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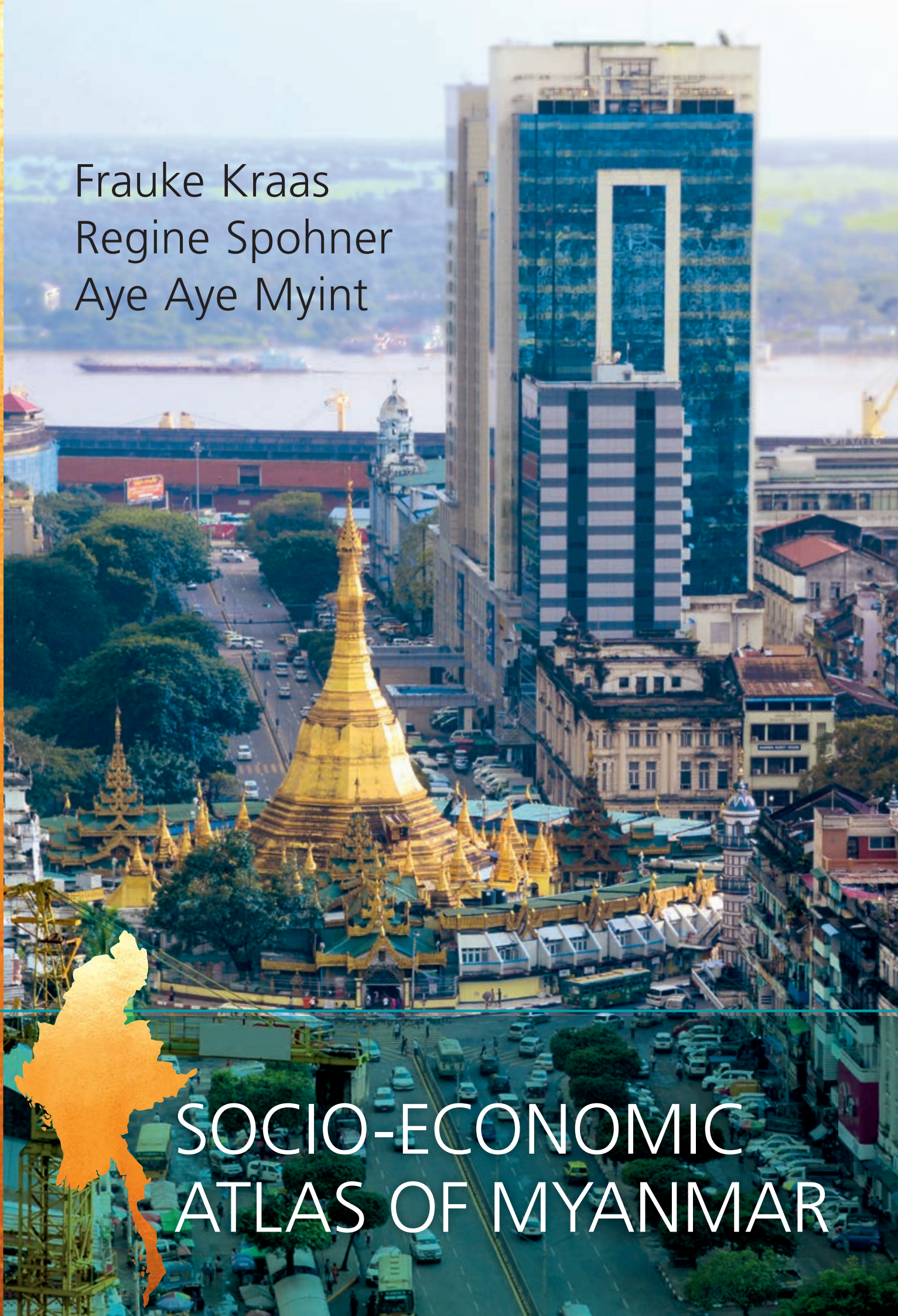

SOCIO-ECONOMIC ATLAS OF MYANMAR

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Franz Steiner Verlag

Sule Pagoda, Downtown Yangon

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SOCIO-ECONOMIC ATLAS OF MYANMAR

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Since Myanmar gained its independence on 4 January 1948, it has passed through several highly distinct phases of development: decades of isolation, at first self-imposed and later the result of sanctions, then the introduction of a market economy in the late 1980s, with various watershed moments in the country's politics, ushering in a period of transition which has recently gathered pace. This has been accompanied by radical political and economic changes, mainly at the national level but also in the international context as the country has opened up to the outside world. In Myanmar itself, at the level of the Union Territory of Nay Pyi Taw, the 14 states and regions and the 330 townships, dramatic changes are taking place: the massive expansion of infrastructure, the intensive development of formerly peripheral areas of the country, much of which has been driven by resource extraction, and stronger links with neighbouring countries, all of which are focusing interest on the nature and pace of, and potential for, development in individual regions. In this setting, the purpose of this 'Socio-Economic Atlas of Myanmar' is to provide, for the first time, a geographical overview and analysis of the country's development progress and the spatial characteristics and disparities in its socio-economic transition using maps and texts.

The idea for the Atlas evolved over the last 21 years, since February 1996, as a result of the increasingly intensive cooperation between the Departments of Geography at the University of Yangon, Myanmar, and the University of Cologne, Germany. The signing of the Memorandum of Understanding between the Universities on 23 August 2003 – highly unusual at the time – led to even more intensive cooperation in the fields of research and teaching. In 2011, the Centre of Excellence (CoE) for Urban and Regional Development was established as a partnership between the University of Yangon and the University of Cologne. Following various joint workshops between Germany and Myanmar, a partnership was also established with the then Department of Human Settlement and Housing Development (DHSHD), now the Department for Urban and Housing Development (DUHD) at the Ministry of Construction. Here too, many years of positive and increasingly intensive cooperation culminated in the signing of a Memorandum of Understanding on 13 June 2012 and the founding of the Myanmar German Research Centre for Urban and Regional Development (MGRC). The results of a joint research project – 'The 81+ urban network system of Myanmar' – were also incorporated into the Socio-Economic Atlas.

Since 2011, an intensive partnership has also developed with the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, which is a German federal enterprise and supports the German Government in international cooperation for sustainable development via technical advice and capacity building. GIZ operates in more than 130 countries and employs approximately 17,000 staff worldwide. On behalf of the Federal German Ministry for Economic Cooperation and Development (BMZ), GIZ resumed its activities in Myanmar in 2012 in the area of sustainable economic development. The GIZ Private Sector Development Project (PSD) in Myanmar aims to strengthen capacities for sustainable private sector development with the focus on improved framework conditions for small and medium enterprises (SMEs) in Myanmar.

All parts of this atlas, from the single maps to the texts, have been created and written with the utmost diligence and care. However, the maps in particular are based on information and statistical data which sometimes may contain errors and uncertainties. They reflect and visualise the current state of knowledge. Any errors and shortcomings in data other than that provided to us by other

institutions remain our own. In order to contribute to the further improvement of knowledge about the country and the current socio-economic transformation processes, we encourage the readers of the Atlas to notify and discuss with us any errors which may come to their attention.

This atlas could not have been produced without the trustful and fruitful collaboration and constant support of countless dedicated individuals in numerous institutions in Myanmar and Germany. The authors are indebted to their many colleagues, department heads, officials, staff members and other individuals who, with great kindness and patience, provided information, data and advice, shared knowledge, experience and passion, and listened and encouraged over many years and in many areas of Myanmar.

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We are sincerely grateful to the German Federal Ministry for Economic Cooperation and Development (BMZ) and the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH for the excellent collaboration and their generous financial support for parts of the cartographic work and the publication of this atlas. Our thanks are also due to Irina Scheffmann, Cho Myat Nwe Tun and Dominik Weidert for the trustful cooperation and creative exchange over recent years. We also thank GIZ's institutional partners, the Directorate of Investment and Company Administration (DICA), especially Director General U Aung Naing Oo, Deputy Director General U San Myint, Director Dr Marlar Myo Nyunt, Assistant Director Daw Aye Aye and Deputy Staff Officer Daw Yin Yin Mar.

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This book is dedicated to our teacher, friend and sister Sayama Gyi Professor Dr Mi Mi Kyi, without whom none of this would have been possible.

Frauke Kraas, Regine Spohner and Aye Aye Myint

Cologne and Nay Pyi Taw, April 2017

Royal

1. CONCEPT AND DATA OF THE ATLAS

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Evening Market, Myitkyina

CONCEPT OF THE ATLAS

DEVELOPING THE SOCIO-ECONOMIC ATLAS

The Socio-Economic Atlas of Myanmar emerged through many years of trusted cooperation between German and Myanmar colleagues. The work involved experts from academics, government and planning practice from the natural and social sciences including diverse disciplines such as physical and human geography, architecture and landscape planning, civil engineering and zoology.

The Atlas aims to present and evaluate key spatial developments in the current transformation process of Myanmar. The focus is on social-economic developments and their uneven manifestation in the states and regions of the country. These development processes are observed in relationship to administrative structures and their dependence on the characteristics of the landscape, natural resources and existing infrastructure. The meticulous spatial analyses aim to increase the state of knowledge about Myanmar both within the country and abroad, and to support decision-making on spatial development policy. In order to ensure wide accessibility the Socio-Economic Atlas is published in print and as an open-access document.

In international publications and media reports it is often said that little is known about Myanmar. Although this may appear true from an outside perspective, it requires qualification if not revision when the situation within the country is considered. In Myanmar there is a significant body of scarcely tapped knowledge that has attracted very little international attention. In the universities and administrations, especially on the local and regional levels, there is a great deal of knowledge – historical, regional, ecological and social – about Myanmar, its sub-regions and local, ethnic and religious communities. Numerous PhD and Master theses (albeit of varying quality, originality and depth of analysis) represent a notable body of knowledge, even if it is scattered over local libraries and hard to access, particularly as some of the work is written in the Myanmar language. Many unpublished investigations, reports and research papers have been bound by the institutes concerned and are not generally known of or catalogued. Furthermore, there is an enormous body of reflected, usually unwritten knowledge and experience. This large pool of different forms of knowledge is practically unknown or is not regarded as a serious resource, especially abroad but also domestically where it has not been systematically compiled and is not discussed among experts and decision-makers. Academic exchange with Myanmar colleagues makes clear that in the concrete social context of Myanmar apparently 'objective' knowledge is very differently assessed, weighted and judged from different 'internal' perspectives. The use of mixed teams of authors for the joint analyses and interpretations of the Atlas was a targeted attempt to take this into account.

THE CURRENT PROCESS OF TRANSFORMATION IN MYANMAR

References to the numerous basic publications in the academic literature on Myanmar are provided here with no further detailed discussion. The historical and political processes of the last two decades are the focus of the in-depth analyses by Carey (1997), Steinberg (2001), Thant Myint-U (2001, 2011), Kyaw Yin Hlaing/Taylor/Tin Maung Maung Than (2005), Charney (2009), Taylor (2009), Steinberg (2010), Than Tun (2010), Holliday (2011), Aung-

Thwin/Aung-Thwin (2012), Keck (2015), Rogers (2016) and Mullen (2016). More recent economic development processes are discussed in the work by Mya Than/Tan 1990, Myat Thein (2004), Mya Than (2005), Perry (2007), von Hauff (2007), Okamoto (2008), Fujita/Mieno/Okamoto (2009), Myint (2010), Findlay/Park/Verbiest (2015) and Odaka (2016). Social changes and ethnicity issues are at the heart of the work by Skidmore (2005), James (2006), Gravers (2007), Ganesan/Kyaw Yin Hlaing (2007) and Walaiporn/Pritchard (2016). The transformation processes currently affecting Myanmar are the focus of several edited volumes, in particular Cheesman/Skidmore/Wilson (2010 and 2012), Gravers/Ytzen (2014), Egreteau/Robinne (2016) and Lall (2016). They are also subject to comprehensive analysis in a series of international reports by global development organisations and consultants (ADB 2012a, Chhor et al. 2013, Nixon et al. 2013, Rieffel/Fox 2013, OECD 2014a and 2014b, World Bank 2014).

The reports focus on the central challenges related to the transformation process and possible development approaches. They largely agree on the development characteristics and problems of the country but vary in their policy recommendations, development approaches and proposed solutions.

The major challenges for the country can be summarised as follows. To date the rich potential of the landscape and natural resources has only been partially tapped. Agriculture provides employment and thus the economic basis for a large proportion of the population. The many political and economic reforms passed after 1988 and particularly after 2010 aim to improve countrywide infrastructure, promote the private sector and attract direct foreign investment. They promote decentralisation of the administration and institutional transformation, the eradication of price controls and subsidies, the modernisation of the tax and customs system, the diversification of the export sector, the improvement of import and export procedures, and the restructuring of wages and prices. They also provide increased freedom of choice for farmers in terms of the crops they cultivate and the processing, transport and trading of those products (MNPED 1995: 33, Mya Than/Tan 1990). However, these measures have not yet overcome state capitalism to a significant extent.

The greatest obstacles to the mobilisation of direct foreign investment are related to the ongoing problems of macro-economic stability, extensive bureaucracy, widespread infrastructural deficits, economic diversification, the ensuring of long-term guarantees, a lack of openness of the financial sector to foreign competition, and restrictions on the transfer of foreign capital and profits. However, the privatisation measures of recent years have led to the emergence of numerous manufacturing, trading and services companies that supplement the large, efficient, state-owned enterprises with their export trade. In addition to growing numbers of companies involved in textile, garment and food production there are more and more service enterprises (especially in the tourism sector). Foreign investment is particularly over-concentrated in the metropolitan areas of Yangon and Mandalay.

THEMATIC FOCUSES OF THE ATLAS

Against the background of the far-reaching socio-economic changes of recent years and the frequently heard call for decision-making to correct inequalities in regional development, the Socio-Economic Atlas focuses on the analysis and evaluation of current regional differences in geographical conditions, infrastructure and socio-economic development. Neither historical developments nor Myanmar's international relationships – for instance within the ASEAN or with neighbouring countries – have been included so as to keep the subject manageable.

Considerable conceptual input was drawn from the existing thematic atlases of neighbouring countries. Thus the Atlas of Cambodia (SCW 2006) focuses on natural resources and issues of poverty, while the impressive thematic atlases of Vietnam (Vu/Taillard 1993), Laos (Bounthavy/Taillard 2000 and Messerli et

al. 2008) and Thailand (Kermel-Torrès 2004) concentrate particularly on socio-economic developments.

For Myanmar itself, the Ministry of Forestry in cooperation with the Department of Geography of the University of Yangon has produced topographic maps displaying the states and divisions of the country (MoF 2004). Insights into resources and agriculture are provided by the Atlas of the Mineral Regions of the ESCAP Region, which analyses the geology and mineral resources of Myanmar (UN 1996), and the Agricultural Atlas of the Union of Myanmar (FAO 2005). Numerous thematic maps of Myanmar are included in the KTAM Report (1953) and the comprehensive fundamental work produced by Hla Tun Aung (2003). Overviews of infrastructure and socio-economic developments are found in the maps included in the regional study by Storz (1967). However, none of these maps are georeferenced and many are either too generalised or not up-to-date.

A number of possible maps could not be produced because of a lack of reliable, consistent or plausible data:

- Thus despite the enormous relevance of questions of ethnicity, especially in the process of national reconciliation (for in-depth analysis see Skidmore 2005, James 2006, Gravers 2007, Ganesan/Kyaw Yin Hlaing 2007, Kipgen 2015), it was not possible to include a map of the regional distribution of ethnic or ethnolinguistic population groups. There are a number of spatial representations of the distribution of ethnic or ethnolinguistic groups, at least of the groups most dominant in the individual areas (e.g. Smith 1993, Smith/Allsebrook 1994: 51, Lintner 1994: 77, Steinberg 2001: xvii, Gravers 2007: xx, South 2008: xii, Gravers/Ytzen 2014: 156). However, there is a lack of detailed regional data and no spatially differentiated cartographical representation of the great ethnic/ethnolinguistic diversity of Myanmar. The most accurate mapping to date is the large-scale key map by Moseley/Asher (1994: Map 49), but even here, for example, only four of the many ethnic and ethnolinguistic groups found in Chin State (Min Naing 2000) have been recorded. In the absence of more accurate data, cartographic representations are often copied from one another with minimal changes; several display the title 'main ethnic groups' but then inconsistently mix ethnic and religious groups in the actual maps (e.g. Smith/Allsebrook 1994: 51).
- On the controversial issue of regional concentrations of foreign population groups (particularly Chinese, Indian, Nepalese/Gurkha and 'western' foreigners) there are practically no detailed regional data and few studies (Cernea 2007, Chang 2014, Maung Aung Myoe 2014).
- Due to political sensitivity, detailed data from the 2014 census concerning the various religious and belief groups – Buddhists, Christians, Moslems, Hindus, Animists etc – have only been released on a national scale and the scale of the states and regions (MoLIP 2016c). Regional and local developments and the interfaith-networks of the religious groups have been subject to little investigation. Research has focused particularly on the development of individual religious groups (see e.g.: Chakravarti 1971, Yegar 1972, Berlie 2008), different perspectives on the religious problems (Gravers 2013, Charles Maung Bo 2015, David Thang Moe 2017) and current issues of reconciliation (Schissler/Walton/Phyu Phyu Thi 2017, Chit Win/Kean 2017).
- Interpretations and statistics on the highly charged and controversial so-called Rohingya issue vary greatly (Leider 2012 and 2014, Kipgen 2013, Gibson/James/Falvey 2016, Ibrahim 2016); it is impossible to produce reliable cartographic representations of this topic.
- Even for less controversial issues, cartographic representations of regional differences in distributions or developments are either impossible or unhelpful. Thus the mapping of numbers of tourists is presently unadvisable due to the unreliability and inconsistency of data – the published tourism

statistics include the numerous business travellers and people who are visiting relatives, leading to the recorded numbers of tourists entering the country being greatly inflated (Kraas/Häusler 2016). A cartographic representation of numbers of alleged tourists would be correspondingly misleading and could result in false conclusions being drawn.

DATA SOURCES AND CARTOGRAPHY

Drawing on topographical maps and satellite data, a Geographical Information System was created as a basis for the cartography, and linked to the statistical data and thematic contents. Great care was taken to ensure precise cartographical representations and meticulous checking of all the cartographic and data sources.

There are undoubtedly severe problems with the availability, quality and reliability of data, especially of statistics: 'Under decades of authoritarian rule, data sensitivity was a political culture ... it is now time for Myanmar to move towards improving the quality, accuracy, credibility, timeliness and availability of economic and social statistical data and information as a first step in building a modern developed nation' (Myint 2010, quoted in Than Tun Sein et al. 2014: 185). Against a background of very varied data quality and reliability, the temptation to create visualisations without quality control was resisted and a number of maps have not been produced that may otherwise have been possible.

The findings of the 2014 census and data from various ministries were vital sources for the Atlas. Many of the themes also drew on a synthesis of different academic sources, even when numerous very different sources had to be brought together and much work was necessary to accurately localise non-georeferenced information. Regionally detailed findings from the 2014 census have been published on population development, agriculture, education and health, allowing good and very accurate presentations of these topics. There are, in contrast, as yet limited data on industrialisation and flows of transport, trade and finance. The information on GDP, for instance, is incomplete simply because the informal sector is not included due to an understandable lack of data. There are to date no data available on the richly diverse crafts, the importance of which has scarcely been addressed, either in terms of cultural heritage or as a traditional source of local income.

Frauke Kraas, Aye Aye Myint and Regine Spohner

Agriculture between Lashio and Pyin Oo Lwin

DATA AND MAPS

The core idea of producing a reliable and spatially detailed Socio-Economic Atlas of Myanmar could only be realized in a targeted manner with the help of a Geographic Information System (GIS) and the available source data. Visualisation of most of the thematic contents is carried out on the basis of the 330 townships, the administrative units of Level 3. All point and line elements of the Atlas geo-database were recorded with great positional accuracy and stored at an appropriate level of generalisation for the mapping scale of 1:7,850,000 in an A4 print format. The accuracy of contents and the consistency of the data, some of which were drawn from many different sources, were ensured by an elaborate plausibility assessment. A combination of close communication with Myanmar colleagues and knowledge of the country enabled the meticulous examination of outliers and spatial anomalies and thus the administration of a reliable database.

The geo-database was compiled using administrative and topographic vector data or remote sensing raster data with the help of the Geographical Information System ArcGIS 10.2. The satellite data provided the basis for recording new or correcting existing geo-data and were processed using ENVI5.0. The final cartographic design of the maps was produced in Adobe Illustrator (Adobe CC 2015/2016). The add-on MaPublisher 9.6 (Avenza) installed in Illustrator proved to be indispensible when operationalizing the workflow between GIS-based data processing and cartographic visualisation in Illustrator. This software allowed the spatially fixed and to-scale import of the GIS data layers and their further attribute-based graphic processing. The combination of Illustrator and MaPublisher permitted the optimal construction of the maps through the establishment of the spatial data layers from the GIS. It furthermore allowed the use of very elaborate cartographic symbols and visualisations of the diverse topics, something that would not have been possible in GIS due to its considerably more limited graphical sophistication. In cooperation with the designers Luebbeke Naumann Thoben (Cologne), the ambitious overall layout was achieved using Adobe Indesign.

The fundamental coordinate system for the national data is a geographical coordinate system (GCS_WGS_1984 / Date: D_WGS_1984). For the regional maps of the urban area of Yangon the Universal Transvers Mercator-System was selected (UTM Zone 47 / WGS84). There was a lack of standards in the various source statistics/data in terms of the coding of the 330 administrative units and the Romanisation of the township names. This meant that the 330 spatial units were only linked after the adjustment of the township names in the statistics in line with the naming convention from MIMU (Myanmar Information Management Unit).

When preparing the thematic maps various steps were required, as follows:

- The basic topographic data were produced using a digital ground model (Shuttle Radar Topography Mission, SRTM 90m vers. 4.1) in combination with Landsat 8 OLI archive data (USGS, Earthexplorer). For Myanmar, a regularly updated archive of Landsat 8 OLI scenes is available to the project. An image sharpening process is used to calculate the Landsat 8 RGB images (channel combination 4, 3, 2) at 15 m; these images serve as the spatial base reference for both the national key maps and the regional maps. The rich objective image data and the accuracy of the 'objects' visible in the images is higher in the Landsat data

than in the available topographic maps. Landsat 8 was used as a basis for the digitalisation of the water network, the updating and correction of the street network and railway lines, the localisation of hydropower plants and the updating of the position of towns. VHR-satellite data serve as the spatial reference for Yangon (WorldView2, GeoEye), supplemented by time periods from Google Earth image data. The topographic names and toponyms for landscapes, mountainous areas, rivers and mountains are derived from the topographic maps of Myanmar at the scale of 1:250,000 and 1:50,000, from the literature and from internet research.

- The relevant dataset of the geo-data made available by MIMU (Myanmar Information Management Unit) was used as the administrative base data (download in August 2014). The data were digitized by MIMU on the basis of the topographic map 1:250,000. As this dataset includes flawed polygon data (gaps and sliver) and for certain regions is too generalized or too roughly digitized, the MIMU dataset was considerably reworked and refined in the Institute of Geography of the University of Cologne with the help of topographic maps and, especially, on the basis of the Landsat 8 image data. This applies particularly to the adjustment of borders where they follow the course of rivers, mountain ridges or roads. Furthermore, in Cologne a line and polygon dataset was created for the geo-database of the Atlas using the administrative codes and assigned names from the MIMU dataset (PCode-list, MIMU/GAUL/DCW and translation of the GAD names). The very differing Romanisation of the township names by the different authorities or ministries represented a major problem, especially as the statistics and geo-data provided had to be linked to these names. A correct 'fit' could only be achieved by very elaborate linking procedures and checking the assignment of every individual data sequence to each township. All datasets in the Atlas are affected by this problem.

The individual thematic maps were subject to further conceptual deliberation, as described in the following. The workflow of GIS-based data processing in ArcGIS and cartographic finalisation in Illustrator applied to all maps.

- Topography and topographic profiles: For this map freely accessible datasets of heights were available (SRTM vers. 4.1). However, a water-network based on the Landsat 8 data and adjusted to the scale of the map was newly created. The corrected MIMU dataset was used as administrative data. Representative cross-sections were selected and calculated in ArcGIS.

- Land use / land cover: For the map the freely accessible datasets from NASA WorldView, MODIS and GlobCover 2009 v2.3 were straightforwardly transferred to ArcGIS, the exemplary districts were representatively selected and were fed into the final cartographic process (Photoshop and Illustrator).

- Population: Data from the 2014 Census were used for total population, population density, sex ratio and urban-rural population. The census statistics were prepared so as to match the GIS dataset of the townships. In light of the problems concerning the Romanisation of the census data it was necessary to ensure the fitting of the data.

- Modeled population density: The modeled Myanmar dataset of the licensed LandScan 2013 data was procured for the spatial visualisation of population density.

- Climate: The precipitation and temperature data were derived from the 'Agricultural Atlas of Myanmar' (FAO 2006); new digitisation of the map of precipitation and temperature distributions allowed for adjustments appropriate to the design of this Atlas. The base data of the diagrams of the selected regional locations come from the 'Climate Change Knowledge Portal' of the World Bank Group; they were consistently re-visualized in Illustrator in graphic form.

- Natural Risks: This map is a compilation of freely available digital data. Firstly, the time

series of all earthquake events with magnitudes over 4.0 of the last 200 years were drawn from the web archive of the USGS-National Earthquake Information Center. Secondly, the ground model data from SRTM 4.1 for the land and from ETOPO1 for the seabed were used. These data were overlaid with the modeled population (LandScan 2013) and supplemented with the fault lines and seismic zones from the literature (tectonic map of Myanmar - www.sagaingfault.info).

- National conservation area: The map was created on the basis of a content comparison of a combination of four primary sources (see sources listed in the map). The spatial assignment was mainly based on Beffasti/Galanti (2011), as here detailed maps showing the extent of the protected areas are available. The visualisation was completed using the Ministry map. The classification of the protected areas is based on the usual IUCN categories.
- Fuel minerals, metallic minerals, precious stones etc.: The Ministry of Mines provided data for these maps. Due to positional errors, omissions and inconsistencies the data needed to be supplemented. An accurate basis was provided by a publication with geological maps of Myanmar (UN 1996). Extensive research was necessary to create the basis for the supplementary contents included in the map on fuel minerals; the presentation of the coal basins and the oil and gas blocks was drawn from various scientific sources (sources cited in the map).
- Urban system of Myanmar: A list made available by the Ministry of Construction provided the basis for identifying the towns and cities. This shows the towns and cities in 2015, categorized in five classes according to urban population (Census 2014) and administrative status. The position of the towns was in some cases corrected using Landsat 8 images.
- Road network, railway lines, towns, harbours and airports (transportation networks and towns) – detailed overviews in four parts: The basis of the maps was provided by comprehensive maps of each state or region from the Ministry of Construction. In some cases no accurate information was available on the year in which the individual road sections were constructed. The course of the roads was sometimes very generalized or visualized as a simple link between towns, so that the exact course of the road could not be determined from the maps. The data provided by MIMU are in some cases more accurate, but the positions and connections of roads are also often incorrect. It was therefore necessary to refer to the current Landsat 8 image data as a basis for interpreting the exact course of roads; additional information from Google Earth images was used for more narrow roads or the course of roads through wooded areas. Interpretation was aided by maps from the Myanmar Transportation Masterplan. A comparison with detailed GIS maps (such as those that exist for the eastern Shan State) was not possible. New road links, for instance between Paletwa and Matupi via Samee, were added based on Landsat images and newspaper reports on the opening of the streets. All the streets were first captured in GIS and later combined with the other map layers in the overall layout of the infrastructure maps. The data on the railway network was provided by the Ministry of Rail Transportation in the form of network plans showing all stops but not their accurate positions. The railway network was also checked using Landsat 8 data and, as far as visible, 'sections under construction' were also digitized. The aim of the infrastructure map is to visualize all 367 towns as connected with the street network. This goal was not fully achieved as the network of paths linking very remote small towns was not accurately visible in either the Landsat 8 or the Google Earth images. The information on airports came primarily from the UNECE platform. Local interview partners and media reports augmented the information on the operational status of the airport, for instance whether it is used seasonally. In addition, research of Google Earth images was help-