions for biodiversity conservation is very low**:

- Current forest politics are polarizing between strict protection of biodiversity in protected areas, but allow the overuse of nature resources in non-protected areas. The concept of biodiversity conservation through a sustainable use of forest resources is not promoted;
- Monitoring of wild life is focused on old-growing forests in protected areas. There is no information of wild life in early succession stage as in *S. tonkinensis* forests;
- Current national-wide logging ban impedes sustainable production of benzoin gum in native forests, as the tree requires shade regulation;
- There is a high unused potential to improve the management of *S. tonkinensis* plantations to increase biodiversity conservation.

Objective of Helvetas BioTrade Project is: "***To promote the conservation of biodiversity*** *through sustainable trade in natural ingredients in a manner that increases the competitiveness of local exporters/producers and the livelihood benefits (income and jobs) of rural population by taking into account all relevant ethical BioTrade principles and criteria*."

So far, Helvetas BioTrade has successfully promoted and connected local companies to international market and has improved income options for many poor households. Nevertheless, as the study shows, benzoin gum stakeholders are still not focusing on biodiversity conservation, and probably will not change on their own in near future. **This is where Helvetas BioTrade should start now, to encourage and empower the actors to combine the production of benzoin gum with biodiversity conservation.**

In order to ensure sustainability, Helvetas BioTrade´s role is limited to facilitating processes and not to implement them by itself. **It is therefore essential to identify partners** which are able to motivate the key actors (by politics, knowledge interchange and transfer, financial incentives), provide training and

monitoring the outcomes of biodiversity conservation at production level **– ideally all done under close coordination with the client.**

For biodiversity conservation at benzoin gum production, the following partners have been identified:

a) Forest protection board (FPB):

The forest protection board is the state forest administration, responsible to set the management regulations and to issue permissions for the use of forest resources. Further, it is responsible to monitor wild life and forest protection. FPB is also providing incentives and technical assistance to households working with native forests and plantations. This makes FPB clearly one of the key actors to achieve a sustainable production system of Benzoin gum.

FBP´s management departments are concentrating on timber production. There is profound knowledge about establishment and management of *Styrax* plantations for timber in a clear-cut system, but there are no technical guidelines on how to manage *Styrax* as a permanent forest cover - which is essential for biodiversity conservation – and on how to keep *Styxrax*-trees along the natural succession in natural forests. These areas could be an intervention topic for Helvetas.

FPB´s department for protected areas monitor wild life, but it is limited to protected areas. This is a second intervention topic where Helvetas could provide support, to increase knowledge at FPB about wild life in *Styrax*-forests and plantations outside protected areas, as a base to set up management rules to increase biodiversity conservation.

When Helvetas started promotion of Benzoin production in 2017, FPB was consulted about the feasibility to do it under respect of regulations. FPB gave permission to extract benzoin gum, but unfortunately the communication between producer (DPC Company) and FPB then stopped. As FPB is not well informed about harvest volumes and positive impacts for rural households economic, they do not really care about the activity, and no efforts has been made to promote permanent *Styrax*-forests and plantations. The potential of *Styrax*-forest to contribute in remodeling of forest landscape seems not to be recognized by FPB.

b) Non-governmental organizations

Because of Vietnam´s rich biodiversity and high percentage of endemism, and the immense pressure on its natural forests from the ever-growing threats of logging, clearing and illegal hunting, dominant world organizations such as Fauna and Flora International, TRAFFIC, WWF, and IUCN have taken presence in Vietnam, working with the country to enhance its biodiversity conservation. As Vietnam develop economically, national organizations are also starting to form such as Education for Nature Vietnam (ENV) to raise awareness of its natural heritage.

The NGOs are implementing diverse support actions to enhance wildlife protection, often with pilot characteristic. As success strongly depends on the behavior of local people, some of the NGOs are also working to improve livelihood for local households (e.g. WWF), whereas others focus mainly on education and monitoring of illegal hunting and traffic (e.g. ENV). As NGOs depend on external funding**,** they are generally focused on areas with presence of animal species which are emblematic and easy to source funds (e.g. protection of monkeys, tigers and elephants). These areas are located in old-growing forests often with difficult access, and therefore, *Styrax*-forests are currently not under their focus.

Nevertheless, due to their many years of experience, the **NGOs have plenty lessons learned in biodiversity conservations and have teams of wild life experts. It is therefore desirable to have them on board when monitoring wild life in *Styrax* forests, and when identifying actions** to increase biodiversity conservation, in addition to the Forest Protection Board. At present, none of them are working in secondary growing forest. To get them involved in *Styrax* production areas, it would require extra funding. An exception might be IUCN with its project of remodeling forest landscapes; however, it is located in the middle part of Vietnam and not in the North where benzoin production takes place.

c) Local government and village leaders

The local government is the third important actor to effectively promote biodiversity conservation in *Styrax* stands. Local government and village leaders can strongly influence the performance of local households in biodiversity conservation, as its opinion and knowledge is generally accepted by all local people. Further, local government can suggest and ask for support for specific actions from governmental institutions in form of technical assistance or financial incentives. DPC is already coordinating with the local government, but outcomes could be improved if done more strategically.

To increase biodiversity conservation, we suggest the following processes that could be facilitated by Helvetas BioTrade:

1. Establish a **communication platform between DPC, Forest Protection Board and local government** in the production areas with the purpose to share information about general market tendencies and production areas, production volumes, households involved, the impact on local economy (as also foreseen in Circular 27 of Forest Administration). Objective is to get FPB and the local government interested in promoting the production of benzoin gum.
2. Knowledge about the benefits of protecting secondary forest: Support the creation of **basic information of existing biodiversity in *S. tonkinensis* forests (plantations and native forests).** It suggests focusing on areas next to protected areas or to old-growing forest, to prove the theory about Styrax´s potential to form biological corridors. Surveys could be done while installing **camera traps** and by carrying out **interviews with local people (including hunters) to document local knowledge** about wild life. Activities should be done under the leadership of the Forest Protection Board of nearby protected areas, in cooperation with NGOs and or the academic sector working in biodiversity conservation, as Flora & Fauna International, TRAFFIC or a national one.
3. **Planning and implementation of pilot trials on permanent Styrax plantations with proof of economic viability**. Main argument against permanent plantations is that selected thinning or harvest is economically not feasible. However, the option of periodic income generated by Benzoin gum harvest may change this picture, and income from tapping might be attractive enough to allow the conversion of mono-aged plantations into permanent forest stands. Selected households should be escorted while doing selective harvest and keeping remaining trees for gum production until they will be ready for timber harvest. Technical guidance should be given to households, and if necessary, additional expenses should be covered. The trial should be documented in close cooperation with FPB, and sharing of experiences with NGO or International Cooperation in similar experiences (e.g. WWF, Kfw-forest projects).
4. **Participatory identification of actions to increase the value of *Styrax* plantations for biodiversity conservation**. In addition to selective harvest of Styrax gum, there might be other income

generating products from its surrounding hedges such as fruit trees and shrubs, i.e. mixed plantations that could be done by the households to improve income. The selection of measures to be promoted should be done in a participatory way, as the action must be feasible to the households. Besides being attractive to the local households, it must be financed too. This discussion could be done at workshops in field, with participation of households, forestry management boards, experts on biodiversity (NGO), local government, and of course with consultation with the exporter and client (at least in a remote way).

5. The lessons learnt of IUCN (2017) approach in **forest landscape restoration,** which is based on a process of regaining health and functionality of the ecosystems and enhancing human well-being across degraded forest landscapes in the middle part of Vietnam, might give interesting insights of what could be done in the north while improving the management of Styrax plantations and forests. DPC and its client should get encouraged to be in communication with the **Forest Protection Board,** especially in Thanh Hoa, where a couple of protected areas is in close proximity to the gum production area. The aim is to check the feasibility **in integrating *Styrax* stands** under gum production into a system of **green biological corridors**, which link high value natural forests to allow interchange of species and genetic flow.

6. There is further urgent need to identify and establish **best forest management practices for implementing benzoin gum production for the long term in native forest** under respect of existing regulations. It is still not clear how a sustainable management of *S. tonkinensis* can be done under the current logging ban. To find solutions, a dialogue is needed with the Forest Protection Board, ideally joined with experts from other initiatives with non-timber forest products. Examples are International Cooperation (Australian Aid / GREAT; KfW forestry projects) and NGOs such as WWF. One possibility is to allow households to cut bamboo shrubs in the small gaps to promote tree regeneration, and to do some thinning of *S. tonkinensis* trees in early years, the aim is to eventually preserve *S. tonkinensis* in some mosaic-spattered areas, while on the remaining areas the natural succession can continue, providing a high diverse habitat for biodiversity.

Case study: Organic chili in Vietnam

Background information

DACE is a young Vietnamese company based in Hanoi that provides technical support and market opportunities to rural households in spice production. DACE has its own processing plant to process and pack grinded species and chili sauce for export. As part of its marketing strategy, DACE has helped its supplying households to obtain organic certification. In 2018, the production of **ginger, turmeric and chili of around 600 producers was certified under the European, US-American and Japanese organic standards** in the name of DACE. Helvetas BioTrade project supported the certification process. In addition, DACE has received management trainings and support to participate in international fairs to facilitate market options. DACE also purchases and processes non-organic spices, which still represent the main part of its production volume.

DACE´s organic production areas are located in the Northeast of Vietnam, in Hà Quảng and Hòa An district of Cao Bằng province. These quite **remote districts** have been chosen for organic production as the soil is **not polluted by dioxin** residues from war. In addition, local farmers use very little agrochemicals because of their **high poverty** and scarce money. Total area of organic production is 33,2 hectare, of which organic chili covers **6,5 hectare**. In **chili production there are some 30 households** involved.

So far, DACE **could not bring its organic chili and derived products for a different price to market;** organic production has been sold mixed with conventional one to clients in South Korea, Japan and China. The company is struggling with **low productivity of organic chili,** production averages 6 - 8 tons per hectare compared to 20 tons per hectare in conventional production. In order to maintain producer´s motivation, DACE guarantees minimum prices, which are currently above the market price. This and high transport costs for the purchase of organic chili from the remote areas still leave the company so far with no profits for its organic chili. DACE's strategy is to increase the volume of organic chili by expanding its production area to 20 hectares in 2019 in order to sell to more attractive markets.

For the study, information were collected in May 2019, during visits to a collective production area of organic chili grown by a women´s group in Hòa An, and a small production areas grown by some individual households in Hà Quảng where chili production will start in 2019. The trip was accompanied by DACE´s production manager and his local field technician, and representatives from the local district government in Hòa An. There were also meetings with representatives from Planning, Growing and Plant Protection divisions of the Agriculture Department at Cao Bằng province level, and the Deputy Chief from Vietnam Organic Agriculture Association in Hanoi.

Assessment of potential of organic chili production to contribute to biodiversity conservation

The **inherent potential of chili** (*Capsicum frutescens*) **to contribute to biodiversity** conservation in Vietnam is assessed as **slightly negative,** scoring a total value of "-1" out of 16 (Fig. 18). Although spicy chili is essential in Vietnamese cuisine, it is **not native** to the region but was introduced from Latin America during the colonial period. Furthermore, chili production is done as intensive agriculture, which applies to conventional production as well as for organic production. There are **many invertebrates** that settle on chili plants, such as aphids, snails, maggots and nematodes, **but these are controlled by the producers as**

pests. The pollination is done by insects and could serve as a food source for pollen-eating insects. However, chili is also self-pollinating and fruit production does not depend on insects. Since producers generally control and rid of all insects without distinguishing between beneficial ones and pests, it is likely that even at flowering, the contribution to maintain biodiversity is very small.

Chili plants need full sunlight for optimal growth. It is therefore difficult to mix chili with other plants or even trees, and cultivation is done in monoculture. Although chili plants are perennial, yields are highest within the first year. For this reason, for commercial production as in the case for DACE, chili is cultivated as an annual crop with two crops within 7 months. This production cycle requires frequent field renewal, removing all vegetation and plowing the soil. The development of natural vegetation and biodiversity therefore is not possible.

Fig. 17: *Inherent potential of red hot chili (Capsicum frutescens) to contribute to biodiversity conservation. 2: high positive impact, 1: low positive impact, 0: neutral; -1: low negative impact, -2: high negative impact.*

Key questions	**Chili**	**Rating**
1. It is a native species?	No, introduced from Latin America	0
2. Is it a rare or endangered species?	No. Some domestic varieties might be rare, but used variety is not endangered.	0
3. It is perennial species?	Yes, but in commercial production growing cycle lasts just 7 month	-2
4. It is a key or dominant species of an ecosystem (e.g. forest stands)?	No	0
5. Is the species shade-tolerant and part of and old growing ecosystem, or a pioneer species?	No	0
6. It is an important food source for wildlife?	Pollination is done by insects, but plant is also self-pollinating	1
7. It is an important host plant for nesting for animals?	Plenty of invertebrates, but those are combated as pest	0
8. It is a host plant for other epiphytic plants?	No	0
Total		**-1**

Fig. 18 – 20: *Organic certified chili production in Hoa An district of Cao Bằng province – still quite poor in organic biomass.*

Compared to conventional chili production, organic production is much more environmentally friendly because it uses no chemical pesticides. The ingredients of organic pest control are less toxic and their effects are focused directly on the plant, and leakage of toxic ingredients into other ecosystems generally does not occur.

The advantage of organic fertilizer is more indirect. Chemical fertilizers themselves are not toxic, but become problematic when the soil has lost its regulatory function through the depletion of biomass and soil organisms. In this case, the soil cannot keep nutrients. FAO (2019) reports that fertilizer-use efficiency is very poor in Vietnam, where only 45-50% of the nutrients are absorbed by soil and the remaining 50% are washed away, resulting in a critical level of nitrate in the water. It is assumed that in organic production systems soil biomass is enriched. Nevertheless, if soil biomass keeps being low, organic fertilizer, e.g. cow dung, can cause critical nitrate levels in groundwater, too.

Organic farming thus indirectly contributes to biodiversity conservation, in particular through the **conservation of aquatic ecosystems** (river, groundwater), as well as by reduced damage to **insects, amphibians and other animals sensitive to chemical pesticides.** However, the **overall impact** of biological chili production on biodiversity is **still rated slightly negative** (Figure 21). The main reason for this is that chili is cultivated in monocultures in short production cycles. Fields are mechanically prepared every year, which hampers the creation of habitats for biodiversity.

Fig. 21: *Potential of chili in organic and conventional production system to contribute to biodiversity conservation. 2: high positive impact, 1: low positive impact, 0: neutral; -1: low negative impact, -2: high negative impact.*

Key questions	**Organic production**		**Conventional production**	
	Description	**rating**	**Description**	**rating**
1. It is grown as monoculture?	yes	-2	yes	-2
2. Is the whole species extracted, or just part of the plant?	Whole plant is removed after main harvest	-2	Whole plant is removed after main harvest	-2

3. Does the production system assume the function of a biological corridor	No, it is rather a barrier for wildlife	-2	No, as on opposite it forms a barrier for wildlife	-2
4. Does the production system allow the natural vegetation succession?	No	-2	No	-2
5. Are other species affected when product is harvested?	No	0	No	0
6. Any side-effects as constructions of roads/path, hunting?	It is done within a cultivated landscape.	0	Risk of shifting cultivation system with slash and burn of natural vegetation	-1
7. Use of chemical insecticides and fungicides	absent	2	High use of pesticides	-2
8. Use of chemical fertilizer	absent	2	In use (NPK + micro)	-2
9. Use of chemical herbicide	absent	2	Glyphosat	-2
10. Soil compacting	Mechanically soil preparation. Slight soil improvement through biomass accumulation	0	Mechanically soil preparation	-1
11. Soil healthy and fertility	Improvement through enrichment of soil biomass	1	Fertility is kept artificially while decreainig soil health	-2
12. Impact on water cycle	Increase of soil biomass is positive, but it lacks a deep root system, and rotation cycle is short	-1	Lack of deep root system, short rotation cycle, grown on bare soil	-2
13. Motivation to keep native forest	In competition to native forest, but reduction of shifting cultivation	0	In competition to native forest, shifting cultivation possible	-1
Total		**-2**		**-21**

Fragility of related ecosystems biodiversity: soil and river

DACE`s organic chili fields are partially located in the middle of the Song Bằng-river valley, which is intensively used for agriculture. Chili plots are surrounded by other agriculture fields, mainly corn and rice in conventional production. Within this location, chili production has no significant impact on terrestrial natural ecosystems such as native forest, but there is some impact on water and soil quality.

The chili plots are placed in the watershed of Song Bằng river, and some of them are planted very close to the riverbank. The river originates in Guangxi China, and flows into Vietnamese territory of Cao Bang through the border gate at rural Ha Quang District and continue into to Hoa An District where the chili production sites are. Although the river has already crossed agricultural land before reaching the chili fields, the distance from source is still short and pollution is probably still low. The river then re-enters China through the south east border gate also at Cao Bang, where it becomes one of the tributaries of the **Pearl River**, which flows into sea at Hong Kong. The Pearl River Delta is one of China´s leading economic regions, and river water there is highly polluted with hazardous chemicals (Greenpeace 2011). **From an ecological point of view, it makes sense to start efforts at the upper part of the river in Ha Quang and Hòa An districts to keep pollution at a moderate level**.

No data were found about water and soil pollution in Cao Bằng province. Representatives from **Agriculture Department of Cao Bằng province quantify the use of agrochemicals in the province as low**. In total, there are 350,000 hectare of agriculture land, on which 25,000 tons of chemical fertilizers are applied per year, and 35 tons of pesticides (equivalent to an average 70 kg/ha/a of fertilizers, and 0,1 kg/ha/a of pesticides). The low use of chemicals is related to the high poverty level in the region, as the ethnic minority mountain people (H`Mong, Nung, Tay, Dao) are too poor to spend money on agrochemicals.

Nevertheless, Agriculture Department concedes the existence of **uncontrolled trade of agrochemicals along Chinese border,** which products and volumes are not included in the official statistics. Actual rate of used agrochemicals therefore might be higher. Most pesticides are applied in rice and tobacco production.

On a global range, official rate of pesticide application in Vietnam is quite low compared to European countries and especially China (Fig. 22). Instead of this, the use of chemical fertilizer is quite high, and its use is often supported by the government, providing it free to rural households.

Fig 22: *Fertilizer consumption and yearly use of pesticides (FAO, 2019) (max/min data per year per hectare of arable land from 2010 – 2016)*

	Fertilizer (kg/ha)	Pesticide (kg/ha)
Vietnam	**310 – 490**	**1,6 - 2,9**
China	500 - 570	> 7
Germany	190 - 220	3 - 6,9
Switzerland	170 – 220	3 – 6,9

Nevertheless, although the quantity of pesticides in use according to official data is low, its toxicity is alarming. An agro-chemical shop in Hòa An district, which has been visited during the mission, has seven pesticides on offer, of which five are partially or totally banned in Europe due to its harmfulness for environment, animals and humans (Fig 23).

This data matches with Pesticide Action Network Asia (PANAP 2010) which reports that 66 % of pesticides in use in Asia are highly hazardous. However, the studies focus on risks to humans when dealing with pesticides and not on biodiversity. The World Bank (Dasgupta & Meisner 2005) documents illegal imports

of pesticides to Vietnam, and the use of banned pesticides such as Methamidophos and DDT. Thien Nhien (2014) and (LURAS 2018) reported non-correct handling of pesticides and frequent over-dosing by producers in Vietnam and neighboring country Laos

Fig. 23: *Pesticides on offer by agriculture shop in Hoa An district, May 2019.*

Active ingredient	Chemical group	use	Current application ban
Thiamethoxam 25%	Neoniocotinoide	insecticide	European Union (only indoor application allowed)
Hexaconazole 50 g/l	Triazole	fungicide	European Union
Isoprothiolane + Sulfat 50 g/kg	Ditiolate	fungicide	European Union and Switzerland
Glyphosat	Phosphonate	herbicide	France, ban discussed for whole European Union
Chlopyrifos Ethyl 530 g	Organophospate	insecticide	Germany, WHO-listed (II)
Emamectin benzonate 5 %	Avermectin	insecticide	none
Cypermethin 55 g	Pyrethriode	insecticide	none

Critical for biodiversity is especially the use of Thiamethoxam, an insecticide of Neonicotinoid-group, which is highly toxic for bees and other insects. It has been identified as one of the main factor of the current ongoing "big bee-mortally" and negative effects on plant pollination and on available food source of birds. Outdoor applications are forbidden in Europe since 2018.

B 4. Performance of supply chain actors in terms of biodiversity conservation

The conservation of biological diversity in organic chili production gets currently little attention. DACE's interest in organic production is market-driven, as it is expected to enter high pricing niche markets. DACE's technical support for growers focuses on complying with **organic certification, which does not require any specific biodiversity enhancement measures.**

According to the Vietnam Organic Agriculture Association, **consumers' motivation to buy organic products is a concern for their own health**, rather than enriching agricultural ecological habitats and awareness of soil and water pollution is low. Neither VEO nor DACE are aware of what types of pesticides are currently used in conventional production in Vietnam, as the problem of pollution is not part of their promotion strategy, and it is not addressed by the clients.

Some producers from remote mountain areas (especially ethnic groups) have a clearer understanding of the biotic interactions and the need to conserve biodiversity in order to sustain agricultural production. For example, they have expressed the need to protect birds in organic farming, as this is useful for insect control. Nevertheless, the **soil management of organic chili fields is still unsatisfactory**. The importance of biomass enrichment in soils is poorly understood by the farmer, or not done due to limited resources (many households keep buffalo and cows in the barn, and accordingly all cut plants are fed to the buffalo rather than being put on the fields.) Biomass is given to the soil only in the form of cow dung, and in some cases in such concentrated dosage that cause fatal fungal attack of the chili roots. **Only few producers apply a mulch layer, and most of them prefer the appearance of "clean" fields with bare soil** (Fig. 18 - 20).

The shift from conventional to biological agriculture requires a rethinking of the entire production system. The Provincial Ministry of Agriculture plays a key role in promoting systemic change as it often supports rural households with agricultural input such as chemical fertilizer. The Agricultural Department of Cao Bằng Province welcomes the initiative of organic farming. In 2018, local government carried out a pilot project of organic vegetable production at 1 hectare, and is now planning to support organic production for 500 hectares. It is about developing a different market strategy for local products, as low yields and high transport costs make it difficult for the region to compete at the national level. Further, main part of the province was **recently declared by UNESCO as a protected area as "Non Nuoc Cao Bang Geo Park",** because of its uniqueness of geology, and also of its traditional use of land. This is a perfect fit to promote organic farming on a large scale as part of a promotion strategy for a green and environmentally friendly province, thus finding better markets for its agricultural products - and boosting ethnic tourism. Even the Hoa Ban district's agricultural shop has expressed its interest in offering organic farming products and is waiting for concrete product inquiries to start ordering.

In addition, national policies are ready to restrict the use of highly toxic pesticides. In May 2019, the Ministry of Agriculture and Rural Development announced to **ban immediately all new imports of glyphosate-based herbicides**, and that the total ban of glyphosate "will be done in the near future" (PANAP, 2019). However, this was based on a decision by the Californian jury that found evidence of a link between glyphosate and human cancer rather than biodiversity conservation or the environment. Harmful pesticides packed in Vietnam are meanwhile freely available in **packaging which design is downplaying the danger as it looks like children's toys** (Fig. 26).

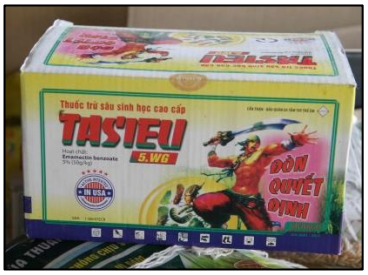


Fig. 24: *Farming cattle requires a lot of green fodder, and is in competition with mulching the fields.* ***Fig. 25:*** *Small organic certificated turmeric field of DACE in a high diverse landscape in remote mountains of Ha Quang district.* ***Fig 26:*** *Packaging of insecticide Emamectin benzonate is downplaying its danger.*

Impacts and recommendations

So far, **contribution to biodiversity conservation by DACE´s organic chili production has been quite low**. Helvetas BioTrade Project has supported DACE to become organic certified for chili, turmeric and ginger production on a total area of 33 hectare, of which chili is cultivated on 6,5 hectares. Organic certification does not require specific measurements to increase biodiversity. As organic yields are low, DACE has not yet been able to market organic produce at a different price. The company's strategy is to focus on increasing yields and expanding production, not biodiversity conservation.

According to the study, the potential of organic chili **production to contribute to biodiversity conservation is low, and even slightly negative**. The positives are:

- Organic farming contributes to keeping river and groundwater clean and is less harmful to insects, amphibians and other animals sensitive to chemical pesticides.
- Organic production allows partial improvement of soil health, but requires high inputs of biomass, which is not yet done by all farmers;

Nevertheless, there are several **negative effects** to biodiversity:

- Chili is not native to Vietnam and South-East Asia;
- The plant could contribute as a food source for invertebrates, but those are controlled by producers as pests;
- Although the plant is perennial, commercial production is done in short cycles with plant harvest after 7 to 8 months;
- Fields are mechanically prepared every year, including removal of total vegetation and soil plowing, which hampers the creation of habitats for biodiversity.

As the chili production takes place in the middle of already cultivated land, impacts to biodiversity of terrestrial ecosystems as native forests cannot be described or studied. The direct impacts mainly concern about the maintenance of water and soil quality and insect's populations because of its organic production. The **impact of agrochemical use** in Vietnam to biodiversity **has not yet been quantified, so the protection needs are difficult to quantify:**

- In Vietnam there are some heavy harmful pesticides in use, which are partially banned in Europe due to its high toxicity;
- The organic chili production takes place in the watershed of the upper part of a tributary of Pearl River, which delta is one of the most polluted at global standard. It makes sense to make efforts here to keep pollution at a moderate level;
- In economically depressed areas of Hòa An and Ha Quảng district, farmers are using just few agrochemicals. Soil and water quality and related biodiversity are probably still in good condition;
- DACE's production area of 6.5 hectares of organic chili production compared to more than 300,000 hectares of conventional production at province level is relatively small, and expected positive impact is therefore limited.

The interest in organic production is based on the manufacturer's **marketing opportunities,** and the customer on a **healthy diet**. This makes the overall performance for the conservation of biodiversity very low:

- Technical assistance is given to producers to comply with organic certification, but no further measures to keep or increase biodiversity;
- A key element in organic farming is increasing soil biomass to restore soil health and micro-organism. However, this is not yet sufficiently implemented by all producers and hinders positive impacts to biodiversity;
- Government plays a key role in promoting organic farming by providing agricultural inputs and technical assistance to households; there is a need to get closer and more involved by local government to have a better understanding of the business;

- There is an increasing interest by government to support organic agriculture in Cao Bang province, especially within the context of the recently declared UNESCO-GeoPark.
- Awareness of the needs of protecting the environment and biodiversity is virtually non-existent among stakeholders. There is a lack of basic information on pollution and biodiversity status.

Objective of Helvetas BioTrade Project is: "*To promote the conservation of biodiversity through sustainable trade in natural ingredients*." As shown, organic certification is not enough to ensure biodiversity conservation in chili production. To **empower the actors to achieve higher impact on biodiversity conservation**, the following actions are recommended:

1. In order to achieve large-scale effects of organic production on environment and biodiversity, **close cooperation** with the Provincial Ministry of Agriculture, which also advocates organic production, should be initiated by Helvetas. While DACE already coordinates some activities with the Department of Agriculture at district level, there is still a lack of a strategic orientation to **better utilize state-funded support programs for households on technical advice (to ensure soil biomass enrichment!) and allocation of organic agricultural inputs**;
2. As far as there is no information of possible intoxication of soil and water made available to farming communities, nobody is aware nor care about it. To justify investment in organic production, it is recommended that at least **samples from the Sang Bằng River are analyzed for pesticide and fertilizer residues**. Ideally, a (public) **data base** would exist about water and soil quality, managed by the Agriculture Department or by the institution responsible for water and sanitary.
3. In order to make the production of organic chili (and other spices and vegetables) in the province of Cao Bằng a success story with greater impact on biodiversity, Helvetas should provide professional support to local companies (and provincial government) involved in organic and sustainable production in technical areas such as **setting up a marketing strategy that takes into account the specificities of the region such as the UNESCO Geopark, the traditional lifestyle of the ethnic groups and the beautiful landscape**.
4. As the organic certification system does not call for any specific measures to increase biodiversity, Helvetas should encourage supply chain stakeholders to carry out a **participatory analysis of what can be done to increase biodiversity whilst improving productivity at the same time**.

Case study: Indian prickly ash in Lao PDR

Introduction

Helvetas implements a Regional Biotrade Project in South East Asia. This project is funded by the Government of Switzerland through the State Secretariat for Economic Affairs (SECO). The main goal of the project is conservation of biodiversity through sustainable trade of natural ingredients, increasing the competitiveness of local exporters/producers and livelihood benefits (income and jobs) of rural women and men. The project operates in Myanmar, Laos and Vietnam. The project started in 2017 and will end in 2020.

In Laos, one of the value chains supported by the project is that of *Zanthoxylum rhetsa*, Indian Prickly Ash, locally known as "Mak Kaen". This is a local spice, similar to Szechuan Pepper, which is also in demand in the international perfume industry. The project is supporting Dakdae, a local company to develop a new export market for this product with local producers. A preliminary study on the Indian Prickly Ash value chain was produced in 2018[4].

This report summarizes findings of a short follow-up consultancy study implemented in April 2019 to document more lessons learned on possible impacts of the project on biodiversity and compliance with Ethical Biotrade Principles from the local perspective (see TOR in Annexes).

Methodology

Ethical Biotrade Principles

The Ethical BioTrade Standard (also known as the UEBT standard) consists of seven principles touching on important social, environmental and economic issues. The standard defines ethical practices for sourcing and innovation that contribute to a world in which people and biodiversity thrive (see also: https://www.ethicalbiotrade.org). The seven principles are:

1. Biodiversity conservation
2. Sustainable use of biodiversity
3. Fair and equitable benefit sharing
4. Local economic development
5. Compliance with national and international laws
6. Respect for human, labour, and indigenous rights
7. Clarity about land tenure

Key Questions for the Case Study

a. What are the impacts on biodiversity of the Prickly Ash value chain?
b. How could the value chain contribute to biodiversity conservation?
c. What are the key lessons learned from local knowledge on the characteristics of Indian Prickly Ash that can support the export potential of this product, in compliance with ethical biotrade standards?
d. How could these conclusions help the project create an innovative approach to product and partner selection for the next phase of the project?

[4] Woda, C. 2018. Mission Report for Helvetas: Background Information to build up Indian Prickly Ash (Zanthoxylum rhetsa) value chain in Lao PDR under respect of BioTrade Principles).

Case Study Methodology

A team consisting of an international bio-trade consultant and the biotrade country program manager for Laos read available reports and designed a checklist of questions (see Checklist in Annexes). In Vientiane, they met with Ms. Anousone Phimmachanh, director of partner company Dakdae. Between 22-27 April 2019 the team traveled to the provinces of Xiengkhouang and Huaphan, where they interviewed producers in three villages (Ban Bong, Phoukoud, Ban Ern and Ban Perm in Viengxay district) and traders in province and district markets (see Itinerary in Annexes).

Findings on conservation of biodiversity

Ecosystems where sourcing takes place

Indian Prickly Ash, "mak kaen", Xanthoxylum rhetsa, is a pioneer species occurring in young forests resulting from swidden agriculture, which is the predominant land use system throughout the mountains of northern Laos.

Swidden (Shifting)agriculture has been practiced for thousands of years, it consists of slashing and burning a hillside for a one-year to grow upland rice crop for example, followed by a fallow period during which the forest recovers. Every year, farmers move to a new plot. As young forests get older, other tree species would eventually shade out Indian Prickly Ash as that was what occurred in older forests; in forests about 12-15 years old, its trees will no longer be found. The species depends for its survival on farmers opening up new plots regularly and its seeds will only germinate after a forest fire. The trees take around four years to mature.

As to the impact on the environment, swidden agriculture results in a mosaic landscape with patches of mature forest, young forest and agricultural plots that creates a very diverse ecosystem, which is very rich in biodiversity. It also provides a range of ecosystems services that support rural livelihoods directly, through provision of food security from Non-Timber Forest Products (NTFPs) and materials for house building and firewood, as well as indirectly by regulating water flows, protection against erosion, provision of clean air and water. It is important to recognize swidden land as an intermediate ecosystem between forests and agricultural land[5].

Due to changes in population pressure and government policies, e.g. changing from subsistence agriculture to commercial agriculture, the swidden system is challenged by increasingly shorter fallow periods. When fallow periods become shorter than 8-10 years, trees can no longer suppress weeds and the system degrades. It becomes more difficult for trees like Indian Prickly Ash to mature and farming becomes difficult due to a proliferation of weeds in the farming phase.

In the two sites visited during this study, fallow periods have fallen to four years or less. Farmers desiring to continue producing Indian Prickly Ash can no longer rely on harvesting the product from fallow forest land. They have tried out several alternative production strategies. In both villages, farmers tried to

[5] Castella J.C., Lestrelin G., Hett C., et al. (2013) Effects of landscape segregation on livelihood vulnerability. Human Ecology, http://dx.doi.org/10.1007/s10745-012-9538-8.

multiply Indian Prickly Ash from seed, but found out that almost all of seedlings derived from seed die within 1-2 years[6].

They also found that if they take seedlings from young forests where the species occurs naturally, taking care to preserve the roots and digging out a large clump of soil, they could transplant such seedlings to gardens around the house and those trees would survive. However this is a lot of work and it does not always work everywhere. In the village of Ban Bong, Phoukoud, Xiengkhouang, this is the predominant form of cultivating Indian Prickly Ash.

The third strategy is to select young fallow forests where there is already a high natural density of Indian Prickly Ash and then convert such patches into gardens by annual weeding, taking out all other tree species and cutting grass and weeds down regularly. This results in gardens where Indian Prickly Ash becomes the dominant species. In such gardens Indian Prickly Ash is more productive than under natural conditions it can grow taller and live up to 20-25 years before dying. Farmers usually practice a seven years fallow after the trees die, then burn the fallow and continue farming Indian Prickly Ash regenerating from the seed store in the soil. This system constitutes a 32-27 year long term rotational farming system. It is practiced successfully in the villages of Ban Ern and Ban Pherm in Viengxay district, Huaphan Province.

Impact of sourcing on biodiversity

In all three villages visited, producers claimed that they were the only villages in the vicinity who could produce top quality Indian Prickly Ash. The species occurs everywhere, but they said that in the trees in other villages either produce very little fruits and a poor smell. This means that the sourcing area for optimum quality Indian Prickly Ash is likely to be confined to a few villages where the micro-climate and soils are optimal

As observed in the background study report[7], traditional harvesting from fallows is often destructive. People tend to cut the whole tree down as a quicker way to harvest the fruits. Produce collected from forests also contains a high percentage of immature seeds. Most importantly, there are not many villages where fallow periods are sufficiently long enough to allow trees to grow to maturity.

Harvesting from gardens allows farmers to wait and select only mature fruits. Farmers observed that good harvesting techniques also requires carefully cutting of the inflorescences that hold the seed. If too much of the rest of the branches are cut, the tree will produce less seeds in the following year.

Yields are very variable from year to year, depending on rainfall. Farmers in both provinces estimate yields from the same mature tree can vary between 10-50 kg between years. They suspect rainfall has something to do with this variation, but there could also be other factors.

[6] More research into this topic maybe useful. In Bali, Indonesia, Indian Prickly Ash is multiplied successfully by seed: Hardiyanto, E.B. 2008. Seed collection and handling of Bunggal Buaya, Zanthoxylum rhetsa (Roxb.) DC. Bali Provincial Forestry Service and Regional Tree Seed Center for Bali and Nyusa Tenggara and Intenational Tropical Timber Association (ITTO). http://www.itto.int/files/itto_project_db_input/2597/Technical/pd386-05-3%20rev1(F).pdf

[7] Woda, 2018.

Indian Prickly Ash is a dioecious plant, meaning it has male and female trees. Most farmers know this and try to maintain a ratio of 10-20% of male plants. There were also farmers saying that if they cut out all the non-productive male trees, this could depress yields.

Pollination is done by insects, mainly bees. In natural forests, seeds are distributed by birds. In Huaphan, the most common birds eating seeds from Indian Prickly Ash are bulbuls: Red-whiskered Bulbuls (*Pycnonotus jocosus*) and Black Bulbuls (*Hypsipetes leucocephalus*). Between these, Red-Whiskered Bulbuls are a common bird found both in cities, farming areas and forests. Black Bulbuls are much more confined to broad-leaved forest areas[8] and can be considered as an indicator for good quality forests.

Alignment with local biodiversity conservation strategies

In all three villages visited, the main local regulations conserving biodiversity at village level are the village land use plans. They delineate strictly what areas are to be protected as conservation forests (for biodiversity conservation) protection forests (for watershed protection) and use or production forests (for harvesting forest products), as well as areas for agricultural use. For example in Ban Ern, 340 ha out of the total village area of 815 ha (40%) is set aside as production forest. So far, perhaps 100 ha out of those 240 ha have been converted to permanent gardens with Indian Prickly Ash. Villagers were very clear that they are only allowed the allocated gardens to be made in the production forest area. Doing so in the protected forest areas is illegal and will be fined.

Findings on sustainable use of biodiversity

Sustainability of sourcing of the species

As explained in section 3.2 above, harvesting Indian Prickly Ash from young fallow forests is not very sustainable. In many places, harvesting is practiced by cutting trees down and in many places, swidden cycles are shortened to the extent that Indian Prickly Ash trees cannot reach maturity. Harvesting from domesticated gardens as done in the three villages visited is much more sustainable and also provides a sustainable process for preserving the genetic source of the species, rejuvenating stands from seed every 30-40 year. The long-term solution is to take Indian Prickly Ash out of the swidden domain and domesticate it in the agricultural domain, in selected locations where soils and climate provide the best quality of the produce.

Documentation and enforcing sustainable use practices

There are no documents prescribing sustainable use practices. The cultivation of Indian Prickly Ash from gardens is quite sustainable and farmers have a clear interest in maintaining their gardens to keep it productive.

Linking purchasing schedules to harvesting seasons

The seeds of Indian Prickly Ash mature around September-October. Most traders prefer to buy the fresh seed from farmers because it allows them to see what seeds are ripe (red color). Farmers sell the bulk of their produce fresh, any remaining amount they may dry themselves and sell during the rest of the year on local markets.

[8] Robson, C. 2005. The New Holland Field Guide to the Birds of Southeast Asia.

1.1 Mechanisms for mitigating negative environmental impacts

There are not many negative environmental impacts from sourcing Indian Prickly Ash from gardens. Farmers do not apply any external inputs (no fertilizers, no chemicals) and they only harvest the seeds, leaving the trees to protect the soils. Soil fertility is maintained by allowing cattle to graze in the gardens every year in the dry season (from December to June). The potential risk of converting all village forests to gardens is being mitigated by village land use plans, which are already in place and are being respected.

Findings on equitable sharing of benefits

Actors, prices, equitable benefit sharing

The main actors along the value chain are: (1) village producers (2) district traders (3) retail traders in markets at district and province level. The prices vary according to the stage of the product. Farmers usually sell fresh fruits with twigs (complete inflorescences) sold around 13,000-15,000 kip/kg. Farmers quote 15,000 kip/kg as their present price (April 2019).

Traders quote a slightly lower price of 13,000 kip/kg, which is likely what the price was in November 2018. Traders usually air-dry the product for a week or so; it takes about 4 kg of fresh produce to get 1 kg of dried produce. The dried inflorescences are sold in bundles ("mat"). These are sold for 5,000 kip each, with 12 bundles making up a kilogram, that gives a price of 60,000 kip per kg. That is slightly more than the buying price of 13,000 kip/kg for fresh fruits (see table 1).

Separating twigs from dried fruits takes another 20% of the weight. The mixture of dried fruit capsules with black seeds is sold for 100,000 kip/kg. The brown seed capsules are the most valuable part which contains most of the flavor. Some traders also sell the capsules only without the seeds, which halves the weight again. These dried capsules only sell for 200,000 to 25,000 kip/kg (see table 1)

One trader also explained she regularly sends bags of dried inflorescences by bus to her relative in Vientiane Capital City for retail sales there. The transport cost is 50,000 kip for two bags of 30 kg each.

Overall, the picture shows a reasonable sharing of costs along the chain. Other than drying there is little processing done along the chain.

Table 1: Prices of Indian Prickly Ash (Mak Kaen) in two locations in northern Laos, April 2019.

Product stage	Fresh fruits with twigs	Dried fruits with twigs	Dried fruits with seeds without twigs	Dried fruit capsules without seeds
Weight conversions (kg)	10.0	2.5	2.0	1.0
A: Village level				
Ban Bong, Phoukoud, Xieng Khouang	15,000	60,000		
Ban Eun & Theum, Viengxay, Huaphan	15,000	60,000		
B: District level				

Viengxay, Huaphan	13,000	60,000	100,000	200,000
C: Province level				
Phonesavanh, Xiengkouang				250,000
Income from 10 kg fresh produce	150,000	150,000	200,000	250,000

Contributions to local sustainable development

Indian Prickly Ash provides 9-23% of household income in the villages visited. (see section 6.1 below). It occupies between 1-12.5% of the land area per village. Indian Prickly Ash gardens also provide roughly 50% of the grazing area used by local cattle in Ban Eun. Local cattle and buffaloes provided 2 million kip per household per year (15% of household income). The income from selling Indian Prickly Ash was 3 million kip per household per year, 23% of household income. The total income effect of the Indian Prickly Ash gardens can thus be estimated to be 5 million kip (including from cattle and buffaloes) or 38% of total household income.

Recognition of traditional practices and knowledge

The farmers in all three villagers were very knowledgeable on Indian Prickly Ash production and had developed their own innovative solutions to cultivate this tree as a crop, to resolve the problem of dwindling returns from natural fallow forests.

All three villages are convinced that they are the only ones producing top quality Indian Prickly Ash in the wider area of their district/province. Especially famous locally is Ban Eun, Huaphan. It is such well known for its good quality that farmers from other villages has started selling their produce as “from Ban Eun”. The village is keen to find ways to protect their unique quality and brand name, but they do not know exactly how.

Findings on socio-economic sustainability

Importance of Indian Prickly Ash for Household Income

The number of trees owned per household was the main determinant of household income from Indian Prickly Ash. Annual Household income from Indian Prickly Ash ranged from 0.75 to 3 million kip (see table 2). The overall impression is that farmers could not sell all of their produce to maximize income. Based on their own estimates of numbers of trees owned and amounts sold, it would seem that they sold perhaps 5-20% of their potential production.

Table 2: Yields and income of Indian Prickly Ash farmers in three villages in northern Laos, April 2019

Village	Ban Bong	Ban Eun	Ban Perm
District	Phoukoud	Viengxay	Viengxay
Province	Xiengkhouang	Huaphan	Huaphan
average yield per tree (kg/tree)	25	30	30
average planting distance (mxm)	10x10	4x4	4x4

average density (no trees/ha)	100	625	625
average fresh yield (kg/ha)	289	18,750	18,750
No. producer households	30	74	32
Average number trees/household	10	50	100
Potential village production (kg)	7,500	111,000	96,000
Potential per household (kg/hh)	250	1,500	3,000
Actual sold per household (kg/hh)	50	200	150
% sold	20%	13%	5%
Price fresh produce (kip/kg)	15,000	15,000	15,000
Income per household (kip/hh)	750,000	3,000,000	2,250,000

Indian Prickly Ash is a minor source of income in all three villages visited, providing between 9-23% of household income (see table 3). The main income source in Ban Bong were wild mushrooms (sold to Lao, Chinese and Japanese markets). The main income source in Ban Eun is selling rice, and in Ban Perm, it is the exquisite traditional silk weaving produced by the Thai Daeng ethnic women there.

Table 3: Role of Indian Prickly Ash in household income in three villages in Northern Laos, April 2019

Village	**Ban Bong**	**Ban Eun**	**Ban Perm**	**Average**	**%**
District	Phoukoud	Viengxay	Viengxay		
Province	Xiengkhouang	Huaphan	Huaphan		
Selling Rice		20.0	3.0	11.5	78%
Weaving	1.2	4.0	12.0	5.7	39%
Selling Mushrooms	5.0			5.0	34%
Selling Bamboo Poles		4.0		4.0	27%
Livestock Sales	1.0	2.0	9.0	4.0	27%
Indian Prickly Ash	0.8	3.0	2.0	1.9	13%
Beekeeping	0.3			0.3	2%
TOTAL	**8.3**	**13.0**	**23.0**	**14.8**	**100%**
% Indian Prickly Ash	**9%**	**23%**	**9%**	**13%**	**13%**

Quality management

The best quality is strongly dependent on the location and on harvesting mature fruits. The local criteria for assessing quality are: the aroma, the size and the color of the seed. The best quality has a rich smell,

small seeds and the fresh seed capsules are red in color when ripe. Villagers discern three types of Indian Prickly Ash:

1) *"Mak Kouang",* leaves and trees look the same as Mak Kaen, but the inflorescences have thorns, they produce big seeds, little smell, lowest quality. These fruits are normally not sold.
2) *"Mak Kaen mi nam lai",* Red Indian Prickly Ash, the inflorescences have a lot of thorns, the fruits capsules are red even when not yet ripe and small, the aroma is so rich. This is the best quality and the number of the trees is so much lesser than the third one
3) *"Mak Kaen mi nam noiy*", Green Indian Prickly Ash, the inflorescences have no thorns, fruits are bigger than the second one, and the seeds capsules are green when young, turning red only when they mature and have less rich aroma. This is the medium quality

There is also a similar product called "Mak Mart", Szechuan Pepper, which belongs to another Zanthoxylum species. The leaves are much smaller, the seeds much bigger and have a more pungent, harsher taste. These do not occur in the natural environment of the villages visited, but a few households had 1-2 plants in their gardens, imported from elsewhere.

The potential buyer, a French Perfume Company, analyzed some samples of Indian Prickly Ash from Laos, collected by the Dakdae company. According to this analysis, the samples from Ban Ern in Viengxay, Huaphan, were of the highest quality. While this confirms local preferences, having the quality assessment done at the end of the value chain in France creates the risk that if shipments may turn out to be of bad quality this will only be found out when it is too late. It would be good if the project and its partners could have a dialogue on options for preliminary quality testing at the producer-end of the value chain, so that only the best quality product will be shipped to France.

Options to ensure traceability
At present, there is no system for tracing the origin of the product. However, the buyer requires local company and producers to estrablish traceability system once they have agreement of export.

Findings on compliance, respect for rights and clarity about land tenure

Compliance with international legislation
None of the stakeholders is aware of CITES or other international legislation.

Compliance with national legal requirements, taxes and fees
The production complies with local legal requirements. Taxes are paid for land use.

Respect for the rights of actors
All gardens are managed by individual households, there is no hired labor involved.

Clarity about land tenure
All the Indian Prickly Ash gardens have individual ownership which is well recognized in the community. While these gardens have no land titles, the ownership is not in dispute. So far, no land has been transacted in either of the three villages. This may change in the future.

Conclusions

Impacts on biodiversity of the Prickly Ash value chain
Indian Prickly Ash naturally occurs in fallow vegetations in a landscape where swidden agriculture is the prevalent land use system. This system is only viable if fallow periods are maintained at a length of 8-15

years. If fallows are longer than 15 years, the species will be shaded out by other tree species. If fallows are shorter than 8 years, the trees will not be able to grow to maturity and eventually lose out to weeds.

Harvesting in natural fallow forests is often destructive, where people chop the trees down to get the fruits. There is also little control over harvesting mature fruits only instead of chopping the trees. As fallow periods are getting shorter due to landscape changes as a result of population pressure and policy changes, farmers need to find alternative production systems for Indian Prickly Ash.

In the villages visited, farmers have developed systems for converting fallows where Indian Prickly Ash naturally occurs into permanent Prickly Ash gardens. As they found it very difficult to multiply this species from seed, they establish these gardens from planting seedlings already occurring in the vegetation and promoting their growth by eliminating other species and weeding regularly.

This system is an excellent way to optimize production and protect the genetic resource of Indian Prickly Ash. The reduction of biodiversity in these gardens is compensated by delineation and conservation of other parts of the village land as conservation forests.

How the value chain could contribute to biodiversity conservation

There are big variations in quality of Indian Prickly Ash. The best quality product can only be found in a few villages per province in Northern Laos. These villages seem to have a unique forest ecosystem, soils and micro-climate that promotes the most aromatic variety of Indian Prickly Ash. Other villages may have the species as well but cannot produce the same quality. Therefore promotion and conservation of Indian Prickly ash in these selected “hotspots” is vital for the sustainable production of the species. As the specie now comes under threat from the swidden system and the resulting shortened fallow period which it is becoming difficult for the specie re-produce naturally, the innovative Indian Prickly Ash gardens created by villagers are a promising sustainable production system that will preserve the genetic resources of the species.

Key lessons learned from local knowledge on export potential

Initial tests from the potential export buyer confirmed that the highest quality of Indian Prickly Ash is derived from Huaphan Province. Therefore it would seem logical for the project and the Dakdae company to start exploring the export potential with the superior quality produce from that area. Farmers should be paid a premium for their efforts to produce the superior quality produce. At the same time, it would seem likely there are similar exceptional villages in other provinces in Northern Laos. An effort should be made to identify other potential villages. The producer group found in Xiengkhouang could have potential for export as well; a sample of their product should be sent to France for further testing.

Implications for the next phase of the project

Consultants were not in a position to compare the quality of Indian Prickly Ash from Laos to the produce from countries like Sri Lanka and Indonesia. So it is difficult to gauge the relative advantage of the Lao produce on the world market. As the first test results for the samples from Huaphan were encouraging, it is recommended that the next phase of the Biotrade Project should include Indian Prickly Ash as a unique niche product. Good quality produce is only found in a few selected villages; these rare resources need to be protected and their production promoted. With better prices and increased demand from export, local communities will be able to improve their livelihoods and incentivized to protect biodiversity in their wider village area.

Case study: Jujube in Myanmar

Summary

The following case study has been carried out on BioTrade value chain of Jujube in Myanmar, in the framework of the Regional BioTrade Project South-East Asia. The objective of this case study is to give a brief assessment whether the BioTrade project in Myanmar is contributing to the conservation of biodiversity in the jujube production areas.

Jujube trees are mainly found in the central Dry zone of Myanmar, in the Mandalay, Sagaing and Magwe Region. Two species of jujube trees are found in this area: the Chinese jujube (*Ziziphus jujuba M*.) recognized in this area as the 'sweet' jujube species, originates in northern China and widely grown in mild-temperate climate. The Indian jujube (*Ziziphus mauritiana L*.) recognized in this area as the 'sour' jujube species is well adapted to dry areas of tropical and sub-tropical countries and originates from India and South Asia. During this study we identified the following jujube species and varieties - as per information from Department of Agriculture, Nyaung-U Township - that we refer to in the rest of the report: *Ziziphus mauritiana ('*sour jujube'*):* Zee- chin-thee and *Ziziphus jujuba* ('sweet jujube'): Zee-taw-thee (Chinese jujube), Pyar-yay-san (honey jujube), Zee Kwe Thi, A Sae Lut, Taiwan jujube, Thai jujube.

This study was conducted in May 2019 through the collection of qualitative data using interviews with actors involved in the production, processing and trading of jujube-derived products in this area, and through direct observations and transect walks in three villages/towns in Chauk Township (TSP) in Magwe Region, and three villages/towns in NyaungU TSP in Mandalay Region.

The findings show that there is a sustainable production and collection practices in this area, with a maintained regeneration rate. The collection of the fruits does not usually affect the trees, as farmers wait until the fruits mature and fall on the ground before collecting them. Only in the case of a high demand, farmers use long bamboo sticks with installed hooks to pick half-ripe fruits causing unintentionally the branches to break. Farmers generally do not propagate the jujube trees, they just prune them to rejuvenate the tree and keep the strong roots in the soil.

After the fruits fall from the trees when they ripe, the farmers collect and sun-dry them on open fields. The fruits are sold dried to the so-called 'seed traders', to middlemen who buy the fruits in assembling points from farmers, or directly to company processing jujube fruits.

There are different derived products of the *sour* and *sweet* jujube species. The main products derived jujube are: Endosperm inside the seed (only from the sour jujube species) is used in the Traditional Chinese medicine; dried fruit is made from sour and sweet jujube species; fresh fruit from some of the sweet jujube species only; powder from the dried pulp to make jaggery; low-quality product is turned into fodder; and broken parts of the seed shell is used for fuel. The BioTrade selected company Salay Shae Saung Co., Ltd used the '*sour*' jujube trees species to produce the jujube syrup (potential Biotrade product) among other products. To obtain the syrup, the dry jujubes are boiled in water with sugar.

Jujube seed processors and jujube factory laborers rely entirely on this activity for their yearly income generation, while jujube farmers (farmers who own the land where jujube trees grow spontaneously) is committed to maintaining and managing their jujube trees as the fruits generate a stable partial income.

HELVETAS VIETNAM LAOS MYANMAR

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Women play a major role in the jujube production and marketing: most of the laborers working in the seed processing plants and jujube factories are women.

There is an increase of the presence of the '*sour*' jujube trees species, which are considered more valuable than cash crops (ground nuts and pulses) by many farmers as they provide a stable income with no risks and almost no costs.

In the archaeological area of old Bagan, the jujube trees merge with the historical and cultural landscape. Jujube trees are good for climate stability and they provide precious ecosystem services. The jujube trees offer habitat to wildlife, like small deers, rabbits, birds like the endemic 'white-throated Babbler', squirrels, etc., spiders, insects, wild bees and reptile such as the Indo-Chinese forest lizard. BioTrade initiative should consider producing different varieties of the same species.

Introduction

Case study framework and objectives

The present case study on jujube in Myanmar is one of the three studies carried out on potential BioTrade value chains, respectively in Laos PDR, Vietnam and Myanmar, in the framework of the Regional BioTrade Project South-East Asia (2016-2020). The Regional BioTrade project currently implemented by Helvetas Swiss Intercooperation in Myanmar, Vietnam and Laos PDR, is financed by the State Secretariat for Economic Affairs (SECO), Government of Switzerland; it aims to create biodiversity-related economic opportunities in Myanmar, Vietnam and Laos, by creating business models for sustainably sourced, traceable and value-added natural ingredients that are derived from biodiversity. The objective of the Regional BioTrade project is the conservation of biodiversity through sustainable trade in natural ingredients in a manner that increases the competitiveness of local exporters/producers and the livelihood benefits (income and jobs) of rural population by taking into account all relevant ethical Biotrade principles and criteria.

The overall goal of the present case study is to help the BioTrade Regional project better understand the impact of the project on biodiversity. The case study's objectives are:

1. Briefly assess in a qualitative manner whether the Jujube value chain in the dry area of Myanmar is contributing positively or negatively to the conservation of biodiversity in the area.
2. Drawing conclusions about how the jujube value chain contributes to preservation of biodiversity.
3. Contribute to capturing key lessons learned about what characteristics of products or species can be taken into account and supplement the selection process of value chains in the current phase of the project -a focus on *export potential assessment – and* for an approach improvement to select product and partners for the next phase of the project.

The jujube trees

Jujube trees are mainly found in the central Dry zone of Myanmar, in the Mandalay, Sagaing and Magwe Region, although a small number of trees is also grown in other parts of the Country, like Rakhine as well the Yangon Region, Ayeyarwady and the South-eastern coastal area. According to the Department of Agriculture, Nyaung-U Township and the University of Yangon (2018), two species of jujube trees of the Rhamnaceae family are found in Myanmar: the Chinese jujube (*Ziziphus jujuba M*.) originated in northern

China and widely grown in mild-temperate climate region, and the Indian jujube (*Ziziphus mauritiana L*. and *Ziziphus mauritiana var. abyssinica*) better adapted to dry areas of tropical and sub-tropical countries and originated from India and South Asia. In Myanmar, people recognize *Ziziphus jujuba* as sweet jujube fruit trees, *and Ziziphus mauritiana* as sour jujube fruit trees. The jujube tree flowers between December and February and its fruits can be harvested between March to end of April. The sour jujube species are more common in the central Dry zone, while the sweet species can be found also in the southern coastal area.

During this study we identified the following jujube species and varieties, that we refer to in the rest of the report:

Species:	Variety local name
*Ziziphus mauritiana ('*sour jujube'*)*	Zee- chin-thee
Ziziphus jujuba ('sweet jujube')	Zee-taw-thee (Chinese jujube)
	Pyar-yay-san (honey jujube)
	Zee Kwe Thi
	A Sae Lut
	Taiwan jujube
	Thai jujube

Methodology

The study was conducted in May 2019 by a team comprised of Alessandra Giuliani (HAFL, Myanmar, BioTrade consultant, AG), Thet Thet Mar (Deputy BioTrade Regional Manager, TTM), and Saw Min Aung (BioTrade Myanmar, National Value Chain Officer, SMA). We collected qualitative data through a rapid assessment on how Jujube value chain in the dry area of Myanmar is contributing positively or negatively to the conservation of biodiversity. For the rapid assessment, we used qualitative in-depth interviews with actors involved in the production, processing and trading of products derived by the jujube growing in this area, direct observations and transect walks (see Annex 1). During our field work (Itinerary in Annex 1 and maps in Annex 2), we visited three villages/towns in Chauk Township (TSP) in Magwe Region, and three villages/towns in NyaungU TSP in Mandalay Region. A total of 14 actors (Table 1) involved with the production and marketing of jujube were interviewed using a check list of questions (see Annex 3).

Table 1: Actors involved in the jujube production, processing and market interviewed

#	type of actor	town	TSP	Region	gender
1	seed processor	Seik Phyu	Chauk	Magwe	M
2	seed processor	NyaungU	NyaungU	Mandalay	F
3	factory	Salay	Chauk	Magwe	F
4	factory	Salay	Chauk	Magwe	M
5	farmer	Salay	Chauk	Magwe	F
6	farmer	Zeekhon	Chauk	Magwe	F

7	farmer	Zeekhon	Chauk	Magwe	M
8	farmer	Zeekhon	Chauk	Magwe	M
9	farmer	Salay	Chauk	Magwe	M
10	scientist	Pakokku	NyaungU	Magwe	M
11	vendor-farmer	Bagan	NyaungU	Mandalay	F
12	vendor-farmer	Bagan	NyaungU	Mandalay	F
13	farmer	Bagan	NyaungU	Mandalay	F
14	scientist	Bagan	NyaungU	Mandalay	F

Findings

The findings are presented around the contribution to biodiversity conservation of jujube –some of its derived products have been selected as potential Biotrade products in Myanmar by the BioTrade Regional Project, namely the jujube syrup produced by Salay Shae Saung Co., Ltd, from Salay, Chauk TSP, Magwe Region. The findings are based on the inputs we received from the interviews, direct observations and transect walks conducted in the selected area.

Sustainable production and collection

The Jujube trees located in the research area in the dry zone of Myanmar are mainly wild trees managed in the forest areas, and sometimes domesticated. However, the land where these trees grow belong to farming families, so all the trees are privately owned.

The farmers whom we interviewed own between a few trees up to 100 trees growing in their land. Many trees are more than 50-year-old. The 'Sour' jujube species is considered very valuable and 'a gift of nature' and the demand for endosperms of their fruits is high and stable and so the trees are well managed. On the other hand, the demand has strongly declined in the last five years for one jujube variety with 'sweet' flavour, whose fruits are less fleshy, and the seed kernel breaks easily because its characteristics are not suitable for industry purpose. This is the reason why some farmers cut down many jujube trees of this variety (Zee Kwe Thi) and replace them with other marketable crops such as fruit trees and ornamental flowers.

The fruits are collected between March and end of April. The collection of the fruits does not usually affect the trees. Most of the time, farmers wait until the fruits mature and fall on the ground before collecting them (see Fig. 8). Only when the demand of fruits is high, some of the farmers use long bamboo sticks with installed hooks at the top, to shake the branches with partially ripe fruits, sometimes unintentionally breaking branches. However, according to the respondents, the regeneration rate is maintained, and the fruit collection practices are also considered sustainable by the researchers of Forest Department of the Ministry of Natural Resources and Environmental Conservation (MoNREC), Pakokku Township office whom we interviewed.

- Farmers generally do not propagate the jujube trees, they just prune them to rejuvenate the trees and keep the strong roots in the soil. If the tree is old (more than 30 years), the production is lower, so the owners prune the trees to rejuvenate them.
- In Nyaung U, we visited the Horticultural Research Farm (of the Department of Agriculture- DoA). The Manager of the centre explained to us that they are the only research farm growing experimental plots of jujube in Myanmar. They propagate the jujube trees and recently, through a project funded by CESVI, they provided local farmers with the plantlets.

Marketing

Jujube trees fall under the national categorization of Non-Timber Forest Product (NTFP), and also under the industrial category, meaning that jujube is considered an industrial crop product, so it can be processed and traded nationally and internationally (pers. Comm. Forest Department of MoNREC, Pakokku Township office).

Farmers collect the fruits from the trees growing on their land mainly to sell for income. An insignificant amount of the collected fruits is kept for household consumption. The drying of the fruits is the usual post-harvest process applied by the farmers, and it is done on by sun-drying the fruits on open fields at home or at the farms, either leaving them on the sand, or using mats of different material (including bamboo and plastic). The sun-drying takes about 3 to 4 days. The sun-drying on the sand is considered by some farmers as a way to keep a better colour of the fruits and also to kill any pests in the fruits. The use of mats eases the fruits collection once they are dried. Some jujube processing companies, including Salay Shae Saung Co., Ltd working with BioTrade project, are searching for improved drying system to enhance food safety and quality management issues. The fruits are usually sold to the so-called 'seed traders', to middlemen who collect the fruits in assembling points or from the farmers, or directly to company processing jujube fruits. Both fruits from the *sour* and *sweet* jujube species are collected and traded. It is a different story for farmers living in very remote areas and having limited transport means. They do not collect the fruits as they cannot sell them.

The derived products of the *sour* jujube species differ from those of the *sweet* jujube species and their values also differ (see Table 2). The main products derived by jujube in this area are:

- Endosperm inside the seed only from the sour jujube species – used in Traditional Chinese medicine. The endosperm is extracted from the dried fruits of the sour jujube species with a machine, owned by seed traders.
- Dry fruit from sour and sweet jujube species, fresh fruit from some of the sweet jujube species only. The sun-drying process is mainly done by the farmers on open fields.
- High quality cracked dried pulp of the fruit (including skin) used to make powder for toffee and jaggery. They are mixed with toddy palm sugar, or with salt and ginger. This process is mainly done at the jujube processing factories, but it can also be done in small scale by farmers in their homes.
- Cracked dried pulp of the fruit (including skin) – low quality used for animal fodder (rich in protein 18%), high quality to make powder used for toffee and jaggery

- Broken part of the seed shell (mainly from sour jujube varieties with hard seeds)– used for producing fuel for special stoves mainly by the toddy palm juice industry and brick baking factory
- Powder by-product(broken pieces) from the spitting the pulp from the seed. The better quality powder is used for toffee and mixed with toddy palm sugar to make jaggery; the lower quality is used for animal feed. The least quality (mixed with parts of seed shell) is used as manure and also for red-colour mixing in the brick-baking factory (MoNREC, 2012).
- The old branches after pruning the trees are used as fire wood and to make fences around the house garden, to keep the farm animals in the yard.

In particular, the BioTrade selected company Salay Shae Saung Co., Ltd used the '*sour*' jujube trees species to produce the jujube syrup (potential BioTrade product) among other products. To obtain the juice, the dry jujubes are boiled in water with sugar. After the extraction of the juice process, the remaining seeds are sold to the seed traders. The company buys back the broken seed shells after the extraction of the endosperm by the seed traders, to be used as biofuel in the company.

In general, there is an increase of the presence of the '*sour*' jujube trees species due to an increasing demand for the seed endosperm, used in the Traditional Chinese medicine and requested for export to China and Korea. *Sour* jujube tree species are considered by farmers more valuable than cash crops like ground nuts, pigeon pea and other pulses, as they provide a stable income and the trees needs almost no inputs, translating in practically no costs and very limited risks. However, Naftali et al. (2008) report that *Ziziphus jujuba* (so the sweet jujube species) are also used in the Traditional Chinese medicine, the pulp of the fruits can be applied to cure different diseases and conditions. This was not reported by any of the interviewed actors.

A problem that has been reported by the company is that the fruit season is a short one (about 3 months), so the processing companies cannot work the whole year round. However, almost all the fruits are sold by May. The storage of the dry jujube is done in wooden large storage room at the seed traders' plants. These stored fruits can be damaged by rats and insects.

The price of jujube varies :

product	price	Other information
Dried fruit of sour jujube species	between 2500 and 3300 Kyats per ***Tin*** (Myanmar traditional unit of volume measured by big basket that comprises 40.91 Litres; 1 *Tin* comprises 16 *Pyi, i.e.* small baskets)	This year (2019) farmers could sell up to 4500 Kyats per basket. The demand has been stable in the last five years
Fresh fruits of sweet jujube species	1000 Kyats per *Pyi* or small basket	The market exists for some of the *Ziziphus jujube* varieties (see Table 2). Some farmers reported that the market of *Ziziphus jujube* varieties is decreasing

Socio-economic importance

Interviewed stakeholders relying on jujube as income generating activities are: i) farmers who collect the fruits from jujube trees managed in their land. The farmers usually dry the fruits before selling them to the jujube factory or jujube seed processors, ii) jujube seed processors, who buy the dried fruits from the farmers, and they separate the seeds from the pulp and trade the different derived products, iii) jujube factories, who buy the dried fruits from the farmers and other part of the fruits from the seed processors, hiring labourers to process the fruits into juice, jaggery and toffees; iv) retailers of jujube derived products, usually on local small stalls or local shops.

Jujube seed processors and jujube factory labourers rely entirely on this activity for their yearly income generation, while jujube farmers (farmers who own the land where jujube trees grow spontaneously) keep maintaining and managing their jujube trees as they bring a stable partial income generation. The knowledge about and the value of maintaining jujube trees is transmitted from generation to generation. For some farmers, jujube trees' income represents a tiny marginal income, but they continue to manage and conserve the trees, and collect the fruits honouring their ancestors.

Women play a major role in the jujube production and marketing: most of the laborers working in the seed processing plans and jujube factories are women. Women are active in managing the jujube trees, and most of the jujube products retailers in the local market are women (Figure 1,2,3).

Fig 1: Women separating the pulp from the seeds in a seed trader plant (Photo AG)

Fig 2: Women working on toffee making at jujube company in Salay (Photo AG)

Fig 3: Women selling dried fruits and toffees in front of Pagodas in Old Bagan (Photo AG)

In particular, at the Company Salay Shae Saung Co., Ltd, 45 women are employed (of whom 4 husbands are also employees).

Biodiversity

Farmers consider (sour) jujube more valuable than cash crops, that it is why they continue to conserve and manage the trees. Almost no inputs are used to manage the jujube trees. The dry land landscape is typically designed by Mother Nature to be most ideal for jujube and toddy palm trees. In particular, in the archaeological area of old Bagan, the jujube trees merge with the historical and cultural landscape. The big trees are traditionally used as shade in front of the houses, jujube toffees are sold at the entrance to temples and pagodas in Old Bagan (Fig. 6). In this area, people add sour jujube to their curries too.

Fig.4 is in Old Bagan, in the archaeological temple area, very recently awarded the UNESCO World Heritage, jujube trees are part of the landscape and jujube taste is part of the local culture. In Fig .5, Jujube toffees and jaggeries are sold outside the entrance to old and sacred pagodas and temples. Fig 6 shows a typical small local food shop under the shade of a jujube tree, owned by 'jujube farmers' and called 'Jujube restaurant' (Fig. 6).

Fig 4: jujube trees are part of the landscape in Old Bagan (Photo AG)

Fig 5: jujube toffees are sold at the entrance to temples and pagodas in Old Bagan (Photo AG)

Fig 6: local food shop in Old Bagan called 'Jujube restaurant' (Photo AG)

The farmers and the two researchers met during the field visit and identified the two species (sour and sweet species) and their different varieties, though there is still some confusion among them. There is limited research in Myanmar and a lack of official classification in the area. The situation of the two main jujube species (sour= *Ziziphus mauritiana* and sweet= *Ziziphus jujube)* and their varieties is not the same. The 'sour jujube' growing in this area belongs to the *Ziziphus mauritiana*, also called Indian jujube, and thought to be introduced in Myanmar from India hundreds of years ago. One variety of the *Ziziphus mauritiana* is found here, named 'Zee- chin-thee'. The 'sour' species is well maintained as there is a stable market. In fact, this variety is mainly traded and demanded for the endosperm (seed kernel), which is used in traditional Chinese medicine and demanded and exported to China and Korea[9]. This variety is also used for other products (see Table 2): juice, toffees and jaggery (mixed with toddy palm jaggery).

Table 2: Variety name, characteristics and derived products of the *sour* and *sweet* jujube species

Species:	Variety local name	Fruit and seed shape	Derived product	comment
*Ziziphus mauritiana ('*sour jujube'*)*	Zee- chin-thee	small, round, bright red	Juice, jaggery, toffees, endosperm for export (trad. Medicine), seed coat	High demand
Ziziphus jujuba ('sweet jujube')	Zee-taw-thee (Chinese jujube)	Big oval fruit with edge, small hard seed,	Fresh or dry fruit	Limited market
	Pyar-yay-san (honey jujube)	Oval fruit, seedless	Fresh fruit	High demand for fresh fruits but very limited number of trees as it is difficult to propagate. Only found in Salay TSP

[9] Info source: Kaung Ya Nant Int'l Trading company, Yangon

	Zee Kwe Thi	Small, little pulp, seedless	No or very limited market	Difficult to get information about this variety. Farmers in Zee-Khone are cutting trees due to declined market in last five years
	A Sae Lut	Oval fruit, no hard seed	Fresh/dry fruits	Only maintained in the research farm in Nyaung U and distributed to farmers
	Taiwan jujube	Big oval fruit without seed		maintained in the research farm in Nyaung U and distributed to farmers
	Thai jujube	Oval fruit with seed		maintained in the research farm in Nyaung U and distributed to farmers

The 'sweet' jujube is only used for fresh or dried fruits, eaten as snacks in Myanmar. The most appreciated sweet varieties are those with big oval sweet fruit and soft seed. Some of the 'sweet' species varieties are neglected because they are considered to be of inferior taste for the market. The Pyar-yay-san - one of the varieties of the 'sweet' species -is less abundant, as it difficult to propagate, though there could be a potential market demand. If demand is created, it would exceed the limited current supply, due to the highly specified required environmental conditions that makes it difficult to grow in a larger area or in any slightly different environment . However, the market for the sweet variety Zee Kwe Thi for dried or fresh fruits seems to be declining, so farmers prefer to substitute these trees with cash crops. The variety having small fruit (less pulp) and no seeds is the one that is mostly neglected, as there is non-existent or limited market for its fruits.

BioTrade project is currently working with a local company producing the 'sour' jujube products (juices and jaggery) as well the 'sweet' variety 'Zee-taw-thee' with juicy fruits suitable for dried fruit snacks. When selecting BioTrade products, the situation of the different varieties of the same species should be considered: not only the species are to be supported for BioTrade products, but also the specific varieties, that may be appreciated or neglected due to their different traits.

Jujube trees grow well amongst other plants whether wild, managed or domesticated species. Other plants that are also very adaptable to the very dry zone such as the Chinese tamarind, Acacia (local variety and the introduced one from Australia which is considered invasive), Neem and the Toddy palm.

Respondents indicate that jujube trees are good for climate stability: they are the best adaptable tree in the dry zone. The researchers at the Forestry Dept. of Pakokku explained that jujube trees in the region contribute to soil improvement, has its own efficient water holding capacity, climate regulation function, reduction of soil evaporation and good for maintaining the sand near the riverbank. In fact, the jujube trees growing around the riverbanks in the Salay TSP is providing precious ecosystem services to the surrounding environment. The performance of this important function is ever the more crucial and relevant in the Salay area, where the extraction of sand has narrowed the river thereby affecting water supply and water level, which goes down very quickly in the dry season and being worsened by climate change effects (Fig. 10).

The jujube trees are well connected with the forest and offer habitat to wildlife, offering shelter and fodder to wild animals like small deers, rabbits, birds, squirrels, etc., which eat their fruits. The jujube trees offer habitat to birds (food and shelter, as they nest in the grooving branches) and they provide shading for animals and human activities (fence and substitute for fire-wood). In particular, one bird species living in the jujube trees environment is the endemic bird to Myanmar 'white-throated Babbler' (*Turdoides gularis*), a species of bird in the family Leiothrichidae locally named as 'Swe'. (http://www.wildlifephelps.com/magical-myanmar. (Shown in Fig. 7) Sightings of Swe are reported by jujube and thanakha farmers interviewed in previous BioTrade studies. According to IUCN, the population of the 'white-throated Babbler' in Myanmar is assumed to be stable and there is no evidence of threat. However, there is a lack of data, and no management or conservation rules about this bird species (BirdLife International, 2018).

Jujube trees offer habitat for spiders, a number of insects including wild bees and other pollinators (see Fig .8), and lizards such as the Indo-Chinese forest lizard (*Calotes mystaceus*), a reptile living in the forests and on trees in neighbourhoods near cities in South-east Asia (Fig. 9). It is common to find these lizards on jujube tree trunks and branches. They control the insect population and they are harmless to humans. Conservation issues related to them is not known. During mating, these lizards can acquire extravagant aspects like a blue coloration and strange motion (Reptiles and Amphibians from Bangkok, no date).

Fig. 7: (upper) White-throated Babbler' bird (Swe) witnessed by jujube farmers (photo by Monywa[10])

Fig. 9: (below) Indo-Chinese forest lizard living in jujube tree in Old Bagan area (photos AG)

Fig .8: beehive in a Jujube tree in Old Bagan (Photo SMA)

Fig. 8 also shows the grounds at the base of jujube tree intentionally cleared for easily collection of the fruits after falling.

[10] Monywa, University of East Yangon, no date

Negative effects on jujube trees and biodiversity

It was reported that the use of fertilisers on the cash crops cultivated around the jujube trees (Fig.11) may affect the trees' habitat for small animals, also resulting in decreasing number of insects, among which are the pollinators. The increasing amount of plastic waste (bottles and bags) dumped, in particular around roadsides (Fig. 12), may negatively affect the soil around the jujube trees, in particular when burned with other waste as waste management plans are lacking. Although plastic waste in the nature is not recognised as a problem by the interviewed actors, it is an increasing issue overall in Myanmar. Finally, rare but bitter cold winters can destroy the jujube flowers and prolonged drought can affect the production of fruits. Recently, the extraction of sand, soil erosion and climate change effects have worsened the sand banks and narrowed the rivers (Fig. 10).

In terms of Biodiversity 'opportunity costs', according to the findings, it can be foreseen that if the farmers do not maintain the jujube trees, they would use the land to cultivate cash crops like nuts, pigeon pea and other pulses, with consequences of losing the ecological services provided by the jujube trees and loss of habitat for some of the small animals, birds, insects and reptiles.

Fig. 10: narrowed river affecting water supply and water level due to sand extraction, worsened by erosion

Fig. 11: Cash crops cultivated around the jujube trees

Fig 12: plastic waste dumped around roadsides in the jujube tree forest

Conclusion and recommendation

Conclusion

Jujube trees mostly belong to the central Dry zone of Myanmar, the Mandalay, Sagaing and Magwe Regions. Two species of jujube trees exist: the Chinese jujube (*Ziziphus jujuba M*.) called here the 'sweet' jujube species, originated in northern China. The Indian jujube (*Ziziphus mauritiana L*.) called here the 'sour' jujube species, well adapted to dry areas of tropical and sub-tropical countries is originated from India and South Asia. The jujube species and varieties found in this study are: *Ziziphus mauritiana (*'sour jujube'*):* Zee- chin-thee and *Ziziphus jujuba* ('sweet jujube'): Zee-taw-thee (Chinese jujube), Pyar-yay-san (honey jujube), Zee Kwe Thi, A Sae Lut, Taiwan jujube, Thai jujube.

The results indicated a sustainable production and collection practices happening in this area with farmers gathering the fruits once they fall on the ground. Only in some cases they use sticks with hooks causing the breaking of the branches. Farmers generally do not propagate the jujube trees.

The farmers let the fruits dry on the sand under the trees before being sold to 'seed traders', to middlemen, or to jujube processing companies. There are different derived products of the *sour* and *sweet*

jujube species. The '*sour*' jujube trees species are considered more valuable than cash crops as they provide a stable income with very limited costs. The export to China and Korea of the seed endosperm of the 'sour' jujube species to be used in the Traditional Chinese medicine is very valuable. Only the sour jujube variety is used for this purpose. Nevertheless, the *Ziziphus jujuba* (sweet jujube species) is also used in the Traditional Chinese medicine (Naftali et al., 2008), but no export demand is present in the area.

Jujube trees help climate stability and provide valuable ecosystem services. They offer habitat to wildlife, like small deers, rabbits, birds like the endemic 'white-throated Babbler', squirrels, etc., spiders, insects, wild bees and reptile, like the Indo-Chinese forest lizard.

Recommendations

According to the present case study, the main recommendations for the BioTrade Regional Project on the future selection of potential BioTrade products, in order to consider more biodiversity conservation aspects are listed in the following:

- When selecting a species for potential BioTrade product, the BioTrade principles should not only be applied to the species, but also to the different varieties present in the area. As in the case of jujube, different species and varieties should be given different considerations for their own specific sustainability and conservation needs and have their own custom-tailored marketing. For example, the variety 'Pyar-yay-san' (sweet jujube species) is difficult to propagate and needs specific ecological conditions, could only thrive in a typical type of area, but it should also be considered. In the case of jujube, an in-depth and reliable botanical identification for the existing varieties is needed but due to limited sources and research, varieties' identification is inconsistent.
- Since the BioTrade selected potential product (jujube juice) is made of *Ziziphus mauritiana,* which endosperm is highly demanded for export to be used in the Traditional Chinese medicine, further information about this trade should be collected and considered, under BioTrade principles. Although this is not the final BioTrade product, part of the fruits used in the BioTrade products is used for export. Hence, general level of compliance with ethical BioTrade principle in the sector should be considered and looked into.

When considering potential BioTrade products, creation of demand can be looked into for products that are presently not being conserved due to lack of market but possess high biodiversity conservation potential and are native to the country. For example, Naftali et al. (2008) claim that *Ziziphus jujube' fruits* (sweet jujube species) are used in the Traditional Chinese medicine, so they may have a market in Myanmar as well. Re-introduction of different varieties contributes to the conservation of all the jujube species.

Lessons learned from case studies

Selection of products

According to the authors of the case studies, the four different products make varying contributions to biodiversity conservation. The following conclusion is taken from the report prepared by Dr. Christine Woda, contrasting the biodiversity impacts of Siam benzoin and organic chili:

> *The study clearly shows that the potential of natural products to contribute to biodiversity conservation can be very different. The potential depends, on one hand, on the inherent characteristics of the species used and the production system. Decisive factors include, among others, its vegetative growth habit (annual or perennial herbaceous plant, shrub, tree); whether the species is native or not; whether it is a key species or dominant species for a native ecosystem; and whether it is part of the food pyramid of wild animals. Further, it is important whether the production takes place in a natural or in an artificial ecosystem (plantation); whether the entire plant or even the whole vegetation is periodically cleared and whether the vegetation if preserved can facilitate the establishment of a natural-like ecosystem. Of the analyzed examples, the production of benzoin gum from the native Styrax tonkinensis tree which is dominant in early succession phase of natural forests has a much higher potential than the annual herbaceous chili plant cultivated in monoculture with periodic removal of all vegetation and soil plowing. The potential of benzoin gum production in plantations is somewhere between these two contrasting examples*.
>
> *In addition, the impact on the affected ecosystem needs to be considered. The organic production of chili without the use of chemical fertilizers and pesticides has positive effects on soil and water quality as well as on the conservation of insect populations. However, impacts are limited to the very local level, as the size of the organic chili production area with just a few hectares is small compared to more than 300,000 hectares of conventional agriculture operating in surrounding fields.*
>
> *In contrast, benzoin gum production can achieve regional-wide impacts while remodeling forest-landscapes. Well-maintained native Styrax-forests as Styrax-plantations under a good management have the potential to link higher-grade mature protected forests, and to form buffer zones. Related forest vegetation type are mountainous mixed and broadleaved forests in North West and Middle North of Vietnam, which are still giving homes to endangered wild cats, bears, canines, monkeys, deer and antelopes. The lack of green biological corridors between protected areas is one of the main problems for the protection of wild animals in Vietnam. The production of benzoin gum in the Styrax forest can perfectly contribute to increase income of local households while contributing to biodiversity conservation.*
>
> *Given the limited resources of a project such as Helvetas BioTrade, it is necessary to focus interventions on selected value chains. As the objective of the BioTrade project is: "to promote the conservation of biodiversity through sustainable trade in natural ingredients in a manner that increases the competitiveness of local exporters/producers and the livelihood benefits of rural population by taking into account all relevant ethical Biotrade principles and criteria", preference should be given to value chains with highest potential to contribute to biodiversity conservation.*

In this case, the lesson learned about product selection is that **additional criteria beyond export potential** should be considered when selecting which products to work with. At the start of the current phase, the main criteria for including products were a) whether products were native species, and b) the export potential of the products. To select products more effectively in the future, the Regional Biotrade Project proposes to:

- **Continue to consider the export potential of products and whether they are native species, but also consider the product's inherent potential to contribute to biodiversity conservation, using a checklist based on the criteria used by the consultants for these case studies.**
- **During the current phase, conduct a rapid evaluation of other products not yet studied to assess their potential contribution to biodiversity and streamline the portfolio to eliminate products that do not provide positive impacts.**
- **Apply both export potential and biodiversity potential assessment when selecting products for a future phase, weighting the two equally.**
- **Based on the results of these analyses, a typology may be developed to speed up the process of understanding and selecting future products.**

Implications for work with buyers

For the Biotrade business model to work to its full potential, **customers must value biodiversity conservation as an integral part of their sourcing strategies, and demand it from their suppliers.** While buyers are in a strong position to drive actions that conserve biodiversity, even the most progressive companies rarely do so. Reasons for this include:

- Very large companies source thousands of natural ingredients, and do not have the resources to invest in gold-standard sustainability for all of them. They therefore prioritize long-term, stable availability of "problematic" raw materials and value chains that carry a high reputational risk.
- Companies place a high emphasis on marketing aspects, such as organic certification, which can have biodiversity benefits in some circumstances, but do not necessarily lead to meaningful biodiversity conservation.

The current project **logic *presupposes that international customers will demand biodiversity conservation***, so the project does not have a strategy or organize activities to encourage buyers to require biodiversity conservation in their sourcing. To optimize its impact on biodiversity, the project would need to find a way to encourage buyers to value and invest in biodiversity. This may require outreach to consumers, which is ambitious but could be possible in collaboration with biodiversity-oriented international organizations with strong existing member and communications networks.

Intervention in biodiversity matters

Producers and collectors of natural ingredients are the front line for biodiversity action, because biodiversity exists primarily in their production systems and in their surrounding landscapes and watersheds. Assuming that buyers of natural ingredients demand biodiversity, producers, collectors and the companies that work with them need support to leverage traditional biodiversity knowledge, access external knowledge and develop and realize biodiversity action plans.

Currently, UEBT has begun working on biodiversity action plans with a limited number of companies interested in membership, but these initiatives are restricted in size and scope. The project does not currently partner with other sources of biodiversity expertise and has very limited internal capacities in this area. This is an area where partnerships with local or international biodiversity NGOs could be useful.

Focus of policy interventions

Policies must be designed to support, not hinder, efforts to conserve biodiversity. As noted in the case of Siam benzoin in Vietnam, even well-intentioned and biodiversity-oriented regulations can sometimes have negative impacts. The project has faced similar issues in Laos, reinforcing observations in all three countries during the inception phase that the concept of "sustainable use" in management of vulnerable species and ecosystems is not widely accepted.

While the project has done some work on governance, initiatives have generally focused on access and benefit sharing (ABS[11]) and trade and marketing related issues rather than conservation and land-use issues[12]. The project's connections to government in all three countries are primarily to economic ministries and arm's length organizations[13] along with institutions involved in Nagoya Protocol implementation and ABS.

To ensure that policies supportive of biodiversity are in place for the value chains it works with, the project would need to increase attention to governance overall[14] and begin to evaluate and engage in environmental, forestry and biodiversity policies and regulations. The project currently has very limited capacities to work on these policy issues, and new partnerships in this area would also be useful.

Final notes

Overall, we can conclude that the project is having a positive impact on biodiversity, but these are not as much as we would hope for a project with biodiversity as its top-level impact goal. There are some relatively easy changes that can be made in the short term to improve the likelihood of biodiversity impacts, such as increasing the focus on products that have good biodiversity impacts and winding up support for products unlikely to have a positive biodiversity impact.

To achieve its stated goals, additional changes should be considered during design of the next project phase. By taking a more holistic approach to analysis, intervention design and implementation, a new phase of the project will be able to deal with the variety of factors constraining the growth of a viable Biotrade sector that makes a real impact on both people and the environment. The starting point for design of a follow-up phase should be a quick but comprehensive *market systems analysis*, which would lay the basic contours of the new phase. With the information developed through this analysis, it will be possible to design a future project phase that works with a diverse but select group of partners, an approach that can be both realistic and ambitious.

[11] ABS is the legal framework for

[12] These issues are often much more politically contentious, particularly related to land and access to natural resources.

[13] For example Vietrade, Lao National Chamber of Commerce and Industry and Myantrade. Other

[14] Not giving up existing policy work, which is also valuable.