

## CHAPTER 5

### CONCLUSION AND OUTLOOK

Mango (*Mangifera indica* Linn) plays a central role among horticultural fruit crops in Myanmar and is believed to have a potential on high value international markets. Yet, improving fruit yields in terms of quantity and quality is fundamental for farmers to participate in the emerging (international) value chains. Based on a quantitative and qualitative research direct correlations between different mango pre- and postharvest management practices and fruit quality could be established.

Mango farmers in the Shan State primarily cultivate the variety Sein Ta Lone. Within the interviews not only the importance of the genetic material has been emphasized but also the superior characteristics of STL mangos such as color, consistency, size and flavor. A reinforced usage of grafted planting material is likely to further promote the development of a suitable cultivar for fresh mango export. Currently, approximately only half of the mango farmers use grafted planting material. Notwithstanding the importance, the quality of the seedlings and the genetic material are not at the core of a GlobalGAP certification. Moreover, with regards to biodiversity and the availability of about 200 traditional mango varieties in Myanmar, mango farmers possess potential to develop different varieties including their specific characteristics. However, up to now no index concerning the different mango varieties in Myanmar exists.

As mango trees are sturdy trees the interviewed experts evaluated the importance of fertilizer and soil additives lower than other pre-harvest management processes. Nonetheless, high training requirements were identified within this study. In particular, a targeted fertilization during phases of fruit growth or after pruning to promote vegetative growth are essential for fruit quality. Currently mango orchards in the Shan State are not fertilized adequately and targetedly and concerning a GlobalGAP certification, no documentation about fertilization date and dosage are kept. The experts emphasized the limited choice and availability of fertilizers as well as the need to systematically integrate

natural fertilization to improve nutrient availability in the soil. Moreover, the link between irrigation and fertilization – fertigation – has been stressed.

Irrigation systems are hardly used in mango orchards in the Shan State. Most of the orchards are rain fed and to a minor extent flood irrigation is applied. Concerning fruit quality, the findings pronounce the positive linkage between irrigation, fertigation and fruit size. Irrigation bears great potential to improve the level of mango production in the Shan State as the periods of fruit growth, harvesting and dry season overlap. The supply of water and nutrients during fruit growth is crucial to increase fruit size. In addition, the uptake of macronutrients such as nitrogen for fruit growth during the dry season is considerably aggravated without irrigation. Thus, the lack of irrigation can result in smaller or shriveled fruits. Concerning irrigation systems the interviewed experts recommended micro sprinklers or drip irrigation systems (if farmers lack access to electricity) as flood irrigation can negatively impact tree health. Currently components for these irrigation systems are barely available or of inferior quality in Myanmar. To complete the picture it needs to be mentioned that despite the high availability of water for irrigation in Myanmar (MOAI, 2014a), studies from mango and longan production in Thailand illustrate that a growing application of irrigation systems in orchards in mountainous regions put local water resource increasingly under stress leading to water scarcity. The situation is further aggravated by an increasing number of weather anomalies in recent years (Schulze *et al.*, 2013). Thus, for the commercial export oriented mango production in the Shan State, Myanmar, it will be crucial to increase the availability of quality irrigation equipment and at the same time to implement technologies with an increasing water use efficiency to ensure a sustainable long-term mango production. To achieve this goal local weather data and farmers trainings/extension services are required to convey up to date knowledge concerning modern technologies and an optimal nutrient and water supply to ensure a high quality product and yield.

The results underline the linkage between insect and pest management and fruit quality as well as the quantity of marketable fruits. Currently 38 % of all post-harvest losses are due to pest and diseases. In this context the results reveal that mechanical orchard management practices like pruning and fruit bagging are pretty evolved and

widely practiced in mango orchards in the Shan State. Concerning chemical treatments of pesticides, insecticides and fungicides, substantial training needs in relation to a systematic and coordinated application of these treatments have been identified. Moreover, the choice of agrochemicals in Myanmar is rather limited and product labels about substances and optimal application are often not available in Myanmar language (Burmese). However, in line with the hygiene requirements concerning mechanical methods, a coordinated and documented application of agrochemicals are central building blocks of a GlobalGAP certification and inappropriate usage of agrochemicals can even lead to a ban of products by importing countries. Therefore, considerable attention should be paid to farmer trainings concerning a systematic and integrated pest and disease management.

The results of the quantitative and qualitative study show that harvest and post-harvest mango handling are at an early stage of development in the Shan State. Currently mangos are harvested, sorted and graded manually and packed insufficiently, resulting in high post-harvest losses.

Virtually no appropriate post-harvest handling facilities and skilled staff for post-harvest processing are available in the Shan State. In line with the importance of an appropriate post-harvest handling of mangos for export including sorting, grading, HWT, VHT, cooling, packaging and labeling, the results of the study point to a high awareness of farmers concerning the significance of these activities. However, the implementation is related to substantial capital requirements. The following ambiguity and risk emerges: An improved mango production and post-harvest handling according to GlobalGAP requirements is related to substantial costs, which need to be offset by a demand for quality products and higher market prices for the produce. Contrary high quality, certified products and a continuous supply of quality products are the basic conditions to enter international supply chains. Thus, a vicious cycle of uncertainties concerning market excess and price levels as well as the coverage of costs for upgrading (post-harvest management and GAP certification) and related risks becomes apparent.

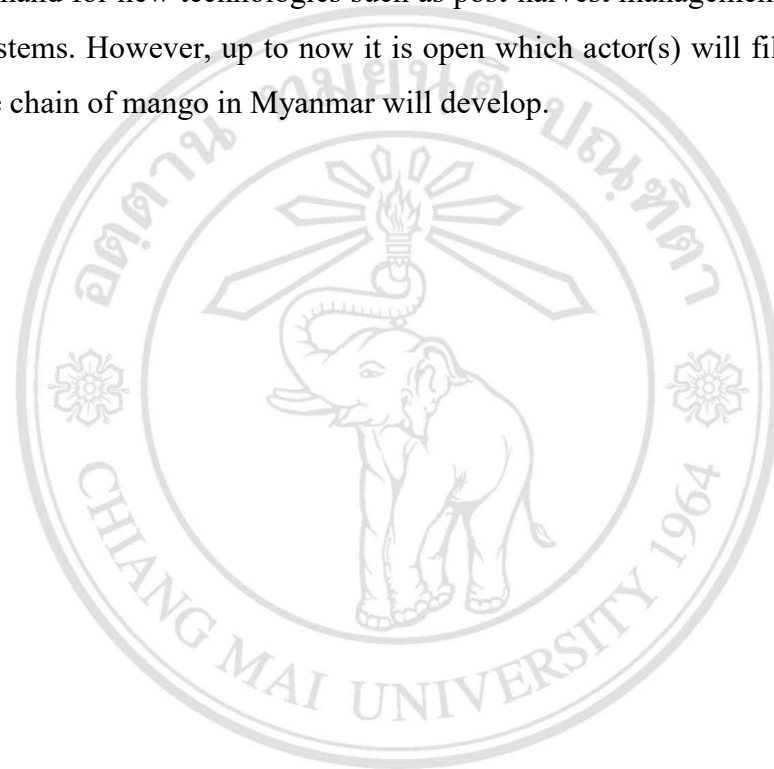
In this context, the analysis of the development and structure of the Thai export mango sector provided useful insights. Apart from the development of a suitable cultivar for export and the implementation of an efficient production and post-harvest

management system and corresponding technologies, the establishment of mango clusters and Thai mango grower groups were decisive for the success of the Thai mango sector. Joint action of mango farmers in grower groups enable the realization of scale effects such as the collective purchase of inputs like agrochemicals or collectively organized trainings. Moreover, grower groups are likely to strengthen the bargaining power of farmers and to support access to information and technological expertise. Exporters ease the flow of information concerning requirements and restrictions from import markets to growers and conduct post-harvest handling. Additionally exporters financially support certification processes of farmers. Thus, as Myanmar mango growers are small-scale growers, collaborative initiatives and horizontal cooperation with actors in the supply chain are crucial. While strengthening the farmers' bargaining power and enhancing the access to information and technology, they make the traditional function of (rural) brokers redundant. It is clear, that the establishment of such institutions and cooperative practices take time to develop.

Analyzing the current situation in the Shan State, where cooperation among farmers and between farmers and further actors are no common practice, illustrated that a development started in pioneer grower groups, but it is still at an early stage. The results of the research confirm the above-illustrated view and highlight different challenges. On the one hand, the general financing of upgrading activities, a low number of exporters and the lack of incentives for exporters to finance the upgrading costs. On the other hand, high coordination requirements and costs of GlobalGAP certification and fears of farmers concerning the implementation of an internal control system for GlobalGAP group certification. Installing field-packing houses seems to be an appropriate and cost-effective stepping-stone before full packinghouse sequences are installed. Moreover, field-packing houses can be financed by farmer groups themselves and guarantee ownership by the grower group besides fruit quality aspects. In particular with increasing Chinese quality requirements, such a development is of central importance. However, to trigger additional spill-over effects, market linkages to further markets need to be established. Concerning GAP certification, the results indicate that before targeting markets with the highest requirements such as the EU, Japan and Korea, proximate markets with lower requirements should be approached. A MyanmarGAP adapted to market requirements of the ASEAN region bears great potential as an intermediate solution and step towards a

GlobalGAP certification. The complexity and low remaining number of farmers in the pioneer farmer group still targeting a GlobalGAP certification points to this direction.

With increasing market linkages for mango export, business opportunities in Myanmar including the supply of improved inputs in combination with an increasing demand for the transfer of knowledge and training for an improved cultivation of mango are likely to emerge. In addition, as the export value chain of Myanmar mango develops, there will be a growing demand for new technologies such as post-harvest management facilities and cool chain systems. However, up to now it is open which actor(s) will fill this gap and how the value chain of mango in Myanmar will develop.



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