

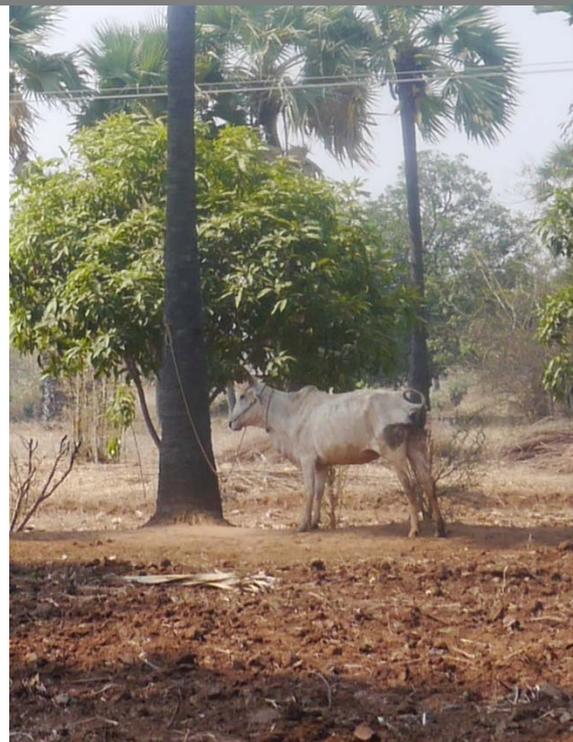
Landuse changes on the way to democracy – the Case of Myanmar

A study tour to Myanmar
from March 13th to March 29th 2015

Report



**Myanmar 2015
Interdisciplinary Study Tour**



Organised by:

German Institute for Tropical and Subtropical Agriculture – DITSL GmbH Witzenhausen

Animal Husbandry in the Tropics & Subtropics (Universities Kassel and Gottingen)

Organic Plant Production & Agroecosystems Research in the Tropics & Subtropics University of Kassel / Witzenhausen

Centre for International Rural Development, University of Kassel / Witzenhausen

Yezin Agricultural University, Myanmar, Nay Pyi Taw, Yezin

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Cover picture (front): Sugar toddy palm and zebu cattle

Cover picture (back): Irrawaddy river delta

All pictures taken by excursion participants unless stated otherwise.

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Preface

The University of Kassel in Witzenhausen and the University of Göttingen offer study programmes in the field of agriculture, resource management, environment, forestry, fisheries, food, nutrition and related sciences in the context of rural development, sustainable resource use and poverty alleviation with a regional focus on developing countries particularly in the tropics and subtropics.

Both universities build on a wealth of expertise on tropical land use systems and the sustainable management of natural resources. Many of the students interested herein will eventually conduct research in subtropical and tropical countries – often in the frame of their MSc or PhD theses. Their academic curriculum must prepare them for this task. It is obvious that even the best lecture at the university in a so-called “developed” and temperate region cannot substitute the experience that is gained while visiting a tropical country. Therefore, field trips to tropical countries are a most desirable part of any such curriculum.

Scientists of the German Institute for Tropical and Subtropical Agriculture (DITSL) and the agricultural and forestry faculties of the universities in Witzenhausen and Göttingen maintain mutual research and academic training and networking activities and projects with Myanmar Yezin University.

The 2015 study excursion of students and lecturers from Göttingen and Witzenhausen to Myanmar has benefitted from these institutional personal linkages.

The Republic of the Union of Myanmar hosts a variety of different ecological zones and agricultural and forest landscapes. Smallholders dominate the agriculture sector. They operate in a similar bio-geophysical environment as their Thai neighbours, but in a different political and economic setting. Independent since 1948 and under military regimes since 1962, the country entered into a democratic process only in 2011. Consequently, all economic sectors of the country currently undergo major transformational change. The 2015 excursion particularly focussed on these transformation processes.

The 2-weeks study tour was organized in cooperation with Yezin Agricultural University in Pyinmana. It aimed at a deeper understanding of the processes and effects of transformation in agriculture, forestry and fisheries by visits to a variety of producers, processors and projects, demonstrating the diversity from large to small scale, from intensive to extensive, and from collective to individual in a dynamic South-East Asian country.

The excursion was preceded by preparatory seminar of two contact hours per week in winter semester 2014/15, where students presented different topics related to the forth-coming excursion.

Funds were acquired, logistics were organised and in March 2015, 21 students and 6 faculty members set out for Myanmar.

Acquiring funds for such a trip is difficult and we are grateful for generous financial support by

DAAD (German Academic Exchange Service) via the PROMOS programmes at the Universities of Kassel and Göttingen

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Universitätsbund Göttingen e.V.

University of Kassel - Faculty of Organic Agricultural Sciences FB11

From March 13th to March 29th, 2015, we followed through a very interesting and physically taxing schedule. Every aspect of the programme moved exceptionally smooth, which was facilitated through the excellent support, received from our partners, to whom we express our sincere gratitude.

We are very much indebted to our colleague and friend Mrs Thin New Htwe. Not only did she plan the trip together with the lecturers; throughout the whole excursion she was our translator, our organiser who always found a solution – no matter how spontaneous it had to be – and of course she always took care that everyone felt at home. Even a cold could not stop her from being the very heart and soul of our trip. Thank you for continued

support, your endurance and charming company throughout the trip!

Thanks also to Mr. Myo Min Aung who helped to translate the many Burmese-English discussions. We would also like to thank our colleagues from Witzenhausen and Göttingen for their great support in preparing this trip.

Finally, all participating students deserve a big “Thank You”. They worked hard to achieve the predetermined goals of this endeavour. But besides dealing with hard-core science we also had a lot of fun together.

We really enjoyed this very memorable trip with all of you!

Eva Schlecht

Andreas Bürkert

Christian Hülsebusch

Achim Dohrenbusch

Grete Thinggaard ter Meulen

Schedule of the Preparatory Seminar / Presentations

During the preparatory seminar on January 10th, 17th and 24th, 2015, fourteen presentations were held as per the schedule below. The time allotted was 15 minutes presentation plus 5 minutes discussion for topics presented by one student and 30 minutes presentation plus 10 minutes discussion for topics presented by 2 students. Each presenter or presenting team submitted a Microsoft

PowerPoint® file and a comprehensive text, the latter are compiled here below.

In addition to the preparatory seminar, the group went on a pre-excursion to Hanover to see the Golden Letter sent in 1756 by King Alaungphaya of Burma to King George II of Great Britain. Being a descendant of the House Hanover, George II archived the letter in the Gottfried Wilhelm Leibniz Library in Hanover, where it still resides today.

No.	Title	Presenter
1	History – the old cities	Myo Min Aung
2	Geography and climate	Vera Wersebeckmann & Ture Jacobsen
3	Ecology and environment	Carsten Bruckhaus & Balint Szell
4	Government and politics	Jens Riemeyer & Dirk Landmann
5	The way of life: Society and conduct – “dos & don’ts”	Luciane Lenz
6	Religion and religious tensions	Anja Lienert & Felix Stiegler
7	Economy – imports and exports	Lisa Haubner & Leonie Kreipe
8	The timber industry – changes over the past decades	Peter Thyen
9	Forests, nature conservation and tourism	Lena Grün
10	Oil palm production	Bernadette Kiesel
11	Rice production	Jan Lanvers
12	Sugarcane and palm sugar	Esther Mieves
13	Agroforestry systems	Mwanaima Rajab Ramadhan & Malte Dunkhorst
14	Livestock production: Buffaloes and cattle	Philipp Seifert & Katharina Stanzel

History – the old cities

Myo Min Aung

History of Myanmar and its ancient cities

Myanmar history could describe from the time of the first known human settlement from 11,000 BC to the present day (Prehistoric and Animist Periods, n.d). According to the earliest inhabitants recorded, the country history could generally start from Mon and Pyu period. After that the three Myanmar empires and small states between empires, colonial period, and after independent period follow. In the respective periods, there were cities scattered around the country, but only structures and remains of some ancient cities are still conspicuous while some are not.

Mon and Pyu period

Evidences show that Mon and Pyu eras were believed to have started in BC 200 and a number of walled cities were built around central Myanmar (Pre-Bagan period, n.d). In that period, Hanlin, Beikthano, Tharay Kittarar of Pyu City States and Thuwunna Bonmi of Mon City State came into existence and were built in the plains and along major river banks of Irrawaddy and Sittaung. Out of these ancient cities, Pyu old cities were inscribed on world heritage lists in 2014 (UNESCO, 2014).

The first Myanmar Empire (Bagan)

From the 9th to 13th centuries, Bagan Kingdom was organized by King Anawrahta to become a first unified empire which later constitutes modern Myanmar. During the kingdom's height between the 11th and 13th centuries, over 10,000 Buddhist temples, pagodas and monasteries were constructed in the Bagan plains alone, of which over 2200 temples and pagodas still survive to the

present day (Renown travel, 2015). But during the Bagan's greatness years, three times Mongol invasions led to the collapsed of the empire (Myanmar Net, 2012). Although the empire had collapsed, the remains of the ancient city mark Bagan as one of the most tourist attraction places in the world.

Small states period

After collapsing of Bagan, being unable to organize as a single big empire, there were the times of small states such as Arakan, Inwa, Pinya, Hantharwaddy, Shan which lasted around two century (Hays, 2013).

The second Empire (Toungoo)

From mid-16th century, 1510 to 1752, King Tabinshwehti reunified disintegrated Bagan again and included some more areas establishing the second Myanmar Empire, Toungoo. At its peak, the First Toungoo dynasty also incorporated Manipur (part of India), Chinese Shan States, Siam (Thailand), and Lan Xang (Laos) into the empire, creating the largest territory in Myanmar history (Web Wiz, 2009). During the second empire, Bago and Inwa were used as strategical capitals. After king Bayinnaung regime, the kingdom became drastically weaken its power, finally coming to the empire's end.

The third Empire (Konbaung)

The Konbaung Dynasty was the last empire that ruled Myanmar from 1752 to 1885, and was founded by a village chief, who later became known as Alaungpaya.

His forces had reunited all of Myanmar, laying the foundations of modern state, and creating the second largest empire in

Myanmar history; it was also the area of current Myanmar. In 1756, Alaungpaya sent

a golden letter to King George II of Britain as his international relationship efforts. In Konbaung period, Yangon was established as the first capital and later moved to Mandalay, the last capital of Myanmar kingdom, which has left many prominent historical buildings and structures.

Under British colonial rule

In three Anglo-Burmese wars over a six-decade span during Konbaung period (1824–1885), the British defeated the Myanmar and ended the millennium-old Myanmar monarchy, under the king Thepaw. British took control of Myanmar from 1885 to 1948.

Independence and Democracy

At the outbreak of the Second World War, General Aung San seized the opportunity and Myanmar got independence on January 4, 1948. Since that time, Myanmar central government was continuously challenged by ethnic groups who felt under-represented in the 1948 constitution. A period of intense civil war destabilized the nation and is still going on until now. Long suffering mostly under military rules, there were two public uprisings in 1988 and 2007. In 2010, the country politics change to parliament democracy, despite 25 % controversial representation from army (Keling et al., 2010).

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Geography and climate

Vera Wersbeckmann & Ture Jacobsen

Geography

The Republic of the Union of Myanmar is located in the southwestern-most part of Southeast Asia. It is a sovereign state and surrounded by the People's Republic of China, Laos, Thailand, Bangladesh, and India. Myanmar also called Burma covers an area of 678,500 km² thus the country is almost as twice as large as Germany. In terms of square kilometres this makes Myanmar the second largest country in Southeast Asia just behind the archipelago of Indonesia.

Geographically, the country can be divided into five major topographic regions. Firstly, the Himalayan sub-range in the most northern tip of the country. Secondly, the Arakan or Rakhine mountain range which stretches along the Indian and Bangladesh border. Thirdly, the Shan Plateau or also known as Shan Hills extends through the central western part of Myanmar to parts of Thailand and the Chinese Yunnan province. Fourthly, the entire country is shaped by the central basin region which runs from north to the most southern coastal region. Lastly, we can distinguish the coastal plains and deltaic zone. One of the most southern extensions of the Himalaya can be found in Myanmar's north. This area of the country ranges from approximately 1,800 m up to almost 6,000 m and inhabits the Hkakabo Razi (5,881 m), the highest elevation in Myanmar.

The Arakan mountains in western Burma extend from the Indian state of Manipur down into the Bay of Bengal and submerge again in the Ocean in form of the Indian Andaman and Nicobar Islands. Its highest point is Mount Victoria with a height of 3,094 m, whereas the average elevation of the area ranges around 1,200 m. In the past and still today the Arakan range divided the Indian subcontinent and Southeast Asia

culturally, linguistically and also meteorologically. This becomes visible, in particular, during the monsoon when the range blocks off the basin from the southwestern monsoon and thus from heavy precipitation. Hence, the regions in central Myanmar are the most arid in the entire country.

The Shan plateau is situated in the central eastern part of Myanmar and extends further eastwards into China and Thailand. Its western flank descends rapidly towards central Myanmar's massive river valleys. The region is, in particular, characterized by its craggy and steep surface and the high number of crossing gorges. The Shan state is divided by the Salween river gorge which runs through the plateau from north to south. This region is rich in various gems such as sapphires and rubies hence Shan state is the area where most of the Burmese mining industry can be found. Myanmar's interior is mainly flat and also referred to as central basin or plain. The low land area stretches approximately 1,500 km from north to south through almost the entire country. This part of the country is dominated and has been shaped by the river and its alluvial soil sediments. The central basin is flanked by the previously described Arakan mountain range to its west and by the Shan hills to its east. In the southern third of the central basin the valley is divided by the Bago mountains which separates the western Irrawaddy river delta from the eastern Sittoung valley. Although the latter river is with a length of 420 km relatively small compared to the Irrawaddy river, the river forms a remarkably large delta east of Yangon.

The fifth topographic region is the coastal plain and deltaic zone of Myanmar, which occupies the entire coastal region from Chittagong Division of Bangladesh down to the Malayan peninsula bordering

Thailand to its eastern flank. The northern coastal strip is fully captured by the Rakhine state and spans 740 km from Bangladesh to the Irrawaddy delta region. Because of the immediate proximity of the Arakan range to the Rakhine coast is one of the most rain abundant regions in Myanmar. South of the delta region adjoins Tanintharyi (Tenasserim) coastline which covers the northwestern part of the addressed Malayan peninsula. Its offshore terrain is characterized by inlets coral gardens and little clusters of archipelagos. As already stressed above covers the Irrawaddy (Irrawaddy) River basin the entire central area of Myanmar and is also the river which completely flows on Burmese territory. Furthermore, accounts for the most navigable rivers in Asia and allows all year around shipping activities up to the city of Myitkyina 1,480 km north of Yangon and 40 km south of the confluence of the two major headstreams Mali and N'mai. The Irrawaddy drains 60% of the entire country and its river basin covers an area of 413,710 km². Its average discharge equals 13,000 m³/s which almost exceeds the European Danube by the factor two. Its most mentionable tributary is the Chindwin River (960 km) which drains the northwestern edge of Myanmar flows into the in the south of Mandalay.

The central delta region is worth discussing a bit more in detail. Typically for a delta the estuary extends in a great alluvial cone-shaped plain. From its apex to the mouth the delta extends for approximately 300 km in north south direction. Excepting for minor pikes the entire regions does not rise above three meters above sea level. Hence, this area is extremely exposed to risks arising from climate change and altering weather patterns. Due to heavy sedimentations transfer and silt load which is transported by the Irrawaddy River, the delta grows by an annual rate of 50 meter per year into the Andaman Sea.

In terms of human geography the most densely populated states are located along the central and southern edges of the Irrawaddy river basin and along around the extremely fertile deltaic zones. Approximately 75 % of the entire population agglomerates in the addressed regions which make Yangon (14.3%), Irrawaddy (12.0%) and Mandalay (12.0%) the most populous states within the country. In contrast to this the predominately mountainous border regions with lower soil fertility and poorer infrastructure are much lower populated than the adjacent states.

Climate

Within the Köppen climate classification system Myanmar belongs to climate type A which means a tropical moist climate with high temperatures and a large amount of rain. Tropical moist climates extend northward and southward from the equator to about 15 to 25° of latitude. The Köppen climate classification system is the most widely used. Köppen divided the earth's surface into climate regions that are generally coincided with the world patterns of soil and vegetation. The system recognizes five major climate types based on the annual and monthly averages of temperature and precipitation. Each type is designed by a capital letter. In order to distinguish specific seasonal characteristics of temperature and precipitation there are climate groups. Myanmar is assigned to the tropical monsoon climate which means that the annual rainfall is greater than 1500 mm/year and the average monthly temperature is greater than 18°C. Weather and seasons in Myanmar are influenced by southwest monsoon winds. The average temperature is between 22-27°C and the annual precipitation varies depending on the geographical location and altitude. In the dry zone in central Myanmar there is less than 1,000 mm annual precipitation. Whereas the delta

region in the south and the coastal regions have a lot amount of rainfall.

The climate can be roughly divided into 3 seasons. The hot and dry summer season from begins March and ends May where daily temperatures often reach 40°C. The monsoon season starts in May and lasts until October with 75% of Myanmar's annual average precipitation. This season is characterized by strong southwest winds, heavy and frequent rains and thunderstorms. The cool and dry winter from November to February is characterized by low rainfall and temperatures between 21-27°C. Climate varies depending on geographical location and altitude. In the north (e.g. Myitkyina) temperatures are relatively low as well as at higher altitudes (e.g. Taunggyi). Precipitation is higher in the west (e.g. Sittwe) and on coastal areas in the south (e.g. Yangon).

The southwest Indian monsoon system is one of the major climate systems of the world. Myanmar's weather and climate are influenced by these monsoon winds. Monsoon is used to describe seasonal reveals of wind directions caused by temperature differences between land and sea. They result from seasonal changes in solar radiation. In spring and summer there is strong solar radiation and low atmospheric pressure over the land while there is high atmospheric pressure over the ocean. The landmass heats up rapidly contrary to the ocean that heats up slowly. Resulting from pressure differences humid air from the ocean is drawn in and as the moisture laden air reaches the heated land it rises and the moisture condenses as (monsoon) rain. In the winter the continent cools relative to the ocean and the pressure gradient completely reverses. Monsoon winds reach the southern part of Myanmar by the third week of May and cover the entire country by the beginning of June. The withdrawal is almost completed by the beginning of October. To have a closer look at the precipitation

distribution during the monsoon season SEN ROY & KAUR (1999) defined five homogenous regions in which rainfall behaviour is homogeneous in time (North-, West-, Central, East-, South Myanmar). This zonation was especially used to work out optimum agriculture and water management strategies as the agriculture is dependent on the amount of rain and timing of summer monsoon precipitation. Precipitation during the monsoon season is high in the north and in west Myanmar and relatively low in central Myanmar. The average rainfall in the high monsoon season from June to September is approximately 1800mm. During the same period India receives 880mm of rainfall. Rainfall series of Myanmar show little correspondence with neighbouring Bangladesh and Northeast India, even though all of them are influenced by similar weather systems. Probably the orographic barrier between Myanmar and India effectively isolates them. Monsoon season is often closely connected to the occurrence of tropical cyclones. The strong tropical cyclone Nagris caused the worst natural disaster in the recorded history of Myanmar. It made landfall in May 2008 and send a storm surge 40 km up the densely populated Irrawaddy delta 85,000 death tolls were assumed, but military leaders in Myanmar did not count the full death tolls. The damage was estimated at 10 US\$.

Relating to climate change and its risks, coastal regions are strongly affected and most vulnerable to extreme weather events as they become much more frequent and more pronounced. According to the Germanwatch global climate risk index Myanmar was one of the countries most affected by extreme weather events from 1992 – 2011. The global climate risk index analyses to what extent countries have been affected by the impacts of weather-related loss events (storms, floods, heat waves etc.).

Climatological details of Myanmar are

mainly found in studies devoted exclusively to Myanmar and there are only a few internationally published studies. Precipitation values vary widely depending on different sources.

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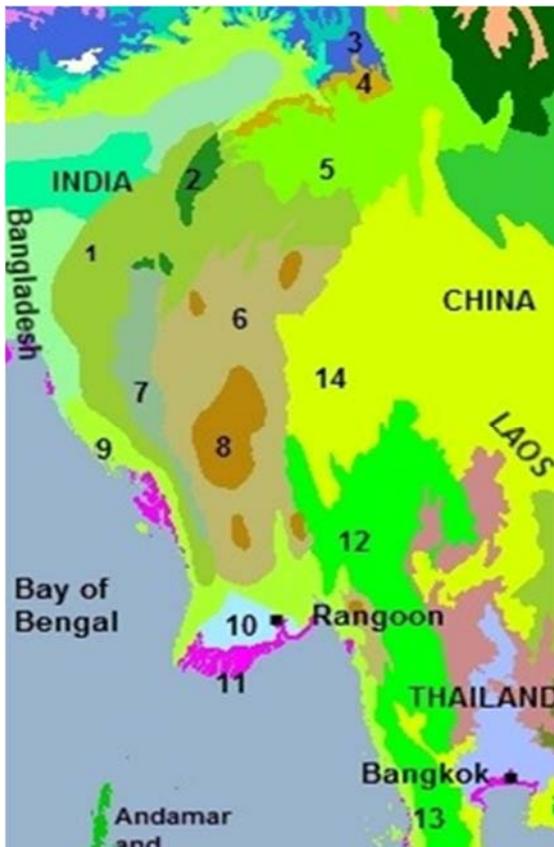
Ecology and environment

Carsten Bruckhaus & Balint Szell

Introduction

Myanmar's environment is part of the „Indo-Burma biodiversity hotspot“. Its environment is very rich and belongs to the most diverse ones of South-East-Asia. There are thousands of species what can be called endemic and in many areas, nature is still quite well intact, whilst

infrastructure is extremely underdeveloped in many of those areas. According to the WWF classification, Myanmar consists of three distinct bioregions, 14 terrestrial ecoregions and 3 freshwater ecoregions. Those 14 terrestrial ecoregions are listed and partly described below:



1. Mizoram-Manipur-Kachin rain forests
2. Northeast India-Myanmar pine forests
3. Eastern Himalayan alpine shrub and meadows
4. Northern Triangle temperate forests
5. Northern Triangle subtropical forests
6. Irrawaddy moist deciduous forests
7. Chin Hills-Arakan Yoma montane forests
8. Irrawaddy dry forests
9. Myanmar coastal rain forests
10. Irrawaddy freshwater swamp forests
11. Myanmar Coast mangroves
12. Kayah-Karen montane rain forests
13. Tenasserim-South Thailand semi- evergreen rain forests
14. Northern Indochina subtropical

Mizoram-Manipur-Kachin rain forests

The Mizoram-Manipur-Kachin rain forests stretch from the Arakan Yoma and Chin Hills of Myanmar's west coast, north along the Bangladeshi and Indian border and into northern Myanmar, covering 135,600 km². They divide the Irrawaddy and Brahmaputra valleys, through which Asia's largest rivers flow. With semi-evergreen submontane rain forests as the main plant community, members of the *dipterocarpaceae* family are the dominant tree species and they can be used for

different purposes, from timber to pharmaceutical use. The actual forest coverage of this ecoregion is around 46 % with a decreasing tendency. Agricultural use makes around 19 % of the area, mainly for grazing. Degradation continuously takes place and affects already 34 % of the area. The remaining 1 % is water. Precipitation is up to 2,000 mm, mainly during monsoon season.



Fig.: Location of the Mizoram-Manipur-Kachin rain forests

Even considering the huge size of this ecoregion, the biodiversity found in the Mizoram-Manipur-Kachin rain forests is still overwhelming and the biological distinctiveness is considered globally outstanding. There are 149 known mammal species in these forests, including a near-endemic bat (*Pipistrellus joffrei*) and a near-endemic rodent (*Hadromys humei*). According to www.globalspecies.org there are 829 animal species recorded in total, featuring endangered and highly endangered mammals like the Majestic Tiger (*Panthera tigris*), Asian Elephant (*Elephas maximus*), Gaur (*Bos gaurus*), Clouded Leopard (*Pardofelis nebulosa*), Red Panda (*Ailurus fulgens*), Eld's Deer (*Cervus eldii*), different Macaques (*Macaca*), Hoolock Gibbons (*Hylobates hoolock*) and others. The diversity of birds is the highest within the Indo-Pacific region. 580 bird species are recorded, six of them endemic or near-endemic. Possibly there are still undiscovered vertebrate species in these forests. About half of the ecoregion is still intact, although the 15 “protected areas” in this ecoregion cover only 3% of the total area. But also the remaining half is endangered by human activities, especially by shifting cultivation and overgrazing, but also illegal logging and

poaching. Because of the remote location, missing infrastructure and economic pressure to the local people, it is difficult for the authorities to prevent unsustainable exploitation of these natural resources.

Irrawaddy moist deciduous forests

The Irrawaddy moist deciduous forests are located in the Irrawaddy river basin of central Myanmar, right next to the Mizoram-Manipur-Kachin rain forest. With 138,000 km², these forests are about the same size as the Mizoram-Manipur-Kachin rain forests. Precipitation is above 1,500 mm in average with dry periods in between.



Fig.: Location of the Irrawaddy moist deciduous forests

Wildlife species richness is considerably lower than in the Mizoram-Manipur-Kachin rain forests, with only 567 species recorded on www.globalspecies.org. Nevertheless, the moist deciduous forests are home to endangered and highly endangered species like the Gaur (*Bos gaurus*), Asian Elephant (*Elephas maximus*), Masked Civet (*Paguma larvata*), Himalayan Sunbear (*Helarctos malayanus*) and others, but no endemics. Tigers and Eld's deer have probably been extinct in this ecoregion. There are three protected areas in this ecoregion, covering 4,200 km². Besides the low percentage, protection is often ineffective due to the absolute size of the area and the lack of educated staff to

manage and actually protect the area. Conversion of forests in favour of agriculture, shifting cultivation, illegal logging and poaching are still threatening the ecoregion.

Irrawaddy dry forests

The Irrawaddy dry forests are located in the central dry zone of Myanmar. The ecoregion measures around 35,200 km². The main vegetation is dry forests, with 650 mm precipitation in average. Although this does not seem really “dry”, the rain usually occurs on no more than 15 days per year, so when it rains, it pours. Therefore, and because of dry winds in summer soil erosion is a problem in this region.



Fig.: Location of the Irrawaddy dry forests

The forests have been under severe pressure by human activity. Common tree species are *Terminalia oliveri* and Dahat Teak (*Tectona hamiltoniana*; endemic, endangered), as well as *Acacia catechu* and *Bauhinia racemosa*. Virtually all of the forests have to be considered degraded. Big mammals have been mostly extinct; some ruminants, Macaques, Gibbons, and mid-sized predators survived, however.

Inle Lake

The Inle Lake is one of the three freshwater ecoregions in Myanmar and a very well visited tourist attraction. Approximately 70,000 people live around and partly even on the lake. While fishing is one of the main occupations of those people, there are around 30 endemic fish

species in Inle Lake. The lake is only two to three meters deep and it shrank around one third in the past 65 years to a size of 45 km². This reduction in size is mainly due to the other big activity besides fishing – horticulture. The famous „floating gardens“ which are swimming on the lake also account for an accumulation of soil onto the lake. This has the consequence, that soil particles sediment into it and therefore reduce the size of the lake. Pollution and eutrophication are the other problems related to the intensive horticulture on the one hand, and a lack of adequate sanitation on the other hand.



Fig.: Floating Gardens at Inle Lake

Environmental policy and problems of implementation

There are only around 2 % of Myanmar’s land surface under protection. Even if this number is constantly rising, compared to the neighbour Thailand with 12 % it is quite low. Due to the long-term isolation of the country, a very bad infrastructure caused by lacking financial resources and know-how, there is a chronic lack of forestry staff members – only two thirds of the protected areas have any employees which could protect it. Even those with more human resources hardly manage to be effective in protecting the nature. This leads to the phenomenon, that these areas are de facto just on the paper protected.

Government and politics

Jens Riemeyer & Dirk Landmann

To analyse the political situation nowadays in Myanmar (historically called Burma) one might start with its history during the Second World War.

In 1940 Aung San formed the independent Army of Burma in Japan and by 1942, Burma was occupied by the empire of Japan. On first of August 1943 Burma declared its independence and officially naming the country "state of Burma". The Japanese occupation ended in July of 1945. During the second world most of the people belonging to Bamar were fighting with the Japanese against the Britain. Most of the ethnical and regional groups supported the Britain against the Japanese and Barman forces. So in this conflict the differences between the ethnical and regional groups were already visible and had an important influence. The independent era started on the 4th of January in 1948 with the Union of Burma as an independent republic. In the same year the British government as a colonial regime gave control over areas which were not Bamar to Aung San of the Bamar group. The consequence was that ethnic minorities have been denied constitutional rights, access to lands and participation in the government, while also suffering in general during this time of dominant Burmese warlords and regional ethnic alliances.

In the year 1961 U Thant was elected to Secretary-General of the UN. He was the first non-western to head an international organization and served the UN in this position for 10 years. Only a year later, General Ne Win overthrew the state and established a nominally socialist military government, what thereby defined the Burmese way to socialism. This was seen as economic policy of autarky or economic isolation, depending on the point of view.

Protest movements against military rule were violently suppressed during the whole period. For example, 15 students were killed on the 7th of July 1962 by the Government. But military force wasn't able to prevent such movement entirely. Anti-government protest by students, for instance, took place at the funeral of U Thant in the year 1974. In 1975, 1976 and 1977 further students protest were suppressed by overwhelming force as well.

With the abrupt demonetization of major bank notes in 1988 causing a nationwide uprising pro multi-party democracy, students once more threatened the military regime. Only by staging a coup, the junta was able to stay in power.

In consequence the regime allowed political parties, like the newfound NLD and promised free multi-party election in 1990. Capturing the power of the 8.8.88 movements for democracy and against the military junta, the National League for democracy (NLD) was able to win these elections. The Junta though refused to transfer power and instead arrested NLD leader Aung San Su Kyi, daughter of general Aung San, known and loved by the people for fighting for the independence of Burma. Assaults on Aung San Su Kyi during phases of controlled releases in 1995 and especially 2003 led to increased international pressure on the junta, inter military disagreement and another concession: The Appointment of General Khin Nyuant as prime minister, who shortly after announced a seven point roadmap to "disciplined democracy". His defeat in an internal battle for party control against Gen Than Shwe in 2004 can be consider another backlash for the democratic movement. In 2007, the Saffron Revolution, an uprising caused by dramatic raises of gas prices, threatened the junta massively. The military resolved

the situation once more and in consequence the 2008 constitution secured influence of the junta and the state structure, as its now described subsequently. Myanmar is divided in divisions and states. There exist seven primarily ethnic divisions and ethnic states. Divisions are: Irrawaddy, Bago, Magway, Mandalay, Yangon, Sagaing, and Tanintharyi, which can be considered minority states at the outside border of the country. The seven ethnic states are: Chin State, Kachin State, Kayah State, Kayah State, Mon State, Rakhine State, and Shan State. These states are mostly inside the country, or at the sea, and mostly populated by Bamar.

The main institutions are the union legislature, region and state legislature, region and states governments, the union government, the defence service as well as the national defence and Security Council. At least 25% of the legislature is composed of the military, selected by the Chief of Defence Services. The president and two vice-presidents will be selected by the parliament.

The currently most important person in the political system is president U Thein Sein, followed by the two Vice presidents U Nyan Tun and U Sai Mauk Kham. The government has 36 ministers (e.g. Ministry of Agriculture and Irrigation, Ministry of Forestry, Ministry of Livestock and Fisheries, Ministry of Cooperatives). Influential political parties in Myanmar are the National League for Democracy (NLD), which is the primary opposition party, the National Unity Party (NUP), representing the primary pro-regime party, and the Union Solidarity and Development Association (USDA) a pro-regime socio-political organization. Apart from these big parties there are a lot of smaller ethnic parties. The legal system is based on a British-era system, but with the constitution suspended, the military regime now rules by decree and there is no guarantee of a fair public trial.

The rise of General Thein Sein as new president in 2010 changed the situation. He approached Aung San Su Kyi and commenced with a policy that tried to end the isolation of Myanmar and envisioned a democratic future for the country. With the "Peaceful Assembly and Procession Bill Right to peacefully demonstrate" between Aung San Su Kyi and Thein Sein, most political prisoners have been set free (about 200 along with the visit of US secretary of state Hillary Clinton in September 2011); the press was liberated to some degree in 2010. There could no literature be found on what possible reasons for this sudden democratic opening was, but still Myanmar could not be considered as a democracy. Although rumours indicate a possible change (Ding Gang 2015) Suu Kyi is currently not allowed to pursue the presidency, because the constitution bars anyone who is married to foreigners or whose children have foreign citizenship from becoming president. A second obstacle is that a quarter of seats in both parliamentary chambers are reserved for the military, whose primacy in presidential elections is thus preserved. Further has to be said that the junta supervises the state media, which is the dominant voice in the media landscape and is judged by their own military court. In addition, the ethnical conflict especially in border regions continues and is encumbering for the central government as for the development of democracy and economy in these regions.

To conclude, Myanmar has faced and still faces obstacles on its way to democratization. This year's election might decide whether the current path of democratization can be continued or the junta will hinder or even prevail this development.

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The way of life: Society and conduct – “dos & don’ts”

Luciane Lenz

Approaching a definition of what shall and shall not be done in a certain society confronts us with the problem of generalizing very diverse habits in diverse societies to single views. It is therefore generally recommended to listen to locals and to observe their behaviour and reactions carefully during stays abroad in order to behave appropriately.

The Ministry of Hotels and Tourism of Myanmar together with the Hans Seidel Foundation approach the task of preparing tourists for a responsible stay in Myanmar by publishing the Do’s and Don’ts Cartoon Project. The following advices are elicited from the project and enriched by information from Martin Schacht’s “Gebrauchsanweisung für Burma” (2013).

The Myanmar people are friendly, helpful and polite. Please learn basic words in Myanmar language. Do smile.

It is part of a good manner to smile and to greet with a “Mingalaba”, which can be translated as “might you be blessed”. The western custom of shaking hands is becoming a vogue among urbanized Burmese men. Handshaking should not be offered to women by men, but might be offered by modern, urbanized women to men. When being introduced to monks or elderly, it is polite to bow or bring palms together. Generally, one uses the right hand or both hands when receiving or giving something; exceptions are casual transactions at shops or food stalls. The advice to smile roots in the concept of “Face” which is spread out in many Buddhist countries. Face refers to the spirit of a person, its image or self-image. Being unfriendly, in particular losing temper in public, screaming, pushing for answers or openly criticizing will cause everyone involved to lose face and is perceived as immensely rude. This follows from the Buddhist way of thinking: Don’t think bad,

don’t say bad, don’t do bad. What remains is to smile.

Don’t point with your foot. Do tuck away your feet. Don’t point with your finger. Don’t touch anyone on the head.

In Myanmar the feet convey messages. Pointing with feet means disrespect, as feet are the lowest part of the body – literally as well as spiritually. The head, by contrary, is the most esteemed part of the body and shall not be touched. When visiting someone’s home, one has to take off shoes and shall not walk on carpets and mats, as they are used to be sat upon. Also take care not to stretch out your feet towards people or Buddha figures. Calling someone with your fingers up is perceived as calling for a challenge while calling someone with your fingers down is considered polite.

Wear decent clothes when visiting religious sites. Women travellers are very safe in Myanmar but are recommended to dress decently.

Please cover your shoulders and knees and take off shoes when entering pagoda areas. Visitors should avoid loud talk and should take care not to touch people meditating. Clothing should also be decent outside of religious sites. It is useful to look at the local dressing to understand how much shall be covered in order not to cause sensation.

Don’t touch the robe of a monk. Respect Buddha images.

Monks are highly respected in the society. They are not only a moral authority and supported by all social classes but also involve in politics. Around 90 percent of the people are Buddhists and over half a million people live as monks or nuns. People are thankful for having offers to monks accepted (instead of expecting gratitude) as they earn for their next life. Monks should not be touched by women,

not by their hands nor any other part of the body. Monks have to go through a cleaning process if otherwise is done. When a woman wants to offer something to a monk, the object has to be placed within reach but shall not be given directly. Furthermore it is polite not to sit on chairs on the same level as monks and nuns and certainly not higher. Buddha images are sacred objects, which one shall not pose in front for pictures and shall definitely not clamber upon.

Myanmar currency should be exchanged at the official exchange counters and banks.

Cash machines are available in the country and Euros and Dollars can be exchanged at the airport and at exchange counters. Black markets shall be avoided even if they offer better exchange rates. Money changing on black markets is often done by grifters. Dollar bills have to look very fine, if not they might be rejected or given a worse exchange rate. The Kyat, by contrary, is often maltreated, probably due to its long problematic history of hyperinflation and the invalidation of the currency by Dictator Ne Win.

Spread your wealth, use your money wisely. If tourists wish to help the people in Myanmar, they should consider creative ways to contribute to communities, not to individuals. Giving money or sweets to children is not advisable.

Tourists are asked to buy non-precious products on local markets to support the local communities. Licensed stores, by contrary, are able to give certificates to prove authenticity of items in the case of valuable goods. If there is a wish to make donations, it is possible to do so for communities, schools, health facilities, NGOs or monasteries that take care for children. It is not recommended to give to individuals and in particular not to children.

Help protect Myanmar wildlife by refusing to purchase wildlife products. To maintain Myanmar's unique heritage, do not buy antiques; buy arts and crafts instead.

Many native species of Myanmar are endangered due to illegal selling of wildlife products. They shall not be bought. A similar situation applies to buying antiques. A wide range of the countries heritage has been lost as they were taken out of the country. If one wishes to buy an antique anyhow, this shall be done in official stores at an adequate price. It is furthermore officially prohibited to take Buddha figures or pictures out of the country.

Practice safe sex. Using drugs is illegal in Myanmar.

Prostitution is illegal in Myanmar but remains a major issue. It was banned in 1785 but the country is a major source of prostitutes to Thailand. A sex industry also developed in the country itself, operating mainly from bars and hotels, tents and bamboo huts. In addition to the high burden on the shoulders of women and the very low payments they receive, Myanmar has one of the highest HIV prevalence rates in Asia. Around 32 percent of sex workers are estimated to be infected. Myanmar is the world's second largest producer of illicit opium after Afghanistan and forms part of the golden triangle. It is illegal to buy or use drug and it is highly warned not to get into conflict with this law.

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Religion and religious tensions

Anja Lienert & Felix Stiegler

Myanmar does not have an official state religion but is still a Buddhist country. A large majority of the population is practising Buddhism especially the Theravada Buddhism. Although placidity is a key attribute of the Buddhism there are social and religious tensions between the Buddhist population and religious minorities like Christians, Hindus and especially Muslims.

Buddhism, the predominant religion in Myanmar, focuses on spiritual development and on teachings about the right way of life. There is no belief in an omnipotent creator-God, i.e. it is a non-theistic religion. Buddhism is approximately 2500 years old and is a result of Buddha's quest for enlightenment around the 6th Century BC. His quest grew out of the dissatisfaction with the increasingly ritualistic practices of Hinduism; Buddhism totally rejects the caste system and seeks equity for all people. Still, Buddhism kept certain key Hindu beliefs, including the belief in reincarnation, the role of Karma in causing reincarnation, the desire to escape from this cycle of rebirth and the belief that ending this cycle results in entrance to Nirvana. Buddhism focuses on the main virtues of love, compassion, kindness and no harm to living beings. It stresses self-reliance and obtaining enlightenment on one's own by following the way of Buddha. The path to enlightenment is created through the practice and development of morality, meditation and wisdom. Buddhists believe that the world, while often a thing of joy, is also a place of suffering; the aim of Buddhism is to relieve the suffering of mankind by eliminating the cause of this suffering.

There are two main Buddhist branches: Theravada Buddhism and Mahayana Buddhism. Theravada Buddhism predominates in Sri Lanka, Cambodia,

Thailand, Laos and Myanmar and is sometimes called "Southern Buddhism" (Mahayana Buddhism is mainly practiced in China, Japan and Nepal). Theravada is a branch of Buddhism that uses the teachings of the Pali Canon, one of the oldest recorded Buddhist texts, and a rich diversity of traditions that have developed over its long history of interactions with various cultures and communities.

Theravada Buddhism is practiced together with a mixture of astrology, numerology, fortune telling and the worship of indigenous pre-Buddhist era spirits called "Nats" (pronounced *Naes*). Theravada Buddhism believes that it has remained closest to the original teachings of Buddha. In contrast to other Buddhist branches, it emphasizes the humanity of Buddha; he was a man who discovered the way to enlightenment and anyone can follow his footsteps and achieve enlightenment as well. Theravada Buddhism emphasizes attaining self-liberation through one's own efforts. Meditation and concentration are vital elements of the way to enlightenment and the ideal road is to dedicate oneself to full-time monastic life.

Buddhism is closely interwoven with daily life. This becomes visible by the high number of monks which are nearly omnipresent in daily life. With around 400,000 monks that form the monastic community, the *Sangha*, Myanmar has the highest share of monks compared to the population number, of all Buddhist countries. In general monks act as advisors of the people and are greatly revered in society. They completely depend on donations of the community for their existence and provide spiritual guidance. Both men and women independently of age can take the oath and become a monk if they are willing to devote their life to 227 rules, called the

Vinaya. These basically concentrate on five main rules. Monks should not harm any living being and refrain from taking that which is not freely given. Furthermore they have to refrain from sexual misconduct, wrong speech and intoxicating substances like alcohol or drugs that would lead to carelessness.

The Nats are spirits worshiped in Myanmar in conjunction with Buddhism. Before the spreading of the Buddhism the Animism was the common religion in Myanmar and the worshiping of natural spirits was widely spread. After a failed campaign to ban the Nat-worshipping in favour of the uprising Buddhism, King Anawrahta of Bagan (1044-1077) designated an official list of 37 Nats. Thus, officially commenced the incorporation of the Nats into the Buddhist tradition in Myanmar. Most of the Nats represent ghosts of heroes who died a cruel death and have their own legend. Simplified the Buddhism is concerned about future life and reaching the nirvana, whereas the Nats act as helpers of the monks concerning problems of daily life. To avoid harm from the Nats people give small offerings and do pilgrimages and annual festivals.

Myanmar has been under the rule of repressive authoritarian military regimes since 1962. In 1988, the socialist constitution was suspended. After that, constitutional protection of religious freedom has not existed. There is no official state religion in Myanmar, however, the government is accused of actively promoting Theravada Buddhism over other religions. Adherence or conversion to Buddhism is generally a prerequisite for promotion to senior governmental or military ranks. In generally it can be stated that there is a correlation between ethnicity and religion; therefore ethnic tensions easily turned into religious tensions and vice versa. Some of the conflicts, especially with Muslim minorities, turned into violent conflicts. Religious

restrictions lead to, for example, Christian and Islamic groups having troubles in obtaining permissions to repair existing religious places or to build new ones. But religious restrictions are not only present for e.g. Christians and Muslims but also for Buddhists. Based on the Sangha Organization Law (1990), the Government banned any organization of Buddhist monks other than the nine state-recognized monastic orders. Violations of this ban are punishable by immediate public defrocking and often by criminal penalties. Furthermore, in 1995, authorities enforced a prohibition against any opposition political party member from being ordained as a monk or religious leader. One of the most visible and constant conflicts with religious roots is related to the Rohingya. They live as a Muslim minority in the Rakhine State in the northwest of Myanmar, close to the Bangladesh` border and are named one of the most oppressed minorities in the world by the UN. The approximately 600,000 to one million Rohingya are not considered to be state citizens but illegal immigrants and are denied citizenship. The conflict between the Rohingya and the Myanmar government has its origin in the time after Myanmar`s independency. Between 1947 and 1961 Muslim separatist groups were trying to annex the Rakhine state to East Pakistan, which today is called Bangladesh, which led to a military campaign to hold down the conflict.

Afterwards the uprising appeared again during Bangladesh` liberation war in the 1970s. During the last decade Rohingya were accused to cooperate with fundamental Islamic groups like the Taliban. What started as a conflict between the Rohingya and the Myanmar government, more and more turned into social tensions between the Muslim population and the Buddhist Rakhine population. In 2012 and 2013 these tensions erupted into series of violent riots which lead to casualties on both sides and

an increase in the number of refugees from the Rohingya community. The riots coincides with the uprising of a Buddhist nationalist organisation called the *969 movement* which is accused of initiating the riots against the Muslim population. Whereas the digits symbolize the virtues of Buddha, the Buddhist practices and the Buddhist community, the movement does not act in a peaceful and tolerant way but is called to be islamophobic. This is demonstrated in their calls for restrictions of Buddhist-Muslim marriages and the promoted boycotts of Muslim-owned businesses. Furthermore, the movement's spiritual leader Ashin Wirathu keeps on warning of an ongoing islamization of Myanmar. Due to the close links to the military elite the movement is called to have a lot of influence on current policies.

Economy – imports and exports

Lisa Haubner & Leonie Kreipe

Economy

If we deal with questions concerning the economic performance of Myanmar, which standard of living people have and which commodities are being produced we face challenges in finding consistent data. The country's GDP has long not been recorded and illegal trade makes accuracy of figures more difficult.

The estimated **GDP per capita** in 2013 is based on a population of 51.4 million (preliminary figure) and with US\$1,105 (World Bank, 2014) it is one of the lowest in East Asia and the Pacific. The GDP has been rising steadily since the opening of the economy in 2011, however poverty is still widespread, with about 26% to 37.5% living below the poverty line in 2010 (World Bank, 2014).

To remove economic distortion, the government of Myanmar set up an ambitious **reform programme** in 2011, consisting of new tax regulations, liberalizations of sectors, development of the private sector and stimulation of direct foreign investments amongst others. Despite an economic growth of roughly 8.3% in 2013/14 (due to construction, manufacturing, services, recovery in agriculture) and of about 8.5% in 2014/15 (gas production, investment), visible benefits of the reforms are limited. This is due to the domestic political situation and human rights violations, which led to international contempt and sanctions by the United States and the European Union. However, some effects now show first success of the implementation of the reform efforts: the sanctions by the US and the EU have been lifted allowing companies to start investment and Myanmar has regained its position in the Association of Southeast Asian Nations (ASEAN) (World Bank, 2014; Ariff, 2013). Western investors are now exploring their opportunities for businesses and trade,

especially in the agricultural sector key investors and private companies are planning investment in the years to come. Behind the service sector (distribution, real estate, construction sector, firms in banking sector) the **agricultural sector** - with 39% of the GDP – is a very important pillar of Myanmar's economy. Rice, pulses, beans, sesame, groundnut, sugarcane and fish and fish are main agricultural activities. Agricultural processing also plays an important role in the industrial sector, as well as wood and wood products and construction materials. Oil and natural gas as well as jade and gems are of particular importance for Myanmar's economy.

Imports & Exports

Myanmar's exports are growing and valued an estimated US\$9.04 billion on 2013 (CIA, 2014). However, the number is underestimated due to the value of timber, gems, narcotics, rice, etc. which is smuggled to Thailand, China and Bangladesh. The largest share of export commodities has natural gas by far. Further export goods are wood products, pulses & beans, fish, rice, clothing, gemstones (jade, ruby). Goods are exported to Thailand (41%), India (15%), China (14%) and Japan (7%). Germany is the most important trading partner of Myanmar within the EU and accounts for only 0.5% (CIA, 2014; AA, 2014). Myanmar is the world's third largest producer of opium and forms together with Laos and Thailand the Golden Triangle. About 690 metric tons have been produced in Myanmar in 2012. Besides illicit drugs, also mainly timber is smuggled outside the country. This is possible as parts of the country are controlled by autonomous military forces which finance themselves by illegal border trade (CIA, 2014).

Imports are slightly larger than exports and amounted about US\$ 10.1 billion in 2013. Again this number is underestimated due to the value of consumer goods, diesel fuel, etc. smuggles in from Thailand, China, Malaysia, and India. The main import commodities which are officially accounted are fabric, petroleum products, fertilizer, plastics, machinery, transport equipment; cement, construction materials, crude oil; as well as food products, edible oil. Important import partners are China (40%), Thailand (20%), Singapore (9%), South Korea (8%) and Malaysia (5%); (Germany, 1.5%) (CIA, 2014; AA, 2014).

Since 1997 Myanmar is a member of the Association of Southeast Asian Nations (ASEAN) founded in 1967. Today ten countries hold a membership of the union (ASEAN, n.d.).

Primarily in 1990 the European Union imposed sanctions and restrictive measurements on Myanmar. But with the opening of the country in 2011 the EU suspended its sanctions. The US followed the EU in the lifting of sanctions (AA, 2014).

As already mentioned, since 2011 numerous economic reforms were realized. The goal was to eliminate inefficiencies, to reduce red tape and improve incentives for private sector businesses; e.g.: barriers in the trading system were removed and a different exchange rate system was introduced. These measures had a positive impact on Myanmar's business environment (Bissinger, 2014). Myanmar is on a good path for further economic growth, especially due to its strategic location in South East Asia.

Outlook

Due to its geographical location, its richness of natural resources and a young enterprising human capital Myanmar is blessed with opportunities and will thrive in the years to come. American and

European markets are now open to imports, but a vast trade any time soon is unlikely, due to the need for investment and development at home before the building up of a true export economy. Regarding agricultural prospects, Myanmar aims at reclaiming the title "Asian rice bowl".

Yet, remarks from the discussion in seminar should also be taken into account: What is behind the economic growth? Is it only a monetization of processes which were there before? What consequences does further growth have not only for the society, but also for the environment? Is a possible westernization a good path for the country?

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The timber industry – changes over the past decades

Peter Thyen

One of Myanmar's major natural resources are its forests. About fifty percent of today's Myanmar remains forested. Although this might be misleading because according to the FAO definition it needs a canopy cover of at least ten percent to be referred to as forested land. We have to assume that the remaining forested land is partly degraded and not intact in terms of economic and ecological benefits. The teak trade is especially important in Myanmar's timber industry's history. The teak tree is of high economical value because of its superior properties compared to most other hardwoods. These properties are its lightness along with strength, stability, ease of working without cracking or splitting, high resistance to weather, bugs, termites and fungi. The timber trade was highly associated with teak at all times. The following text describes who was in charge of Myanmar's forests and therefore in charge of timber extraction.

At the end of the nineteenth century timber extraction was shared between two major groups.

The **Burmese Forest Department** which was founded in 1856. The Forest Department had several purposes: to install economical sustainable forest management in Burma based on scientific concepts, to gain back control over forest resources from European timber companies and to grant the colonial government additional income (until the first forest act in 1882 nearly all profit went to European companies and India). The Department promoted a contract system in which locals could participate as subcontractors. Therefore the Department was given reserved forests to supervise. In 1904 these reserved forests held fifteen percent of Burma's land area.

The other group with even greater influence was the **European timber companies**. The legal foundation of their success in Burma was long term timber extraction leases in mostly Upper Burma. Due to their great political influence they managed to maintain these leases and in 1907 gain access to teak forests in Lower Burma. However, due to proven over-harvesting incidents their rise in Burma was controversial.

The development between 1900 and 1925 can be illustrated by the official teak extraction per agency. In 1900 non-European companies and Burmese timber traders were responsible for one fourth of total teak extraction, European companies and the Forest Department were roughly the same. This division between the big participants in the teak trade changed drastically. In 1924 non-European and Burmese traders' teak extraction was down to one twentieth. Also the Forest Department's extraction dipped from about one third to one fifth and in 1927 to one tenth of total outcome. This development is linked to degradation of forests in a paradoxical manner: because of the over-harvesting heavily committed by European firms the tapped forests were no longer sufficient, therefore remote forests had to be accessed and European firms were favoured because only they could provide the needed capital to do it. The dominance of European firms continued until the independence of Burma in 1948. After independence Burma's timber industry was nationalized and timber extraction was managed by the new founded **State Timber Board**. From then on the Forest Department functioned as a research and conservation department. Although on paper these two institutions controlled timber extraction and research/ conservation tasks, the practice in the years after independence differed.

The bigger part of forests could not be used because they were controlled by insurgent groups. It was not until the mid-1970s that central Burma was largely pacified and forest usage could extend to greater levels (Operation Aung Soe Moe 1973- 1975 cleared Pegu Yoma forest from insurgent forces).

When the SLORC started to rule Burma in 1988 timber extraction became even more relevant. The regime was in need of hard currency and therefore sold big logging concessions to Thai firms in the Thai-Burmese border area (Thailand banned further logging in 1988 because forested area had shrunk to fifteen percent of the land area). In the forests outside of government control the situation was similar since the various groups in control of the outlying areas depended partly on the income from timber revenues. The contracts between SLORC and Thailand were suspended in 1993 due to illegal and unsustainable practices of Thai loggers. The SLORC were no longer as dependent on timber revenues as before and furthermore, the ability to directly supervise logging activities in the border areas had increased by then, hence there was less need for Thai loggers. Also the country was for the first time since the independence mostly pacified and forest management could be implemented on a national scale (pacified does not mean in control of all areas but the controlled areas could now be accessed to full extent). The National Timber Board was renamed twice, once in 1974 to Timber Corporation and second to Myanma Timber Enterprise in 1989.

The **Myanma Timber Enterprise** remains in charge of state controlled timber extraction and trade which includes nearly all forested land in Myanmar excluding non- controlled areas mainly in Kachin State and Shan State (partly due to ceasefire- agreements). The Forest Department is still supervising conservation duties. Their agenda aims to establish

sustainable forest management which succeeds in meeting both ecological and economical needs. But today road to success is still very long indeed. One main issue is the damage already done to the forests. As was mentioned at the beginning, the history of Myanmar's forests in the twentieth century is shaped by over-harvesting, damage from shifting cultivation and daily needs of the population, for example firewood supply. Time and good management are needed to undo forest degradation and deforestation. It is a continuing problem that the government is not able to prevent illegal logging in border areas. The ideas of Myanmar's forest management seem promising but the execution is not there yet. Still there are signs of good will, such as the ban on raw timber exports in March 2014, although illegal logging and timber smuggling are not likely to be affected by the new law.

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Forests, nature conservation and tourism

Lena Grün

Forests

Myanmar has a forest area around 343.000 km², it includes round about 45% of the total land area. 103.000 km² are protected area. There is a high diversity of climate zones which are not simple to differentiate. The Burmese plant associations are the less explored of the world, what dues to the closed border for the long time. Lot of numerous and famous hardwood populations take place in the Burmese economy. Almost 10% of the external trade is with wood, 70% of the world reserve is located in Myanmar, which is also the principal supplier of teak. The forests have a dominant role to improve the socioeconomic life, 75% of the population is rural and is depended on the reserves of the forests. The biodiversity of the Burmese forest is very high, especially in the northern area, the Kachin-state. The total forest area has been reduced dramatically over the last years, caused by many reasons. One of them is the higher demand of wood made by the higher affluence and the increase of the population. Furthermore, the increasing industrialization, illegal deforestation, shifting cultivation, corruption and deforestation by investors. In addition to the deforestation there are also irreversible damages of soil, soil erosions, a higher flood risk and threaten biodiversity.

Forest Types

The **mixed deciduous forest** (including 38% of the forest area) is the major forest type of Myanmar. The trees lose their leaves during the dry periods and turn into green during the rainy season. It includes a high value of *Tectona grandis* (teak), the plant with the highest economic importance, the Dipterocarpaceae- family and also many bamboo species. They are an important source and support for many wildlife species as well as endangered species, for example the Hoolock Gibbon.

Another forest type is the **hill and temperate evergreen forest** which contains about 25% of the total forest area. It is characterized by high rainfall areas, many climber species of wood and also rich and lush undergrowth. There are sub-alpine forests (over 1800m), coniferous forests (between 900 and 1800m) and partial deciduous forests. The dominating tree species are for example *Quercus*, *Castanopsis*, *Fagaceae* and *Lauraceae*.

As a lush vegetation forest the **tropical evergreen forest** takes circa 16% of the forest area. Beside the domination of high value commercial species like the *Dipterocarpus*-species, there are nearly 100 bamboo species (only china has more). It is well conserved along the coast of the Tanintharyi-region and on the islands of Myeik.

The **dry forest** (10%) is the forest type of the Irawaddy valley at the central dry zone. There is a dry and seasonal climate with rainfall under 1000mm. Because of that, only unpretentious trees can exist, for example *Terminalia oliveri* and the *Acacia* species.

Located in only five countries in the world (Myanmar, Laos, Cambodia, Vietnam, Thailand), the **deciduous dipterocarp forest** (Indaing forest) takes round about 5%. It is isolated from other similar forests of Southeast Asia. That is why it is one of the centres of endemism. Examples are the Burmese Star Tortoise and the Eld's Deer.

The last main forest type is the **mangrove forest** (tidal forest, 4%). It takes place in the Irawaddy region (46%), in the Tanintharyi region (37%) an in the Rakhine state (17%). The trees need to be very salt tolerant and can be flooded by seawater during high tide. There is a very important ecological function, which is the stabilization of the shoreline, including the

protection of the coast from erosion. Furthermore, it is a habitat for migration water birds. 8.8% of the total mangrove forest area of Southeast Asia is hosted by Myanmar.

Nature Conservation

Myanmar has round about 40 national parks, which are organized by the Myanmar Forest Department and the National Park System (PAS). The parks are subdivided in wildlife sanctuaries, bird sanctuaries, protected areas and botanical gardens. Until 2030, they are planning to have 10% of the forest area in a protected system.

The **Hukaung Valley Wildlife Sanctuary** was founded in 2004 and has a size of over 15.400 km². Nature conservation, research, education and ecotourism are the main purposes of the sanctuary which is the world biggest tiger reserved area. It includes typically evergreen forest, in upper regions the mixed deciduous forest and the hill pine forest. 3.500 km² of the park are occupied by commercial plantations. The sanctuary is supported by the US-based Wildlife Conservation Society (WCS).

Founded in 1989, the **Alaungdaw Kathapa National Park** (~1600km²) is the oldest Park in Myanmar. It is focused on conservation, cultural heritage, recreation and tourism. The forest types are also evergreen, mixed deciduous and hill forest. The Park is famous for the cave and the pagoda. Every year many local pilgrims and tourists come to these sights, especially during the pagoda festival. There are lots of problems in the organization of the protected areas, for example bad payments, missing know-how, lacking financial resources and corruption. Myanmar depends on financial and technical help from abroad. This is easier since the land opening. The WCS in the Hukaung Valley Wildlife Sanctuary is only one society who is engaged in Myanmar. They install, for example,

camera-traps for tigers and have a strong partnership to the community.

Tourism

There are many sights in Myanmar. Only to name a few of them: Shwedagon-Stupa (Rangun), Bagan, Mrauk U, the Inle lake and the cities of Mandalay and Pyin U Lwin. The natural forests enable also many opportunities for the development of eco-tourism.

Most of the Burmese tourists are foreign, independent travellers (~40%), only about 20% are business travellers or package tourists (~20). The development of the tourism over the last few years increased rapidly. In 2010, about 800.000 tourists arrived in Myanmar, **in 2014 they reached 3 million**. But the infrastructure and the hotel situation improves too slowly, the country will need several more years to actualize them. One of the reasons is the CLMV, a cooperation between Cambodia, Laos, Myanmar and Vietnam. They try to improve and stabilize the economic situation of their countries. To intensify the tourism is one of their goals.

Consequences of the heavy development of the tourism are shown in environmental pollution (waste and water destruction), western adaption and an overload of the infrastructure (streets, electricity, water).

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Oil palm production

Bernadette Kiesel

Introduction on Oil Palm

- Oil palm is world's most important oil crop (producing 24.9% of the total vegetable oils and fats)
- 2 Types of oil from its fruits, mesocarp oil and kernel oil known as crude palm oil (CPO) and palm kernel oil (PKO) (Soh et al. 2009)
- The oil palm tree is native to West Africa, where it was traditionally cultivated as subsistence crop for food, fibre and medicine. Originally, trees were interplanted in traditional, small-scale agriculture production systems with other crops – now mainly grown in plantations. Reason for the shift towards large-scale plantations was/is the rising demand for vegetable oils since the 1970s (WWF).
- Global production has doubled over the last decade. By 2000, palm oil was the most produced and traded vegetable oil (FAO). The worldwide demand for palm oil is expected to double again by 2020.
- Oil palm is one of the most profitable land uses in the humid tropics (Sayer 2012).
- Palm oil comes from the fruit of the oil palm tree (*Elaeis guineensis*). It can be separated into a wide range of distinct oils with different properties. This versatility has seen palm oil replace animal and other vegetable oils in a wide variety of products.
- Today it is:
 - used as a cooking oil
 - the main ingredient for most margarine
 - used in confectionary, ice cream and ready-to-eat meals
 - the base for most liquid detergents, soaps, and shampoos
 - the base for lipstick, waxes and polishes

- used as an industrial lubricant
- used as a biofuel
 - Multipurpose Oil (WWF)

Economic Impacts – Trade Flow

Primary production regions for palm oil are Malaysia and Indonesia, while the primary palm oil consumer markets are India, Indonesia, China, EU and the U.S.. Palm oil production is economically vital for Malaysia and Indonesia and their rural communities. The industry is inherently labour-intensive, requiring a global average of five workers per hectare. Competing oil crops often require approximately one worker for every 200 hectares. In Malaysia, the palm oil sector employs 590 000 direct workers (including many labourers imported from Indonesia, and 35% of production derives from smallholders (NEAC, 2009). In Indonesia, 3.7 million people are engaged in the palm oil industry and downstream industries, with 45% of production from smallholders (RSPO, 2011a). Booming commodity prices in recent years have trickled up through this labour-intensive system, helping to lift millions out of poverty in Indonesia and Malaysia and contributing to a more than doubling of the Indonesian middle class in the decade leading up to 2009 (Bellman, 2011). This development (creating jobs, poverty reduction) might take place in Myanmar as well.

Environmental and Social Impacts

Establishment of vast monoculture oil palm plantations has a number of environmental impacts. The 2 *most serious* are:

- large-scale forest conversion
- loss of critical habitat for endangered species (biodiversity loss)

Including furthermore impacts on:

- soil erosion
- air pollution
- soil and water pollution
- climate change

Social conflicts arise if the rights and livelihoods of local communities are ignored. Expansions of plantations have in some cases lead to the eviction of forest-dwelling peoples (WWF).

Oil Palm cultivated in Myanmar

- Oil palm is mainly cultivated in Tanintharyi and Mon states on slightly above 200 000 acres
- out of which approximately 50 000 acres were harvested in 2006/07.
- Palm oil production represents 7.5% of the domestic edible oil consumption
- this share is expected to increase to above 30% in 2015/16, once the 200 000 acres will be in full production (FAO 2009: 67).

Palm Oil Mills Capacity

- There are 14 palm oil mills in Myanmar, 3 owned and operated by the government and 11 by the private sector. All palm oil mills use press technology.
- The total extraction capacity, based on 8 hours operation per day and 24 days per month is 260 000 tonnes. However, given the inefficiencies of the plants, the capacity in 2009 does not exceed 150 000 tonnes per year (FAO 2009: 107).
- Given that in 2011/12, just over 200 000 acres of palm oil are assumed to be in production, the total expected fresh fruit bunch production is over 700 000 tonnes.
- The existing palm oil milling capacity in 2006/07 is well below the anticipated production in 2011/12.
- Investment in well-designed oil palm processing is required to cope with the upcoming fresh fruit bunch production (FAO 2009: 107f).

Trading Centres in Myanmar

Most of the oil crops, edible oil and oil cakes trading centres are located near production areas in the central dry zone. There are 7 main trading centres in the oil

crops sub-sector:

1. Yangon
2. Mandalay
3. Myingyan
4. Monywa
5. Pakkoku
6. Magway
7. Pyay (FAO 2009: 121)

Oil Palm Market and Trade

- Domestic production of crude palm oil (CPO) from Tanintharyi division is shipped by boat to Yangon and refined at Yuzana refinery. Unprocessed CPO is used by the soap industry or locally as biofuel.
- Imported palm oil, mainly from Malaysia is shipped in bulk to Yangon. Palm oil is dispatched to all parts of Myanmar from Yangon through the Myanmar Edible Oil Dealers Association and municipalities administrations. Palm oil is shipped in drums by boat to Rakhine state from Yangon.
- Informal palm oil imports from Thailand enter the country mainly via Myawadi and Kaya state border points and are estimated to account for 20% of all palm oil imports in the country. This proportion varies depending on government palm oil price and import policies.
- Informally imported palm oil is redistributed to all parts of the country through traders and wholesalers.
- Informal exports of palm olein and sterin to India takes place in Tamu border, stimulated from price differences between India and Myanmar (FAO 2009: 128).

Sustainable Palm Oil Development? - Controversial discussion

- To date, over 140 000 hectares of oil palm have been planted and 400 000 hectares allocated to 44 national companies. Myanmar is in the early

stages of palm oil expansion and can learn from other country's mistakes (The Nation 2014). But companies coming to Myanmar are basically copying the system going on in Malaysia and Indonesia.

- Land awarded to large corporations for palm oil plantations in Tanintharyi was in fact taken from civilians during the 1990s. The social and environmental impacts of the plantation sector have drawn criticism across Southeast Asia. The expanding of Myanmar's oil palm sector likely expands corruption which defines the industry for decades.
- Sustainable practices in plantation development can help maximize economic, social and environmental benefits (O'Toole 2014). The Roundtable on Sustainable Palm Oil (RSPO) Organization supports a global standard for sustainable palm oil and holds workshops in Myanmar (The Nation 2014).

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Rice production

Jan Lanvers

Some general characteristics of Rice

Rice is the world's most important human food crop and a staple food for more than a half of the world's population. It is the seed of the grass species *Oryza sativa* with more than 120,000 varieties worldwide. In contrast to most of the weeds and pests rice can survive flooding and was adapted to it by breeding and selecting over thousands of years. Depending on how much water is available, there are four main rice growing environments:

1. **Irrigated lowland rice** which can be grown in both the wet and dry season.
2. **Rainfed lowland rice** which is grown in waterlogged, submergence and floodprone areas.
3. **Rainfed upland rice** which is drought tolerant.
4. **Deepwater or floating rice** which is grown in flooded areas with water up to more than one meter deep.

Rice production in Myanmar

Despite of a decrease in the percentage of caloric intake, rice remains the staple food also in Myanmar. 67% of the population live in rural areas and depend on agriculture. As a major crop rice also has a large contribution to the gross domestic product (GDP) of which 36% derives from agriculture.

Myanmar grows rice on approximately 4.6 million hectares per year which equates to 70% of the agricultural land. More than 60% of the rice is grown in rainfed lowland areas where usually only one yield per year is possible. Irrigated systems can achieve 2.5 yields per year but only account for around 20% of the area. Modern high yielding varieties were introduced to Myanmar in the early 1980's, but nevertheless the average rice yield is stagnating at a low level with 3.2 - 3.4 tons/hectare.

Myanmar is the 7th biggest rice producer in the world behind Vietnam and Thailand with a production of 28 million tons in 2013. Before the military rule Myanmar used to be the biggest rice exporter in the world. Nowadays, Myanmar plays only a subordinate role on the world rice market. Since the political and economic liberalization in 2011 exports slightly increased, but are still on a low level.

Rice in the Irrawaddy Delta

The Irrawaddy Delta is the main growing area of rice in Myanmar with more than two million hectares (= 26% of the total rice area of Myanmar). Especially when the country was the world's biggest rice producer in the early 1960's, this area was called the "Asian Rice Bowl". During monsoon season (May - October) rice is the main crop here. Rice production in the dry season is small because of a lack of varieties with different harvesting periods, growth durations and appropriate irrigation. As second crops after rice mostly pulses crop is sown, particularly mung bean and green gram.

The typical farm size is 2.4 hectares with plot sizes of around 0.2 hectares. Land is owned by the state and only issued to farmers. The taxes are minimal, amounting to an average of 8 kyats/ha (~1200 kyats = 1 €). The taxes are paid to state collectors who hold land right certificates. Land borrowing or lending between the farmers does not take place.

For land preparation the use of a power-tiller is widely spread. The towed machinery consists of a plough and a harrow. The use of draught cattle is not common anymore because it is labour-intensive and relatively expensive. The purchase of power-tillers has been subsidized and the price is comparable to that of two water buffaloes. Usually, there

is only one small tractor in a farm village but threshing machines are widely utilized to save time and reduce post-harvest loss. Seedlings are pre-grown in a nursery and transplanted by hand. Harvesting is also done manually with a small sickle. Farm labourers are scarce, particularly in the seasons of transplanting and harvesting. Typically farm labourers

consist of at least two family members and one hired labourer. The salary for a hired labourer is 2,500 – 3,000 kyats/day (~ 2 to 2.50 €).

To give an overview of the economic performance of a farm in the Irrawaddy Delta, the following table summarizes the costs and revenues of rice production.

Table: Cost structure and Economic performance of a typical farm

	Wet Season Rice	Unit
Yield	3,6	t / ha
Market price	153	€ / ton
Market revenue	550	€ / ha
Seed costs	2	€ / ha
Fertilizer costs*	(182)	€ / ha
Plant protection	-	-
Contract worker	13	€ / ha
Total direct costs	195	€ / ha
Net income	355	€ / ha
Machinery costs	70	€ / year
Net income for average area of 2.4 ha	782	€ / year

Source: Own calculations based on Liese et al. (2014)

**Usually farmers use very little or no fertilizer at all due to the high costs. A main reason is a 1992 government reduction of the private importation of agricultural inputs which resulted in a shortage of fertilizer supply and increased prices.*

The main source of credit for farmers is the Myanmar Agricultural Development Bank (MADB) and local moneylenders. MADB is a state-owned bank which supplies seasonal loans for rice supplements. The available credit from this bank is

250.000 kyats per hectare, eligible for up to 4 hectares. The interest rate of the credit is 8.5% and farmers have to pay back after crop season. Local moneylenders usually charge much higher interest rates. Most farmers need to sell their crop products right after the harvest to pay back credits and borrowed money. There is no official credit arrangement for buying machineries and usually no services for hiring machineries. Instead farmers help each other on mutual agreement.

Rice Price volatility

A big problem on the internal market is the price volatility of rice. It is the highest among net rice price exporting countries in Asia. The main reason is that 70% of the rice is harvested at the end of monsoon season. This leads to sharp price drops between January and February and

peaks between May and October. The volatility is amplified by poor infrastructure, such as fragmented seed markets, poor roads, weak phone coverage, a too small number of storage facilities and inadequate market information. There is a lack of working market-based instruments

to decrease the volatility.

Despite the price fluctuations of rice the average rice prices have risen by 41% between 2009 and 2013. This affects in particular the poor people who spend more than 60% of their income on food.

Concerns and opportunities of Rice Production in Myanmar

The potential for rice is extremely high in Myanmar, given a vast land surplus and a great potential in increasing yields. But fertilizers and high yielding varieties are still expensive because all of them are imported and not easily accessible to a majority of farmers.

In accordance with high costs of agricultural inputs and a lack of microfinance laws, rules and regulations farmers cannot overcome from debt cycle. This issue has to be addressed by the government using different approaches (e.g. increasing access to credit, microfinance organizations and insurance schemes).

Compared to the price of inputs, the price of rice is rather low to get earnings from rice. On the production level, there is a need to introduce better rice varieties and proper management (e.g. irrigation, fertilizer application) to reach export quality. Farmers should be empowered and supported by various means to increase their production practices and knowledge and to facilitate the access to agricultural inputs. After harvesting, the grain quality is often affected by the country's simple storage facilities and antiquated mills. Therefore, it is necessary to provide adequate infrastructure and post production facilities.

Improving the infrastructure and expanding storage capacities would also have a positive effect on the rice price volatility. An increase of rice exports would provide additional benefits as it would stabilize the prices during harvesting time. However, it would be necessary to realise different production and harvesting periods to

equalize the rice supply. Furthermore this would help increasing the income of the farmers and at the same time lowering the prices on the internal market.

It will take some years before Myanmar can regain its former position as one of the world's largest rice exporters. The favourable factor is that seemingly most of the people like to introduce reforms into the agricultural sector. If the right steps are taken Myanmar, could be an important country contributing to food sufficiency in the world.

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Sugarcane and palm sugar

Esther Mieves

Sugar cane production

The trivial name sugar cane refers to several species of tropical, perennial grasses (Poaceae) of the genus *Saccharum*. Indigenous to South and South-East Asia, sugar cane is well adapted to climatic conditions of Myanmar. For intensive cultivation different commercial sugar cane cultivars or hybrids of *Saccharum officinarum* are used. Around 80% of worldwide produced sugar derives from sugar cane; therefore it is the key crop for sugar production. The top producers in the world are Brazil, India, China and Thailand. With its extraordinary height between 2 to 6 m and a huge water content of 63-73 % sugar cane accounts for the crop with largest production quantity in the world.

Growth conditions:

As C4- Plant these grasses are well adapted to grow under high temperatures and meager conditions in terms of water and nitrogen supply. But under ideal supply sugar cane can unfold its fast growing potential. Thus, to gain high yields for commercial sugar production often irrigation and fertilization is used. A minimum of 28 C and precipitation of 1000 mm per year is needed to gain satisfying yields. As a matter of course the higher the Temperature is the more water is required.

Cultivation and processing

The grasses are mostly vegetative propagated. Therefore, the stalks are cut in pieces with 2-3 internodes that are inserted into the soil. First harvest takes place after 9-18 month. Once planted, the stand can be harvested several times which is called ratooning. The main benefits of this method is that the crop matures earlier in the season and also costs and labour for preparing fields and replanting are decreased. The disadvantage is that successive harvests

give decreasing yields and are more susceptible to pests and diseases. Depending on the intensification of the system ratoons are harvested two to eight times before new sets are planted. The harvest usually takes place after two month of aridness, when the relative sugar content is highest. After harvest the stalks containing 12-16% sugar are crushed or smashed in sugar cane mills to collect the juice, from which the main product sugar (sucrose) is processed. Different products obtained from sugar cane are for example ethanol, molasses, rum, bagasse and others.

Around 1000 kg sugar cane is needed as raw material in average to produce 100 kg sugar or 70 litre ethanol, but for sure this highly dependent on the efficacy of the production facilities.

Sugar cane in Myanmar

Traditional sugar cane cultivation has a long history in Myanmar. The first Sugar Cane Research Farm was founded 1925 in Pyinmana (between Naypyitaw and Yezin). During the colonial period (1824 to 1948) white sugar was considered a luxury item for which the demand was not very high instead jaggery was used in the average household diet. During the socialist economy period (1954 to 1988) factories of centrifugal sugar production were nationalized. The cultivation outside the mill areas was restricted and close to the mills the farmers had to grow sugar cane according to issued cane quotas. The government controlled sugar production declined gradually. After the restructuring of agricultural sector from 1994-96 the Ministry of Agriculture and Irrigation is recently the responsible authority for sugar cane cultivation and processing. Under the same reforms the Myanma sugar cane Enterprise (MSE) was constituted as an additional agency which promotes sugar cane processing

and production.

Today the major constraints of the industry are the huge price drop for sugar, high costs of energy inputs, declining supply of fuel feedstock and delivery shortages of sugar cane. These circumstances force the enterprises to shift from market-oriented to raw material oriented locations. In those areas sugar cane cultivation may be expandable but many socioeconomic needs are required to be fulfilled first, before a skill and technology intensive factory could be settled.

Palm sugar production

The oldest and most variegated types of palm utilization along with the greatest palm species diversity can be found in Asia. Throughout the tropics the multipurpose uses (edible fruits, palm sap, building materials, fibres, wax, etc.) of palms has played a major role in diminution of poverty. An immense contribution to the nutrition of humans and animals is delivered through extracted palm sap that contains between 10 to 20% sucrose. For human consumption, the obtained palm sap is processed to different palm sugar products like jaggery, syrup or alcoholic drinks as arak or fermented toddy (palm wine). Through the provision of additional income this products are very important for Myanmar's rural economy. Palm sugar compared to sugar cane is rather seldom refined to white sugar. Therefore palm sugar is more often sold in form of jaggery also called "*Htanyet*" in Burmese. This brown sugar bulk in which molasses and crystals are not separated is mostly traded as cones, blocks, in paste form or as sweets mixed with other ingredients on local markets. It is estimated that over 80 million kilos of jaggery is produced every season in Myanmar. The main constraints processing palm sap is the increasing price of fuel and also a lack of fuel in general. Furthermore, is white palm sugar considered to be of inferior quality than

those from sugar cane? This could explain the low demand for refined palm sugar. Just if production methods are improved and product specifications can be met it may be possible to export to overseas markets to meet the demand for wholesome organic jaggery.

Palm cultivation and palm sap extraction

Many species of the palm family (*Arecaceae*) can be used in order to produce palm sugar or related products. Mostly Palmyra palms of the Genus *Borassus*, Coconut (*Cocos*) and Date palms (*Phoenix*) are tapped to extract the plant sap. This sap is also called sweet toddy, hence the palms used for sugar production are sometimes colloquially called toddy-palms. These grow primarily throughout the lowlands of Myanmar in grooves and also often associated with crops and pastures. For palm tapping the inflorescence or the trunk are cut depending on the palm tree and the technique. After an average of 15 years of maturity the juice can be harvested for the first time. Once done, the palm sap has to be collected the whole season at least once a day in the morning. Juice may be collected from the male and the female flowers, but the period of time in which they can be harvested differ from 3 month of the first to 6 month and longer of the latter. To harvest the sap, workers climb up bamboo ladders which are fixed to the stem of the palm trees to empty containers that has been left in the palms to collect the sap. On average, five litres of juice can be collected daily per palm tree. Depending on the physical condition and experience of the worker, between 25 to 50 palms can be harvested in one day. It is a difficult and dangerous work to climb up the rickety ladders because the palms grow to a height up to 30 meters.

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Agroforestry systems

Mwanaima Rajab Ramadhan & Malte Dunkhorst

History of Agroforestry in Myanmar

Agroforestry is a land use system that combines food crops with tree crops and/or livestock on the same unit of land. These systems are sustainable, because they are less intensive than conventional agriculture. The distribution of agroforestry is dense in the tropics and subtropics, because vegetation grows throughout the year and soils are often threatened by erosion after clear cutting. In the mid-19th century, the Taungya system was introduced in Myanmar. The British colonists requested local shifting cultivators, without landownership, to plant teak trees into the cotton plantations. Later on, when the trees had grown taller, the British forestry office controlled these areas. The system gained popularity when farmers were well paid for their teak sowings.

Due to shifting cultivation, agricultural expansion and infrastructural development, many forests have been degraded. The average annual rate of forest loss reached a peak from 1991-2000, of about 500,000 ha per year. In 1995, the government agreed on new forestry laws (Community Forestry Instruction). According to that, the government aims at steadily promoting participatory forest management in partnership with local farmers.

Benefits and costs of Agroforestry

The benefits of agroforestry systems in Myanmar are primarily food security, insurance of employment for smallholder farmers and forest conservation. In addition, there is increased biodiversity and water quality in areas where agroforestry is practiced. Furthermore, the roots of the tree crops prohibit erosion and degradation of soils and enhance the soil with an organic layer. These interrelations enable the landscapes to withstand floods and droughts. Thus, agroforestry can be

used as a mitigation factor against climate change.

Although agroforestry has developed positively in Myanmar, with regards to its benefits, smallholder farmers still need more government support to savour its advantages. The adaptation of shifting cultivation to modern land use systems is a highly important challenge and needs a lot more support and educational advertising. Many farmers are inhibited to husband their fields in an adapted and modern way, because they have no access to expertise knowledge and resources.

The agroforestry types in Myanmar are:

Taungya

This system originated in Myanmar in the mid-1850s. The word taungya is Burmese, "Taung" meaning hill and "ya" meaning cultivation. Taungya involves the cultivation of annual food and cash crops in between planted forest trees for 2-3 years, after which the cutters have to shift to other areas. The major components are forest trees and agricultural crops during the early stages of establishing a forest plantation. The system has two main limitations: Lack of land security and lack of the possibility of continued cultivation. Although it appears to be labour exploitative without land ownership, the system provides opportunities for increased food production at subsistence level. The seasonal plantation works also generates additional income for the farmers. It is thus the most preferred agroforestry system in Myanmar's forestry plantation.

Agricultural cropping under shade trees

In this system, coffee, tea, medicinal herbs and sometimes pineapple are planted in between forest and fruit trees. The species combination and choice depends on the

locality and its climatic conditions. This cropping system is most common in the hilly regions of Chin and Shan states. The system has been proved to be economically viable, thus local farmers have become more interested in this system for their living.

Home gardens

That system includes mixed planting of forest and fruit trees in homesteads. Forest trees are mainly planted along homesteads for shade, firewood and as wind breaks. In the upland regions with cool climatic conditions, home gardens usually contain tea, coffee, jackfruit, avocado among others. In the Coastal regions, mango, pumelo and coconut are common. Whereas in the Central dry zone, grapes, tamarind and plums are the major species are planted in homesteads.

Alley cropping

Alley cropping consists of growing agricultural crops in between hedge rows of shrubs and trees, especially of leguminous species. During growing of crops, the hedges get pruned and trimmed regularly, to avoid shading and to provide biomass thus enhancing nutrient status and physical properties of the soil. This system is mostly done by UNDP/FAO projects as demonstration plots in Irrawaddy Delta, Southern Shan state and in Central Myanmar.

Woodlots

Woodlots involve planting of trees in blank areas near homesteads, farms and on village communal marginal lands. The woodlots are designed from fast growing, high-coppicing power and locally available multi-purpose tree species. The primary objective of the system is fuel production. Woodlots are common in Central dry zone and hilly regions of Myanmar.

Agrosilvopastoral

Those systems are the combined farming of agricultural crops, trees and pasture. Open grazing is commonly done in off seasons. Species commonly browsed by animals are either planted or grow wildly. These include: *Cassia* spp. *Ipil-ipil*, *Prosopis* spp. and *Acacia* spp. In these systems migratory bee-keeping is also done especially in the upper and middle parts of Shan state. This is an activity undertaken yearly. Species such as sesame, sunflower, ziziphus are planted to provide bee fodder especially when flowering.

Agrosilvofisheries

Agrosilvofishery is the farming of fish in a pond, raising of pigs in a shelf on water surface and planting of trees and vegetables on the bunds constructed along the pond periphery. This system can also include ducks instead of pigs. It is mainly done in the wetlands of Myanmar. The ponds are usually constructed taking advantage of the natural settings such as low-lying depressions, valleys and water-logged areas. Mixed planting of banana, citrus, papaya are commonly done on raised bunds of the pond.

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Livestock production: Buffaloes and cattle

Philipp Seifert & Katharina Stanzel

In Myanmar's livestock sector, cattle, buffalos, pigs and poultry are the most important animals. Small ruminants, fish and unconventional livestock are less common. A main part of animal husbandry is going on small-scale and backyard level. Only few industrial/ commercial farms have been established so far (HLAING 2011).

A melting pot of cattle breeds and multipurpose animals

Cattle husbandry was brought to Myanmar mainly by the Indian people. They did not only bring along special cattle breeds but also the dairy production, milk products as contribution to diet. Hence Burmese cattle breeds are of Indian as well as of Pakistani origin (HLAING, 2010). The Pyar Sein breed is a typical multipurpose breed but is rather considered a draught or beef cattle breed (HLAING, 2011). As milk still resembles an important part of the Burmese diet (e.g. used in pastry and drinks such as milk tea), milk production from cows is very essential. While in former times simply local breeds were used from multipurpose breeds, nowadays exotic breeds, e.g. Holstein or Jersey are crossbred with local breeds in order to improve milk yield (FAO, 2007).

Not only cattle breeds are used as dairy and draught animals but also the water buffalo (*Bubalus bubalis*). It is the domestic form of the Asian buffalo and two breeds (Shan/Myanmar kywe) are traditionally used by small holders in mixed farming systems.

Swamp buffaloes are smaller and have lower milk yields than river buffaloes. They are primarily raised for draught power. River buffaloes usually produce between 1,500 and 4,500 litres of milk per lactation. They have a significantly longer productive life than cattle, providing calves and milk until they are up to 20 years of age. The many factors that constrain commercial

buffalo milk production include animals' late age at first calving, the seasonality of oestrus, and the long calving interval and dry period (FAO, 2015).

Meat production as such can be neglected (FAO, 2007, p. 11) and should rather be seen as a way of "utilizing retired draught animals" because of the majority's Buddhist belief. According to that Buddhists are not allowed to kill any living being and therefore if necessary, slaughtering is done by Muslim butchers, at the end of the live span of the cattle. However, meat production and consumption in Myanmar is slightly increasing, producing per year 227,869 mt of beef, 569,434 mt of pork and 976,419 mt of poultry meat. Especially poultry and pork meat production gains importance. The number of pig heads kept in Myanmar increased from 2,655,000 heads in 1993 to 10,530,000 heads in 2013; this is an increase of 390%. The number of poultry heads increased significantly from 27,120,000 heads in 1993 to 190,000,000 heads in 2013. This equals to an increase of 700% (FAOSTAT, 2015).

Besides the utilization as milk or meat producing livestock species, buffaloes and cattle are typically used as draught animals or are part of cultural events. Firstly, the draught power is taken advantage of in field cultivation or as a mean of transportation. That is, mainly in rice cultivation, either two cattle or one buffalo oxen are normally pulling the *tun*, a traditional harrow, in order to prepare the field for the planting (ANDO et al., 2010, p. 26). Moreover, at the time of harvest, the two large ruminants are used to pull carts loaded with rice straw, hay or to transport timber. Secondly, buffaloes or cattle are decorated beautifully for religious ceremonies, e.g. the Buddhist *Shinbyu* celebration or are honoured in the *Pone ma gyi Tin De* celebration (ANDO et

al., 2010, p. 30). During the latter mentioned rice festival buffalo or cattle shaped sticky rice is put on a plate which is brought to a special place in the room as an offering.

Buffalo or cattle?

While both bovine species are used in Burmese farming systems, there are major differences between the utilization of cattle and buffaloes. Usually a higher milk yield can be obtained by cattle, particularly from crossbreeds. Nevertheless, that only holds true if appropriate fodder is available. Moreover, beef is preferred by consumers which are mostly Muslims since the Buddhist population rarely eats beef (FAO, 2007, p. 3). Theoretically there is also the possibility for artificial insemination in cattle (FAO, 2007, p. 10) but due to a lack of poor storage and cooling facilities people rather keep breeding bulls and sell their service to farmers (FAO, 2007). Generally, cattle husbandry can be found in and around Mandalay, Magwe, Shan and Rakhine. In contrast to that, buffalo husbandry is restricted to areas where water bodies are found, i.e. Irrawaddy (DRIEL and NAUTA, 2013) or Shan (FAO, 2007, p. 5), because water buffaloes need the water to cool down. They are perfectly suited for rice field cultivation since their hooves are suited to wet grounds so that they do not sink in. It is said that buffaloes are gentle family animals, that buffalo oxen are stronger than cattle oxen and that they are better adapted to low pasture quality (WANAPAT and KANG, 2013, pp. 3-4).

The future of buffaloes and cattle

The wide spread global phenomenon of rural migration to the cities, is also found in Myanmar. Therefore, there is an increasing demand for dairy products among the urban population, especially for milk tea and milk used in coffee (HLAING, 2010 and MYANMAR TIMES, 2011). At present Myanmar is not self-sufficient in milk production and depends on imports of

dairy products from China and India. A small number of commercial dairy farms (HLAING, 2010 and HLAING, 2011) have already emerged and according to the availability and accessibility artificial insemination or cross breeding with cattle breeds from Western countries could improve the milk production of traditional cattle. However, it is questionable in which way milk production Myanmar can compete with the products from countries like China and India which have a further developed dairy sector (HLAING, 2010). When it comes to beef and buffalo meat production, figures show even though there might be a slight increase, poultry, fish and sea food production are and will remain the most important pillars of the Burmese livestock sector concerning consumption purposes. That results mainly from the facts, that poultry has a shorter live span than cattle and buffalo, that they can be slaughtered earlier and that the eggs add animal proteins to the mostly vegetarian Buddhist diet. In addition, national buffalo conservation programmes brought along several slaughtering restrictions, e.g. the last one from 1970 which determined 16 years as the earliest legal slaughtering age of buffaloes (FAO, w. y., p. 10). Last but not least, mechanization or more precisely the use of tractors and tillers threatens the importance of cattle and buffaloes as indispensable multipurpose farm animals. According to the FAO in CRUZ (2010, p. 12), the growth rate of buffalo numbers in 2006 was still higher (2.1%) compared to the growth rate of tractors (-2.4%) in Myanmar, however it is doubtful that buffaloes or cattle will be preferred over power tillers in the following years and decades. In all other ASEAN countries, except for Laos, the argument that fuel run tillers need less space, fodder, housing, care as animals on the one hand and on the other hand are cheaper, require less technical know-how as tractors (DRIEL and NAUTA, 2013, p. 16 and RIEDEL et

al., 2012, p. 142) and can be used on smaller fields. Thus their use only limited by and the availability and accessibility of fuel. Since that remains a crucial point in a country where infrastructure still is in its infancy and especially buffalo husbandry has not only a long tradition but is strongly linked with religious and emotional values the near future buffalo and cattle will continue to be an essential part in Burmese farming systems. That is at least in remote areas where the combination of draught power and milk production are of vital importance in order to cultivate fields and to cover the household's protein needs in Burmese small holder mixed farming systems.

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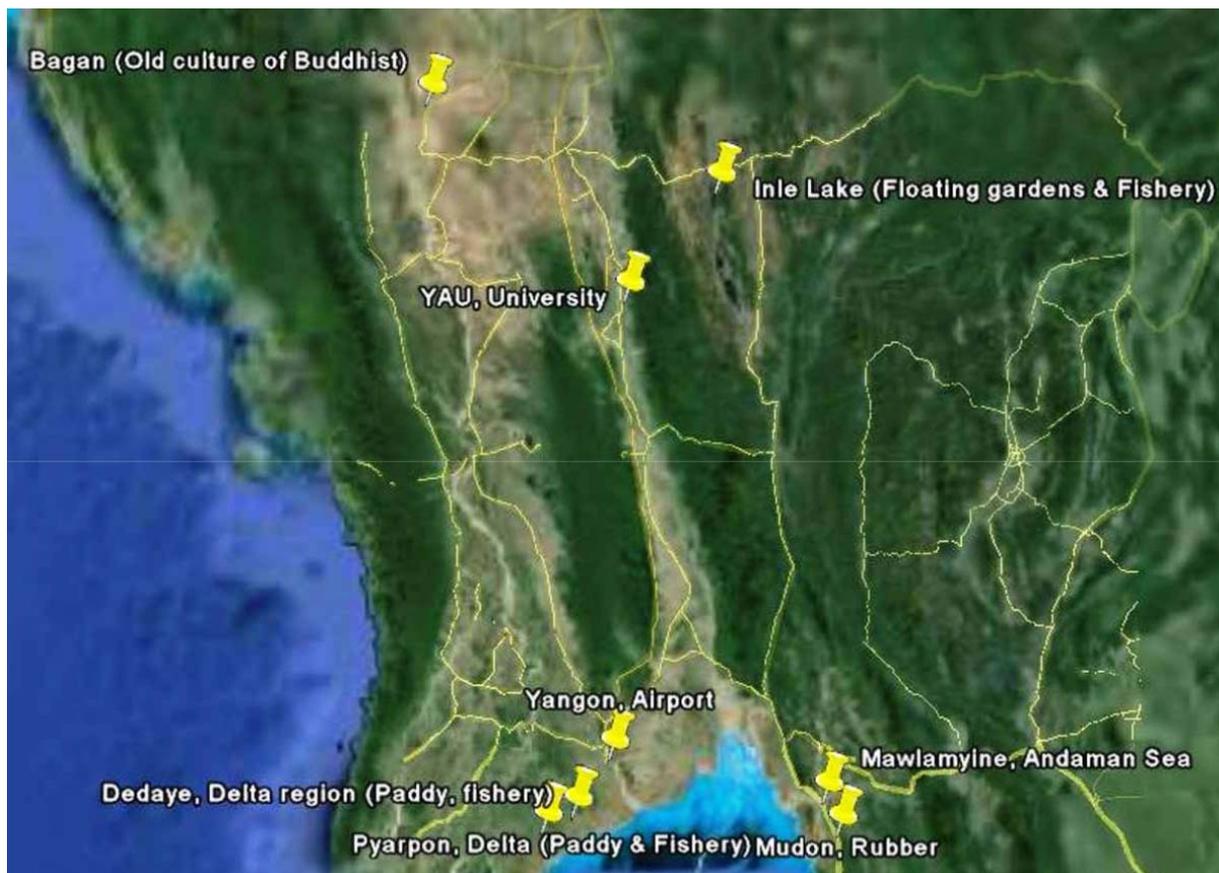
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Excursion Programme and Itinerary

Birma, Burma, Myanmar – three names for a small South-Asian country with an ancient history and surrounded by Thailand, Laos, China, India, Bangladesh, the Bay of Bengal, and the Andaman Sea. Between the Himalaya and the Indian Ocean, the Republic of the Union of Myanmar hosts rainforest, dry savannahs, fertile hill slopes, inland lakes, humid coastal zones and river deltas. Because Myanmar entered into a process of democratization only as from 2011, and started opening to the “outside world” only thereafter, the largely smallholder dominated agricultural sector operate

under different political and economic situation as their Thai neighbours.

Currently, all of Myanmar’s economic sectors undergo major transformational change, and the 2015 excursion particularly focussed on the associated processes. In cooperation with Yezin Agricultural University in Pyinmana, a two-week itinerary plotted below was organized to lead along a variety of farms, enterprises, service providers, government organisations, NGOs and educational institutes, demonstrating the diverse nature and the many different facets of the agricultural and forestry sector.



Day	Activity	Overnight stay	Report
13.03.	Departure from Germany	Witzenhausen to Myanmar, aircraft	
14.03.-15.03.	Arrival at Yangon Travel to Mon State - <i>pomelo plantation</i> ¹ - large scale and small scale ² <i>rubber plantations</i> ³ Andamon Sea: - <i>fisheries</i> ² Mawlamyine - <i>impressions of the city</i> ⁴ - <i>Kyaikhtiyo Wildlife Sanctuary</i> ⁴ Travel back to Yangon	Mawlamyine & Mudon, Mon State (Hotels)	¹ Carsten Bruckhaus ² Lena Grün ³ Malte Dunkhorst ⁴ Lisa Haubner
16.03.-17.03.	Delta region of Irrawaddy River: - <i>duck egg collection cooperative</i> ⁵ - <i>pig production</i> ⁵ - <i>paddy fields</i> ⁵ - <i>rice mill</i> ⁶ - <i>mangroves</i> ⁶ in Phyarpon and Dadaye Townships	Yangon (Hotel)	⁵ Bernadette Kiesel ⁶ Ture Jacobsen
18.03.-19.03.	Yangon - <i>Shwedagon Pagoda</i> Train trip to Inle Lake region - <i>impressions</i> ⁷ - <i>technical notes</i> ⁸	Train	⁷ Jan Lavers ⁸ Dirk Landmann
20.03.-21.03.	Inle Lake region: - <i>floating gardens</i> ⁹ - <i>fishery</i> ⁹ - <i>weaving</i> ⁹ - <i>rice nursery</i> ¹⁰ - <i>sugar cane mill</i> ¹⁰ - <i>dairy farm</i> ¹⁰	Inle Lake, Nyaug Shwe (Hotel)	⁹ Leonie Kreipe ¹⁰ Anja Lienert

Day	Activity	Overnight stay	Report
22.03.-23.03.	Travel to Mandalay: - <i>Last King Palace</i> - <i>the largest Damma Book</i> - <i>U Pain Bridge (the longest wooden bridge)</i> - <i>Current economic situation (China dominant area)</i> - <i>Teak plantation</i> ¹¹		¹¹ Luciane Lenz
24.03.-25.03.	Travel to Bagan: - <i>old Buddhist culture</i> - <i>animal production small-scale goat production</i> ¹² - <i>dry zone agriculture sugar toddy palm</i> ¹³ - <i>betel leaf production</i> ¹³ - <i>private sesame and peanut oil mill</i> ¹³ - <i>vegetable production</i> ¹⁴ - <i>lacquerware</i> ¹⁴	Bagan (Hotel)	¹² Esther Mieves ¹³ Jens Riemeyer ¹⁴ Katharina Stanzel ¹⁴ Philipp Seifert
26.03.-27.03.	Travel to Nay Pyi Daw - <i>draught animals</i> ¹⁵ Yezin Agricultural University - <i>visit of campus and experimental facilities</i> ¹⁷ - <i>hybrid rice programme</i> ¹⁷ - <i>Department of Veterinary Sciences</i> ¹⁸ - <i>discussion among students</i>	Nay Pyi Daw (Hotel)	¹⁵ Felix Stiegler ¹⁷ Balint Szell ¹⁸ Vera Wersebeckmann
27.03.-28.03.	Travel back to Yangon and Germany - <i>Visiting the orphanage "Happy Haven Humanitarian Project"</i> ¹⁹	Yangon (Hotel)	¹⁹ Leonie Kreipe ¹⁹ Peter Thyen

Pomelo Plantation

Carsten Bruckhaus

After a long flight from Frankfurt to Yangon and a bus tour from Yangon to Mawlamyine, we are heading to a pomelo plantation. This is going to be the first station of our excursion, we have been travelling for more than 24 hours now and we are all very tired. Yet we want to adapt to the time shift as soon as possible, so we do not plan for a rest in the hotel. On the way from the airport we had a short stop at a war memorial in the first light of the day.

We walk a few hundred meters from the bus stop to the pomelo plantation. Even before arriving at the plantation we see a jackfruit tree: a large tree carrying big green fruits with strong spikes and a bad smell. The tree does not belong to the plantation but is planted in the front yard of some local peoples' houses. Some more jackfruit trees follow during our walk to the plantation.

Another tree causes discussion: During summer season it carries fruits that look like single bananas, but they contain fibre. Some people consider this tree to be a kapok tree, others are sceptical. After discussion, a majority claims this tree to be a kapok tree. Kapok is an interesting fibre, because it is quite water resistant and does not soak like other plant fibres. Therefore, it was formerly used as a filling of rescue rings, but also for pillows, puppets etc., even in Europe.

Arriving at the plantation, Mr. Ulaten, the owner, is already waiting for us. Thin kindly introduces us to him. Mr. Ulaten cultivates around 2.5 hectares or 6 acres that are mainly planted with pomelo trees. Pomeles are his main business and his primary source of income, but he cultivates

more than 50 plant species in total, most of them for home consumption. His pomelo production is around 40,000 pomeles per year. The farm is run by his family and additionally he has two permanent workers employed. Mr. Ulaten says he is a big fan of pomelo production and his pomeles are very high quality. He has two ways of distribution: The first is selling his pomeles to a broker, who then sells them in Myanmar.

Second, he is selling the pomeles to local people who then export his pomeles via Mandalay to China and Thailand. He is in contact with the customers in Thailand and China and according to his information they prefer to buy his pomeles because of their high quality. More interesting than the "good quality" is the fact that he is in contact with his very distant customers. Being asked how he produces better quality than other farmers, he says that it is because of the special climatic conditions in his farm and because he does not use pesticides or chemical fertilizers, but only natural compost and cattle manure. He also applies lime to the soil to make the fruits sweeter. He is concerned about pesticides and fertilizers leaching into the ground water and intoxicating him and his family. Other farmers in his neighbourhood use mineral fertilizers and pesticides, but he has read articles about bad health effects. Some of his neighbours know about organic farming, but since "natural" fertilizers are very expensive, they often use mineral ones. He does not sell his fruits as "organic" or anything else because customers do not know about organic farming until they visit his farm and he can show them.

Last year he made a trip to Thailand where he got convinced about a new irrigation system. Before he used sprinklers to irrigate his pomelo plantation, but they need a lot of water and the maintenance is labour intensive. In Thailand he was introduced to flood irrigation and now he has started to adopt this irrigation system because it saves water and labour. The trees would even survive without irrigation, but fruit quality and yield are much better with irrigation. Young trees are raised in the shade of the older trees and it turns out that, contrary to what he told us before, the young trees are treated with pesticides to protect them if necessary.

The young trees start carrying fruits from the age of around seven years. A tree can usually be harvested for 30-50 years, then fruit quality and yield drop and the tree needs to be replaced. As a protection against fruit-flies there are traps installed in the trees: small plastic bottles with pheromone-soaked sponges inside them to attract fruit-flies and a little water to drown them.

The nutrient balances just do not seem to fit. He is exporting 40,000 pomelos, which is around 3 tons of dry matter per year with a high load of potassium. He applies compost and manure six times per year. It remains uncertain how much fertilizer he really applies in average, because he and his workers do not conduct any soil analysis but rather "fertilize by heart": if a tree is healthy and has dark green leaves, they use only a little bit. If a tree is ill or has yellowish leaves he would apply more fertilizer.

According to Mr. Bürkert's estimation Mr. Ulaten should have a yearly export of around 200-250 kg N/ha, plus a considerable amount of potassium. This is can hardly be provided by compost and cattle manure only.

Mr. Ulaten insists that he does not use mineral potassium fertilizers, but he collects river sediments and uses self-made plant ashes. Also he collects bamboo leaves in a ditch next to the bamboo hedge surrounding his farm. During the rainy season the bamboo leaves start composting in the ditch and he can collect them and ash them or use as a fertilizer directly. On a walk apart from the group Mr. Hülsebusch finds empty bags of NPK-fertilizer.

Our visit at Mr. Ulaten's pomelo plantation ends with a small present for Mr. Ulaten, a group photo and a warm "Good Bye".

Rubber plantation in Mon State

Malte Dunkhorst

Natural rubber

Rubber is harvested from the rubber tree (*Hevea brasiliensis*). Therefore the bark is cut to extract the latex (phloem sap). It flows into a cup tightened underneath the cut, before workers collect it. Latex contains 25-40% dry rubber. In a factory the latex is refined into rubber and sold for further processing. Natural rubber accounts for least 1/3 of the world's rubber production. The rest is synthetic rubber.

Plantation properties

The plantation's size is 300 ha. It is completely covered with rubber trees. Founded in 1924, the plantation now provides labour for 220 people, who work on the plantation and in the rubber factory. By including the family members of the workers, about 450 people benefit from the rubber plantation. In addition 100 people are employed temporarily. A worker earns 3 US\$ per day for collecting 30 pounds of latex. If he harvests more, he receives an extra pay. The manager has worked 15 years on this plantation. He has no special education. Instead, he learned all work skills on the plantation. The plantation owner lives in Yangon. Rubber yields on the plantation range from 230 to 250t per year.

In the field: Preparation of rubber trees and collection of the sap

Latex can only be harvested in the dry season, because the tree needs a rest period for regeneration and further growth. To extract the rubber from the tree, the tree's bark has to be cut. The workers do this in the night from 1-3 a.m. During this time the internal pressure of the tree is highest. The angle of cutting has to be 45° along the trunk axis, then 20° for long-term production. Then workers apply a vertical cut from where the rubber can flow into a small cup. Hormones are placed on the

wounds after the cutting process, but only for the first time when trees are over age 25. A rubber tree should only be cut every second day to allow for regeneration. Therefore the plantation is divided into two 150 ha areas.

Cutting on only one plantation part today means cutting on the other 150 ha tomorrow. The latex is collected from the cups at 8:30 a.m. This has to be exactly 5 hours after cutting the bark, not later, otherwise the rubber gets thick and coagulates.

The trees are cut down at an age of 35 years, because productivity declines and trees are no longer economically viable. The timber is sold, even for producing furniture.

Some herbicides are applied to control the ground vegetation. Organic and mineral fertilizer is distributed in holes spaced 5x5 feet.

In the factory: Production of natural rubber

The collected latex is brought to a small factory on the plantation for further processing. At first it runs through several sieves filled with water and sand for separation and sedimentation. This process takes one night. To stimulate coagulation, formic acid is added to the sap.

When the latex is clean and coagulated (the material is solid now), a one-cylinder diesel engine driven machine is used to compress the rubber by rolling it out into quadrangular sheets. This work is done by hand. With their fingers close to the rolls, the workers face a dangerous task.

Drying process

Last step of production is the drying. At first the rubber sheets dry in the sun. Therefore they are hung on a cart with several pipes to attach the rubber sheets. It's about 4 m high and 3 m wide. There

are also other methods to extract water from the rubber sheets. After the sun drying the carts with the rubber are brought into a drying hall, where they are smoked with rubber wood to evaporate the formic acid. Smoking also protects the rubber against fungal attacks. The temperature in the hall is 60° to 65°C. The colour of the rubber sheets has now changed from white to brown.

Preparing rubber for sale

Rubber sheets are bundled and sold in packages. Each package weighs 55 kg. The rubber is only sold to one customer, “Yangon Tyre”.

Rubber prices are decreasing dramatically. Seven years ago 3 US\$ were paid for a kg, today it's 1.5 US\$. Relating to the collapse of price, the plantation has no contract with the customer. Prices are negotiated constantly.

Three standards are implemented for rubber quality. First, the colour must be uniform. Secondly, the rubber may not have any sand inclusions. Least, the factory has to use formic acid. Small-scale rubber farmers use sulphuric acid, because it is much cheaper to purchase.

Fishery Systems, Forest Department, Rubber Plantation

Lena Grün

Fishery systems

In the afternoon of the 15th March, we visited a small village at the coast of the Mudon state.

Around 150 households are located at this place; about 120 of them depend on the fishery. Some other products are produced, but most of them are for own use, not for trade. The majority of the people working in the village are from there. The boats are owned by the fishermen and were built by other people, not by themselves. The men go fishing at sea and the women do the work on land in the village. Their kids are helping them when they are out of school. When they are older, they often move out of their birth place to find some work in the towns.



Fig.: The drying process of fish

The fishing process is seasonal; most of the fish are caught in April, the month before the monsoon comes. It also depends on the tide; the fishermen go out during the up tide and come back at the low tide. Some of them are about 16 hours per day out at the sea, whereof they fish 4 hours. The remaining 12 hours include the shipping to and from the fishing grounds. Considering the fact that the fishermen go out two times a day they spend 3 hours one way for a fishing time of two hours. When they go out one time they catch

about 350 kg of fish per boat, therefore thus about 700 kg per day. One third of the catch is usable, the remaining two thirds are wastes. That corresponds to around 230 kg usable fish per day.

Back on land the fishermen get the fish out of the boats and dry them for one week, afterwards the fish get salted. The prawns they collect are boiled for a very short time and get dried too. Every two weeks a trader comes to the village and buys their fish. Most of the export goes to Thailand, also some to Japan. The price depends on the fish and on the season.

Forest department

After lunch we arrived at the forest department of Mon State. The department manages around 200,000 acres of land. Of this, however less than 1% is actual forest still, the rest of the land (i.e. former forest) has been turned into plantations. The daily work of the forest department staff consists of the replantation of mangroves, training of the local farmers and controlling illegal deforestation. The main task includes the work with the mangroves to stabilize the coast line. Due to the fact, that natural forest is less productive than a plantation, the remaining forest is going to disappear over the next years. The people who work at the forest department do not have a high level of education, they work as rangers and visited a ranger forest school.

Small rubber plantation

Later we visited a small rubber plantation with an area of 4.5 hectares. The farmer earns round about 60 US\$ per month and pays 6 workers. The technique of rubber harvesting and the quality of rubber, respectively, are much different to the plantation we saw in the morning. The trees are planted in non-technical rows

and have different ages.



Fig.: Red paste put on the old cuts to protect the tree from drying

To harvest the latex, the workers cut the bark from up to down. The farmer told us that this is the local technique. After rubber collection from this cut, they seal the wound with a red compound. This paste includes normally sediments and covers the barkless area of the trees, which is especially important in summer. The process is nearly the same than what we saw in the morning, but on a smaller scale. But the smoking process is left out and the acid added to the latex is sulphuric acid, which is cheaper. Also the quality is lower, the rubber sheets are not as clean as the others. At the moment, the owner collects and stores all the finished rubber sheets. He does not want to sell them currently because the price is actually bad. Next year he will sell his products to Mudon. There they get sorted and he will get paid by quality. At the local market he has no selling power because there are too many small-scale providers. The latex collection and rubber production processes run every day. In the high period the farmer earns and produces nearly 220 pounds of crude rubber per day, now, in the off season about 60 p. For one pound the owner gets about 0.55 US\$.

On the way back to the bus we saw a laying battery with round about 1,000 hens. We learned that the owner gets 1,000 Kyat (~1 US\$) for one egg.

After a short bus drive we arrived at the department of Yezin University at Mawlamyine. We were shortly introduced to some research projects and topics, particularly on cashew, rubber, coconut and some more plants. In addition to that, the department scientists and students study plant diseases, the behaviour of seedlings and execute laboratory tests.



Fig.: Entrance of the Department of Yezin University

Mawlamyaing, Kyaikhtiyo Wildlife Sanctuary, Oil palm plantations

Lisa Haubner

Mawlamyaing

The third excursion day started with a walk through the city centre of Mawlamyaing which reflects the city's colonial history

and Islamic influences. We were passing mosques, colonial mansions, various small market stalls and the wholesale market.



Fig.: Impressions of Mawlamyaing

At that day we were leaving the south of the country heading back north to Yangon. While in the area around Mawlamyaing rubber plantations are the main land use system, further south oil palms are prevalent. Due to rising labour costs the former rubber plantations are converted into palm oil plantations. As from Mawlamyaing Myanmar extends another 1,000 km south, although only almost 100 km broad this amounts to a huge land area. In Mon State the dry season is too pronounced to switch from rubber to palm oil plantations.

Along the first kilometres after leaving Mawlamyaing, people grow areca palm (a rather small palm tree) to harvest betel nut in their gardens. The betel nut, wrapped up in a betel leave (*piper betel*) and slaked lime added to improve the desired effect, is a weak narcotic used by large parts of the society by chewing it.

The physical addictiveness is low, while the psychological addictiveness is notable. The regular chewing of betel nut makes teeth red and black. For the growers of betel palm it is an economic factor. A betel leaf plantation has been visited on 23rd of March 2015.



Fig.: Betel nut ready to chew (unfolded)

Further along the way the landscape is dominated by more rubber plantations and rice fields. We passed various villages, many pagodas and also a Buddhist ceremony called Shin Pu which is a monk son donation ceremony (Shin Pu) accompanying children to the monastery who will become monks (in this case the children were riding ponies, alternatives: elephant, tractor etc.).

Kyaikhtiyo Wildlife Sanctuary

Expecting to visit a forest the next stop was the Kyaikhtiyo Wildlife Sanctuary near Kyaikhtiyo Pagoda in Mon State. Entering the forest area a check point needs to be passed, the forest is a very restricted area, controlled by the government. This seems to be the main task of the forest

administration as the technical information given was rather poor.

The forest administration which acts rather like a forest police is in charge of around 50,000 acres (~20,000 ha). All of this is forest, more than 6,000 acres (~ 2,400 ha) are given to the monks for temples. Some people live in the forest.

Since 2002 the area is protected, meaning that no more trees are extracted whereas before trees were harvested. Basically no forest management exists; there is rather an agreement to leave the forest well enough alone.

According to pictures, in the administration offices the following animal species live in the forest: toucan, Himalayan black bear, Himalayan sun bear, serow, common muntjac, dusky leaf monkey, clouded leopards, leopard and wild pig.

A truck drove the excursion group, accompanied by the forest staff, up in the mountains from where we took a walk further up into the forest. During the walk uphill we first came through a dense bamboo savanna and finally stopping at an elevation of around 725 m. There are some bigger trees and less bamboo. The dry season lasts 5 to 6 months; our visit took place in the driest season of the year. The rainfall information given cannot possibly be right (5,000 mm per year), probably it is rather around 2,500 mm per year. The water availability seems to be high, and there is no water stress to be seen on the trees.

Some natural fires (probably due to smoking) as well as intensive cutting of trees before 2002, allowed the spread of bamboo (not a tree, but a grass; pioneer



Fig.: Kyaiktiyo Pagoda, bamboo savanna, driving up the mountain and insular forest at ca. 725 m (from left to right)

species). Due to the high density of bamboo there is hardly any light for young trees. Only in the upper parts bigger trees are growing insularly. How to go from bamboo to forest? There are few options for the forest management as mechanical treatment does not help against bamboo. The current climax vegetation is bamboo; forest will grow in the long run (decades/centuries). To accelerate the process older trees should be protected so that other species can grow in their vicinity.

Comparison of tropical and temperate forest

There is hardly any topsoil humus layer in a tropical forest due to the fast decomposition of fallen leaves and the fact that there has not been any ice ages like in Europe. Furthermore the rain washes humus away (sign: giant eroded granite along the street, there have been good soils millions of years ago). The leaching of carbonates results in a soil pH < 6 and a shallow A horizon. The buffering capacity is not in the soil, but in the B horizon. Nevertheless, there is high biodiversity in tropical forests, although they are vulnerable ecosystems.

In comparison, temperate forests “stand” on more soil. Due to lower temperatures and less rainfall (in single events, but also totally), the transformation of the leaf litter is rather slow.

Oil palm plantation

The palms trees for oil production are planted wider than those of a rubber plantation (500 vs. 300 trees/ha). The fruit of the oil palm can be harvested once a year, either at the end of the rainy season or the beginning of the dry season so that there is enough water in the fruits. Palm oil plantations can be used for 40 to 50 years. The first harvest is after 8 to 10 years. About 4,000 to 6,000 litres of oil can be harvested, 80% of which is mesocarp oil (yellow colour due to high beta-carotene content, extracted from the fruits) used for

human consumption, and 20% endocarp oil (white colour, extracted from the kernel of the same fruit) used for industrial purposes and cosmetics.

To get started in the palm oil sector, a factory is needed as well as enough suitable land to plant oil palms to produce at full capacity; after that start, further farmers can be persuaded to grow palm oil trees, too.



Fig.: Oil palm plantation in Mon State

Basically, the opportunity to keep animals (cattle, sheep, pigs etc.) within the plantation exists, although the management in the tropics with pest pressures is not as easy.

Due to the deforestation of tropical rain forest that precedes planting oil palm, such a plantation, will only be environmentally sustainable (concerning its carbon footprint) after 80 years of age.

Remark on rubber (15th March 2015)

The official recommendation is to do intercropping of rubber trees with other plants. If legumes are to be integrated, tree lines need to be more widely spaced, otherwise there is a lack of light. Generally in countries like Myanmar there is a conflict between getting foreign currency into the country and to fight food insecurity of the population.

Ducks, pigs and small-scale paddy rice

Bernadette Kiesel

The agenda for today's excursion included a bus trip from Yangon to the Delta region of the Irrawaddy River where visits to a local rice farmer, small and large rice mills, a lunch break and the visit of the forest department in Pyapon followed by a boat trip close to Dedaye with forest officials to see mangroves, were planned. The estimated size of the Irrawaddy Delta amounts to at least 30,000 to 40,000 km².

Duck egg collection farm

Along the road to our first appointment on the 4th excursion day, we spontaneously stopped at around 10 a.m. as we have sighted a duck egg collection point (farm) next to the road at a small canal. Through the interview with the farmer family and additional explanations from Prof. Schlecht (at the farm and later in the bus), we received following information about ducks. There are three main types of ducks:

- Campbell Ducks, which are suitable for egg production;
- Muscovy Ducks, which are mainly used for meat production as they are bigger in size;
- Runner Ducks, which we have not seen but are also used for egg production

Ducks are here in Myanmar typically kept next to rice fields as they can use the canals between the fields. Their feed consists of a variety of sources such as snails, worms, insects, fish, small amphibians and molluscs, aquatic plants and grasses.

It seems to be one of the largest deltas in the world. On the map we have seen surprisingly few roads, so obviously most (transport) connections are covered through boats.

During the 3.5 hour bus drive to our first stop in this region various agricultural features could be seen and unexpected stops with short interviews of local farmers took place.

In the last days we could see smaller and larger flocks of ducks in the countryside. People keep them mainly for home consumption. The ducks are let out into the canal in the morning but mostly only after they have laid their eggs.

The egg collection farm is a family-run business and is selling their own eggs and also from other farmers around the area. The sold eggs are picked up by boat every second day and transported mainly to Yangon but there is no payment for the transport required of the farmer.

The collection farm's supply lays around 3,000 eggs per day. On average, a farmer receives 85 Kyat/egg (~0.085 €) from the collection farm where the eggs are sold for ~90 Kyat/egg (~0.09 €) to traders. The farm earns 5 Kyat/per egg (~0.005 €) multiplied with 3000 eggs/day the daily earnings add up to ~15 €. In Yangon the eggs are sold for approximately 120 Kyat/egg (~0.12 €) for big eggs of standard weight.

The price depends on the size/weight of



Fig.: Duck egg collection farm. Eggs ready for being picked up.

the eggs but there is no different price if eggs are not clean or even broken.

These are sold as well. No governmental price control or fixed price for this agricultural commodity exists but its price is connected to other agricultural products (e.g. rice, chicken) which are consumed together with eggs. 300 eggs weigh around 19 kg. Therefore the average weight of one egg amounts to ~65 g.

The main laying period is in June and July, at the start of the rainy monsoon season. Ducks have many economic uses, being farmed for their eggs, meat and feathers (particularly their down).

Pig farm

Next to the egg collection farm we had a glimpse at a pig farm that keeps typical Asian type of pigs.



Fig.: Pig farm in the Irrawaddy Delta

The pigs were mainly black and of crossed breed as they were relatively large in size but usually Asian pigs are much smaller and often they have a hanging belly. The pigs looked like weighing 100 -120 kg also the females, and the boar we saw was even bigger. The Asian pigs are very prolific, so they have lots of piglets and pregnancies. The sow has enough teats to nourish all the piglets this is/was a problem in the European breeds, if a sow has many piglets, it often had not enough teats. Already several centuries back the Asian pig was crossed into the European types of pigs especially in Great Britain to improve the mothering abilities such as the care of the sow for the piglets and also ability to really feed all the piglets.

But if you look from the consumer sight at the problem of the Asian pig, it is normally their very high fat content, especially

subcutaneous fat which is lying directly under the skin, which consumers do not like much. This is the reason why we could see also on this farm black and white pigs crosses which are now often used even in China. Crosses with modern breeds like

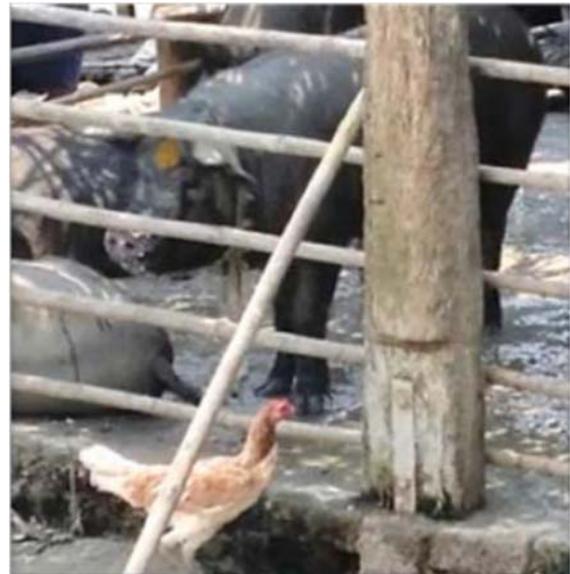


Fig.: Asian black pig

Landrace are getting more common, they replace the old breeds as also the Asian consumers shift towards meagre meat. This is then a disadvantage because the local Asian pigs are well used to the heat and humidity so they do not suffer that much from parasites and other diseases and besides they can cope with poor quality feed which European breeds cannot. As a result the same problems that occur with cattle breeds arise as soon as high yielding European breeds are crossed in because the adaptability of the animals to the environment is getting lost. Better product quality or higher milk yield in the case of cattle can probably be gained but only on the conditions of better feed that has to be purchased and improved housing which has to be provided. In conclusion, the whole production gets more expensive. The pigs here in the delta region most likely are fed with grasses, leftovers of rice production (rice grain), leftovers of meals and maybe also with residues of fishery.

The animal house in our example seemed

to be built more or less on land but we have seen before that some are built on holes and then droppings are going to the canals and small ponds nourishing the zooplankton and phytoplankton which are growing in the water. The outcome is a direct recycling of the nutrients from the pigs, ducks or goats.

With regard to castration of male pigs, which is an issue in Germany, it can be noted that generally, in all animal keeping societies the males which are not used for breeding are castrated to avoid uncontrolled mating and inbreeding.

Castrating around here is not done for the sake of taste or the problem of boar taint. Castrated animals subsequently grow bigger and put on more fat which is the case we could observe here. Above summarized details about the seen livestock were given by Prof. Schlecht.

Small-scale paddy rice farmer

After the spontaneous stops along the road we arrived at 11:30 a.m. at a local rice paddy farmer's field and met Aung Zaw Myint and Ohnmar Aye, both staff members of the Agriculture Department in the region, who have helped organising the visit to the local farmer. These two, the rice farmer and Prof. Bürkert shared the below mentioned information about rice cultivation. Rice paddy fields consist of an elaborate network of pipelines and channels which bring the water for flooding the fields and for forming a deep layer of soft mud. The paddy field has to be levelled so that all parts get the same



Fig.: Paddy rice field in the Irrawaddy Delta

treatment.

The paddy rice field we inspected represented an average field in the country and was treated with fertilizer. The rice was approximately 90 days cultivated and ready for harvesting in 5 days hence. The rice seed came from trade between farmers (which might be a problem with regard to transmission of diseases). The seedlings mostly are pre-grown in the nursery until they are ready for planting. The farmer expected to achieve 2.5 t of yield but according to his inputs the yield should be higher. The fertilizer used amounted per hectare to five bags/baskets of urea ($\text{CO}(\text{NH}_2)_2$) each weighing 50 kg (= 2 bags per acre). This adds up to 250 kg/ha of urea which contains 46% of nitrogen that equals to about 120 kg of nitrogen per hectare. This is not much for rice but still, normally one would expect to need about 40 kg of nitrogen per 1 t of harvested rice and therefore the farmer should achieve at least 3 or 3.5 t of rice out of this 120 kg of N. The question arose then what could be causes for this low yield? It was mentioned that the water management or the quality of the urea that



Fig.: Rice which is just before harvesting

were not as expected; that might also be effects of fungal diseases (rust, red stripes) which could be seen on the leaves at a closer look.

For rice fields under certain conditions, multiple stresses are typical and can have a negative impact on the yield. Influencing conditions/factors concerning this matter manifold, e.g. seed quality (not collected from a central seed distribution facility), fertilizer use efficiency, fungal or viral diseases, phosphorus nutrition, potash and sulphur deficiency or lack of micronutrients (e.g. zinc). Multiple nutrient deficiencies are known in Myanmar. Aung Zaw Myint from the Agriculture Department explained that the farmer uses as fertilizers only urea (nitrogen) and phosphorus but no sulphur or potassium and no organic manure application takes place. Since Triple Superphosphate (TSP) is the P fertilizer which is applied, sulphur is missing (single superphosphate (SSP) contains sulphur but that is not used). The farmer utilizes 2.5 bags (= 125 kg) TSP per hectare (= 50 kg for one acre) that contains 46% of P_2O_5 . Divided by 2.3 one receives the actual amount of P from P_2O_5 (= artificial unit from fertilizer industry) concluding that less P is in the mineral fertilizer. As can be seen in the photo of the rice paddy field there are green and yellow colour differences in the field which indicate a non-uniform ripening. The irrigation of the rice is carried out by flooding the paddy field five times during 90 days of cultivation and the farmer is not requested to pay for the used water but for the electricity which is needed for pumping the water. Rice is cultivated twice a year here and due to more sunlight in the winter season (dry season) higher rice yields can then be harvested. Highest rice yields worldwide are found in Mediterranean type climates like California and Australia but not in Southeast Asia because of too much cloud cover in the monsoon time. Prof. Bürkert added that some rice fields we have seen to the left and right of the

street during the drive were not cultivated which most probably has to do with problems of irrigation facilities so they are dependent upon rainfall. Rainfed systems are intensive only if the water is available. Myanmar is characterized on the one hand, by a strong dependence on rice culturally, as well as in terms of food security but on the other hand, by insufficient dominance of water and likewise, two decades ago, mutual non-availability of fertilizers, not even in nitrogen. That is why average rice yields here in Myanmar are the lowest in Southeast Asia ranging between 2.5 and 3.5 t per hectare even though the potential yield is 8 to 10 t per hectare. The harvest of rice is, as previously mentioned, rather low to receive reasonable earnings from it. To improve production, suitable, healthy rice seed varieties (homogenous/ uniform sorts; grain size; grain and husk proportion) and, more important, proper management (e.g. irrigation, appropriate fertilizer application, micronutrients supply) are needed. These suggestions might help to reach higher yields and the necessary quality for exports. The quality in principal is good but processing problems with a lot of broken grains also resemble an issue and make Myanmar rice not competitive on the international markets compared to Thailand or Pakistani rice. Farmers should be supported and qualified accordingly, to improve their production practices and knowledge, and they should also be provided with access to agricultural inputs such as micronutrients.

The interviewed rice farmer can sell his yield to any rice mill around his township area, therefore he can choose between around 100 small and 25 large mills which mill the rice and sell it further. Ohnmar Aye from the Agriculture Department explained that the mills pay 4,500 Kyat for one basket of 45 to 50 pounds of rice (ca. 23 kg). To facilitate calculation, we assumed 4,500 Kyat for 20 kg multiplied by 5 amounts to 22,500 Kyat per 100 kg

and converted this equates to 0.20 € per kg. The estimated world market price of rice presently is about 0.40 € per kg. Aung Zaw Myint mentioned as bottlenecks or major problems for local rice farmers:

1. Soils (due to deficiencies in N, P, K, S and Zn linked with high investments in fertilizers),
2. Pests and diseases (which more and more are an issue),
3. Production costs (higher input costs in relation to market price).

Main expenditures with regard to production, are those for fertilizers, herbicides, pesticides, fungicides and insecticides followed by labour costs, land preparation (e.g. tractor costs) and harvesting costs (e.g. combined harvester (10% of farmers use one); threshing). Almost all farmers in the delta region no longer use buffaloes for land preparation or harvesting, due to a cyclone 5 years ago when many animals were killed and afterwards replaced by machines. Around this farmers place no other effects of the salt water intrusion from back then are left but maybe at other lower situated places like Pyapon. The application of herbicides in the rice field can take place at two times, pre-emergence or post-emergence. Fungicides are applied curatively according to a specific scheme, in case a problem occurs, but not protectively.

Small farmers who do not own a threshing machine, have to pay three baskets of rice grain per harvested acre for threshing which amounts to approximately 75 kg rice for one acre and this equals in our calculations to 7.5% of yield if 1 t of rice per acre is harvested. Contrary to this calculation the staff members of the agricultural department stated 3% of yield as threshing costs because in their estimations roughly 100 baskets are harvested per acre. This would equal 2.5 t of rice per acre and multiplied by 2.5 one reaches more than 6 t of rice per hectare which would be very high yields then. It

was argued that this area is a special high production area and then it was clarified that the yield which can be harvested depends on the season. As previously stated higher yields are reached in the dry season but not in the rainy season, due to clouds and lower light intensity.

The vast majority of farmers own on average 10 - 50 acres (= 4 - 20 ha) of land. There are also farmers who hold 100 - 400 acres (= 40 - 160 ha). We were informed that the inheritance of property is equally split between female and male children.

Rice mill and mangroves

Ture Jacobsen

In the early morning of Monday, March 17th 2015, the excursion group left Yangon in westerly direction towards Pyapon a town located in the identically named district and the Irrawaddy Division of Myanmar. The city is a major infrastructure hub for the local rice production and serves as collecting, refining, and trade centre within the eastern Irrawaddy region. After having lunch and visiting a medium-scale rice mill and a local paddy rice farmer in the morning we continued our journey around the rice processing hub Pyapon. Our first visit after stopping for lunch took us to another rice manufacturing plant which was situated right next to the Pyapon River. Compared to the previous rice mill which we have visited in the morning this place was still rudimentary in terms of technology, however, its production capacity was one of the larger ones in the region. The manager who is in charge of the production process offered us a vast insight into the various processing stages of rice refining and stressed that milling is one of the most crucial steps after harvesting. The rice milling system can be divided into several processing steps. Fully automated processing plants are capable of removing the husk and bran in one step. However, more common for less technologized and simpler plants are multiphase or at least separate refining systems.

Firstly, the machine removes the outer husk of the rice grain, also referred to as rice hulls. Husk leftovers can be burned and used as combustible for generating power and providing part of the required energy.

After removing the husk layer the machine takes off the rice bran which is known to be an actual inner part of the rice grain. This spin-off product (rice bran) resulting from the milling process exhibits an

extremely high nutritional value for a remnant of the production. Hence, the bran can be used as feeding material for cattle. After removing the outer layers from the rice kernel the grains are polished in order to transform the brown rice into white rice. This is achieved by rubbing the grains on each other. This process causes damage to a certain percentage of kernels. Afterwards, the polished kernels are separated by a shaking machine which separates long, short and broken grains. As we got to know from the rice plant manager, perfectly shaped rice grains are exported to the Asian market, whereas the grains of inferior quality can only be sold to the African market.

Beyond the production process which was rather impressive in particular because of its technical simplicity, most of the students were deeply frightened by the prevailing working conditions. Before the refining of the rice can be started the bags (approx. 70 kg) filled with freshly threshed rice have to be carried from the riverside jetty into the plant.



Fig.: Women carrying rice from boats to the mill

This work is not only conducted by men, the majority of labourers performing this task are women. Moreover, the health and safety circumstances within the rice refining factory were extremely concerning. The air was fraught with dust particles, workers and instruments were thickly coated with dust. People within the factory were not sufficiently equipped to

prevent themselves from inhaling the air, no one was wearing a breathing mask. Furthermore, we witnessed the hazards arising from uncovered driving rolls and V-belts which were installed right next to the passageways and staircases of the plant. In my opinion it is only a matter of time before a labourer is seriously injured by one of the naked machineries.

After leaving the rice refining plant in Pyapon, our bus left in easterly direction and crossed wide green plains covered with rice fields. However, this area is not only famous for its massive rice production it is also the home of the mangrove forest, one of Myanmar's most important ecosystems. Because of the mangrove forests' importance in terms of coastal protection and erosion prevention the Burmese forest department has a very special stance concerning the protection of mangrove coastal forests.

This opinion was underpinned during our visit at the Htaung Gyi Tan forest department which was visited by our group on our way to Dedaye. Shortly after arriving at the regional forest department, the forest ranger in charge of the Forest Extension Centre for Nursery was presenting his current projects and daily responsibilities. Among others he stressed the JICA/FD Mangrove Project running from 2007 to 2013 aiming at the re-foresting of cleared coastal strips in the immediate surroundings of Htaung Gyi Tan.

Before we got in touch with the issue of mangrove protection, Professor Dohrenbusch had already offered us a wide and very detailed insight into the ecological and environmental importance of mangroves for the Burmese coastal region. As we were taught by Professor Dohrenbusch, mangroves are trees that preferably grow in saline coastal water areas and have developed very unique ways to cope with these extreme conditions.

In order to consolidate our acquired know-

ledge, our journey took us to the town of Dedaye which is located at the most eastern edge of the Irrawaddy Delta. The city lies right next to the Thande River which is one of the estuary arms of the Irrawaddy River. Accompanied by members of the Htaung Gyi Tan Forest Department our group was driven to the jetty where we boarded a traditional Burmese river boat. The boat ride took us down the river for approximately half an hour before we entered an even smaller arm of the Thande River. Although our main objective was the visit of the mangrove resources visible from the riverside, the cruise turned out to be relatively disappointing.



Fig.: Fishermen at Thande River

Surprisingly, there was hardly any continuous area of mangrove forest. The tremendous efforts, however, being undertaken to support reforestation in this area could be seen in form of mangrove replanting in formerly destroyed areas.

Train ride from Yangon to Shwemyaung, Inle Lake

Jan Lavers

It is Wednesday the 18th of March 2015, 10:45 a.m. when the participants of the Myanmar excursion reach the train at the Yangon Railway Station. The group is heading for Shwemyaung, the last railway station in Shan State before Inle Lake which is their final destination. The train ride will take 31 hours, even though nobody knows this exactly at that time. At the station there is lively drive as the group enters the wagon labelled "2nd upper class". After stowing their personal belongings, water, bananas, snacks and toilet paper, everyone takes a curious look around. The wagon is spacious, divided into compartments of two double seat benches facing each other and sharing a small table in front of a window. The floor is made of wood and between the floorboards one can see the track bed underneath. People are laughing when someone calls it a "fully slatted floor" for

train passengers. The seat benches are covered with grey imitation leather. The small depressions of the leather grain are filled with dust which adds a black polka-dot design to the basic colour. Further steel dominates the image. Everything makes an old but massive, unbreakable impression.

It smells like dried fish. Everyone seems to be happily excited. Some are talking to vendors, mostly children, coming to their windows and trying to sell apples, grapes, cigarettes, beverages or the inebriating betel nut. Others are walking around outside the train to take photos or to take a closer look at the diesel locomotive which shall pull their wagon the next 640 kilometres. One of the professors buys some cigarettes for his colleague and has a short but fruitless discussion with the street vendor as he realizes that he paid too much.



Fig.: Diesel locomotive and vendors selling food, drinks and other goods to passengers

As the engine starts running everyone outside hurries to get back into the train realising a few minutes later that this haste was unnecessary. The train begins moving very slowly and the doors are kept open, hence jumping on the bandwagon is much easier than in Europe.

Slowly the train picks up speed. One female student swings the hula hoop. But she has to quit abruptly as the wagon sways from left to right and makes even

walking a challenging task.

The wheel and driving noise is very loud and creates a rhythm every time the wagon enters a new track section. Sometimes black clouds of smoke from the diesel locomotive pass by. The air tastes like a mixture of exhaust fumes and dust. But the windows are kept open to catch some airstream. It is 36°C.

In Yangon, the train winds around the centre. Dense building with big houses

dominates the image when you look through the windows to the left. Looking to the right there are more often small huts made of bamboo, plastic or corrugated metal. Small shops selling beverages, sweet and savoury biscuits, fuel and cigarettes can be identified from a distance by the ad banners from "Myanmar Beer", "Telenor" or "Pepsi Cola". On the dirt roads women with colourful dresses carry goods on their heads. A man wearing a checkered longyi takes a rest in his bicycle rickshaw, smoking one of the local greenish cigars. Some children carrying big bags walk along the rails and collect plastic bottles that can be sold to collectors for a little money. Some rambling dogs accompany them, searching the rails for something eatable.

The train seems to stop at every station. Many golden pagodas can be seen on the way. After 1.5 hours the train passes Bago, the old cultural capital of Myanmar. Vendors await the passengers at each stop, offering their goods at the windows or joining the train to the next station. The train does not sway from left to right any more but bounces heavily on the tracks. When the people realize that it seems to be normal, they start laughing when they get shaken up, shaking their heads unbelievably. The group members are chatting, playing cards, taking photos and gesticulating, still in an excited mood. The few Burmese people in the wagon don't seem so much interested in what's happening around them. Some are playing with their smart phones while others are looking bored through their windows, having experienced all of this frequently. But sometimes one of them steals a glance at the group, smiling as they get swept up by the exuberant mood of the Europeans.

Some students introduce the game "Secret friend" and explain the rules to the group. After a short discussion, if the professors would like to join or not,

everyone draws the name of his secret friend out of a hat. Now, everyone has to take care of this person and delight the friend with secret pleasantries.

One of the students takes a hammock out of his backpack and fixes it between the seats. With a smile and a bit of envy the others compliment him on his foresight. But after a few minutes the student has to leave his nest quickly. Set into vibration by the train the hammock bounces so heavily that he fears that either the seats or the hammock won't withstand the load.

During a stop at a small station the students are watching one professor who is apparently hugging a big tree. It turns out that he just wants to measure the circumference because the professors placed bets on the diameter of the stem. But the forestry professor is not satisfied with that simple method.

In the absence of a long tape measure one of them asks for the hammock to use it as a measuring instrument. They are in a hurry, running back and forth between tree and train as they don't know when the train starts moving again. Apparently still not satisfied the forestry professor places a DIN A4 sheet of paper at the tree and takes photos of it in order to determine the diameter with that reference point. When the professors argue about that method because the tree is not perfectly circular the train starts moving again, leaving behind some puzzled Burmese who were following the strange hustle.

The train moves through vast, flat land which becomes more and more rural. The sun is burning on fallow rice fields. Lush green marks the fields where people are able to irrigate and to grow rice or watermelon. Great White Egrets look for frogs between the rice plants and occasionally a water buffalo herd moves through the picture. Several solitary trees provide shadow between the fields and give the landscape a character of a savannah. Here and there, enclosed within the fields are a few small forests, more or

less cultivated. From a distance one can see the crowns of different palm trees rising high above the dense undergrowth. Around the forests grows big bamboo, both used as a natural fence and supply for construction material. The landscape is getting drier and the lush green is getting rare as the train moves slowly towards the central dry zone. Two boys sharing one bicycle leave clouds of yellowish dust in their wake.

In several places people produce bricks which are drying in the sun next to primitive brick kilns. Two Zebu cows are harnessed to a carriage waiting to be loaded with this heavy cargo.

The people's huts around are made of bamboo. To feed their cattle some have piled up rice straw next to their huts.

On the arable land grows mainly mung bean, peanuts or cotton now. Irrigated rice or watermelon fields have become rare. From time to time one can see some sugar cane from a distance. Some acres contrast with its red hibiscus from the surroundings, some are black because they were burned while others just lay fallow. On some fields mung beans are harvested. Men and women bend down to cut the plants and put them on small piles for drying and later threshing.

The hustle on the few stations where the train still stops is getting less. And as the sun starts to set, people also get calmer within the train. But because the speed is higher now the driving noise has increased. Only a few of the group have earplugs and some roll some toilet paper to plug it into their ears.

Suddenly there is a murmur. Apparently two of the students are missing. After a short time, it turns out that they have persuaded the locomotive driver to join him to the next station.

During a longer stop, one female student swings the hula hoop on the platform. The people around her have set their sleeping berths with lots of luggage around, as if they all embark a long-haul journey.

But when they see the skilled artist many people come closer, marvelling and making videos with their smart phones. When the show is over, people applaud and wave when the train moves further. As night falls one can see palm trees silhouetted in the moonlight. Here and there burns a fire and the smell of the village cooking fires drifts into the train through the open windows.

The people try to sleep and try any position which might be comfortable. Due to the scuffed benches and the bouncing, they moan about their aching buttocks. Some lay down on the floor not caring anymore that they might get dirty. But one gets shaken up, slips back and forth so sleeping seems to be impossible.

Some students and a professor have given up trying to sleep and build a small group sitting close to each other on two benches and the floor. They are chatting, telling each other little anecdotes and having academic discussions. They start buying beer from the vendors and share some Burmese whisky, possibly hoping to get some sleep when they have had a few.

At around 2:15 a.m. the train stops at Thazi station. The stop will take 5 hours and finally allows the people to rest. Many of the group find their seats occupied with sleeping persons, so they just lie down on the floor, entirely satisfied with that luxury of quietness and not to be shaken up any more.

The train moves on at 7:15 a.m. Many people try to continue sleeping and succeed because the train moves very slowly. One student is finally enjoying his hammock which he gave to another person last night.

The landscape becomes mountainous and small structured. Arable land is getting less and instead there is much dry forest which has almost lost all of its leaves. Some chili grows in between and many people try to grow bananas which seem to suffer from the drought. From a distance one can see

huge amounts of raw timber at some kind of collection point.

The train winds through and around the hills with sometimes not more than one meter space between the train and the rocks. It rides along several switchbacks and crosses worrying simple bridges. Shrubs produce a scratchy noise when they touch the train and people have to watch their heads because some branches whip into the windows from outside.

The bouncing of the train is replaced by swinging from left to right again. When the luggage flies all over, some people quickly stand up, seemingly expecting the train to jump the rails now.

The stations in the hills seem to be at the same time the market place of the villages. Women offer tomatoes, onions, cabbage and other vegetables. Some vendors come to the train and offer food, flowers and some pieces of pine wood as incense.



Fig.: People selling mainly fruits, vegetables and flowers at the train stations. View on the diesel locomotive while driving through a more hilly area.

The wagon of the excursion group seems to have problems with its breaks. The train driver and an employer try to fix it with a wooden beam as their only tool. One of the professors who has obviously some technical understanding, lays down under the train and helps them while asking questions about the history of the train. At the next station, another break of the wagon has to be repaired and a second professor joins the team of mechanics. The first one mentions that he would need a wrench to fix it properly but that it should be okay for the last ten kilometres. One of

them convinces the train driver to let him join the locomotive and try to control the train to the destination. In the meantime some students are playing football with some children and others enjoy a coffee at a small shop. At around 6:30 p.m., after more than 31 hours, the train arrives in Shwenyaung and everybody cannot believe that they have finally made it. Quickly they take all of their belongings and move to the bus which is already waiting for them. It shall bring them to their hotel, in about 15 minutes only.



Fig.: Dr. Hülsebusch with the mechanics. Children playing along the railway

Technical notes on the train ride from Yangon to Taunggyi

Dirk Landmann

In 1877, the construction of the Myanmar railway started. Nowadays there are around 6,000 km of railway with a width of track of one meter. The locomotive was built in the 1970th and the engine is of Chinese origin. The train is in rather bad conditions because almost nothing has changed since the installation due to a lack of investment. This is one reason why the current equipment like lights, toilets - basically almost everything - looks very used. In the locomotive, for example, electricity is not well installed. The train driver works with a torch-light in the night to check the speed and the other instruments. The train runs a maximum speed of 40 km/h and needs roughly 3 times the time compared to a bus on the same distance. Protocols of the train rides are manually written. At every important station - around six times per hour - papers are collected. For the documentation, there is one person responsible who gives the information collected on to the train driver. The instrument to collect the papers looks like a very big tennis-racket without a net. The

person at the railway attaches a piece of paper with the information about the time and the circumstances to the instrument and waits for the train until he hears the horn.

When the train comes close to the checkpoint, he holds the instrument up very close to the train. The person in the locomotive then collects it by using his arm. He takes off the paper and throws the instrument out of the door again, so that the guy can collect it and prepare it for the next train. The papers are collected during the whole train ride and a detailed protocol about the train ride is processed.

During the passage through the mountains of the uplands in the Shan State it is impossible for the trains to continue driving into one direction. Consequently, serpentine lines are driven always changing from forward to backward driving. The train is pulled to the first station and then pushed to the second one. After this it will be pulled again and so on. This quite old system costs a lot of time and is not very efficient because mostly the railroad can only be used in one direction.



Fig.: Diesel locomotive of the train. Signal for the train driver.

The Floating Gardens of Inle Lake

Leonie Kreipe

Introduction

The Inle Lake is a freshwater body in the Shan State of Myanmar, near the towns Taunggyi and Nyaungshwe. With about 120 km² surface area and an elevation of 900 m above sea level, it constitutes a rich ecosystem of plants and animals, which however has lost about 80% of its original size due to human activities like deforestation and intensive farming. The lake's worldwide known floating gardens play an important role for the country's vegetable production and the Intha – 'the people of the lake' - are well-known for their craft products like silver, brass and ceramic works as well as hand-woven fabrics.

Fishing

On our way by boat to the floating gardens we met a group of fishermen, who gave us a little insight into the life of a fisherman making his living on the lake. Their fathers and grandfathers had been fishermen, too. The sons traditionally became fishermen; the daughters were engaged in cigar rolling.

Over 100 fishermen live on the lake. They usually fish together in groups of two or

three; however, they do individual fishing, so everybody keeps what he has caught for himself. A fisherman earns roughly 3,000 Kyat per day from a catch of 6 pounds or 8 to 10 fish. The annual fee for using the Inle Lake as a fishing ground is 3,000 Kyat. Fishing is allowed everywhere on the lake, except for the preservation areas. Most of the fish is sold on the local market in Nyaungshwe. The traditional way of fishing is still practiced today: the fishermen row upright with one leg holding the paddle while the other leg provides for stability on the boats edge from where they can best spot the fish (via bubbles). A two metres long, large, cone-shaped basket containing a net inside is then put over the fish in the water to trap them. The upcoming tourism in recent years has changed the lives of the fishermen. Today their main source of income seems to have shifted from the act of fishing itself to the presentation of their fishing technique to tourists for which they receive 7-8 US\$ per day. This probably enhances the trend of more and more fishermen appearing on the lake and hence aggravates the fish decline perceived in recent years.



Fig.: Impressions of Inle Lake, fishermen and floating gardens

Floating gardens

To the crops planted in the floating gardens belong calabash, eggplant, tomatoes and beans for the Chinese market as well as cucumber. How is a floating garden established? First, seaweed is collected from the lake and fixed with bamboo sticks to prevent the mass of seaweed moving (some plants touch the ground of the lake but the

gardens are mobile). Then mud, resulting from erosion-bringing sediments from the surrounding hills, is added and over time a thick humus layer develops. This provides the roots of the crops with a substrate rather than just a nutrient solution.

Since a few years ago, farmers fear that the lake will collapse, as already 10 % of the lake area has been lost and signs of

pollution are visible. This is mainly due to the 50 % loss of surrounding forest in the last 40 years and the increased intensification of vegetable production, heavily relying on fertilizers and pesticides. The marshlands of the lake are artificial islands with today 30 to 40 villages planting floating gardens every year. The locals have dug out sediments from the side of the lake and put them on top in the marshlands which today have been extended to the more intensively managed floating gardens.

A possible alternative to the 'vegetable after vegetable' mono-cropping (e.g. tomato/eggplant after tomato/eggplant) could be the flowering plant Chrysanthemum, as it is a good option to diversify from a holistic point of view. The problem is of economic origin: The market for flowers is small. Who is going to buy all the flowers? For tomatoes, the farmer gets a guaranteed price but for flowers he does not. A rotation could look like the following:

1. Tomato
2. Egg plant
3. Cucumber
4. Snake bean
5. Flower (Chrysanthemum, Tagetes)

Currently only very few farmers are growing flowering plants due to limited market possibilities. In one village only 2 to 3 farmers plant Chrysanthemum.

Tomato production

The tomato farmer we got the chance to ask questions, is growing tomatoes on 1 ha, less than 30 years ago on two floating islands, today on four. The growing period is 6 months, after that a fallow period of 3 months follows, before cucumber succeeds as the second crop. The old tomato plants are taken away to be burnt. Then seaweed is spread on the harvested rows for fertilizing and to suppress weeds.

Harvesting of tomatoes is done every 10 days. Most of the fruits are harvested

green, because they are afterwards transported for 10 to 14 days to Nyaungshwe and from there to Mandalay and Yangon.

If the price is very low, the Inle farmers also export to China (likewise Myanmar sometimes imports tomatoes from China). One kilogram of tomatoes is worth 250 Kyat (4 kg=1 US\$). Per harvest (every 10 days) 2.5 t/ha result in an income of 600 US\$. This displays an income which is 5 times higher than that for paddy rice production, making clear how much more lucrative the tomato production is. The extension of the floating gardens is hence not surprising. The treatments comprise fertilization, fungicides, insecticides as well as a nematicide application. As the lake water represents a nutrient-rich solution (in particular high in N), many farmers use only sediments from the bottom of the lake as fertilizer for the crops. In recent years however, applying combined NPK has become a common practice among the tomato farmers. As the lake water and seaweeds provide enough nutrients for the young plants, the first application takes place after two months. During summer time two applications of fertilizer and fungicides are sufficient while in monsoon time a seven day rhythm (depending on crop and weather) is necessary.

Obviously, no irrigation is necessary in the lake environment. However, due to the continuous moisture, the floating gardens represent an ideal growing environment for fungi, making the use of fungicides inevitable.

Against insects, derivatives of phosphoric acid are used which are known to be very effective. Carbofuran (a nematocide not allowed in Europe due to mutagen effects) is used as a result of the monocropping (tomato after tomato...) allowing nematode populations to grow continuously. Apart from a hat and normal clothes no special protection is worn by the farmer when applying the pesticides.

A solution to the nematode problem in tomato production could be Tagetes, a flower from the sunflower family planted by strawberry farmers to tackle nematodes. It would certainly be useful but again, what to do with all the flowers?

Concerning land rights, all the land on and around Inle lake is owned by the state, but the land our tomato farmer uses is from his father, who himself adopted it from his grandfather and so on. There is an official fee of 10,000 Kyat per year to pay to the government, but in reality the picture looks



Fig.: Tomato farmer and impressions of tomato production on Inle Lake

Role of Tourism

As tourists are interested in visiting the lake and not only floating gardens, tourism may constitute a chance for a sustainable continuation of use of the Inle Lake. Flowers which could break up the unilateral crop rotation for example, are of value to visitors coming to see the lake. The same holds true for the fishermen. They are much better off since they are not only fishing for a few kilograms of fish but also serve as a tourist attraction. Another advantage can be the renting of rooms, providing extra income for farming families. The building of hotels would provide the region with infrastructure like internet and with jobs. Tourism offers a lot of different opportunities to diversify the fragile lake system and to avoid further intensification of agricultural production at the expense of natural resources.

The Inle Lake has a long history of old farming tradition and farmers there have brought agricultural production to perfection. However, there are risks and the fishermen and farmers have to

different.

The work in the floating gardens is mostly done by hired labour. In the case of our tomato farmer, five workers per day come to his gardens, working 7 days per week for 2,000 Kyat per day when they are female. Male labourers earn 3,500 Kyat per day as they can harvest more and do other jobs as well.

Apart from hired labour, three family members (not paid) also work in the vegetable production.

manage them.

The two main ecological threats to the lake are sedimentation and an agricultural production relying on external inputs. The lake area has been shrinking due to pollution and despite the fact that many international organizations are trying to protect more areas, the expansion of the agriculturally used area has not been prevented (floating garden area grew by 2.3 times during 2000 and 2015, from approximately 50 km² to more than 100 km²).

The tomato farmer we talked to knows that he also contributes to pollution but the main driving force for the reduction of the lake area is the sediment erosion from the surrounding mountains.

The solution would be to immediately stop the cutting of trees. So far, the government has not asserted comprehensive restrictions and instead some individuals have been able to make a lot of money from the erosion which is threatening the viability of the lake. Concerning the management of intensive agriculture on the lake, the gardens should be run in a closed system

mainly relying on internal nutrient cycles instead of on external inputs.

Weaving

On the lake in stilted houses made of teak wood, women are weaving cotton, lotus and silk, sometimes together with synthetic threads to traditional clothes, longyis and shirts. During our visit we were able to follow the origination of the colourful longyi materials which we have seen worn by Myanmar people all over the country.

Rice nursery, sugarcane mill, dairy farm

Anja Lienert

In the afternoon of that day, we stopped by at a rice nursery, visited a sugarcane factory, and at the end of the day went to a dairy farm.

Rice nursery

When driving to the sugarcane factory, along the road we could observe many workers transplanting rice by hand. Professor Bürkert took the opportunity to explain us the different production steps in paddy rice cultivation.

The first step, before sowing, is called puddling. Puddling is the name for the soil preparation in paddy fields, and its goal is to destroy the soil structure and to create a soil layer that consists of fine aggregates and that is as water impermeable as possible. Puddling helps to control weeds and significantly decreases water losses. The consequence of this special way of soil preparation is that crop rotation on fields where paddy rice has been cultivated is basically not possible, because the soil structure is unfavourable for other crops.



Fig.: Workers transplanting rice plants

The next step after soil preparation is sowing. As the seeds need oxygen to germinate, they are not put into irrigated fields, but into dry fields. One of the few places in the world, where rice is directly sown into water (with a plane) is in California. The decisive factor in this region is that the water comes from the

Sierra Nevada. This water is very cold and therefore contains a high amount of oxygen - enough for the seeds to germinate. The place where the rice is grown for the first weeks, is called nursery. After approximately six weeks, the young rice plants are pulled out of the soil and put into packages of a few hundred seedlings. With these bundles in the hand, the workers manually transplant the young plants one by one into irrigated fields. In this transplantation process spacing is very important. The workers first plant marker rows. In the case of the fields we saw, approximately every tenth row was a marker row. Then the rows in between are filled, so that the optimal row spacing is obtained. The transplantation process represents a very stressful moment for the rice plants. When they are being pulled out of the soil, the roots get damaged and the plants need more or less one week to recover.

After the transplantation process, the rice needs about 100 more days to be ready for harvest.

Adding the time in the nursery, the growing season is more or less 130 days long. This would mean that under the climatic conditions we can find in Myanmar, two crop cycles would not be possible.

Two rice yields per year are only possible due to the nursery that has a time-saving effect. Further advantages of the nursery are that for sowing, a high spacing density can be chosen. If the seeds were sown with the final spacing, there would be a high probability that gaps would appear in the rice field, leading to a decreased yield per hectare.

Sugarcane mill

Our next stop was at a sugarcane mill, where we had the opportunity to talk to the factory owner. The owner of the farm himself has 120 ha of land where he

grows sugarcane. Five more farmers with more or less the same amount of land have a contract with him and deliver sugarcane to his mill. The factory processes 60 t of sugarcane during six months of the year. From the factory, the sugar is sold to confectioners, who make sweets out of it. In the following, the factory owner talked about the cultivation of sugarcane in general. Sugarcane has a growing season of 12 months, and approximately two months after the rainy season, the harvest begins. The owner stressed that it is inconvenient to harvest during or shortly after the rainy season, because the sugar concentrations are lower since there is less direct sunlight and high moisture content in the plants. After harvesting the shoot, the sugarcane re-grows and can be harvested for three more years. However, the sugar yield is decreasing in every additional year. The reason for the lower sugar yield is the decreasing biomass.

After cutting the shoots for the first time, apical dominance is weakened. This means that more lateral tillers are grown. The diameter of the tillers gets smaller; they contain relatively more celluloses and more support structures. The owner told us that most of the sugarcane farmers, who have a contract with the factory, produce sugarcane during four years and then they cultivate maize once. The problem with this rotational system is that sugarcane and maize both belong to the grass family (*Poaceae*) and they are attacked by the same pests and diseases. On the land of the factory owner, sugarcane is now already grown for 50 years and the owner told us that there are severe problems with pests like the stem borer. When we asked for the harvesting process, the owner explained that harvesting is done by hand and that the fields are not burned down, like in other regions of the world.

After this introduction to sugarcane production, Professor Bürkert explained how

sugar is produced in the mill.

First the phloem sap is squeezed out of the shoots. Then the liquid is collected and heated, so that the water evaporates. The syrup that is gained is mixed with lime and then it is heated again. The lime has two purposes:

1. to attain a higher sweetness level and
2. to take out the impurities.

Sugar without impurities is called refined sugar. Usually, the refinement process consists of several filtering processes but in the factory we visited, only one filtering step was done.

After heating, fine sugar crystals remain. These crystals are put into a vacuum tank where they grow again.



Fig.: Vacuum tank

The by-product of the sugar purification processes is called molasses, which consists of impurities and also large amounts of sugar, and is used for alcohol production. The separation of sugar and molasses is a critical aspect in marketing. In Germany, for example, brown sugar is more expensive. It is considered as being more natural, but actually it is just the first result in the sugar processing: it is sugar mixed with molasses and minerals. In Myanmar, it is the other way around: the whiter the sugar, the higher the price for it. When we looked at the machines in the factory, the owner told us, that he shut down the factory last year due to low sugar prices, and that the farmers are now selling their sugarcane to a bigger sugar

factory. We furthermore noticed that the factory looks as being far behind what modern technology is nowadays. But Professor Bürkert emphasized that the health-standards are met and that sugar is an antibacterial substance: just like salt, has a high osmotic pressure and therefore, bacteria are immediately dehydrated. However, the problem with these small factories is that the world price for sugar is very low and small factories cannot compete with bigger factories anymore. Furthermore the labour costs are increasing, as many Burmese people are going to Thailand, where they can get better wages.

Although the owner of the factory stated explicitly that he wants to put the factory back into operation when the prices are better, it is questionable whether this will happen.

Dairy Farm

Our last stop this day was at a dairy farm, where the manager of the farm waited for us. The manager first gave us some basic information about the farm. The owner started the business only five years ago. He has his own sugar cane fields and needed the manure as fertilizer. When he built up the businesses, he started with 30 cows. Currently he has 50 cows, of which 30 are female adults; most of his animals are Holstein Frisian cross-breeds.



Fig.: Stable and cows at the dairy farm

The manager explained that the price for a cow depends on whether she is pregnant (ca. 700 Kyats) or lactating (ca. 1,400

Kyats). The farmer keeps all female calves and sells the males when they are two years old. From the 30 adult females he is currently only milking ten. He gets 108 l of milk per day and milks them twice a day per hand, at 8 a.m. and at 2 p.m. This means that he gets about 10 l per cow per day.

There is some pasture for the animals to go outside and usually the animals are outside from 7 a.m. to 12 a.m. and the rest of the day they are in the stable. He is feeding them with chickpeas, legumes, rice straw and the tops of sugarcane shoots. He also feeds minerals and vitamins.

The calves get the same feed, but they also get milk, which they can suck before milking. On his fields, the farmer does not grow any special fodder for the animals. He possesses 600 ha of land and uses it for sugarcane production only. After the manager told us what he is feeding the animals, Professor Schlecht made some suggestions on how to improve the nutritional status of the animals. To improve the feeding, he could feed the rice bran to lactating cows which can provide the animals with more digestible energy. Another option would be to feed molasses (but in lower amounts than rice bran). The milk is sold to three customers that live in surrounding cities. The price per l is approximately 0.50 € but he stressed that there are seasonal variations in the milk price. In the rainy season the price decreases because the demand for milk decreases. His explanation for the reduced milk consumption was that during the rainy season people tend to stay more at home and go less to the tea houses. The milk is transported without cooling twice per day to his customers who are located at a distance of about 20 km. This is the reason why the second milking takes place at 2 p.m. - he still has to deliver the milk and the customers do not accept the milk at a late hour.

The manager furthermore explained that

on the farm they use artificial insemination but that they also use the two bulls they have. When the question was raised, how he chooses the semen for the insemination, he said that he has to trust the veterinarian that brings the semen. To the question, whether there are problems with diseases and whether the claws of the animals are cut on a regular basis, he answered that until now there were no diseases and that they usually cut the claws once a year.

Overall, the manager said that the farm owner is very happy with the decision to invest in dairy production. If he had enough capital, he would try to extend the business and to construct a milk factory for processing milk, e.g. to produce coffee milk. He could then buy the milk of the more than 100 smallholder dairy farmers located in that region. The manager himself thinks that milk is a good investment, because milk consumption has increased over the last years as people get more and more aware of the fact that milk is healthy for children. At the end of our visit, the manager asked us, if we could give him some advices for improving the dairy farm. The outcomes of a short discussion were

1. to improve genetics on the farm,
2. to improve the composition of the feed ration and
3. to cut the claws on a more regular basis, as some of the cows seemed to suffer from cow hock due to the bad state of their claws.

Teak plantation and bare root trees

Luciane Lenz

The first part of the day was characterized by a theoretical and practical introduction into afforestation and forest inventory. Exact planning of tree propagation, the choice of species and inventory keeping is required in order to maximize the economic value of forest timber and to assure the protection and sustainability of the forest. Therefore, first of all theoretical introduction into Bare Root Trees and teak (*Tectona grandis*) was given. Furthermore, a teak plantation was visited, the forest officer of the respective area was interviewed and the methodology of forest inventory was explained and thereafter applied by the students in the field.

Theoretical background on Bare Root Trees

A very large share (an estimated 90%) of afforestation projects rely on the usage of Bare Root Trees. Bare root trees are characterized by specific propagation procedures in arboriculture. The plant is removed from the nursery and transported with bare roots. Prior to replanting to new soils, the plant shall soak water and it will then be replanted densely in the respective plantation; hereby only limited digging is required.

Generally, around 5 million hectares of plantations are done per year on a worldwide level. They rely on mainly three types of bare rooted species, which are Eucalyptus, *Pinus radiata* and Acacia. The question of why forestry focuses on few species to such a large extent was answered as following: The plants have a very high productivity, high growth potential and are well suited for tropical and subtropical climate and soil conditions. Furthermore, the plantation of those trees is favoured as they can be planted densely and as plantation is relatively simple. Density of planting and optimal spacing is decisive from the economic perspective of forestry, as one

of the main quality criterions of timber is a low number of side branches. Optimal spacing adapted to the needs of each species reduces the development of branches and thereby increases the market value of the timber.

Teak Plantation Visit

The forest officer described himself as a ranger who is mainly responsible for the protection of the forest. He had gone through a two year forest education, composed of theoretical and practical education. In his daily work he mainly advises farmers about afforestation and takes care of a pine nursery.

His theoretical knowledge, such as the scope of his duties, appeared to be only a reduced form of what a forester should know, according to a German definition. The forest officer informed that past plantations completely focused on teak propagation, while recently the policy changed towards a promotion of more diverse species. In concrete terms, this means teak plantations are installed above 900 m of altitude and pine plantations below. Teak plantations are supported by a public policy, requiring every household living above 900 m.a.s.l. to plant 3 teak trees.

The visited plantation has an area of 50 acres, was planted in 1995 and harvested once in 2002. It has on average 360 remaining trees per acre. The interview confirmed that forest officers are not involved nor well informed about timber selling processes and prices. The government controls the whole process of cutting, processing and selling.

Students were introduced to forest inventory methods, which are required to measure the productivity of a forest or plantation stand. Generally, inventories are easier to conduct in plantations where trees stand in rows compared to native forests. It is necessary to measure and

multiply the volume of an average trunk (diameter and corrected height) and the number of trunks. For the former, we can either use a calibrator or calculate the trunk's perimeter times Pi (π). Furthermore we calculate the height times a correction factor controlling for the cylindrical trunk form (usually 0.5 in temperate zones and around 0.6 in the visited plantation). Height can be measured using the intercept theorem and the Biltmore stick method, applying trigonometry or simply using an ultrasonic hypsometer.

According to literature, teak trees grow up to 65 m; the respective plantation showed trees of up to a maximum of 40 m.

Stamp density can be measured in the case of plantations either by taking average distances between trees or by counting the number of trees inside a quadratic area. Different measurement methods were applied and results compared.

In addition to measuring techniques, it was learned that a high number of trunks must be measured to find a representative average trunk diameter and that a big area of plantation must be taken into account for measuring an accurate density.

Goat-herd management in a low input system near Inle Lake

Esther Mieves

The consumption of goat meat appeared to be common in Myanmar. This was noticeable during the excursion as goat-meat-curry was often written on the menu in restaurants and it was served to us at a private dinner invitation. Thus, in order to full fill this public demand on goat meat, goat keeping seems to be a good source of income in central and northern Myanmar, where the weather conditions are suitable for the small ruminants. The dry zone as well as the mountain area of Myanmar offers good opportunities for the rural population to keep these undemanding animals. Therefore, many goats could be observed in this Acacia rich dry-lands which are suitable for free-ranging production systems. Near the town Wundwin, round about 30 km north from Thazi at Inle Lake, on the way to Mandalay, we met a farmer who was recommended to us as a model goat keeper.

This well-off Burmese who was also the head of the village, started 15 years ago with six does and one buck. Today he owns 40 females and 6 bucks to breed - including their offspring - there were 160 goats in total. These animals were kept at an enclosed site that included a few traditional huts, where the family was living, and the roofed goat barn, all build out of natural materials. The does, that had just given birth, were separately fixed for one month under these typical Burmese houses on stilts.

Although from their phenotype, the animals appeared to be very diverse, the influences of three different types of breeds were visible, but could not be identified properly. The goat owner stated that most bucks he uses for reproduction purpose are offspring of his own herd. He mentioned an exchange of male goats between other farmers in the village but just once in seven to eight years. Due to

those facts, the very small lambs and some goats with bone and teeth deformations may be seen as an indication for inbreeding depression.

The farmer explained that there are two periods of lambing each year during which two to three lambs per goat are born, which appeared to be a high birth rate concerning the circumstances.

At the beginning of our meeting, the farmer answered to our question concerning the health of the goats that the animals do not suffer from any serious health problems. He acknowledged that if goats are not well, he uses remedies made of grinded lemon, ginger and some leaves from the mountain area. This yellow powder is bought in a traditional medicine shop.

The owner can afford to employ a herder to take care of the goats for 3,000 Kyat per day (3 US\$). The worker's duties are to clean the barn two times a day by collecting the manure and through it on a heap at the outside of the fence. Additionally, he drives the flock to search for foraging possibilities in the morning and afternoon for up to 3 hours each. Therefore, he takes a long stick with a sharp knife at the end to cut branches to gain and provide additional feed stuffs. When applying this purposeful method one has to consider that many trees contain tannins which may decrease protein and carbohydrate digestibility. Therefore, the feed sources have to be chosen carefully by an experienced herder. In addition to that, a single big bowl, containing legume grains, was provided outside of the barn to some animals.

The goat keeper explained that no milking of the nannies is done. Instead, he sells goats, mostly intact, i.e. uncastrated, males, for meat when they are 5 to 6 years old for around 70 US\$ each. Younger goats, i.e. those which are aged up to two

years, he sells for breeding purpose for around 30 to 35 US\$.

It remained unclear for which reason the farmer kept and fed even bucks for such a long time. Because the animal is not gaining more weight after a certain age and the meat is getting tougher and stronger in odour and taste with age, especially that from intact male animals. Possibly the information he gave us was distorted through translation because the teeth development of an inspected animal indicated a lower age of than the farmer had stated.

The overall health status in most goats of the flock was not good. Through examination of some animals, we could discover goats with diarrhoea, underweight, cough, bone and claw deformations, maxillary prognathism (under-bite) and gum inflammation.

The goats do not receive any treatments against gastrointestinal parasites. When the goats live closely together with humans there is a high risk of worm infestation, especially for small children. To our question about mortality of lambs he answered that six lambs died this year. The cadavers were buried and the barn was disinfected with lime powder afterwards.

After we have made our inquiries to which the farmer answered friendly and with abundance of patience, we asked him if he would like to address questions to our excursion group.

Therefore, he explained that he had observed dizzy goats that walked in circles and refused water and feed intake before they died. An exact diagnosis, just on the basis of those explanations, was not possible. However, we discussed that small parasitic worms which are able to enter the brain, could be a possible reason for such a defect of the nervous system. In such a case, no medicine can help when the parasite has passed the blood brain barrier. Therefore, preventive measures like keeping the barn and resting areas dry

and clean are highly recommended. Especially during the rainy season, there is a high parasite load in water bodies which makes it worth to prevent grazing in muddy areas. Frequent disinfection of the barn through lime applications lowers the overall infectious pressure.

Another problem which the farmer stated, were goats that had eaten green coloured larvae. Whether the larvae is toxic or has eaten toxic plants remained unclear. If the goat is not able to vomit, which is very difficult for ruminants, it dies after 2 to 3 days. In those cases, it might be helpful to administer charcoal with water to the goats to lower the acute poisoning.

Overall I would conclude that the breeding and health management of this flock can be improved even under low input conditions. Therefore, shorter intervals of the already frequent exchange of male goats would be desirable to avoid inbreeding. Treatments against gastrointestinal parasites two times a year would be good; alternatively, planting an *Azadirachta indica* fence around the barn would provide additional feed stuff that has an adverse effect on parasites. I appreciate the opportunity the goat owner and the herder gave us to discover some of the challenges of proper herd management in a low input system in a rural area.

From Mandalay to Bagan

Jens Riemeyer

On the 21st of March 2015 several sites along the road from Mandalay to Bagan were visited.

Petrified wood

The day started with a note of Prof. Dohrenbusch on petrified wood found near the hotel. This “stone” at first sight is actually an old wood which is noticeable by visual annual rings. After being covered and conserved by mud, silica slowly replaces the cellulose in the tree’s cells causing the wood to harden, a process that takes centuries.

Sugar Palm

The production of sugar of *Phoenix sylvestris* was the first excursion topic of the day, introduced to the group by worker Win Naung. He explained that he was climbing the palms twice a day using two ladders of which one is mobile and the other one is fixed at the upper part of the palm.



Fig.: Sugar palm seeds. Win Naung climbing the sugar palm.

Once reaching the top part of the palm, the palm leaves are cut in order to collect the phloem sap in a pot made of clay. While he is able to harvest 10 litres during the first collection in the morning between 5 and 8 a.m., the second harvest beginning at 3 p.m. per palm and day is yielding only about 4 litres. Starting in

December, the harvesting season lasts for eight months during which the jaggery is sold once or twice a week to a trader.



Fig.: Freshly harvested sugar palm sap.

The jaggery is produced by Win Naung’s wife. For that purpose, the palm sap harvested in the morning is cooked in a small hut. The afternoon’s harvest is, due to the small amount, only heated to 70°C, to achieve pasteurisation and to process it in the following morning.



Fig.: Fire needed to heat the sap. Several pans with differently condensed sap stages. Ready-to-eat jaggery.

In several steps and by using different pans, the sap is cooked for three hours in order to get rid of the water and to obtain a caramel-like sugar paste. Only women cook the sugar sap, using pans over open fire and having to cope with high temperatures and smoke in the hut. To make sure that the paste does not crystallise, any further and thus to keep the jaggery smooth, oil is being added. Afterwards, small balls are rolled out and sold for 1,000 Kyat per kg (about 1 US\$ per kg). Additionally to the sweets production, the palm leaves, cut in small stripes, are used as construction material.



Fig.: Ladder made from bamboo sticks, rundle made from wood. Both linked with stripes of sugar palm leaves. Farmer demonstrated cutting of palm leaf stripes.

Moreover, the fruit, as well as the palm leaves, are used as fodder for zebu of which Win Naung had two oxen, one cow and a calf. The farmer reported that so far during the collection no accident has happened to him nor had he heard of severe accidents from other farmers. Since living from jaggery production only is not possible according to Win Naung, he has several other sources of income. Therefore, he cultivates the fields around his house with sesame and beans or works as a field worker for other village members. He learned the job from his father, but none of his four children wants nor should become a collector as well.

Zebu cattle

The villagers also held animals. The zebu (*Bos indicus*) which the main bovine species in Myanmar from South East Asia is mostly spread in Africa and Asia, but also found in Latin America. Several characteristics show how well-adapted it is

to semi-arid and subhumid climates. First of all zebu are tolerant to many diseases, except the sleeping sickness occurring in Africa only. Secondly, their white hair colour and a dark skin allow them to reflect a good part of the sunlight and thus regulate body temperature. Thirdly, *Bos indicus* has a large hump with fat storage capabilities that enables the animal to store surplus energy during the time of peak weight gain, i.e. the monsoon season, and which can be mobilised during times of fodder shortage, i.e. the dry season.



Fig.: Male zebu. Slightly fermented palm leaves serve as animal fodder. "Ergonomic" oxen cart.

A valuable fodder for zebu cattle especially in dry areas is are the branches

of Acacia trees, whereas Prosopis stands, a fast spreading weed, is not eaten by the animal due to secondary plant compounds. Thus puniflora indicates degraded grazing land. Win Naung stated that they were not milking their zebu cow. The reason for that might be that milking of zebu is only possible in the presence of the calf which has to be attached to the legs of the cow at time of the milking process. Female zebus, according to Win Naung, are just used in order to get male offspring which can later be used as draught animals. Since there were no injuries at the neck of the zebus visible, the carts used for field work or transportation seemed to be animal friendly.

Piper betel leaf production

Close to Win Naung's homestead, the group was fortunate to visit the piper betel (*Piper betle* L.) production by Zaut Zaw and his wife Ma Jul. The leaves are produced in a greenhouse.



Fig.: Piper betel plant. Non-glass-greenhouse used for piper betel leaf production.

They are used to wrap the popular drug called kun-ya or betel nut. Kun-ya consists of areca nuts (*Areca cathecha*) which are wrapped in the betel leaves with lime (calcium hydroxide) and sometimes tobacco, and are chewed for mild euphoria and feelings of wellbeing. The piper betel leaves are used as a traditional medicine that is reported to possess a lot of therapeutic values (Pradhan et al., p. 162). According to Zaut Zaw the piper betel's fruits are used in traditional medicine as well. The leaves contain a special

coalkaloid which accelerates and intensifies the effect of the areca nuts caused by another alkaloid. The widely spread betel nut is a commonly consumed drug (not only) in Myanmar and problematic because it destroys the teeth of the person consuming and can cause oral cancer. Nevertheless, cultivation is not illegal. Rather, cultivation of piper betel leaves seems to be (quickly) profitable: The perennial crop can be used for 10 years and can be harvested the first time after only 6 month. 1 kg of leaves is sold to local traders for 3,750 to 7,000 Kyat, while on average 24 to 40 kg of leaves are harvested per week.

Privat peanut and sesame oil mill

The last agricultural production site visited that day was the private oil mill of Daw Tin Pju.

Peanut and sesame oil is processed in the mainly female run enterprise. The two mills are driven by electricity and consist each of a wooden trunk which is stirring in big wooden barrel topped by a metal bowl in which the nuts are filled. The barrel and the trunk are rotating in opposite directions causing a crushing of the nuts so that the oil can be extracted in a small plastic vessel at the bottom of the barrel. Legume leaves are stuck to into the top of the trunk to avoid noise and a bit water is added to the peanuts in order to smoothen the milling which, however, does not have a negative influence on the oil quality. The reason for that is that is that trough the centrifugation water and oil are being separated and thus the lighter oil can be easily poured off.

From 200 kg peanuts 80 litres of oil can be extracted, with a profit of 750 Kyat per litre peanut oil, whereas a profit of 250 Kyat per litre sesame oil can be achieved. Thus, although able to process both peanuts and sesame, the milling of peanuts is preferred for their better price. All in all, it seemed to be a good business, even if 21,000 Kyat electricity costs every

month are taken into account. The left over, about 48 kg of nut cake from 200kg of peanuts is sold as animal fodder to a local trader at a rate of 700 Kyat per kg. A transformation process, even though unaffected by the democratic changes

since 2011, was very clearly visible, as Madame Pju switched from zebu cattle powered oil milling to electricity 15 years ago, five years after she started her business.



Fig.: Mrs. Pju in front of one of the mills. Dried peanuts and peanut cake. Bottling instruments. Bottled peanut oil.

Reference

D. Pradhan, Dr. K. A. Suri, Dr. D. K. Pradhan and P. Biswasroy, Golden heart of the nature: Piper betle L., in: Journal of Pharmascognosy and Phytochemistry, Vol. 1, Issue 6, 2013.

Edible and colourful treasures of Bagan

Katharina Stanzel and Philipp Seifert

Vegetable production

Still being impressed by watching the sun rise at Shwesanda pagoda in the morning, the group was taken to the shore of the Irrawaddy River. There, everyone got on a boat which headed to a small island in the river. 1,000 inhabitants live on this island village and their main source of income is vegetable production.

They mainly produce butter beans (*Phaseolus lunatus*) in four different

colours; red, brown, white and black spotted. One of the female farmers told us, while separating good quality beans from low quality beans, e.g. broken ones, that the red variety yielded the highest price. They are preferred by locals for their traditional dishes and they earn 23 US\$ per 43 kg of red beans. In one year the farmers on the island harvest about 900 kg of beans.



Fig.: Interview with a butter bean farmer. Different coloured butter beans. Drying beans and chili.

On the island not only beans but also other vegetables, such as *Cucurbitaceae*, chili, onions, herbs, castor-oil plants (*Ricinus communis*) and peanuts are cropped. The families on the island make their living from selling seeds and vegetables to traders in Bagan. Not the entire harvest is sold but stored for home consumption. Even though they live close to the river, they do not fish; as the farmers do not eat fish, due to their Buddhist belief.

However, they keep zebus as draught animals. Usually, every household owns one to two male zebus to pull carts which are used for transportation, e.g. hay to the homestead or vegetables to boats. Zebus are fed butter bean straw and chopped leaves which are steeped in water. If they are not needed for transportation, the zebus are tied with ropes close to their troughs.



Fig.: Butter bean straw. Butter bean pods. Zebu trough. Oxen cart.

All houses are made from wood, bamboo and leaves and that is built on wooden stilts. Solar panels are used by all families

as source for electricity which is needed for cooking and watching TV or using computers. The lady told us that the

younger members of her family worked in Yangon in sewing enterprises. With their loan of approximately 90 US\$ per month they support their parents.

At the riverbed of an arm of the Irrawaddy River which runs dry during the dry season, a farmer who planted onions explained how they practised their vegetable production. First of all, the riverbed is common land, i.e. no farmer owns parts of the riverbed. Instead, the planting area is divided among the villagers and the land is distributed rotationally every year. When the monsoon stops and the arm of the Irrawaddy River starts to dry out in October, farmers start to prepare the land by cracking the soil's clay clusters in order to allow the water to drain from November to January. The clay sediments are washed up by the Irrawaddy from the Tibetan Himalaya where the river has its source. In January, farmers purchase

small onions at a local market in Bagan which are then planted on different layers of crashed clay which should fix the (irrigation) water, organic matter that provides nutrients and sand which serves as a protective layer.

The vegetables and herbs are irrigated by using water which is pumped to the riverbed from the Irrawaddy River. Even if they use tubes for irrigation, the water is distributed on the whole riverbed surface. Other crops are planted in between the onions, i.e. they practise relay cropping with black cow peas which are harvested after the onions. According to the two female farmers, the main issues of the vegetable and bean production on the island is a shortage of labour which is the limiting factor of that farming system. Furthermore, they stated that the efficiency of the irrigation system could be improved.



Fig.: Vegetable field on the riverbed. Farmer explaining the procedure of vegetable production. Water pump with black irrigation tube. Schematic drawing of planting bed for onions.

Lacquerware production

The group visited another cultural heritage of Bagan, a typical lacquerware workshop afterwards. The famous handicraft has its centre in Bagan and almost all lacquerware products being sold in Myanmar are produced in Bagan. Pots, vessels, plates and jewellery are made from bamboo and painted with lacquer and are decorated with colourful modern and traditional patterns. The owner of the workshop and the associated store which were visited informed the group about the production process. In the beginning, a bamboo stick is cut vertically and after that thin layers are pulled off separately. At

first, the layers are processed with scissors like a gift tape so that they curl. Then they are glued together to the desired form, e.g. a bowl. Afterwards, the bowl is brought to a cellar room where it is left until the glue is dried. Then a first layer of lacquer is painted on the bowl. The lacquer consists of a mixture of black powder and the sap of *Toxicodendron vernicifluum* that is extracted from the tree like we had seen it in the rubber production systems.

Following that step, the bowl is stored in the drying room and when the lacquer is hardened, surplus lacquer is removed;

another layer is added and left to dry. That procedure is repeated until 18 layers of black lacquer have finally been applied. After that, the bowl is polished with grinded, petrified wood and first carvings are added to the bowl. A layer of colour or gold is applied. When the layer is dry again, the surplus colour can easily be washed off from the polished areas and the colour remains within the grooves. Further carvings and colours are added, if wanted. The decoration requires a lot concentration and therefore takes its time. Traditional colours are green, yellow and red while modern patterns are usually

painted with blue or purple.

The produce is sold in the store next to the workshop. The owner explained that the production of cheap lacquerware copies by Chinese companies is threatening the value and quality of traditional Burmese lacquerware. They use paper instead of bamboo, thus that produce is not as robust as the original lacquerware and can be sold for a cheaper price. In addition to the products made from bamboo and lacquer only, they also produce cups and bowls by weaving horsehair into a basic structure made from bamboo.



Fig.: Cutting of bamboo and gluing of the layers. Different production stages of a lacquerware bowl. Carving of traditional pattern.

Draught animals in agriculture

Felix Stiegler

The current state of agriculture in Myanmar reveals several transformation processes that indicate the shift from traditional low input agriculture with low level of mechanization and high intensity of manual labour in production and processing to a more mechanized and input-oriented agriculture. Two examples for traditional labour-intense working and processing operations are animal drawn (ox, water buffalo, horse, etc.) ploughs and cultivators or processing machines like oil mills.

Ox drawn ploughs and cultivators

Whereas the use of draught animals is more efficient and less labour intensive than manual labour, today most of the draught animals are replaced by the ongoing mechanization. The ox plough traditionally was used to cultivate the fields either for soil tillage or seedbed preparation, depending on the construction of the plough.



Fig.: Seedbed preparation with ox drawn cultivator.

If the working result is a non-inversion loosening of the soil, the observed locally-constructed machinery rather can be called cultivator than a plough. Often these kinds of cultivators are used for seedbed preparation, which normally is done in the period before the rainy season. In the observed case the farmer was preparing his seedbed for the sowing of sesame and used zebu oxen for drawing the cultivator. The zebu cattle are well adapted to the

conditions in semi-arid and arid regions and frequently used as draught animals due to their strengths.



Fig.: Design of the cultivator with four plough shares made of iron.

Normally, they are tied to the animals with wooden harnesses and ropes and the oxen are wearing a muzzle to prevent them from feeding while working. The simple construction of the cultivator made the working process quite labour intensive, because the plough shares had to be pushed strongly into the soil by the farmer during the working process.

The ox drawn oil mill

In general, an oil mill is a mill for grinding, crushing or bruising seeds that contain oil, such as peanuts or sesame or oily vegetable material such as the fruits of the oil palm or olives. Whereas oily vegetable material has to be pressed after crushing to extract the vegetable oils, oil-containing seeds can be grinded directly to extract the oil. While nowadays oil mills normally are mechanized, some small processors still use draught animals for driving the oil mill, normally oxen, donkeys or even camels. The draught animals move in circles around the grinding container and are fixed with a wooden harness. By moving they drive a grinding plant, which normally consists of a wooden stick that circulates in a milling vessel. A drain at the bottom of the vessel allows to collect the oil directly.

It is possible to use zebu oxen for driving

the oil mill.



Fig.: Ox driven oil mill for peanut oil production.

The processing result as well depends on the construction of the harnesses. If the wooden construction between the grinding stick and the harness is too short this might lead to wounds and lesions at the draught animal's neck. A longer connecting piece would make the ox move more comfortable and work more effectively.



Fig.: Short connection piece leads to bruises and lesions at the ox's neck.

Value Addition

Besides the agricultural perspective, the ox-driven oil mill can be seen as a way to attract tourists. By positioning the oil mill close to the street the local people are creating an attraction that makes visitors stop. Shops that sell local handicrafts and food and drinks can provide additional income for the local population. This additional income may help the rural people mainly involved in agriculture to cope with yield risks and create off-farm

employment. The nearby ancient city of Bagan that is visited by thousands of tourists in recent years is the main driver for these transformation processes that lead to an addition of value for the rural people.

Yezin Agricultural University

The excursion group was welcomed at the main campus of Yezin Agricultural University (YAU), located in Yezin, in the capital Naypyidaw.



Fig.: View on YAU main campus.

Both, the Universities of Kassel and the University of Göttingen, and the DITSL were presented briefly after the university's rector presented the structure and history of YAU.

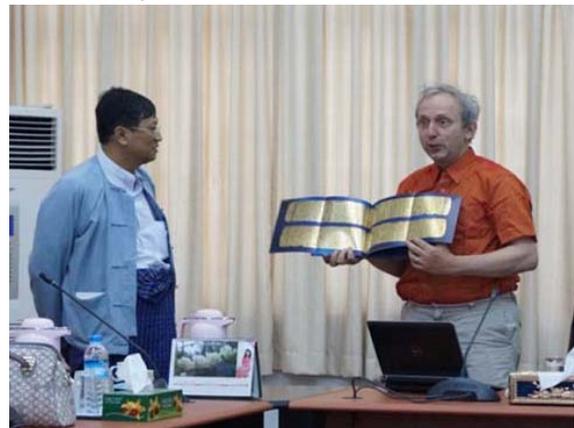


Fig.: Prof. Dr. Bürkert hands out presents to the YAU's rector.

The Yezin Agricultural University is the only institution of higher education in Myanmar that focusses on agricultural sciences. The university names its main objective to "train students appropriately and enable them to attain high standards in agricultural sciences and generate well qualified agriculturists for the country". The

YAU is administered by the Ministry of Agriculture but shall soon be shifted to the Ministry of Education. The university has nine major departments that cover a broad range of agricultural sciences and that are located at the main campus and surrounding areas.

Besides agronomy, agricultural botany and agricultural chemistry, the departments focus on agricultural economics, horticulture, entomology, animal science and agricultural engineering. They are supplemented by sub-departments that focus on general education like mathematics, physics, Burmese and English.

The university of agricultural education in Myanmar itself has a long history starting in 1924 with the foundation of the Agricultural College and Research Institute in Mandalay. During the changing history of the YAU the Agricultural College was given the status of a faculty of agriculture, located in Mandalay but under administration of the University of Yangon, before it was relocated to Yezin and given the final name and status of a university for agricultural sciences in 1997.

The YAU accepts around 300 students per year out of a large number of candidates who have to pass several examinations. The normal bachelor programmes last for a period of five years. After general agricultural studies in the first two years, the last three years focus on a deeper understanding of agricultural sciences with the students selecting specializations and getting involved in specific projects in the field. During their regular studies it is compulsory for the students to work at the university's experimental fields for getting involved in practical fieldwork. Besides the bachelor degree that most of the students aim at, the YAU offers various masters programmes.

Yezin University: Veterinary Sciences

Vera Wersebeckmann

We were received by Prof. Dr. Ye Htut Aung the head of the University of Veterinary Science (UVS) in a conference room. There is only one University for Veterinary Science in Myanmar. Their vision is to align national veterinary education with ASEAN/international standard through modern academic expertise, innovative research resources and progressive training capacity, and to make UVS an internationally recognized university. As they say their mission is to educate and train the national human resources to be competent graduates and postgraduates who will take a leading role in veterinary sciences, the livestock sector and rural development.

The general objectives are to produce qualified graduates and postgraduates of veterinary medicine and animal sciences and to conduct research of veterinary medicine and animal sciences for sustainable development of the livestock sector in Myanmar and to cooperate and collaborate with other national and international organizations.

Their motto is to develop the nation through livestock production and veterinary sciences, even though there is no long tradition of livestock keeping in Myanmar. It has developed in the past 20 to 30 years. Especially in recent years, there was a development towards large scale farms. However, so far, the livestock sector has been dominated by small and medium scale farms.

The UVS is made up of 7 basic departments (department of Myanmar, - English, - Mathematics, - Zoology, - Botany, - Physics, - Chemistry) and of 7 veterinary sciences departments (department of Medicine, - Animal Science, - Surgery and Theriogenology, - Pharmacology and Parasitology, - Microbiology and Pathology, - Anatomy, - Physiology and Biochemistry).

The academic teaching includes medicine and anatomy, surgery, histology and embryology, theriogenology and physiology, pharmacology and biochemistry, parasitology, breeding and genetics, public health and animal production, epidemiology and animal nutrition and pasture, pathology, microbiology and veterinary extension, jurisdiction and farm economics.

The university also has a veterinary teaching hospital with an anesthetic machine, an x-ray machine and an ultrasound machine where every student has to practice once a week.

At the moment there are 1,284 undergraduate students (682 male, 602 female) and 20 postgraduate students (33 male, 87 female). Students that graduate from the UVS work for the government, for the private sector and the animal production industry or increase the production on their home farms.

Current research trends in animal sciences are studies on different protein sources for poultry nutrition and studies on the feed additives and physical form of diet. In medicine studies focus on immunopathogenesis of poultry viral diseases and on diagnosis and control of mastitis in dairy cows. Pharmacology and parasitology concentrate on food borne diseases and epidemiological studies on animal diseases and drug residues in animal products.

Current research trends in pathology and microbiology are clinical pathology of animals experimentally induced by snake venom, chemicals and microorganisms such as studies on prevalence and antibiotics resistance patterns of food borne microorganisms.

In theriogenology studies pay attention to the improvement of male reproductive performance and on effects of feeding some natural leaves on semen quality in

small ruminants.

Anatomy focuses on immune-histology of calves and poultry, especially mucosa associated lymphoid tissue of calves and bursa of Fabricius of poultry.

Physiology and biochemistry concentrate on feeding high fiber roughage by increasing their nutritive values; for in vitro tests of feedstuffs a rumen-fistulated ox is kept on the experimental farm.

During the discussion among the staff of the University of Veterinary Science and us the question arose if there was an own department of animal breeding and it turned out that there was none.

Genetic resources are assigned to other animal departments and there is little information on local breeds and breeding strategies for Myanmar. Current research mainly focuses on exotic high performance breeds, not on local ones. Primary importance is given to commercial production with hybrids. There is an increasing competition with China and India, especially concerning the beef and pig market. Therefore, exotic and productive breeds are chosen such as Duroc and Yorkshire for pigs and Holstein-Friesian for cattle. Local breeds are not growing fast enough, don't provide enough meat and also are more expensive so that the meat is not suitable as export good. One of the Burmese professors mentioned that Myanmar cannot out stand in competition with its production of local livestock breeds. They find themselves in the dilemma to try and create a competitive export market on the one hand and to preserve indigenous breeds on the other hand. During the exchange Dr. Hülsebusch advised that the only way to conserve local breeds was to put them into production. Otherwise there would not be any economic profit. He advised to develop an idea to put value on local breeds e.g. by creating products for higher value class customers in China. Even perhaps local organic products. The question arose of whether there is any

exchange of knowledge between university staff and local farmers. But so far only little exchange in dairy cattle production takes place, when farmers come and visit the university's demonstration farm.

The main goal of the livestock sector in Myanmar is to ensure food security and to export to other countries and the focus clearly lies on export. The university works closely together with the private sector. The poultry and the dairy cattle demonstration farm are sponsored by CP foods. CP foods is an agro-industrial food conglomerate from Thailand. The company's core business lines are livestock and aquaculture. Its products can be divided into animal feed, live animals, meat and food products. Their products are mainly exported to the EU, to Japan and to other Asian countries.

Greenpeace criticized the company because of destruction of mangrove forest, the use of chemicals and the polluting disposal of waste water. In June 2014 the British newspaper The Guardian reported on widespread trafficking in human beings and slavery in fishery industry in Thailand, including CP Foods and subcontractors of CP foods.

After the exchange we were shown around starting at the Department of Physiology and Biochemistry by the head of the department Prof. Dr. Aung Aung. They were doing growing trials with different herbage and legume species for the dry zone.



Fig.: Growing trials with different herbage and legume species for the dry zone.

Therefore they used species from Australia, China and Indonesia in order to select varieties that are adapted to the dry climate. During the research size of leaves and height of stem were measured. Feeding experiments were to follow.

Outside the department they kept two fistulated Zebu bulls with whom they experimented on feeding high fiber roughage to increase their nutritive values.



Fig.: Rumen-fistulated bull

A rumen-fistulated cow has an opening in her rumen with a rubber cannula around it that can be opened and closed with a plug. Scientists can measure how fast the cow digests feeds and can sample rumen microbes. The zebu bull's fistula was a little dirty and looked unattended.

They also performed experiments with goats by feeding them *Leucaena*. *Leucaena* belongs to the family Mimoseae and is a legume. It is commonly known as leadtree and used as livestock fodder. But in some species high levels of mimosine are toxic. If one slowly increases the dose of *Leucaena* containing mimosine toxins, rumen bacteria can adapt so that this source of fodder can be used better. The goat that was fed with *Leucaena* showed symptom of poisoning due to poor adaptation to the forage. It had been given a relatively high dose of *Leucaena* instantaneously, even though the feeding with *Leucaena* had been interrupted for a couple of weeks. As a result it's rumen bacteria could not manage the high dose

of mimosine.

Afterwards, we moved to the dairy cattle and poultry demonstration farm. Before going in, we had to pass a disinfection bath. We could not see the poultry farm due to high hygiene requirements, but we discovered that they used broilers.

The dairy cattle farm was divided into two parts. In one part two dairy cows of Holstein-Friesian breed were kept. The cows are feed at 8 a.m. and at 4 p.m. and their feed is put on a feeding table, but it was empty during our visit. Their feed consists of grass that is cut fresh (there is no pasture land), rice straw and minerals according to the milk yield. The average milk yield per cow per day is 3.5 litres which is very low, probably due to a lack of knowledge in feeding practice of high performance dairy cows. In the other part there were calves of different ages and a bull, also of Holstein-Friesian breed. The bull was not used for breeding, because the government is providing the semen for free (also for the local farmers as we have discovered before), but they do not know anything about its origin. They suspected the semen to come from New Zealand. The claws of all cows had never been cut. The professor admitted that he would rather want to do research towards good milk yields with local breeds, but there is no money for that. If he wanted to do experiments of local breeds he would have to hire them, because their department has not enough money.



Fig.: Dairy cattle demonstration farm.

The whole demonstration farm is sponsored by CP Foods. It is not used for research but for demonstration. Students should get used to intensive production and to productive breeds, because CP Foods has in mind setting up broiler and dairy cattle production in Myanmar.

There was a huge difference between the demonstration farm and what we have seen during our visit and the question arose whether Myanmar will move into the direction of food security and small and medium scale local farming or into the direction of highly intensified agriculture for exporting. Furthermore it is questionable, how independent research can be when being sponsored by CP Foods.

Yezin University: Current field research on crop production

Balint Szell

The second day at Yezin University was at 8:15 a.m. on Thursday, 26th of March 2015. First, staff of the university gave us the chance to have a look on what they were working in the lab. We saw tissue cultures of orchids, bananas and potatoes which were grown for micro-propagation. This made it possible to get virus-free seedlings, as one PhD student explained to us.

After that we were shown several field trials. The first two field trials were set up by two M.Sc. students. Paddy rice was grown under different levels and combinations of manure, mineral and organic fertilizer (compost). The students used a randomized block design, which we found to be unnecessary due to the quite homogeneous trial plots. The rice was still very young; therefore treatment effects could not be estimated yet.



Fig.: Student explaining her rice experiment.

Next, we stopped at a small composting place. The reason for doing research in this section was the fact that the university was planning to include organic agriculture in their field of research. The key factors and conditions for composting turned out to be a good air-ventilation, an adequate temperature, moisture and shade. Materials of high and low C/N-ratios were mixed.

The following experiment was also about paddy rice. In this case a hybrid-variety was used. The treatments were all differ-

ent combinations of the 3 most important macro-nutrients nitrogen, phosphorus and potassium – no fertilizer at all, +NPK, +PK (no N), +NK (no P), and +NP (no K). The experiment was in its second year and the treatments on each plot were remaining over the years, in order to achieve an accumulation effect for each treatment. The experiment should run for several years. As a result of the first year, the “no N” treatment turned out to have similar effects like the “no fertilizer at all” treatment. The yield for those two treatments was around 4 tons per ha. The other treatments +NPK, +NP, +NK also had very similar – yet not significantly differing – yields in the range around 7 to 10 tons per ha. This indicates that N was the limiting factor in that experiment, while P and K, at least in the second year of this experiment, were not limiting yet. Interesting would have been an experiment about some relevant micro-nutrients in the paddy rice system, e.g. iron and zinc.

On the way back we were shown a couple of important tropical crops. One of them was the miracle tree – *Moringa oleifera* – a legume very rich in vitamin A and C, which is used in the tropics for various purposes. The seeds are utilized for purification of water, the leaves are an animal feed, the fruit is edible. Additionally it has some medicinal purposes as an ideal supplement and against high blood pressure.

We also saw a cassava plant which is an important starch crop in the tropics. In the humid tropics, cassava is sensitive to fungal problems and it is capable of engaging in a very intensive symbiosis with mycorrhiza. However, people living on cassava are very likely to become protein and micro-nutrient deficient, if their diet does not contain an additional protein source and vegetables.

The third mentioned crop we saw at that place was “noni”, a traditional medicinal plant. Its efficacy is not yet scientifically proven, but mixing the fruits with honey and consuming it is said to be beneficial during menstrual cramps, and also the leaves can be eaten.

After that, the group split up into three sub-groups – plant, animal and forestry.

The “plant group” went to the plant pathology department and was shown a couple of small outdoor pot-experiments. There was one experiment about different disease causing bacteria on Burmese high yielding rice varieties.

Another trial was aiming at producing disease-free orange seedlings and grafting them on plants that were received from Taiwan University.

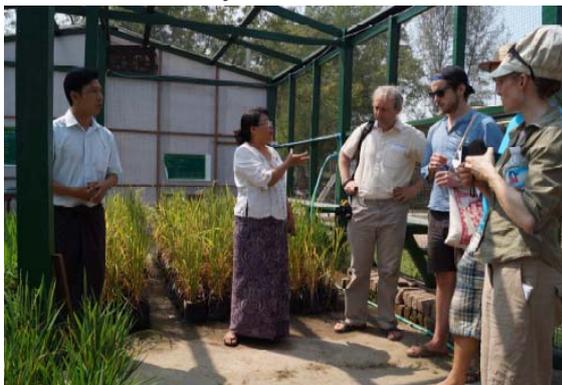


Fig.: The “plant group” learns about different experiments on various crops being carried out outdoor.

The last pathological outdoor experiment we could see was about red rot in sugar cane. They inoculated ten different sugar cane varieties with four red rot strains in order to find out about the pathological damage and the degree of resistance and tolerance of the sugar cane varieties. Subsequently, the Burmese professor for plant pathology guided us through the labs, which appeared to be outstandingly clean, even if most of the equipment was rather old-fashioned. However, this simple equipment was in a quite good condition and seemed to be very well used. Inside, we could see some tissue culture experiments of M.Sc. and PhD students. The department also had very nice display

cabinets with a collection of various insects and other small animals. It was shown very nicely, how specific pests and their predators interact. On the walls, there were posters with soil maps and soil types. Back in the main building, there was a colourful exhibition of different seeds sorted by plant family and species, mineral fertilizers, pesticides, technical equipment etc. for educational purposes.



Fig.: Technical equipment. Exhibition of different butterflies.

At Yezin University, only about 5 % of the B.Sc. students continue with a M.Sc. study. One reason for that is the fact that a B.Sc. programme takes regularly 5 years. Contrasting to the German system is also, that every M.Sc. student is obliged to conduct an own experiment over the 2 years of his or her M.Sc. study.



Fig.: Entrance to the main building of Yezin University.

Visiting the orphanage “Happy Haven Humanitarian Project”

Leonie Kreipe and Peter Thyen

Having heard and read many times that you should not give money to begging children but rather give a donation to a local project if you want to improve children’s situation in developing countries, our excursion group decided to support an orphanage for unfortunate children in Yangon. Thanks to Myo’s great social network around the old capital, we could choose a care centre which we would then visit to give our donation personally to the team. It summed up to about 420 US\$.



Fig.: Meeting the staff of Happy Haven Humanitarian Project.

The Happy Haven Humanitarian Project (HHHP) gives 113 HIV positive orphans a home and provides them with parental love and care in a familial environment. The idea to establish such an institution is based on a handful of people having experienced the disease in their families, wanting to give a chance to live in dignity to children being somehow involved in a HIV context. Typically children infected with HIV are not taken into common orphanages. This is the reason why orphanages like the Happy Haven Humanitarian Project are the only chance for these children to envisage a fulfilled life in future. Children of any age are accepted and looked after with three meals per day, kind attention, with medicine (if necessary) and anything necessary for a child’s life until they feel ready to leave.



Fig.: View on part of the building.

When we arrived on Saturday midday around 1 p.m., the under 5-year-old children were taking their nap after lunch. On mattresses on the ground they were sleeping peacefully in groups of 4-6 under colourful mosquito nets in a big house built of stone. A young woman was talking in quiet tunes to one of the boys who had not fallen asleep yet. With a total staff of 30 the three buildings seemed to be well organised and are in very good conditions: clean, tidy and with a lot of possibilities to play for the children.

In the middle building, a few metres away from the dorms of the young children sleeping, a group of about 20 girls was dancing joyfully. Music was playing on a TV in the background and the girls were improvising and repeating steps they had already learnt. They were laughing, chatting, running around and watching the four girls who were currently dancing in front and cheered for them. We learnt that they were rehearsing for a show planned to take place in the context of the water festival, Myanmar’s New Year’s celebration which is celebrated extensively all over the country in mid of April.

The boys have a separate dancing hall in another building where they too get dancing classes and enough space to practice by themselves, just like the girls. Apart from one of the ladies running the care centre who always had an ear for the

Participants

The participants of the 5th joint interdisciplinary study tour were 8 students enrolled at Georg-August-University Göttingen (*GOE*), 7 students enrolled at the University of Kassel (*KS* and campus in Witzenhausen, *WIZ*), 6 students were enrolled at both universities (*GOE/WIZ*). Six lecturers from different disciplines were accompanying the students from the University of Göttingen, Kassel and the German Institute for Tropical and Subtropical Agriculture (*DITSL*).

Most of the students taking part in the

excursion were enrolled in the Programme Sustainable International Agriculture (*SIA*) and Organic Agriculture (*OA*). 3 students were enrolled in the German Forestry Science programme (*Forst*) and 2 in Development Economics. In addition to that, from each of the programmes Molecular Ecosystem Science (*MolEco-Sys*), Sustainable Economics (*SustEcon*) and Political Science (*Po/Sci*) one student took part in the study tour. One PhD candidate (FB 11) completed the group of 21 student participants.

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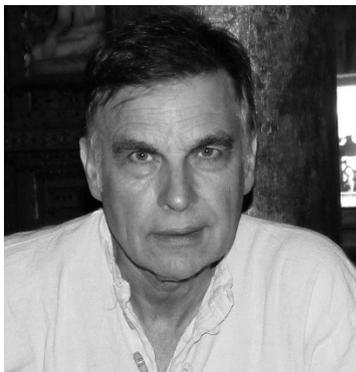
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