CHAPTER 2
LITERATURE REVIEW

2.1 Myanmar – The role of the agricultural sector

The Republic of the Union of Myanmar – formerly known as Burma (1989) – constitutes a sovereign state in Southeast Asia between latitudes 09° 32' N/28° 31' N and longitudes 92° 10' E/ 101° 11' E. With a total land area of 676,552 square kilometers and a population exceeding 51 million people, Myanmar belongs to the largest countries on the mainland of Southeast Asia with a comparatively low population density. Its geographic location between the Peoples Republic of China (North/Northeast) and the Republic of India (West), position Myanmar between two rapidly developing economies. Moreover, Myanmar shares borders with the Lao Democratic Republic and the Kingdom of Thailand (Southeast) as well as with the Republic of Bangladesh (West) (The World Bank, 2016).

Presently Myanmar is undergoing a rapid political and social change. The transition to civilian rule, which was triggered by the May 2008 constitution and elections in April 2012/ November 2015, were a first step to an ongoing series of far-reaching political and economic reforms (UNPD, 2015). The current government prioritizes the agricultural sector as a crucial stepping stone of (economic) development and poverty reduction (Kudo et al., 2013; MOAI, 2014a).

In 2010, agriculture accounted for 60 % of the country's Gross Domestic Product (GDP) and 30 % of total export earnings. During the past decade, the rapid growth in the natural gas and related sectors have led to a declining contribution of the agricultural sector. In 2012/2013, agriculture contributed to approximately 31 % of the country's GDP and to 20 % of the total exports (MOAI, 2014b). Smallholder, subsistence agriculture is predominant and more than 2.7 million farms (approx. 55 %) are smaller than 2 hectares. The vast majority of the population (70 %) lives in rural areas and depends primarily on agriculture, livestock and fishing for their livelihood. According to the OECD, the gap between employment and output reflects on the one hand a low labor productivity and on the other hand translates into low incomes in the agricultural sector. In fact, 30 % of the rural population live in poverty and agricultural income per capita is the lowest in Asia (approx. 200 US$/year) (OECD 2014).

According to different scholars, Myanmar has multi-faceted development opportunities and in relation to the agricultural sector, a considerable potential to become an agricultural-food production and trade hub in Southeast Asia:

- Myanmar possesses favorable natural resource endowments such as abundant land and water resources. Currently 18 % of Myanmar's land area are used for agricultural
- production with considerable room for expansion (ADB, 2014; OECD, 2014). Moreover, the Ayeyarwady and related river systems supply fresh and renewable water *"over ten times the levels available in China and India and more than double the water resources of Vietnam, Thailand and Bangladesh"* (MDRI & CESD, 2013).
- Myanmar's diverse topography and ecological zones, with a broad span of elevations, latitude, temperature and rainfall, create a diversity of micro climates that enable the production of a wide array of crops at different times of the year (MDRI & CESD, 2013; OECD, 2014).
- Myanmar´s geographical location between China and India, it's membership in the World Trade Organization (WTO) and the rise of the Association of Southeast Asian Nations (ASEAN) present an unique opportunity to expand the range of agricultural export products and destinations (ADB, 2014; OECD, 2014). Moreover, the easing of sanctions and trade restrictions from the European Union (EU) and the United States of America (USA) since 2012 offer substantial market access opportunities (GIZ, 2015b; OECD, 2014; Reuters, 2015).

However, despite of these comparative advantages in production and geographical location, Myanmar underperformed in contrast to its neighboring countries during the past decades (Smit et al., 2015). Based on Myanmar's current production and prospective market opportunities, developmental institutions such as the GIZ and OECD identified a range of promising candidates for value chain development. These candidates include mangos, fisheries and rice (GIZ, 2015a, 2016; OECD, 2014). Moreover, given the large share of the population engaged in agriculture and the vast amount of small-scale farms, the participation of small-scale farmers "in demand-driven markets will be central to the modernization of the sector and critical to expanding exports" (OECD 2014).

In the following, opportunities and challenges for the mango production, post-harvest management and the mango value chain in Myanmar will be elaborated in more detail. The analysis will focus on opportunities and challenges in relation to pre- and post harvest activities in mango farms to increase production quantity and fruit quality. Notwithstanding their importance, financial, political and cultural constraints will not be placed at the center of attention of this study as they have been analyzed in detail elsewhere (OECD (2014); ADB (2014); Kudo et al. (2013); MDRI & CESD (2013); Smit et al. (2015)).

Moreover, despite of the uniqueness of country specific development trajectories in relation to history, culture and domestic conditions, it is assumed, that lessons from development experiences in mango value chains from Myanmar's neighbors are useful to support the structure of argumentation in this study.

2.1.1 Mango in Myanmar

Mango is one of the chief fruit crops in Myanmar with a long cultivation history. According to Hirano *et al*. (2011), the bibliographic records of mango cultivation in Myanmar can be traced back to the 5th century AD and the various vernacular names for mango, used by different ethnic groups, provide further evidence for its long cultivation history (Hirano *et al.*, 2011). Today, nearly 200 traditional mango varieties are officially recorded nationwide. The most popular and commercially cultivated varieties are *Yin Kwe* and *Sein Ta Lone*. The variety *Yin Kwe* is grown throughout the country and possesses a relatively long fruiting period and high fruit load. The variety *Sein Ta Lone* is generally traded for higher prices and known for its unique aroma and sweetness (Mekong Institute, 2013b).

Although mangos can be cultivated all over the country, most of the mango production (67 %) takes place in the Mandalay region. This is due to most suitable climate conditions (prevalently hot) and higher yields. Further growing areas of mango are located in Ayeyarwaddy, Bago and Yangon (southern Myanmar), Mandalay, Sagaing (Central Myanmar) and in the southern Shan State (high altitudes). More recently, an expansion of the planting area can be observed in central regions and at higher altitudes in the Shan State. Growers in higher altitudes (over 800 meters above sea level) can benefit from the late maturity of fruits at the end of the fruit season (July, August and September) and higher prices (Mekong Institute, 2013b; Myat, 2012).

According to the Ministry of Agriculture and Irrigation (MOAI), the planting area of mango in Myanmar increased steadily between 2005 (70,938 ha) and 2010 (79,228 ha). However, mango yields stagnated during recent years (2005: 458,398 metric tons (MT); 2010: 482,235 MT) and increases in yield were achieved by an expansion of the planting area (Mar, Yabe, & OGATA, 2013; MOAI, 2014b). In relation to neighboring mango producing countries e.g. Thailand (30.34 MT/ha), yield levels per hectare of Myanmar (2.73 MT/ha) are relatively low (Myat, 2012; Schulze *et al.,* 2013). Nonetheless, between 2007 and 2009 Myanmar's export quantity increased from 16,700 MT to 44,400 MT corresponding approx. 10 % of Myanmar's mango production. That said, export prices per MT remain relatively low (268 US/MT) (Myat, 2012).

2.1.2 Myanmar's export value chain for mango

In Myanmar, mainly fresh mangos are traded. In fact, value-added products such as salted mangos, dried mangos, mango leather and mango juice are not produced in a market-relevant volumes (Mekong Institute, 2013b).

The persisting value chain is highly fragmented and several types of intermediaries exist including small brokers, fruit collectors, wholesalers and exporters (Myat, 2012). Figure 1 illustrates the persisting relations between actors in the export mango supply chain in the southern Shan state:

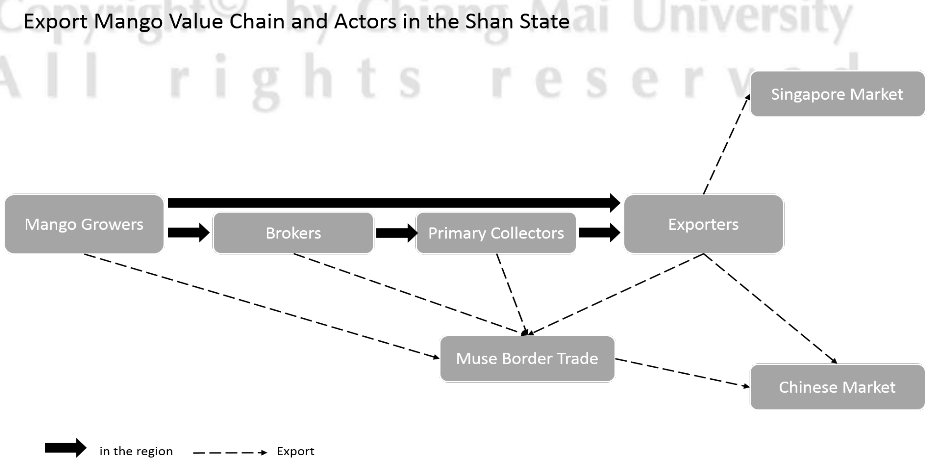

Figure 1 Export Mango Value Chain and Actors in the Shan State (own, adapted from Myat (2012))

Concerning Myanmar's mango export, fresh mangos are exported almost exclusively to China, with Myanmar being one of China's main suppliers of fresh mangos. For the export, mangos are wrapped in paper, packed in boxes and transported by trucks from the growing regions via Muse/Ruili to Kunming (Yunnan Province) and from there to other parts of the country. As Ksoll et al. (2013) emphasize, mango exports are usually conducted on a free carrier basis. Consequently, the exporter has to deliver the freight to the truck or warehouse of the buyer. The fresh fruits are gathered by township traders and either transported to Mandalay for consolidation with fruits from other growers or directly forwarded to the trading center for mangos and watermelons in Muse. It is noteworthy to mention that the consolidation of the perishable fruits can take up to one full day and the fruits are often stored outside, where they may be exposed to high temperature or humidity. After that process, Chinese brokers buy the produce. The sales agreements are done informally (without written contracts) and on a delivery-to-delivery basis. Then, the mangos are brought across the border to the lorry or storage facility of the Chinese counterpart. This part of the supply chain i.e. transport, sales and distribution is organized by the Chinese traders whereby delays of the transport of 2-3 days in Ruili (China) are not unusual (e.g. delays in acceptance of the cargo). As the fruit remains on his truck, the risk and cost are borne by the Myanmar exporter and delays, for whatever causes, may be used to re-bargain the mango price. The weaknesses of this current supply chain comprise low farm gate prices for the produce, little protection of the mango during the transport (as well as insufficient infrastructure) and high risks for the Myanmar exporter that result from no insurance coverage, insecure payment, no mechanism to enforce contracts, to name a few (Ksoll et al., 2013; Mekong Institute, 2013b).

As current newspaper articles illustrate, Myanmar has a strong interest to diversify its mango export channels, increase its exports and participate in trade within Asian countries (Kyaw, 2014; Taw, 2015). Establishing wholesale markets (e.g. in the Mandalay region) for fruits are a first step in this direction (Taw, 2014). However, the Mekong Institute attributes differences in Mango export and the success of neighboring countries to differences in "quality and safety of ASEAN-produced fruits […] due to the wide diversity of systems, infrastructure, resources and capacities in the region" (Mekong Institute, 2013a) and in particular, to the fact that countries such as Myanmar and Laos have struggled to develop and implement Good Agricultural Practice (GAP) and Postharvest Practices (Mekong Institute, 2013a; Mitv, 2015; Myo, 2009). As illustrated above, currently most of the mango trade takes place at relatively low prices with China by (road) border trade as no certificates are required (Ksoll et al., 2013; Mitv, 2015).

2.2 Quality Standards – The GlobalGAP

Since its development in the late 1990s, Global GAP, a private standard originating from Germany, has evolved to the *de facto* standard in international supply chains. According to the FAO, good agricultural practices (GAP) are *"practices that address environmental, economic and social sustainability for on-farm processes, and result in safe and quality food and non-food agricultural products"* (FAO, 2007). In general, it is assumed that GAP certifications are associated with several benefits including improved quality and safety of food, enhanced market access and competitiveness of farmers as well as a reduced non-compliance in relation with permitted pesticides and further contamination hazards. Since its introduction in 1999, the worldwide number of GlobalGAP certifications increased constantly. Also, different public GAP programs with a varying degrees of compliance were launched such as MyGAP (Malaysia), Q-GAP (Thailand), PhilGAP (Philippines), VietGAP (Vietnam), JGAP (Japan), (AseanGAP) (FAO, 2007). Table 1 illustrates the adoption of GAP standards in different countries:

Table 1 Adoption of GAP standards in different regions (Amekawa *et al*., 2015)

Country/region	Program	Year of Inception	Number of certified farms (Year)	Responsible Agency
Europe	GlobalGAP	1999	112,576 (2011)	EurepEuro-Retailers Produce Working Group
Malaysia	MyGAP	2002	313 (2013)	Department of Agriculture
Thailand	Q-GAP	2004	≒220,000 (2012) ≒119,000 (2015)	Ministry of Agriculture and Cooperatives
Singapore	SingaporeGAP-VF	2004	7 (2013)	Agri-Food & Veterinary Authority
The Philippines	PhilGAP	2005	15 (2013)	Department of Agriculture
Vietnam	VietGAP	2008	575 (2013)	Ministry of Agriculture and Rural Development
Brunei	BruneiGAP	2013	1 (2014)	Ministry of Industry and Primary Resources
Asean Region	AseanGAP	2015	T.B.D.	Asean Secretariat

In particular food scandals such as BSE and other animal diseases and toxic residues in foodstuff as well as stricter food laws decisively promoted the emergence and implementation of private standards such as GlobalGAP (Dannenberg, 2012).

2.2.1 GlobalGAP governance and steering

GlobalGAP was founded in 1997 as EUREPGAP (Euro Retailer Produce Working Group Good Agricultural Practice) by European (foremost British) retailers as a business to business initiative. The objective was to harmonize existing standards and help farmers to comply with standards concerning *"food safety, sustainable production methods, worker and animal welfare, and responsible use of water, compound feed and plant propagation materials"* (FoodPLUS, 2016a). Since then, the GlobalGAP standard gained considerably in worldwide popularity. The number of certified producers increased from 18000 in 2004 to more than 100000 in 2010. 2014 more than 139000 producers were certified in over 110 countries. In one line with this global development, in 2007, EUREPGAP was renamed to GlobalGAP (FoodPLUS, 2014, 2016a).

The governance of GlobalGAP is carried out by a board composed of an equal number of elected representatives from producers (50 %), retailers (50 %) in the committees and an independent chairperson. Here, decisions concerning product and sector specific issues are made and all major decision have to be ratified by the board. Figure 2 illustrates the consultation process of the board (FoodPLUS, 2016a; Fuchs & Kalfagianni, 2010, 2011).

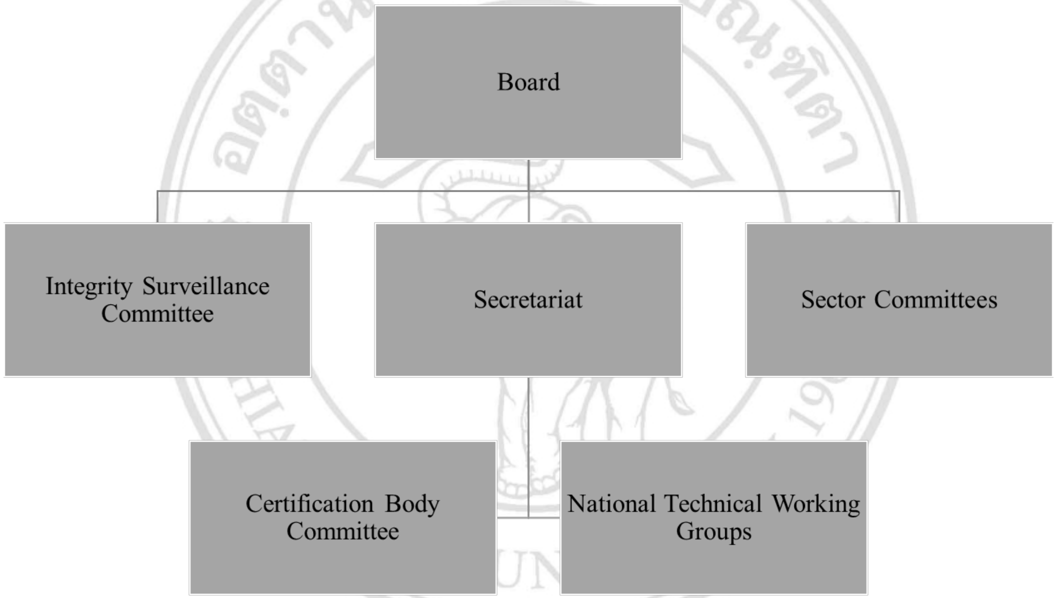

Figure 2 Steering Structure of the GlobalGAP (Fuchs & Kalfagianni, 2010)

The German based non-profit limited company FoodPLUS GmbH supports the work of the board and committees and holds a secretary function. The National Technical Working Group (NTWG) aims at facilitating the implementation of local GAP regulations by providing national interpretation guidelines focusing on a local scale. Moreover, the GlobalGAP represents a body member of the International Accreditation Forum supporting accreditations with ISO Guidelines. The Certification Body Committee manages feedback from now more than 139000 audits worldwide and the harmonization of interpretation guidelines of the compliance criteria set by the sector committees (FoodPLUS, 2016b; Fuchs & Kalfagianni, 2010, 2011).

Different scholars such as Dannenberg 2011 and Fuchs Kalfigianni criticize that the governance and decision structure is EU and retailer dominated. The board members of the FoodPlus GmbH originate primarily from the retail sector and the FoodPlus GmbH is 100% financed by the EHI Retail Institute (Euro Handel Institut), which has been funded by retailers in 1993. Moreover, suppliers in the board are rather large-scale producers from the EU and to a minor extend farmers' associations. Nonetheless, during the past years, different measures to improve the inclusion of smallholders were implemented including an information mechanism to the sector committees about the status of smallholder involvement (Dannenberg, 2012; Fuchs & Kalfagianni, 2010, 2011)

2.2.2 Instruments of the GloablGAP

From an operational point of view, GlobalGAP focusses as a pre-farm gate standard on agricultural production processes. Subsequent steps in the supply chain are not considered. Regulations and specifications exist currently, as figure 3 illustrates, concerning crops, livestock and aquaculture.

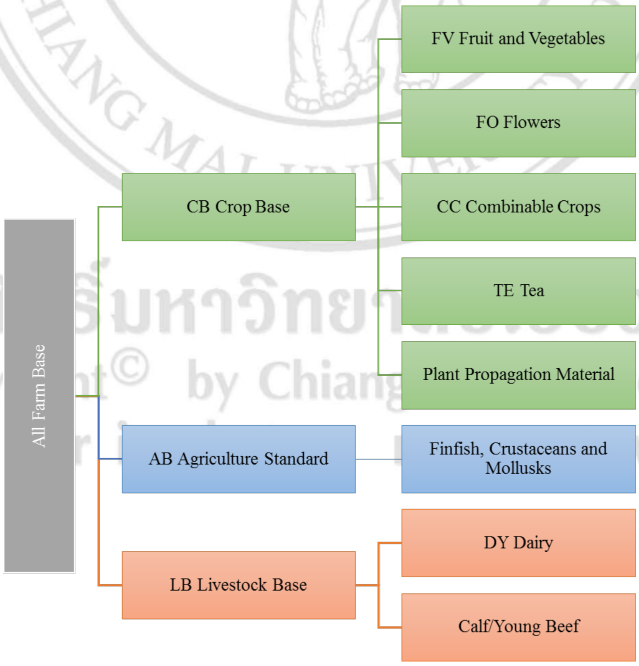

Figure 3 GlobalGAP Modules and Integrated Farm Assurance (v.5.01) (adapted from FoodPLUS, 2016b)

For each of the modules illustrated in figure 3 exists a set of normative documents which form the basis of the certification process including (1.) General Regulations, (2.) a protocol concerning Control Points and Compliance Criteria (CPCC) and (3.) a checklist (FoodPLUS, 2016b; Fuchs & Kalfagianni, 2011):

1. The General Regulations give an overview of the certification process, the accreditation bodies and certification rules. Moreover, these documents inform about different types of certification. Option 2, the group certification (in contrast to option 1 individual certification), aims at reducing costs for certification by centralizing for example pesticide controls and help farmer groups to realize scale effects. Currently most of the producers (67 %) choose group certification. Moreover, rules concerning benchmarking rules are outlined in the General Regulations.

2. The Control Points and Compliance Criteria Protocol represents the standard rules against which producers are certified. This document is divided into modules highlighting different control points, compliance criteria and required level of compliance. Within this system a fruit or vegetable producer has to comply with the "All Farm Base", the "Crop Base" and the "Fruit and Vegetable" Modules. The Control points specified in the modules encompass a wide range of aspects of agricultural production including inter alia the dimensions site history and site management, record keeping and internal self-assessment, hygiene, worker health, safety and welfare, waste and pollution management, soil, fertilizer, integrated pest and water management. For each category, the control points are divided three categories (major must, minor must and recommendation). Major musts require 100% compliance, minor musts demand 95% compliance and within recommendations, no minimum percentage of compliance is set.

Table 2 illustrates the distribution of 213 control points of the actual version of the Integrated Farm Assurance for fruit and vegetable farmers (version 5.0-1_Feb2016)

	Major must	Minor must	Recommendation	Total
All farm base	29	19	8	56
Crop base	25	76	5	106
Fruit and vegetables	33	14	4	51
Total	87	109	17	213

3. The checklists form the basis for the internal and external audit requirements. They are formulated in one line with the CPCC and encompass a checklist for inspecting producers, a checklist concerning the group quality management system (producer groups) and a benchmarking checklist. It is important to mention, that non-compliance of one member of a group may result in termination of GlobalGAP certification of the whole group (Amekawa, 2009; Fuchs & Kalfagianni, 2011).

Table 3 Illustrates major GAP requirements in relation to fruit quality and quality hazards according to Sareen (2014).

Dimension	Description
Planting material	Planting material should come from organizations, which are acknowledged, by a Plant Health authority in order to guarantee high quality and absence of diseases.
Fertilizer and soil additives	Fertilizer application must be based on requirements of crops, applied properly and in accordance with authority regulations. Records containing details about the provider, amount of fertilizer, application date and responsible person should be kept.
Water/Irrigation	Irrigation should be done according to crop specifications, availability of water for irrigation and soil moisture content. Water sources should be free of contamination in form of hazardous materials and microbes. Records should be obtained about date, place, time and amount of water applied.
Chemicals (including pesticide)	Trained workers should conduct the application of chemicals. The use of chemicals must refer to recommendations obtained by a registered product label or a responsible authority. IPM should be used where possible. The equipment should be in good working condition and reviewed regularly. Records including names, aim, date and amount of usage should be kept.
Harvesting and handling of produce	Harvest of the produce must take place at an appropriate timeline, set by criteria in the production control plan. Harvesting and handling equipment must be clean to produce a quality produce without contamination. Appropriate containers should be used for the harvested produce and mechanical damage reduced. Direct contact with soils or floors should be avoided.
On farm processing and Storage	On farm practice must correspond to the production control plan. Inadequate produce (below standard) must be sorted out and stored separately. Storage facilities must be clean, well ventilated and protected against contamination from alien and hazardous materials.
Traceability and recall	The produce and containers should be labeled appropriately by name/code to allow traceability.

In sum, the CPCC give a broad summery about criteria addressing the safety of food, environmental issues and the safety and welfare of workers in agricultural production. However, the scope of the standard is relatively broad and specific requirements of certain crops like for example mango are not covered. Thus, the GAP Control Points provide a sound general basis to identify processes relevant for fruit quality. In chapter 3.2, these processes are specified for mango production.

2.2.3 Benefits and constraints of GAP approaches

In the past decade, scientific studies emerged that discuss controversially the success or failures of GAP certifications of producers in developing countries. Several studies highlight socioeconomic advantages of certified farms over uncertified farms. Yet, trends about the socioeconomic marginalization of small-scale farmers and their exclusion from international value chains are reported (Asfaw *et al.,* 2009; Burghardt & Schölmerich, 2011; Colen & Maertens, 2011; Graffham *et al.*, 2007; Holzapfel & Wollni, 2014). Thus, the imperative of balancing food safety and quality in production and the participation of small-scale farmers in food value chains becomes apparent.

In several industrial countries, like the EU, retailers require the certification and stringent compliance with the GlobalGAP standard for their suppliers. The tendency that a voluntary standard turns to a de-facto compulsory standard becomes apparent.[1] In this context not certified farms face the risk of being excluded from lucrative horticultural value chains and global markets (Fuchs & Kalfagianni, 2010). In case of a successful GlobalGAP implementation and certification several studies indicate an increasing farm level productivity, better health of the workers and higher prices for the produce (Asfaw, 2010; Asfaw *et al.*, 2009; Graffham *et al.*, 2007). Asfaw illustrates in his study on small-scale horticultural producers in Kenya that small- scale adopters of the GlobalGAP

[1] An in-depth discussion concerning the consequences of private regulation in global food governance and food value chains, its legitimation and accumulation of power and decision making in the retail segment by e.g. large super market chains will not take place in this study as it has been conducted elsewhere e.g. Fuchs and Kalfagianni (2010). As this study focusses on pre- and postharvest management processes in mango production a brief reference to this discourse should suffice.

standard enjoy substantial positive health and income benefits. Farmers who implemented the standard experienced 78 % less incident of illnesses (such as skin and eye irritations, headache, dizziness and vomiting) and spend in average 50 % less on restoring their health in comparison to non-adopters. The pay-off period of initial investments was lowest with donor/exporter support (2-3 years) and can take up to 7 years depending on the number of cropping seasons (2 cropping seasons) and lack of donor/exporter support. Thus, the adoption of the standard can serve as a catalyst concerning higher incomes and the transformation of the production system towards a safer and more ecologically sustainable production. Yet, the question remains, if farmers are able to cover the high initial investment costs for the implementation of the standard including farm infrastructure and equipment such as pesticide storage, sanitary facilities, chemical sprayer equipment and so on (Asfaw, 2010; Asfaw *et al.*, 2009; Holzapfel & Wollni, 2014).

Holzapfel and Wollni point out *"that GlobalGAP adoption is particularly challenging for small-scale farmers and is influenced by factors such as farm size, wealth, education, access to credits, extension services and trainings"* (Holzapfel & Wollni, 2014). They found in a study with 214 Thai fruit and vegetable farmers that farmers, who are certified in producer-managed groups can derive most significant benefits from a GlobalGAP certification. Farmers in producer-managed groups could realize on average 62 % higher prices for their produce and an increase of their net income of USD 14,678 between 2009/2010. Moreover, these income effects vary with land size of the farms. While large farms realized significant net income increases, smaller farms realized significant effects on income if the recurrent costs of the certification and compliance were borne by a donor (e.g. exporter). In contrast, exporter-managed groups realized a positive but not significant increase of net income. However, exporter-managed groups had an 85 % higher recertification rate. These differences in producer and exporter managed groups can be traced back to do different marketing conditions. Prior to the certification, the farmers (of producer led groups) sold their produce almost exclusively to middlemen. In one line to the GlobalGAP certification farmers were now able to sell to supermarket chains in Thailand, receiving a price premium for certified products. In contrast, exporter-managed groups were not able to sell all their produce to the exporter and continued selling their produce to a varying degree to lower-value local markets despite of their certification. Therefore, the certification in exporter-managed groups seems to aim at maintaining market access rather than to enter new markets and realize significant higher incomes. These results indicate that despite of the benefits associated with a GlobalGAP certification, the majority of farmers in producer-managed groups were not able to maintain a long-term certification without external support. Yet, support of exporters represented one crucial factor for a long-term and sustainable compliance with the GlobalGAP standard (Holzapfel & Wollni, 2014; Kersting, 2012). These findings are consistent with other studies about smallholder mango farmer compliance with GlobalGAP in Peru (Kleinwechter & Grethe, 2006; Lemeilleur, 2013). Lemeilleur (2013) emphasizes that smallholder adopters of GlobalGAP *"comply with the standard thanks to the support of exporting companies through farming contracts, technical advice, and by paying the annual certification costs" (Lemeilleur, 2013).*

In view of small-scale farmer participation, most notably ASEAN Governments, introduced public GAP standards. An illustrative case is Thailand, where a public GAP, called Q-GAP (Q as an acronym for quality) has been introduced in 2003. The primary focus was to reduce the use of agrochemicals in agricultural production. Due to looser compliance requirements than the private GlobalGAP (2008: 84 control points and 51% compliance required) lower certification entry barriers for farmers were set and by the end of 2007 more than 224334 households were Q-GAP certified. From a commercial point of view, in particular the access for small scale farmers to emerging local supermarkets has been facilitated (Amekawa, 2009). However, Schreinemachers *et al.* (2012) show that farmers who adhere the public GAP standards do not use fewer and less hazardous pesticides due to a too rapid expansion of the program and a lack of understanding of farmers concerning the control points specified in the standard (Schreinemachers *et al.,* 2012).

In the following, major processes to produce high quality mango in one line with GAP recommendations will be discussed and in Chapter 4 analyzed in the Myanmar context.

2.3 Quality Aspects of Mango

"Mango is famous for its attractive appearance, delicious taste, excellent flavor [and] high nutritional value" (Hai, 2012).

While the appearance of fruits is important for local markets, quality attributes in relation to appearance are even more important for export markets. Shewfelt (2006) stated that *"the success or failure of any food is determined by the consumer"* (Shewfelt, 2006). In general, consumer acceptance is higher if mangos are free of external damages (purchasing quality) including bruises as well as sap burn. Uniform color weight and shape are required

(Kader, 2008). Thus, understanding consumer expectations about what constitutes quality and how to achieve this quality during production is essential in the mango production. Grade standards such as ISO (International Standardization Organization) or GAP (Good Agricultural Practices) provide in this context reference parameters for producers and traders. For mango, these quality attributes encompass *inter alia s*ize, shape, uniform weight, color, aroma and firmness, free from external damages, chemical residues and pests (Sareen, 2014).

The aim is that consumers and producers alike benefit from GAP, as beyond tangible quality aspects, GAP certified fruit guarantees a certain standard of production, including the protection of the environment and safety standards for the producer. An optimized use of farm input enables sustainable high yields and good revenues for the farmer and – last but not least – aims on avoiding post-harvest losses. These losses, particularly in developing countries, reduce the quantity of marketable fruits considerably and restrict the grower's income (Sivakumar *et al.*, 2011).

In the following, vital pre- and post-harvest steps to produce high quality mango and to reduce post-harvest losses in the mango value chain will be discussed in detail.

2.3.1 Cropping practices (pre-harvest practices)

Planting material: Naturally mango reproduces by seed; the trees can be more than hundred years old and grow to a height of more than 40 meters (Mukherjee & Litz, 2009). Nevertheless, mango trees for commercial production are usually propagated using vegetative multiplication techniques. Whereas seed propagation systems do not ensure a "true-to-type" plant reproduction, grafting preserves distinct characteristics (phenotypes of superior selections) of the trees. Besides, mango trees which were grafted onto seedling rootstocks flower after 3-4 years. In contrast, trees, which have been propagated by seedlings flower after 5-10 years (Ram & Litz, 2009). The export market generally focuses on a small number of varieties, which have to be produced in different regions to widen the harvesting season. In this case the use of rootstocks from site adapted varieties ensures a better plant fitness.

Planting systems should be planned well in advance to maximize yields from young mango orchards and maintain yields of older ones. In overcrowded orchards trees compete for water, nutrients and light, the efficiency of foliar spray applications is reduced and a high planting density makes the harvesting of mangos more difficult. In e.g. Brazil mango trees were traditionally planted with a spacing of 10 x 10 m in a rectangular or quadratic format and a density of 100 trees/ha. Advances regarding the physiology of mango trees, irrigation systems, fertilizer management, pruning systems and growth regulators made it possible today to increase the planting density to 250-400 trees/ha (Crane *et al.*, 2009).

Management of the canopy and crop load represent further techniques to improve the quantity and quality of the yield in mango orchards. Pruning, which requires experience and training, aims at enhancing the quantity of sunlight interception by leaves due to tree shape regulation. Open tree canopies support increasing fruit size and quantity of fruits. Sunlight is absorbed by the green leaves, sugars and carbohydrates are synthesized and forwarded to the buds, flowers and fruits. Anyhow, inappropriate canopy and crop load management can lead to fruit trees with high yields but in one line with a high percentage of smaller fruits. Thinning techniques, including thinning of spurs, buds, flowers and/or fruits seems necessary to increase the amount of marketable fruits. By the same token, a good canopy management helps to decrease the risk of fungal diseases due to better aeration and eases fruit handling during bagging and harvesting (Hai, 2012).

In general, mango can be produced on a wide variety of soils. The trees are sturdy and grow even on marginal sites, although an optimal fertilizer application during fruit growth is the key for a high yield and well-shaped fruit. The appropriate fertilizer regime depends on local conditions such as soil type and depth, irrigation practices, cultivar, production objectives and availability and cost of organic and inorganic materials. A balanced and integrated fertilization should incorporate a plant and soil analysis to identify requirements, especially with respect to presence and availability of phosphorus (Crane *et al.*, 2009). Fouad *et al*. (2003) found that potassium (P_2O_5) fertilization can positively improve fruit weight, size and sweetness of the fruits (Fouad *et al.*, 2003). Based on these findings and considering the complementarity of potassium and nitrogen uptake by the trees, the application of soluble K_2O and N containing fertilizers during fruit growth is advisable. As a result, applying small quantities in short intervals prevents the loss of nutrients and the pollution of groundwater by leaching. The application of foliage fertilizer, such as thio-urea or KNO_3 is common practice to stimulate bud break and thereby support uniform flowering. Foliar application of micro-nutrients after fruit set can help to improve fruit growth, as not all micro-nutrients can be translocated from older to younger leaves and to the fruit. Excessive fertilization after harvest can lead to continuous vegetative growth, reduced flowering and corresponding lower fruit yields and physiological disorders of fruits (Hai, 2012).

Limited *water supply* for mango production is also likely to influence yield and quality of fruits. Irrigation practices depend on a wide range of factors such as availability and cost of technology, soil type and depth, plus the amount and distribution of rainfall and production objectives (Ram & Litz, 2009). Studies carried out on commercial mango orchards in Thailand showed that constantly high yields can only be achieved under irrigation (Spreer *et al.*, 2009). Regarding yield formation, irrigation is especially important during the time of the fruit set, when the number of cells of each fruit is determined and about 60 days after fruit set, when the highest increase in fruit mass takes place during the time of rapid fruit growth. Nonetheless, the last weeks before harvest may be crucial, as a drought period may lead to a higher share of undersized fruit and even losses due to early maturity and resulting fruit fall (Schulze *et al.*, 2013; Yasunaga *et al.*, 2013). Under the impression of scarce water resources the application of deficit irrigation practices has gained increasing attention. Mango trees are generally drought resistant and have been found to respond well to partial rootzone drying (PRD) (Schulze *et al.*, 2013; Spreer *et al.*, 2007; Spreer *et al.*, 2009).

In developing countries in particular, *pests and diseases* are major causes for losses concerning fruit quality and quantity of marketable fruits (Sivakumar *et al.*, 2011). Important pests for mango include fruit flies (*Ceratitis* ssp.), tree borers (*Batocera rufomaculata*), seed and pulp weevils (*Sternochetus* ssp.) and mango hoppers (*Idioscopus* ssp.) (Pena *et al.*, 2009). W. Spreer illustrates that the mango fruit fly lays its eggs under the surface of ripe mango fruit. The spots of oviposition are usually not detected during the manual sorting process. Fruit bagging is used to prevent fruit fly infestation. Adult individuals of the tree borer feed on the leaves of mango trees, without causing economically relevant damage, while the larvae develop in the splint wood of the trees. Older trees and rotting wood are preferably infested and complete loss of trees is possible. A good fertilization regime and adequate pruning, including the removal of cut branches, are measures to avoid tree borer infestation. After infestation, mechanical removal of the respective plant parts is necessary. Mango seed and pulp weevils and mango hoppers are controlled by standard chemicals and are therefore not major problems in more developed countries, such as Thailand. That said, excessive use of agro-chemicals leads to environmental pollution and residues on the fruit, which, if detected in the importing country, may lead to bans. According to GAP standards, three weeks before harvest no insecticides may be applied (personal communication, 15.12.2015).

Fungal diseases, namely anthracnose (*Colletotrichum* spp.), stem end rot (*Phomopsis* spp.), black mold rot (*Aspergillus niger*) and mango black spot (*Xanthomonas campestris* pv.), are major problems. W. Spreer and S. Vicha show that Anthracnose may infest leaves and fruit and spores can endure in the vegetation beneath the trees. Economic damage results from infestation of young leaves as well from direct infestation of fruit, which is an early stage is invisible to the naked eye and not detected during grading. Fungicide treatment, in combination with good pruning practices and control of vegetation beneath the trees, is necessary to prevent anthracnose. Stem-end rot is caused especially if fruits get in contact with soil containing spores. An appropriate post-harvest handling including hot water treatment and hygienic conditions while packing and transport are essential control measures (personal communication, 15.12.2015; 09.02.2016).

Managing tree health can considerably reduce post-harvest losses (Prusky *et al.,* 2009). Pena *et al.* (2009) and Prusky *et al.* (2009) provide a detailed list about pests and fruit diseases and measures to control them. However, specific chemicals are subject to development and active substances and brand names undergo frequent changes. The same is true for the knowledge about critical levels of residues, which depends on the results of biological and medical research. In many cases substances, which have been believed to be sub-critical, are discussed vividly concerning their implications for consumers' health and adverse effects on the environment, when new research data is published. In this context, growers face the challenge of ensuring high-quality production by optimizing the use of agrochemicals and minimizing the impact on environment and consumers alike. GAP standards focus on the safe storage of agro-chemicals, application under protective gear and following schedules of application. According to W. Spreer GAP provides an excellent baseline for pest and disease management, but can only be effective if producers are aware of the state of the knowledge about agro-chemicals on the market. In a developing country like Myanmar, the challenge is to provide appropriate extension services to all farmers (personal communication, 15.12.2015).

Fruit bagging or wrapping has a long history in Asia and is used as a physical protection against birds, insects, in particular fruit flies. Traditionally, individual mangos were wrapped by newspaper or paper bags (PAL, 1999) for about 45 days after fruit set. The success with mangos was substantial, however, research in the early 90s demonstrated that the bagging materials did not resist the effect of wind and rain (Pena *et al*., 2009). Recent studies emphasize several beneficial effects of fruit bagging including improved visual fruit quality, faster fruit development (microclimate in the bags) and a reduced incidence of mechanical damage, fruit cracking and agrochemical residues (Sharma *et al.*, 2012) in relation to different bagging materials. Even significantly reduced diseases and blemishes, increased mango weight (up to 15%) and accelerated mango ripening was achieved with wavelength-selective materials in comparison to paper bagging (Chonhenchob *et al.*, 2011).

Figure 4 Left: Mangos bagged in newspaper (Thailand, 2003) Right: Mango orchard with fruits in commercial bags (Myanmar, 2014) (Spreer)

Harvesting practices are often underestimated in their importance for the final product quality. Yet, one may simply imagine that all pre-harvest activities, including pruning, thinning, irrigation, fertilization, as well as the management of pests, diseases and below canopy vegetation, may have been in vain, if the fruit itself is damaged during harvest or harvested at a sub-optimal degree of maturity. Bruised or cut fruits are highly susceptible to an infection with fungi such as *Aspergillus* sp. or *Botryodiplodia* (Sivakumar *et al.*, 2011). If stored together with other fruit, one infected fruit can spoil the whole lot. While obviously damaged fruit can be rejected during sorting, some bruises become only visible after days. Bruised fruit develop ethylene, which accelerates the ripening process of other fruits.

Selecting fruits with an ideal maturity is of major importance in order to extend storage life and to develop optimal sensory quality attributes during the further supply chain. Harvested to early, the fruit will not develop the full taste and typical mango aroma. Harvested too late, the fruit will reach the consumer in an over-ripe stage. General speaking, harvest maturity of mango is achieved 12-16 weeks after fruit set (Sivakumar *et al.*, 2011). In Southern Shan State, growers calculate with 110 days after fruit set for *Sein Ta Lone* fruit for export and 150-180 days for *Yin Kwe* fruit, which is mainly for domestic consumption, and therefore harvested ripe. The calculation based on days after fruit set is the most common way for harvesting time determination. If non-simultaneous flowering occurs, different colored bags are used to distinguish the different fruit set times. Short before harvest, samples are checked for maturity by the smell, firmness of the flesh or the typical black spot, which are the result of fungi developing in the pores (lenticels) after the latex production in the skin has stopped. Maturity determination by color is not possible, when fruits are bagged as chlorophyll cannot develop in the absence of light. Destructive sampling for the determination of sugar:acid ratio is another reliable maturity indicator (Crane *et al.*, 2009), but variations in ripeness, e.g. due to the position of the fruit on the tree (Johnson & Hofman, 2009), cannot be accounted for. Thus, this method has little relevance in the practice. During the grading process the maturity can be checked by submerging the fruit in water. W. Spreer highlights as a general rule, that fruits at the appropriate maturity stage for export handling sink to the point that only an area of the size of a 10 – Thai Baht coin (approx. 40 mm2) remains at the surface (personal communication, 15.12.2015)

Off-season mango production: In Thailand, off-season mango production is practiced since 1986. This involves the application of a growth regulator called Paclobutrazol (PBZ) (sometimes in combination with theourea (to break flower buds) (Nartvaranant *et al.*, 2000). The aim is to induce flowering (inflorescence) (visible 2.5-4 month after application), reduce alternate bearing and shift/enable off-season mango production where the price for mango is higher (Neidhart *et al.*, 2006). By applying PBZ, 2-3 cropping times can be achieved in mango production (Chomchalow & Songkhla, 2008). However, due to environmental considerations PBZ has been banned in different countries and maximum residue levels of the Codex Alimentarius have been revoked. In the European Union residue levels of Apples 0.5 mg/kg and other fruits 0.05 mg/kg are tolerated (Neidhart *et al.*, 2006).

2.3.2 Postharvest practices

Postharvest practices refer to the *"transformation of a product from its state at harvest to its ready-to consume-state"*. The aim of postharvest management is to create value by reducing post-harvest losses and ensuring product quality and safety (Florkowski *et al.*, 2014). Postharvest losses are still high, in particular in developing countries. Regarding the decay of fruits, pests and physiological breakdown, quality losses during the supply chain can be considerably reduced by proper postharvest handling and export conditions. For commercially traded export mangoes postharvest practices include sorting, grading, postharvest treatments (hot water treatment (HWT), vapor heat treatment (VHT)), packing and labeling, transportation, temperature and storage conditions as well as ripening at destination (Sivakumar *et al.*, 2011).

Figure 5 illustrates major activities widely used in a packinghouse sequence whereby different facilities for collection, cleaning, treating, packing, cooling and storing the fruits are necessary to avoid contamination of fruits:

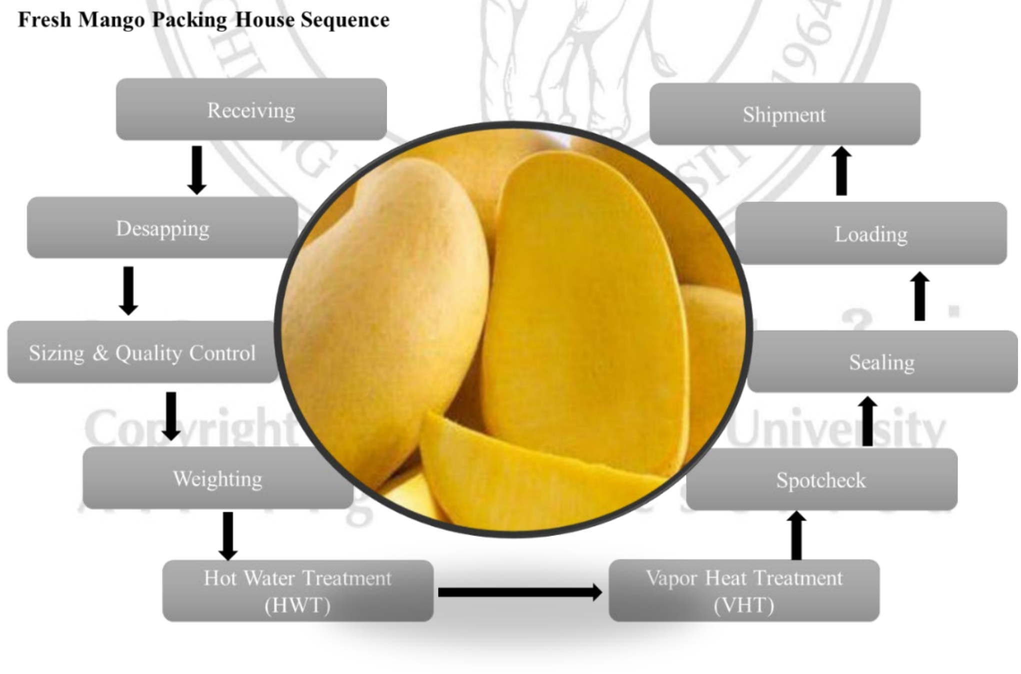

Figure 5 Packing House Sequence for Fresh Mango (Vicha & Spreer, 2015)

Post-harvest mango processing begins with desapping and putting the mangos upside down on a customized rack to protect mangos from sap burn and latex strains. In the next steps mangos are washed, sized and quality controlled. Scarred, bruised or otherwise defective mangos are discarded.

The *hot water treatment (HWT*) aims at controlling insects, decay and fungi on mango. HWT (52-55°C) of 10 minutes with previously bagged mangos can reduce anthracnose infection by 83 % and stem end rot by 100 %. However, temperature and duration are depending on the cultivar, size, weight and stage of maturity of the mangos. Alvindia/Acda (2015) confirm that these positive results for bagged fruits and show that HWT has no negative effect on the overall fruit (Alvindia & Acda, 2015). HWT is increasingly used, as it represents an effective technology to reduce postharvest losses and can easily be implemented by small and medium scale mango farmers (Sivakumar *et al.*, 2011).

Vapor heat treatment (VHT) aims at eliminating fruit fly larvae and pathogens causing anthracnose and stem rod. VHT represents an effective treatment to control internal pests. Within VHT mangoes are treated with vapor at 47°C for 20 min and relative humidity between 50-80 %. After the treatment fruits are cooled down by spraying water (Alvindia & Acda, 2015). Mangoes to be exported to Japan and South Korea have to be submitted to an expensive vapor heat treatment under the supervision of sanitation inspectors of the importing country. This costly process limits the number of exporting companies to these two countries (Panichsakapatana, 2013).

After the treatments, mangos have to be packed, labeled and transported to designated ports. The short storage life of mango represents one of the major constraints for export to overseas markets. As a climacteric fruit, mango ripens after being harvested. A process, which can be slowed down by cold storage and controlled atmosphere, but not stopped (Kienzle *et al.*, 2012). The changes in hardness which ripening fruit undergo are of critical importance for export, where it is exposed to a variety of external influences, such as changes in temperature and physical impact (Yasunaga *et al.*, 2013). This is especially true for a country as Myanmar with bumpy roads and the absence of cooling facilities for fruit storage.

Regarding pre- and post-harvest management practices to produce high quality mango it becomes clear that these practices require experience, extensive training and availability of appropriate technology.

In the following, attention will be payed to institutional arrangements as enabling conditions in high quality fruit production.

2.4 Clusters, Value Chains and farmer producer groups

Companies – independent from size and location – which aim at (technological) upgrading cooperate (to various degrees) with other companies and actors. According to Pietrobelli & Rabellotti (2006a) the term upgrading refers to the ability to improve products and processes, to make products more efficiently and increase the value added. They stress that:

"Of particular importance for innovation and upgrading are interactions that go beyond arm's-length market transactions and that involve more than information about prices and quantities. Laws, regulations, social rules and norms, technical standards, and cultural habits constitute the institutional context within which firms and organizations interact. Such institutions may importantly foster or hinder the interactive learning processes that are essential conditions for upgrading" (Pietrobelli & Rabellotti, 2006a).

These relations are not static in nature, rather dynamic and companies co-evolve with market structures and institutions (Pietrobelli & Rabellotti, 2006a).

In chapters 2.1-2.3 the terms clusters, value chains and farmer producer groups have been used without defining and specifying these concepts. In this section, the terms will be defined and differentiated to better capture ways of small-scale farmer cooperation and inclusion before the structure of the export mango sector in Thailand is outlined.

2.4.1 Conceptual Delimitation and Usage

The 21st century is characterized by a significant changing economic environment due to globalization, rapid development of new technologies, intense competition and changed consumer expectations towards higher living standards (Irshad, 2009). Since the 1990s clusters attract a great deal of attention in theory and practice due to the ability of clustered companies to better anticipate these changing conditions and to improve the productivity, competitiveness as well as export performance by levering opportunities for cooperation of its actors (Pietrobelli & Rabellotti, 2006b; Pietrobelli *et al.*, 2006) .

The United Nations Industrial Organization defines clusters as (UNIDO, 2001):

"sectoral and geographical concentrations of enterprises that produce and sell a range of related or complementary products and, thus, face common challenges and opportunities. These concentrations can give rise to external economies such as emergence of specialized suppliers of raw materials and components or growth of a pool of sector-specific skills and foster development of specialized services in technical, managerial and financial matters. Networks are groups of firms that cooperate on a joint development project complementing each other and specializing in order to overcome common problems, achieve collective efficiency and penetrate markets beyond their individual reach."

Schmitz (1995) introduced the term collective efficiency, used in the second part of the definition. It is key to capture the positive impacts of clusters. Collective efficiency refers to *"the competitive advantage which they [clustered companies] derive from local external economies and joint action"* (Schmitz, 1995). Local external economies, mentioned in the first part of the definition, are economies, which are external to a company but internal to a region. Examples of external economies encompass inter alia the establishment of a marketplace for and increased availability of skilled workers or specialized technology. Thus, clustering can lead to an easier access to specialized knowledge and a rapid propagation of information within a cluster (Pietrobelli & Rabellotti, 2006a). Joint action describes on the one hand mutual linkages between local producers. Common joint actions common purchase of inputs, joint usage of specialized technologies as well as collective sales and marketing activities and the sharing of market information and know-how. On the other hand, joint action denotes improved vertical backward linkages to e.g. supplies and forward linkages to e.g. local traders and markets (Pietrobelli & Rabellotti, 2006a; Schmitz, 1995).

However, the changes in production systems and distribution systems due to globalization and the spread of information and communication technology emphasize the need to consider external linkages. The concept of (global) value chains shifts the focus from production to include further activities happening outside a cluster and the role of external actors (vertical forward linkages). Moreover, the idea of value chains is not necessarily based on regional conceptions. The value chain concept puts the focus on a sequence of activities and processes to convert inputs into a finished product. Each step of the value chain adds value to the product. However, in order to decide what is produced, how is it produced and how much is produced some degree of coordination (governance) is necessary. According to Pietrobelli and Rabellotti (2006a), this coordination can either be (1) network oriented and relying on cooperation between different companies in a value chain sharing their competencies, or (2) hierarchical, whereby one actor dictates the rules. In global value chains for fresh fruits, inter alia two trends can be observed. First, an increasing consolidation in the middle (processing) and downstream (retail) segments in the global value chains leading to a shift of power in favor of the retailers. Second, a quality based competition of consolidated retailers tightening requirements for vertical coordination (Pietrobelli & Rabellotti, 2006a, 2006b).

Reardon (2015) shows that in Asia, like in other developmental regions, food value chains are originally rooted in sales from farmers to nearby villages. In one line with growing cities, intermediaries (rural-urban brokers) proliferate, collecting agricultural goods in rural areas and selling them to villagers and semi-wholesalers who then resell to cities. Then, driven by public sector investment in hard and soft infrastructure and wholesale markets, private sector initiatives increasingly lead to a restructuring of rural distribution. Wholesalers from rural, as well as urban markets, begin to buy directly from farms sidelining (rural) brokers. In a third wave, modern, “specialized-dedicated” wholesalers emerge, buying direct from processors and farmers on behalf of supermarkets. Where products are perishable, the procurement is generally conducted with the assistance of logistic companies - fulfilling different tasks including warehouse management, cool chain development and packing. This general development trend – the gradual or quick consolidation of at first highly fragmented, small-scale companies due to investments of local or foreign companies or organic growth of the small-scale companies – could be observed in most value chains for fruits and vegetables in the past decades (Reardon, 2015).

Concerning the second trend, Humphrey and Schmitz (2000) argue, that in current buyer-driven value chains for fresh fruits the decisions of the final buyer are decisive of what is produced, how and by whom (Humphrey & Schmitz, 2000). As illustrated in chapter 2.2 buyers are no longer only interested in product characteristics alone, but also in ways of production and processing and their effects on the environment, workers and the safety of food itself. This in turn leads to increasing importance of buyer-driven standards, such as GlobalGAP and processing standards, enabling retailers to differentiate their products towards higher quality, consumer safety and environmental protection to generate additional profits and leading to the creation of new markets (Reardon & Farina, 2001). As a consequence, the information flow concerning quality and food safety standards as well as further requirements and coordination among the actors becomes increasingly important (Gomes, 2006).

In this context, growers in fruit value chains, in particular small and medium-scale farmer, do not only face a fierce price competition and high market entry barriers in relation to high investment requirements, limited production and insecure access to post-harvest facilities and transport services. *"They must now meet the mounting demands for better fruits, "better" being whatever the supermarkets define as better: varieties, production methods, post harvesting technologies, packaging and labeling specifications, and acceptable environmental impacts and working conditions"* (Gomes, 2006).

Recognizing the increased power of retailers in global agri-food value chains is an important aspect. However, in one line with Gomes (2006), in this master thesis it is argued, that joint action and cooperation among farmers and with other local actors can significantly influence the way, how small- and medium scale farmers participate and integrate in these global value chains. On the one hand, farmer cooperation in form of cooperatives, farmer grower groups or farmer associations can drive economies of scale and reduce transaction costs. Economies of scale can either relate to the common purchase of inputs, provision of training, technical assistance and logistics or to non-price factors such as reputation (brand building) and improving quality attributes.

Moreover, cooperating farmers act in an optimal case as one unit reducing transaction costs for buyers (retailers), as joint actors can provide larger quantities of standard quality. On the other hand, farmer grower groups and other forms of collaboration bear great potential to improve bargaining power and negotiation capacities of small-scale farmers (Berdegué *et al.*, 2008; Lee *et al.*, 2012).

Thus, the consideration of the concepts clusters and value chains represent in terms of small-scale farmer inclusion two sides of the same coin. Clusters emphasize cooperation among upstream actors and between upstream-midstream actors, whereas value chains can be seen as means of information flow including requirements of and access to global markets. Berdegué *et al.* (2008) and (Pietrobelli & Rabellotti, 2006b) provide several case studies in Africa and Latin America illustrating ways of upgrading and small-scale farmer inclusion strategies in global value chains. In the following chapter, with the example of the Thai mango sector it will be illustrated, that in praxis both concepts are mutually enhancing as local and global dimensions operate simultaneously.

2.4.2 Mango production and trade in Thailand – The role of mango grower groups and clusters

Thailand and Myanmar are neighbors. Although, in contrast to Myanmar, Thailand has a fully developed export market for fresh mangos. In 2013, Thailand ranked among the top three mango exporting countries worldwide (FAOSTAT, 2015).

According to Chomchalow/Songkhla (2008) and Panichsakpatana (2013) the success of the Thai mango sector is based on four pillars which developed simultaneously and with strong interrelations during the past two decades (Chomchalow & Songkhla, 2008; Panichsakapatana, 2013):

1. Development and improvement of a suitable cultivar for export, namely Nam Dok Mai No. 4

2. Implementation of an efficient production and post-harvest system and corresponding technologies

3. Support of the Thai Department of Agriculture (DOA)

4. Establishment of Mango clusters and Thai mango grower groups

As the pillars 1-3 have already been described in chapter 2.2 and 2.3, this section will focus on the role of mango clusters and producer-managed groups. Originating from efforts of the DOA in 1997 to encourage grower networks in close cooperation with the government, Thai mango grower groups evolved gradually and in 2008 the Thai Mango Growers Association was established. Currently 20 grower groups throughout the country exist. Each group is managed by a committee to set up policies and coordinate activities of the group. Some of the groups are organized as cooperatives, others as community business groups. Within the groups, production schedules are arranged in order to efficiently comply with orders from the exporters. Due to different climatic conditions in Thailand and a close cooperation between the grower groups in the mango cluster, mangoes can be supplied all year round. Besides, input resources such as agrochemicals are collectively purchased and shared among the members, continuous trainings relating up-to-date management practices like pruning, bagging, application of chemicals, harvesting, grading and packing are organized and appropriate collecting spaces were established. As a result, mango grower groups do not only strengthen the bargaining power of mango growers, they also support the members in terms of access to information and technical know-how (Chomchalow & Songkhla, 2008; Panichsakapatana, 2013).

In case of mango export to Japan, exporters arrange post-harvest activities including sorting, grading, HWT, VHT, cooling testing, packaging and labeling. After setting up post-harvest facilities, the operating cost for the mango handing appear to be rather marginal (16 %) in relation to the transport costs by plane (84 %) and value addition due to post-harvest handling (Kantaburta *et al.*, 2012). In addition, a close cooperation between mango groups and exporters (contract farming and sharing of information concerning legal agrochemical restrictions and certification requirements) ensures an efficient coordination of mango supply and demand. Costs for GlobalGAP certification and re-certification of grower groups are borne by the exporters or by the farmer groups. Thailand’s own “Q-GAP” is comparatively cheap for farmers to obtain. Governmental institutions oversee the functioning of the system and compliance with standards. The DOA decisively forwarded the Q-GAP certification processes by providing guidelines to the grower groups and certifying orchards that apply Q-GAP. Furthermore, a “One Stop Service Center” has been established in order to facilitate exports and coordinating the activities of growers, exporters and government agencies (Chomchalow & Songkhla, 2008; Panichsakapatana, 2013).

In sum, the effectiveness within Thailand’s mango value chain is considerably enhanced by a close collaboration of different stakeholders. This collaboration ensures an efficient production in the cluster and flow of information alongside the value chain.

The brief description of the Thai mango sector illustrates a positive example, how conditions of (small-scale) farmers and an effective linkage of smallholders with dynamic markets against the background of on-going, (inevitable) changes in the agri-food system can be improved by collaboration in grower groups, with private actors and due to supportive governmental action.