Developing a Web-based Regional Tourism Satellite Account (TSA) Information System

Abstract

Tourism satellite accounts (TSAs) have been widely recognised as standard tools to measure the contribution of tourism to destination economies. However, issues such as high costs of data collection and delayed release of TSAs have limited their regular compilation and practical application in some countries/regions. This study therefore introduces an innovative Web-based TSA information system that integrates all functions of the entire TSA compilation process chain, covering data input, data storage and management, TSA table compilation, statistical analysis and other extended applications. The system not only improves the efficiency of tourism data management and TSA compilation, but also enhances and extends the usefulness of TSAs for assessing the economic contribution of tourism to destinations. This Web-based TSA information system is established and discussed for a case study in Guangdong Province, China. Overall, the methodology and results reported herein provide academics and practitioners with new perspectives on regional TSA development and applications.

Keywords: economic contribution, Web-based TSA, information system, Guangdong Province

1. Introduction

Tourism is playing an increasingly important role in the economic and social development of destinations across the world over time. Assessing tourism's contribution to economic growth is not only valuable for a destination's government and industry, aiding the formulation of tourism policies and strategies, but also essential for academics who analyse the economic impacts of tourism.

The tourism satellite account (TSA) has been recognised internationally as a standard framework for measuring the direct contribution of tourism to the destination economy (Frechtling, 1999, 2010; Libreros et al, 2006; Song et al. 2012). It is also the basis for estimating the direct, indirect and induced effects of tourism (Giannopoulos and Boutsias, 2016; Smeral, 2006). Tourism consumption relates to various products across different sectors, including accommodation, food and beverages, transportation, entertainment and retail. National TSAs estimate the consumption of both foreign and domestic visitors in each sector and derive tourism added value and other macroeconomic indicators based on the 2008 Systems of National Accounts (SNA 2008) of the United Nations (UN and UNWTO, 2010: 69). The United Nations Statistics Division, the Statistical Office of the European Communities (Eurostat), the Organization for Economic Co-operation and Development (OECD) and the World Tourism Organization (UNWTO) jointly published *Tourism Satellite Account: Recommended Methodological Framework 2008* (UNWTO, 2008, hereafter referred to as *TSA: RMF 2008*), which provides general guidelines for the development of national and regional TSAs across the world. Following *TSA: RMF 2008*,

more than 60 countries have compiled national or regional TSAs to measure the contribution of tourism to their economies (UNWTO, 2010).

The information provided by national and regional TSAs is useful for both public and private stakeholders. Specifically, destination governments can use the statistics generated by TSAs to form their tourism development strategies (Frenţ, 2018) and to evaluate the effectiveness of their tourism policies (Ahlert, 2008; Dwyer, Forsyth et al., 2007). Tourism practitioners can also benefit from TSAs in terms of their business decision-making (Dwyer, Deery et al., 2007; Jones and Li, 2015). Based on the TSA framework, researchers can further measure different aspects of tourism impacts, such as sustainable tourism development (Jones and Munday, 2007; Sun, 2014). Reliable and sufficient data are essential for the compilation of a TSA (UN and UNWTO, 2010), which consists of 10 interrelated tables (UNWTO, 2008). Inter-relationships between data, and thus constructs of interest, are important considerations in terms of the aggregated variables in TSAs and at the micro and sector levels. It has been argued that TSA data are still underutilised in practice (OECD, 2010). For government and industries, there is no systematic standard or framework to analyse all of the data in TSA tables. It is therefore important and desirable to bridge the gap between academia and practice with respect to TSA development and applications.

To enhance the utilisation of TSAs in practice, this study introduces an innovative Web-based TSA information system that comprehensively integrates functions on the entire TSA compilation process chain, covering data input, data storage/management, TSA table

compilation, statistical analysis and other applications. The system is able to efficiently store and manage data input, and automatically and regularly compile the main tables of TSAs. Furthermore, the system provides applications such as statistical analysis, scenario forecasting and policy evaluations based on the tables generated by the system. This proposed information system provides academia and industries with a new focus and direction for TSA development and utilisation.

The remainder of the paper is organised as follows. Studies of TSAs and their applications are reviewed in the next section. In Section 3, the Web-based TSA system and its main functions are introduced, followed by a discussion of the Guangdong TSA information system. The last section concludes the study and provides suggestions for future research.

2. Literature Review

2.1 TSA Development

According to UNWTO (2010), Canada was the first country to release a national TSA in 1994 and by 2010, national TSAs had been compiled by more than 60 countries. The first academic study of a TSA was by Nordström (1996), who focussed on Sweden's TSA and found that tourist expenditure accounted for 4.5% of that country's GDP from 1992–1993. Smith (1997) compared the TSA methodologies adopted by Canada and the World Tourism and Travel Council (WTTC) and suggested that the former was superior in terms of rigor and reliability. The framework proposed by UNWTO was introduced to the academic literature by Frechtling (1999). This framework is based on the principles of SNA 2008 and the methodology is similar to, but not the same as, that of the Canadian TSA.

Holtz-Eakin (2001) discussed the concepts of capital stock in tourism and ways to measure tourism gross fixed capital formation. Frenţ (2009) proposed an index to evaluate the contribution of vacation homes based on the TSA framework. Frechtling (2010) updated the concepts and methodology for TSA compilation based on the new *TSA: RMF 2008* framework (UNWTO, 2008).

Various scholars have introduced TSA developments in different country contexts, including Germany (Ahlert, 2007), Iceland (Frenţ, 2018), the Netherlands (Heerschap et al., 2005), Ireland (Kenneally and Jakee, 2012), India (Munjal, 2013) and Tanzania (Sharma and Olsen, 2005). Frenţ and Frechtling (2015) argued that it was difficult to fully implement the standard of *TSA: RMF 2008* in each country and thus caution was needed when comparing the results of TSAs across countries. Taking Austria as an example, Smeral (2006) showed that the usefulness of TSAs was limited, as a TSA only measured the direct contributions made by tourism to the national economy. He suggested that indirect and induced effects should be estimated using other methods, with a view to assessing the impact of tourism more comprehensively.

When regional TSAs are compiled, tourism receipts from both foreign visitors and non-local domestic visitors should be considered as an injection to the regional economy. Thus, the methodology for regional TSAs is more complicated and primary data collection is costlier (Jones et al., 2003). To simplify the compilation of regional TSAs, those authors used a ‘top-down’ method to compile the regional TSA for Wales in the UK. They estimated the regional TSA from the national TSA using the shares accounted for by Wales

in national input-output tables. Similar methods were applied by Pham et al. (2008) for Queensland, Australia, and by Smeral (2015) for the lower and upper regions of Austria. Smeral (2010) developed a regional TSA at the city level, taking Vienna as the case study. In contrast to the top-down approach, a 'bottom-up' approach was used that compiled this TSA directly, based on regional tourism consumption and visitor arrivals. Jones et al. (2009) argued that compared with the top-down method, the bottom-up method was more accurate, but also more complex and expensive.

2.2 TSA Applications

TSAs provide detailed and comprehensive information that can be used to measure the contribution of tourism to the destination economy. Scholars have attempted to evaluate the contributions of specific tourism-related activities under the existing TSA framework. For example, Dwyer, Deery et al. (2007) used the TSA framework to estimate the economic impact of the meetings industry. Jones and Li (2015) and Zhang (2014) developed satellite accounts for the meetings industry based on national TSAs for the UK and Denmark. Diakomihais and Lagos (2008; 2011) estimated the impact of yachting and costal leisure shipping on the Greek economy. Eraqi et al. (2011) developed an independent human resource module based on the Egyptian TSA. Hadjikakou et al. (2014) focused on the expenditure of UK tourists in Cyprus and found that visitors from the UK contributed the most tourist revenue to the Cypriot economy.

TSAs have further been used to evaluate the effects of tourism on the environment. Jones and Munday (2007) explored the environmental impact of tourism in Wales, UK based on

a ‘top-down’ regional TSA. Dwyer et al. (2010) evaluated the indirect impact of the carbon footprints of Australian tourists. Based on Jones and Munday (2007), Jones (2013) developed four possible scenarios to explore how greenhouse gas emissions from tourism could be reduced. However, he concluded that the contribution of tourism to greenhouse gas emissions was limited and thus that the impact of any mitigation activities would be similarly constrained. Munday et al. (2013) investigated the carbon footprints of tourism in Wales, UK using the bottom-up TSA compilation method and taking the indirect effects of tourism into consideration. To examine the reliability of for the estimates of environmental impact, Collins et al. (2009) compared the environmental consequences of mega events in the UK using both ecological footprint analysis and an input-output TSA model. They concluded that the two methods had their own advantages and were complementary.

TSAs has also been integrated into macroeconomic general equilibrium (GE) frameworks. Blake et al. (2001) incorporated a TSA with a computable general equilibrium (CGE) model to assess the effectiveness of tourism policies in the USA. Ahlert (2008) developed an inter-industry forecasting model to estimate the impact of tourism on income and employment generation in Germany. Rossouw and Saayman (2011) and Gül and Çağatay (2015) integrated a TSA with a social account matrix instead of input-output tables to evaluate the impact of tourism in South Africa and Turkey, respectively. Cooper and Wilson (2002) examined the spillover effect of tourism on other industries in the UK. Ünlüönen, et al. (2011) studied the linkage of tourism receipts resulting from international visitors.

It has been argued that the TSA and CGE models are two complementary tools for analysing the economic impacts of tourism (Dwyer, Forsyth et al., 2007; Dwyer et al., 2008).

2.3 Web-based Information Systems in Tourism

With the development of Internet technologies, there has been rapid growth in the development of Web-based information systems in tourism. Of particular note is tourism recommender systems (TRSs), which aim to offer customised information to match the demand of tourists with the supply of leisure resources and attractions (Ricci, 2002). Some TRSs also take a dynamic approach, incorporating locational and weather information, to provide appropriate and intelligent recommendations to tourists (Lamsfus et al., 2009). The main recommendations provided by TRSs concern tour packages, attraction suggestions, trip planning and social interaction (Borràs et al., 2014). According to a review by Borràs et al. (2014), more than 95% of TRSs are capable of suggesting attractions to tourists based on their preferences and contextual factors. For example, Ruotsalo et al. (2013) developed a system called SMARTMUSEUM that could identify users' locations and provide different information based on specific scenarios. Moreno et al. (2013) evaluated the usefulness of TRSs and found that the correlation between tourists' travel motivations and the activities recommended by the system was above 0.7, indicating a good match. With the development and proliferation of smart phones, TRSs have had to integrate with Web-based interfaces on mobile devices. A comprehensive review of the development of mobile TRSs can be found in Gavalas et al. (2014).

Beyond TRSs, Web-based systems are widely used in forecasting tourism demand. Petropoulos et al. (2003) proposed a Web-based tourism demand forecasting system (TDFS) using time-series methods, and Song et al. (2008) developed a TDFS using autoregressive distributed lag models. To improve forecasting accuracy, judgemental (subjective) forecasts combined with quantitative (objective) forecasting techniques were introduced to this system by Song et al. (2013). Such Web-based systems provide an effective bridge between academics and industry practitioners (Wu et al., 2017). However, compared with other contexts, the incorporation of Web-based systems in TSAs has thus far been limited.

Although TSAs are the most useful tool for evaluating the contribution of tourism to destination economies, their compilation and practical applications are limited in many countries or regions for the following reasons. First, the compilation of TSAs is very time consuming and costly in some countries or regions where not all the required data are available or easily acquirable. Because tourism activities occur in various sectors, the compilation of a TSA requires data spanning this breadth which exacerbates these data availability issues in some destinations. Therefore, considerable effort and well-developed administrative infrastructures are needed to collect the required data using surveys (direct) or appropriate modelling methodologies (indirect). Second, the separation of tourism data from national accounts or input-output tables can be complicated due to lack of classification of tourism characteristic products or tourism industries in these accounts/tables. This is particularly problematic for regional TSAs, such as those focussed

on cities, because many cities do not collate their own input-output tables. Third, TSAs are often released in a delayed manner which limits the application of TSAs in practice. TSA compilation is a complex process, and release of national accounts/input-output tables, which are the foundation of TSAs, is not timely in most countries/regions. For these reasons, the compilation of TSAs, especially regional TSAs, has been infrequent and even absent for some destinations/regions; and for regions where TSAs have been complied, their subsequent use and application has been limited to some extent. For example, although a number of regions in China have compiled regional TSAs, such as Beijing for 2004 and Jiangsu for 2002, these are not annual endeavours subject to regular updating to generate time-series, but one-off works.

This study proposes a Web-based TSA information system, which, although it cannot completely solve all problems, is capable of improving the efficiency and practical application of a TSA. The system provides a platform for the continuous and timely compilation of TSAs whereby different sources of data are input and organised efficiently on one platform with TSA tables and statistical analysis produced automatically. In addition, because this system is Web-based, users can access data and information in any place and at any time which provides convenience and efficiency to users. This system advances the state-of-the-art in terms of TSA development and goes at least some way to bridging the gap between academic knowledge and practice in the tourism economics domain.

3. Web-based TSA Information System

This section introduces an innovative Web-based TSA information system that can produce key TSA tables regularly and in a timely manner. All salient points concerning the TSA compilation process chain are covered, namely, data collection, data storage and management, statistical analysis and other extended applications. This information system significantly improves the efficiency of TSA compilation and the application of TSAs in destinations/regions where tourism plays a major role in the economy.

3.1 Design Architecture of the Web-based TSA Information System

The design architecture of the system is illustrated in Figure 1. The first layer is the Client Layer. Authorised clients can log into the system via Internet browsers through their local computers. Clients can be categorised as external or internal users. External users are the government and industry practitioners who are authorised to browse the outputs of the system, including the results of the TSA and subsequent applications. Internal users include the system administrator and TSA experts. All accounts/users are registered and managed by an administrator, who also owns the rights to maintain and update the system. The experts are in charge of TSA compilation and extended applications.

The Function Layer is the core component of the system. It includes the procedures by which clients communicate with the system, including Security Management, Data Collection, Data Management and Database Applications. Security Management is an important component of the system: it allocates the different types of users with different levels of authorities to the system. The components of Data Collection, Data Management

and Database Application are used to compile the TSA tables and apply the results of the TSA to varying extended functions. The third layer of the system is the Database Management Layer, which is composed of two databases. The first database is used to store data collected from different sources, the TSA tables and extended applications. The second database stores the code to compile the TSA tables and carry out extended analyses.

[Insert Figure 1 here]

3.2 Functions of the Web-based TSA Information System

The major functions of the Web-based TSA information system include the Data Collection module, Data Management module, TSA compilation module and Statistical Analysis module, as shown in Figure 2.

3.2.1 Data Collection and Data Management Modules

One objective of the system is to reduce the time and financial costs of data collection. As shown in Figure 2, data are collected from various sources. Both on- and off-line surveys are supported by the system. Compared with off-line surveys, the on-line survey is less time consuming. On-line survey data are delivered directly to servers from data collection devices, which can reduce input errors relative to off-line surveys. National account data and other tourism-related data can also be uploaded to the system via the Internet from governmental authorities responsible for statistics and tourism. All of the data are stored in the data management server and are released by the Web servers. Two Web servers are built for the system. The first of these is used as the routine server and the second is a

backup. The data management server is independent from the Web servers. A storage array network connects the servers, all of which are behind a firewall to maintain security. After the data are uploaded to the system, data quality is checked and any outliers or other types of anomaly are identified.

[Insert Figure 2 here]

3.2.2 TSA Compilation Module

The compilation of the TSA is guided by *TSA: RMF 2008*, which is constituted by 10 output tables. Table 1 records the tourism expenditure generated by inbound visitors categorised by products. In a regional TSA, in addition to international tourists, non-local domestic visitors from other regions in the country are identified as external visitors and their tourism expenditure is also described in Table 1. Table 2 focuses on domestic tourism expenditure categorised by products. In a regional TSA, this refers to regional tourism expenditure by residents of that region. Table 3 represents outbound tourism expenditure. In the same manner, in a regional TSA both outbound visitors and domestic visitors travelling to outside of the region are considered separately in Table 3. Based on Tables 1–3, internal tourism consumption is aggregated in Table 4 to show the tourism output from the demand side. Table 5 presents the production accounts of tourism industries and other industries in the economy of reference. Table 6 is the core output of the regional TSA. By merging the results of Tables 4 and 5, Table 6 reports the direct economic impact of tourism industries. Table 6 also includes the gross value added attributable to tourism in each sector. Tables 7 and 8 refer to employment in tourism industries, tourism gross fixed capital formation, tourism collective consumption and some non-monetary indicators. Although

these 10 tables are recommended by *TSA: RMF 2008*, they are rarely fully compiled by destinations due to data availability issues and resource constraints.

In a TSA information system, once the basic data from both demand and supply sides are input, the accounts, particularly for Tables 1–6 are automatically complied, which not only improves efficiency but also institutes consistent compilation principles and rules to ensure the comparability of TSAs across different spatial and temporal dimensions. This compilation module is the foundation and core output of the TSA information system.

3.2.3 Statistical Analysis Module

The compilation process of the TSA yields substantive data and related statistics. Besides the output tables, data used in intermediate calculation processes are also of value for practitioners. For example, in conjunction with a geographic information system (GIS), the system can spatially decompose visitor arrivals and expenditure data. Analyses of the geographical distribution of tourism data are essential for government and industries to allocate resources efficiently over different periods and different subnational governmental jurisdictions to improve the travel experience of visitors to the destination. Furthermore, analysis of tourism consumption may enable the destination to determine visitor preferences for certain tourism goods and services. Travel propensity data are considered as an indication of the well-being of local residents, as travel is an effective way to improve psychological or subjective well-being (Gilbert and Abdullah, 2004; Millan, 1998).

3.2.4 Extended Applications Module

The outputs from TSAs may be used for more advanced functions. As argued by Smeral (2006), TSAs only report the direct impacts of tourism, which underestimate its economic contribution because this does not consider indirect and induced effects. By introducing various multipliers for each sector, the indirect and induced impacts of tourism on output, value added and employment can be obtained. Another extension of the system is to use TSA outputs as inputs for CGE models. By incorporating an input-output table with TSA data, the calibration of CGE models can be further improved and better policy simulations can thus be conducted. The TSA system can also be used to forecast not only future visitor arrivals and their total expenditure (Song et al., 2008, 2013), but also tourism consumption in various sectors such as accommodation, dining and transportation. Furthermore, once TSAs are continuously compiled using the system, the tourism demand and/or tourism supply forecasting module can be developed based on time series data in the system. The forecasting modules could produce scenario forecasts using advanced econometric techniques and the results of which can provide both industry practitioners and governmental decision makers with valuable information for policy and strategy formulation.

3.3 Case Study of Guangdong TSA

3.3.1 Background to the Guangdong TSA Information System

Guangdong Province, located on the southeast coast of China and bordering Hong Kong and Macao SARs, is ranked first in terms of both gross regional product and population among all provinces in China. Guangdong is a magnifying glass on China's economic reform over the past four decades. Benefitting from rapid economic development and

strong government support, the tourism industry of Guangdong has experienced sustained growth. Indeed, the annual growth rate of tourism receipts in Guangdong reached 15.3% in 2014, ranking first among Chinese provinces.

Commissioned by the Guangdong Tourism Administration of China, a Guangdong TSA (GDTSA) for 2010 was first compiled by the research team using the 'bottom-up' method in 2012. However, hitherto, compilation of regional TSAs have always been one-off endeavours in China. For example, Jiangsu Province (the second best performing province in China according to gross domestic production) compiled the first regional TSA for the year 2002 and Beijing (the capital of China) for 2004. However, both are one-off compilations, and there is no region in China that compiles TSA regularly. Without regular TSA compilation, it is difficult to study the features of tourism development dynamically over time or across regions. Thus, the Guangdong Tourism Administration engaged the research team to develop a Web-based GDTSA information system, and based on this platform it will be viable to regularly, and automatically, compile TSAs.

This system is especially valuable to governmental and industry decision makers. Based outputs from the system, the Guangdong Tourism Administration published tourism data and information concerning the economic contributions of tourism. This also represents the first time that quarterly TSAs have been compiled and published in China, providing richer information than before. The system also offers advantages in terms of being easy to use, integrated and easy to manage which improves the efficiency of TSA development and utilisation.

3.3.2 Features and Functions of the GDTSA Information System

The Web-based GDTSA information system is an effective way to bridge the gap between theoretical development of TSAs and their empirical application to different case-study areas by diverse stakeholder groups. This platform is constructed and configured based on a number of features and principles, which are described and discussed below.

Convenience. Because this is a Web-based system, it is not necessary to install specific software. The GDTSA information system can be accessed from anywhere with Internet access. Different users, such as government or industry practitioners, can share information and easily obtain valuable data and statistics from different locations and at any time.

User Friendliness. All operations are menu-driven via a generalised user interface (GUI). Users who are familiar with Web browsers are able to work with this system easily, and no further skills are required.

Modularity. The system was designed based on standalone modules. All of the modules can be updated and redesigned independently when new functions are integrated or algorithms are updated. This allows continuous updating, extension and development of the system. This modularity characteristic can also reduce the maintenance costs of the system.

Flexibility. The TSA compilation algorithms in the system were designed based on the international standard of *TSA: RMF 2008*, which represents the key guidelines for TSA compilation around the world. It is therefore easy to apply the system to other provinces in China or to provincial regions of other countries with minor adjustments.

Relevance. TSA: RMF 2008 encourages different destinations to further supplement specific tourism industry categorisations which are salient to local contexts. Therefore, in the GDTSA information system, three industries, golf, hot springs and exhibition sectors are compiled separately as region specific tourism industries in Guangdong, and expenditures on these three region-specific services are also separately considered.

The functions of the GDTSA system thus far cover data management, system management, TSA compilation, statistical analysis and geographic distribution analysis. The system can quickly and effectively generate Tables 1–6 of the TSA based on *TSA: RMF 2008*. As the focus herein is on a regional TSA, Table 1 includes not only international tourism but also domestic tourism from provinces other than Guangdong. Table 2 shows Guangdong residents' tourism expenditure within Guangdong Province. Particularly residents' tourism expenditure in Guangdong before or after an outbound or domestic trip outside of Guangdong is included. For example, if a resident buys a pair of sunglasses in Guangdong for his upcoming international trip, this expenditure is counted as internal expenditure in Table 2. Residents' expenditure on entertaining visitors from outside of Guangdong is also counted separately in Table 2. Table 3 covers their travel both internationally and in China beyond Guangdong Province. Based on Tables 1–3, Tables 4–6 are compiled according to

TSA: RMF 2008. Tables 7–10 are currently in development. The statistical analysis functions in the GDTSA information system include the analysis of seasonal fluctuations, geographical tourism distribution, preferences for tourism consumption in Guangdong, travel rate and tourism expenditure by Guangdong residents. Extended functions such as impact analysis and linking with CGEs and forecasting models are in development.

3.3.3 Outputs of the GDTSA Information System

The login interfaces of the GDTSA information system are shown in Figures 3 and 4. Figure 5 is an example of TSA output where Table 6 data are reported. Users have flexibility to choose which TSA tables to report over which periods, depending on their specific needs and goals.

[Insert Figure 3 here]

[Insert Figure 4 here]

[Insert Figure 5 here]

Data for international visitor arrivals are obtained from the China National Tourism Administration. Tourism expenditure data and number of non-Guangdong visitors are provided by the Guangdong Tourism Administration from quarterly surveys. Other data for the compilation of the GDTSA emanate from the Guangdong Statistics Bureau.

An on-line survey was also carried out to collect tourism expenditure data for Guangdong residents. By cooperating with NetEase, one of the largest Internet companies in China,

3.25 million e-mails were sent to registered customers of that company in the Guangdong area, and 9,178 completed questionnaires were collected. The demographic distribution of the survey respondents was compared with population census data for Guangdong Province to ensure representativeness.

This system has been used to compile quarterly TSA tables for 2014. Figure 6 shows that in 2014, 435.52 million people visited Guangdong. International arrivals totalled 44.12 million, arrivals from non-Guangdong regions of China numbered 164.30 million and arrivals from Guangdong Province numbered 227.10 million. Total visitor arrivals over the first to fourth quarters were 93.76 million (21.53%), 98.17 million (22.54%), 108.02 million (24.8%) and 135.57 million (31.13%), respectively. Figure 7 demonstrates that Guangdong Province was a net inflow region in terms of both visitor arrivals and tourism expenditure in 2014. Net inflow was observed in all four quarters of 2014 for visitor arrivals, whereas there was an outflow in the first quarter in terms of tourism expenditure and the other quarters were net inflows. Thus, Guangdong residents spent more when they travelled in the first quarter, particularly during the Chinese New Year.

[Insert Figure 6 here]

[Insert Figure 7 here]

Total regional tourism consumption in 2014 was RMB965.33 billion. Total tourism expenditure was RMB864.59 billion; total expenditure on second homes for vacation purposes was estimated to be RMB17.23 billion; residents' expenditure on receiving

tourists was RMB78.9 billion; and social tourism transfer payments amounted to RMB45.65 billion. Regional tourism expenditure in the four quarters was RMB186.2 billion (19.29%), RMB217.3 billion (22.51%), RMB269.8 billion (27.95%) and RMB292.0 billion (30.25%), respectively (see Figure 8).

[Insert Figure 8 here]

The direct value added from tourism in 2014 was RMB429.4 billion. As shown in Figure 8, the direct value added from the first to the fourth quarters was RMB84.13 billion (19.59%), RMB98.99 billion (23.05%), RMB119.01billion (27.72%) and RMB127.87 billion (29.78%), respectively. Direct contributions of tourism to the Guangdong economy measured by different indicators are summarised below. The direct value added of the tourism industry in 2014 accounted for 6.33% of Guangdong's GDP. Quarterly contributions from the first to the fourth quarters were 6.17%, 5.74%, 6.90% and 6.50%, respectively (see Figure 8). The net production tax revenue generated by the tourism industry in 2014 was RMB53.73 billion, which accounted for 5.03% of the total tax revenue in Guangdong Province. The direct tourism compensation of employees in 2014 was RMB260.19 billion, which accounted for 8.04% of the total compensation of employees of Guangdong Province.

4. Conclusions

This study introduces an innovative information system for TSA compilation and analysis. The TSA information system shares some common features with other Web-based systems,

namely good accessibility, convenience and ease of use. In addition, the system can specify tourism-related sectors according to the characteristics of the destination to estimate economic impacts more comprehensively.

This study makes a number of contributions. First, it provides an easily accessible Web-based TSA information system to improve the practical utilisation of TSAs by relevant governmental, industrial and third-sector stakeholders. This system is an effective way to bridge the gap between academic development of TSA methodologies and their empirical application in different case-study areas. Second, different functions are designed and integrated on this platform covering the entire TSA compilation process chain: data collection, data management, TSA compilation, statistical analysis and other extended applications. Consistent rules are configured for the generation and application of TSA results, which facilitates rigorous and robust comparisons of tourism development over time and space. Third, the proposed innovative system not only improves the efficiency of TSA compilation, but also provide researchers with a new focus and perspective for future research and applications in this domain. Fourth, based on the system it is possible to compile TSAs at regular intervals. For example, herein, we presented a case-study where TSAs were compiled quarterly for the Guangdong Province of China.

The main functions of the TSA information system cover data collection, data management, TSA compilation, statistical analysis and other extended functions. On- and off-line data collection methods are supported by the system; tourism and national accounts data from relevant government departments can be uploaded via the Internet as and when required.

After screening, cleaning and other quality checks, the collected data can be used to compile major tables of regional TSAs based on *TSA: RMF 2008*. A range of data are generated as intermediate outputs of the TSA, and they can be analysed by statistical tools and GIS. Such data are meaningful and valuable to tourism practitioners. Another function of the system is to extend the application of TSAs. The outputs of TSAs can be used as inputs for impact analysis, CGE modelling and tourism demand/supply forecasting.

The region-specific GDTSA information system was developed in 2015, and since then the system has been used by governmental decision makers in Guangdong Province. By using the system, a regional TSA is compiled by a 'bottom-up' method, and Tables 1–6 of the TSA are generated accordingly. Quarterly TSAs for 2014 were compiled using this system. The number of visitors to Guangdong Province in 2014 totalled 435.52 million, comprising 44.12 million international visitors, 164.3 million non-Guangdong domestic visitors and 227.1 million internal visitors. Total regional tourism consumption in 2014 was RMB965.33 billion, generating RMB429.4 billion direct value added of tourism. The direct contribution of tourism to GDP in 2014 was 6.33% in Guangdong Province, and the fourth quarter accounted for 29.78% of this contribution, followed by the third (27.72%), second (23.05%) and first (19.59%) quarters.

The GDTSA information system is still in development. By incorporating input-output multipliers, impact analysis can be introduced to highlight the indirect and induced impacts of the tourism industry. Connections to CGE models and tourism-demand forecasting systems are further possible ways to expand the functions of the system. Internet security

is also an issue deserving further attention. Notwithstanding the possibilities for further development, the GDTSA information system represents the first attempt to compile a TSA and extend its applications based on a Web-based system. Successful development of the system has made it viable to compile TSAs regularly and provide valuable information to government, industry and academic stakeholders. The outputs of the GDTSA information system have been considered as a reference for decision-making by the Guangdong government and have been widely used by tourism researchers in China.

References

Ahlert G (2007) Methodological aspects of preparing the German TSA: Empirical findings and initial reactions. *Tourism Economics* 13(2): 275–287.

Ahlert G (2008) Estimating the economic impact of an increase in inbound tourism on the German economy using TSA results. *Journal of Travel Research* 47(2): 225–234.

Blake A, Durbarry R, Sinclair MT and Sugiyarto G (2001) Modelling tourism and travel using tourism satellite accounts and tourism policy and forecasting models. *Tourism and Travel Research Institute Discussion Paper* 4: 2001–4.

Borràs J, Moreno A and Valls A (2014) Intelligent tourism recommender systems: A survey. *Expert Systems with Applications* 41(16): 7370–7389.

Collins A, Jones C and Munday M (2009) Assessing the environmental impacts of mega sporting events: Two options? *Tourism Management* 30(6): 828–837.

Cooper A and Wilson A (2002) Extending the relevance of TSA research for the UK: General equilibrium and spillover analysis. *Tourism Economics* 8(1): 7–37.

Diakomihalis MN and Lagos DG (2008) Estimation of the economic impacts of yachting in Greece via the tourism satellite account. *Tourism Economics* 14(4): 871–887.

Diakomihalis MN and Lagos DG (2011) An empirical approach to coastal leisure shipping in Greece and an assessment of its economic contribution. *Tourism Economics* 17(2): 437–456.

Dwyer L, Deery M, Jago L, Spurr R and Fredline L (2007) Adapting the tourism satellite account conceptual framework to measure the economic importance of the meetings industry. *Tourism Analysis* 12(4): 247–255.

Dwyer L, Forsyth P and Spurr R (2007) Contrasting the uses of TSAs and CGE models:

Measuring tourism yield and productivity. *Tourism Economics* 13(4): 537–552.

Dwyer L, Forsyth P, Spurr R and Van Ho T (2008) Tourism's economic contribution versus economic impact assessment: Differing roles for satellite accounts and economic modelling. In: Woodside AG and Martin D (eds) *Tourism Management: Analysis, Behaviour and Strategy*. Oxford and Cambridge: CABI, pp. 459–469.

Dwyer L, Forsyth P, Spurr R and Hoque S. (2010) Estimating the carbon footprint of Australian tourism. *Journal of Sustainable Tourism* 18(3): 355–376.

Eraqi MI, Kasem AM, Hassan SB and Ragab AM (2011) Towards a comprehensive human resources module for tourism satellite accounts in Egypt. *Tourism Review* 66(4): 30–44.

Frechtling DC (1999) The tourism satellite account: Foundations, progress and issues. *Tourism management* 20(1): 163–170.

frechtling DC (2010) The tourism satellite account: A primer. *Annals of Tourism Research* 37(1): 136–153.

Frenţ C (2009) The economic importance of vacation homes from the tourism satellite account (TSA) perspective. *Tourism Review* 64(2): 19–27.

Frenţ C (2018) Informing tourism policy with statistical data: The case of the Icelandic tourism satellite account. *Current Issues in Tourism* 21(9): 1033-1051.

Frenţ C and Frechtling DC (2015) Assessing a tourism satellite account: A programme for ascertaining conformance with United Nations standards. *Tourism Economics* 21(3): 543–559.

Gavalas D, Konstantopoulos C, Mastakas K and Pantziou G (2014) Mobile recommender systems in tourism. *Journal of Network and Computer Applications* 39: 319–333.

Giannopoulos K and Boutsinas B (2016) Tourism satellite account support using online analytical processing. *Journal of Travel Research* 55(1): 95–112.

Gilbert D and Abdullah J (2004) Holiday taking and the sense of well-being. *Annals of Tourism Research* 31(1): 103–121.

Gül H and Çağatay S (2015) Impact analysis of demand-driven shocks in Turkey's tourism industry within the framework of the social accounting matrix. *Tourism Economics* 21(1): 33–48.

Hadjikakou M, Chenoweth J, Miller G, Druckman A and Li G (2014) Rethinking the economic contribution of tourism: Case study from a Mediterranean island. *Journal of Travel Research* 53(5): 610–624.

Heerschap N, de Boer B, Hoekstra R, van Loon A and Tromp L (2005) A tourism satellite account for the Netherlands: Approach and results. *Tourism Economics* 11(3): 393–409.

Holtz-Eakin D (2001) Capital in a tourism satellite account. *Tourism Economics* 7(3): 215–232.

Jones C (2013) Scenarios for greenhouse gas emissions reduction from tourism: An extended tourism satellite account approach in a regional setting. *Journal of Sustainable Tourism* 21(3): 458–472.

Jones C and Li S (2015) The economic importance of meetings and conferences: A satellite account approach. *Annals of Tourism Research* 52: 117–133.

Jones C and Munday M (2007) Exploring the environmental consequences of tourism: A satellite account approach. *Journal of Travel Research* 46: 164–172.

Jones C, Munday M and Roberts A (2003) Regional tourism satellite accounts: A useful

policy tool? *Urban Studies* 40(13): 2777–2794.

Jones C, Munday M and Roberts A (2009) Top down or bottom up? Issues in the development of sub-national tourism satellite accounts. *Current Issues in Tourism* 12(4): 301–313.

Kenneally M and Jakee K (2012) Satellite accounts for the tourism industry: Structure, representation and estimates for Ireland. *Tourism Economics* 18(5): 971–997.

Lamsfus C, Alzua-Sorzabal A, Martin D, Salvador Z and Usandizaga A (2009) Human-centric ontology-based context modelling in tourism. In: *Proceedings of the International Conference on Knowledge Engineering and Ontology Development*, pp.424–434.

Libreros M, Massieu A and Meis S (2006) Progress in tourism satellite account implementation and development. *Journal of Travel Research* 45(1): 83–91.

Milman A (1998) The impact of tourism and travel experience on senior travellers' psychological well-being. *Journal of Travel Research* 37(2): 166–170.

Moreno A, Valls A, Isern D, Marin L and Borràs J (2013) SigTur/E-destination: Ontology-based personalized recommendation of tourism and leisure activities. *Engineering Applications of Artificial Intelligence* 26(1): 633–651.

Munday M, Turner K and Jones C (2013) Accounting for the carbon associated with regional tourism consumption. *Tourism Management* 36: 35–44.

Munjal P (2013) Measuring the economic impact of the tourism industry in India using the tourism satellite account and input–output analysis. *Tourism Economics* 19(6): 1345–1359.

Nordström J (1996) Tourism satellite account for Sweden 1992-93. *Tourism Economics*

2(1): 13–42.

OECD (2010) Tourism satellite accounts: Data for business and policy development. In: OECD (eds) *Tourism Trends and Policies*. Paris: OECD, pp.83–105.

Petropoulos C, Patelis A, Metaxiotis K, Nikolopoulos K and Assimakopoulos V (2003) SFTIS: A decision support system for tourism demand analysis and forecasting. *Journal of Computer Information Systems* 44(1): 21–32.

Pham TD, Dwyer L and Spurr R (2008) Constructing a regional tourism satellite account: The case of Queensland. *Tourism Analysis* 13(5-1): 445–460.

Ricci F (2002) Travel Recommender Systems. *IEEE Intelligent Systems* 17(6): 55–57.

Rossouw R and Saayman M (2011) Assimilation of tourism satellite accounts and applied general equilibrium models to inform tourism policy analysis. *Tourism Economics* 17(4): 753–783.

Ruotsalo T, Haav K, Stoyanov A, Roche S, Fani E, Deliai R, Mäkelä E, Kauppinen T and Hyvönen E (2013) SMARTMUSEUM: A mobile recommender system for the Web of data. *Web Semantics: Science, Services and Agents on the World Wide Web* 20: 50–67.

Sharma A and Olsen MD (2005) Tourism satellite accounts: Implementation in Tanzania. *Annals of Tourism Research* 32(2): 367–385.

Smeral E (2006) Tourism satellite accounts: A critical assessment. *Journal of Travel Research* 45(1): 92–98.

Smeral E (2010) Application of the TSA in a regional context: The case of Vienna. *Tourism Review* 65(1): 57–65.

Smeral E (2015) Measuring the economic impact of tourism: The case of lower and upper

Austria. *Tourism Review* 70(4): 289–297.

Smith SL (1997) TSAs and the WTTC/WEFA methodology: Different satellites or different planets? *Tourism Economics* 3(3): 249–263.

Song H, Dwyer L, Li G and Cao Z (2012) Tourism economics research: A review and assessment. *Annals of Tourism Research* 39(3): 1653–1682.

Song H, Gao BZ and Lin VS (2013) Combining statistical and judgmental forecasts via a Web-based tourism demand forecasting system. *International Journal of Forecasting* 29(2): 295–310.

Song H, Witt SF and Zhang X (2008) Developing a Web-based tourism demand forecasting system. *Tourism Economics* 14(3): 445–468.

Sun YY (2014) A Framework to account for the tourism carbon footprint at island destinations. *Tourism Management* 45: 16–27.

UN and UNWTO (2010) *International Recommendations for Tourism Statistics 2008*. New York: UN.

Ünlüönen K, Kiliçlar A and Yüksel S (2011) The calculation approach for leakages of international tourism receipts: The Turkish case. *Tourism Economics* 17(4): 785–802.

UNWTO (2008) *Tourism Satellite Account: Recommended Methodological Framework*. Madrid: UNWTO.

UNWTO (2010) *TSA Data around the World: Worldwide Summary*. Madrid: UNWTO.

Wu DC, Song H and Shen S (2017) New developments in tourism and hotel demand modeling and forecasting. *International Journal of Contemporary Hospitality Management* 29(1): 507-529.

Zhang J (2014) Assessing the economic importance of meetings activities in Denmark.

Scandinavian Journal of Hospitality and Tourism 14(3): 192–210.

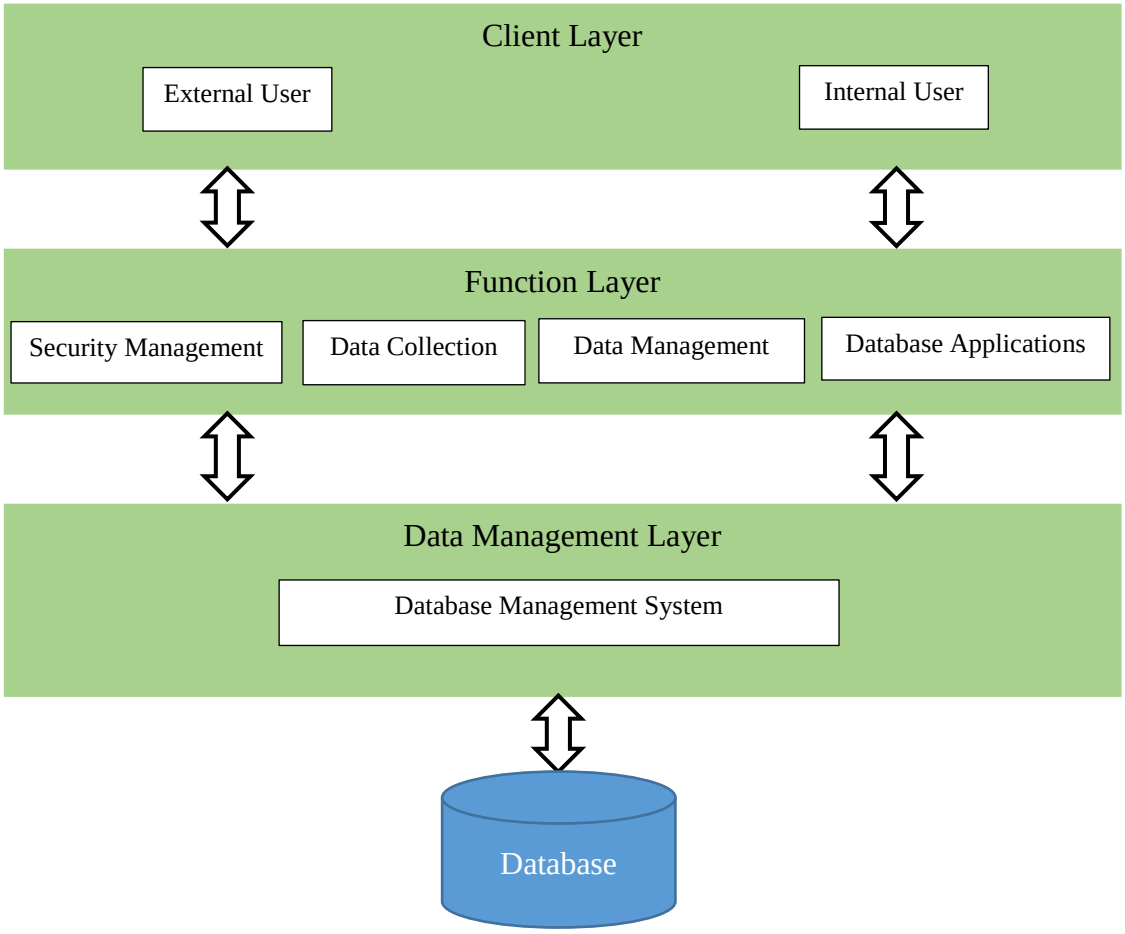


Figure 1 Design Architecture of the Web-based TSA Information System

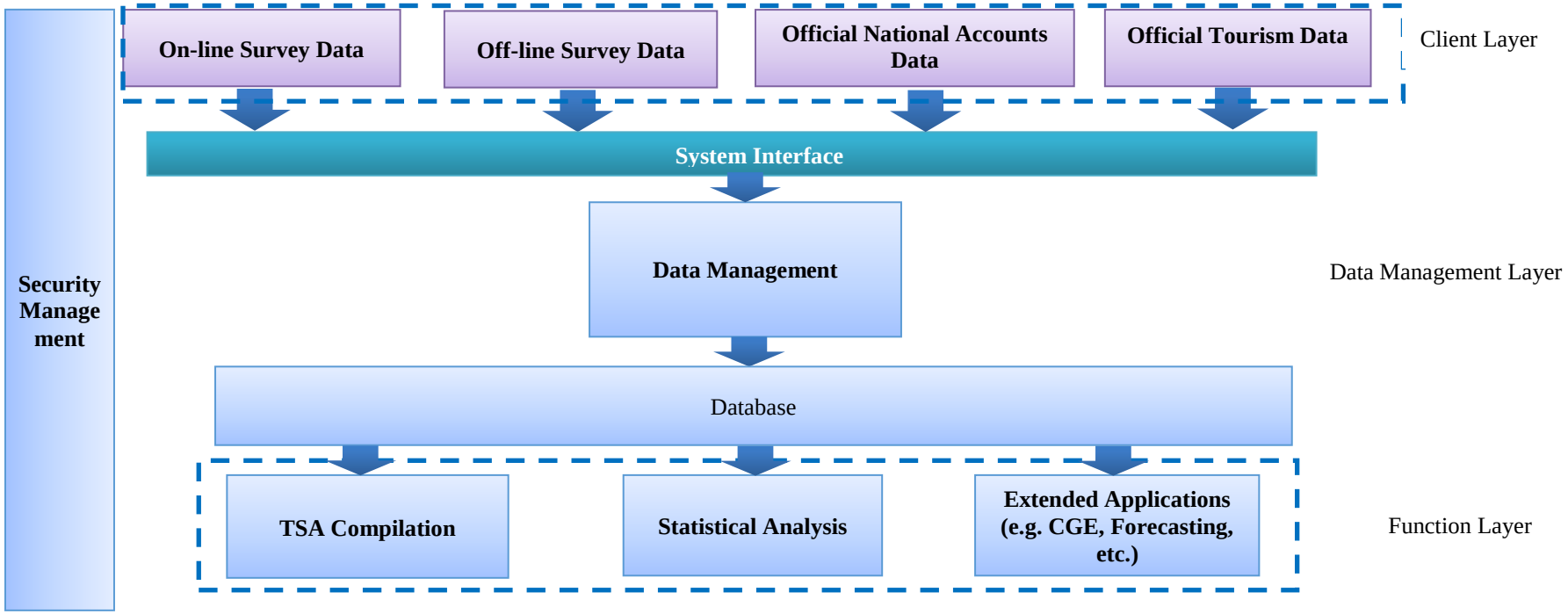


Figure 2. Functions of the Web-based TSA Information System

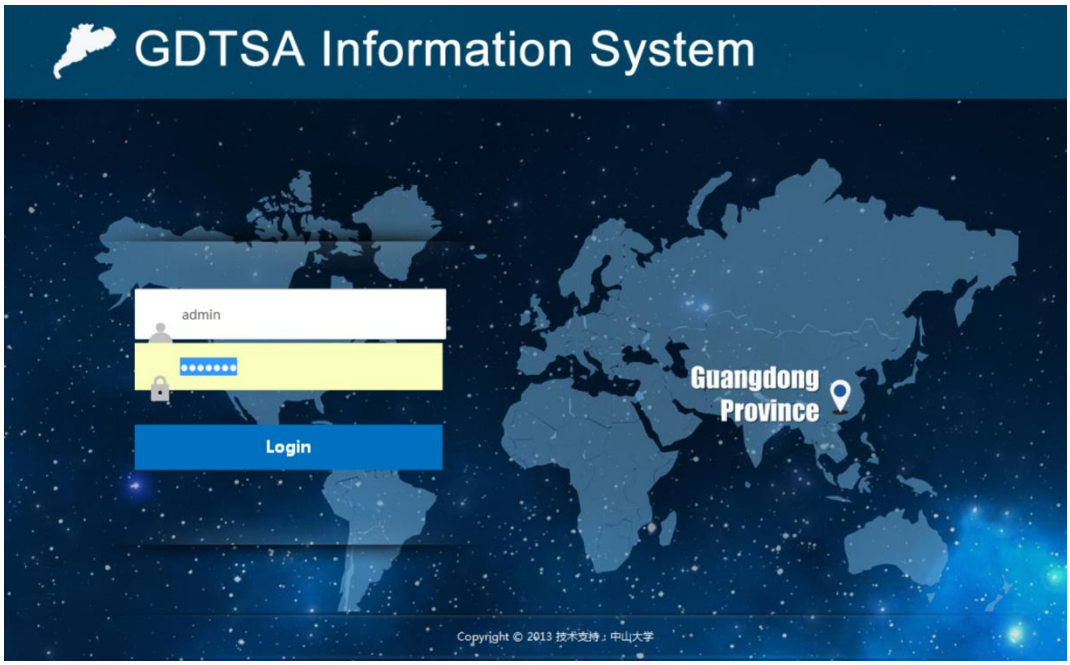


Figure 3. GDTSA Information System Login Page

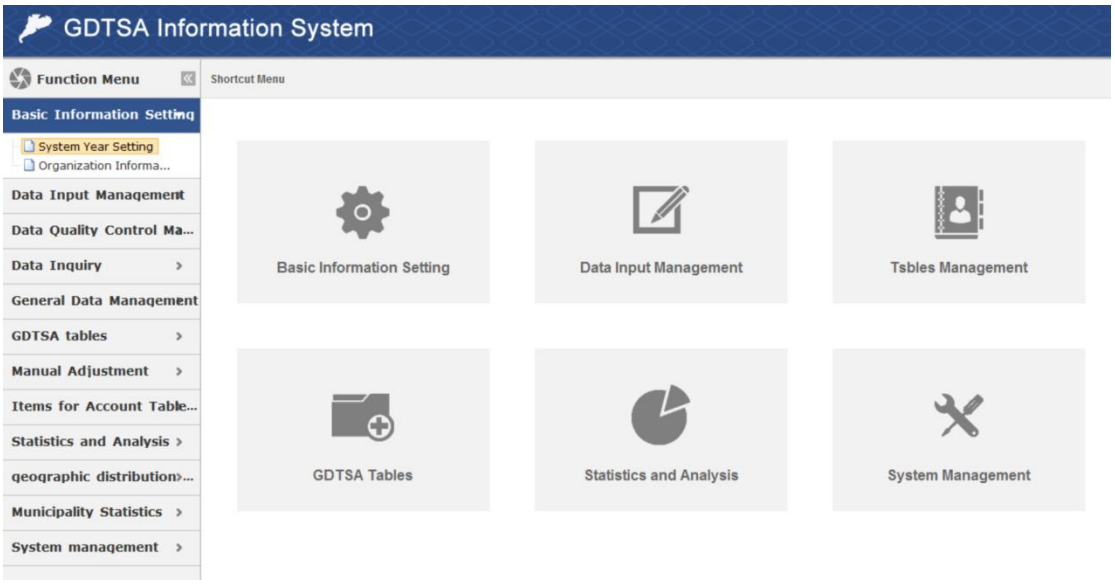


Figure 4. GDTSA Information System Opening Page

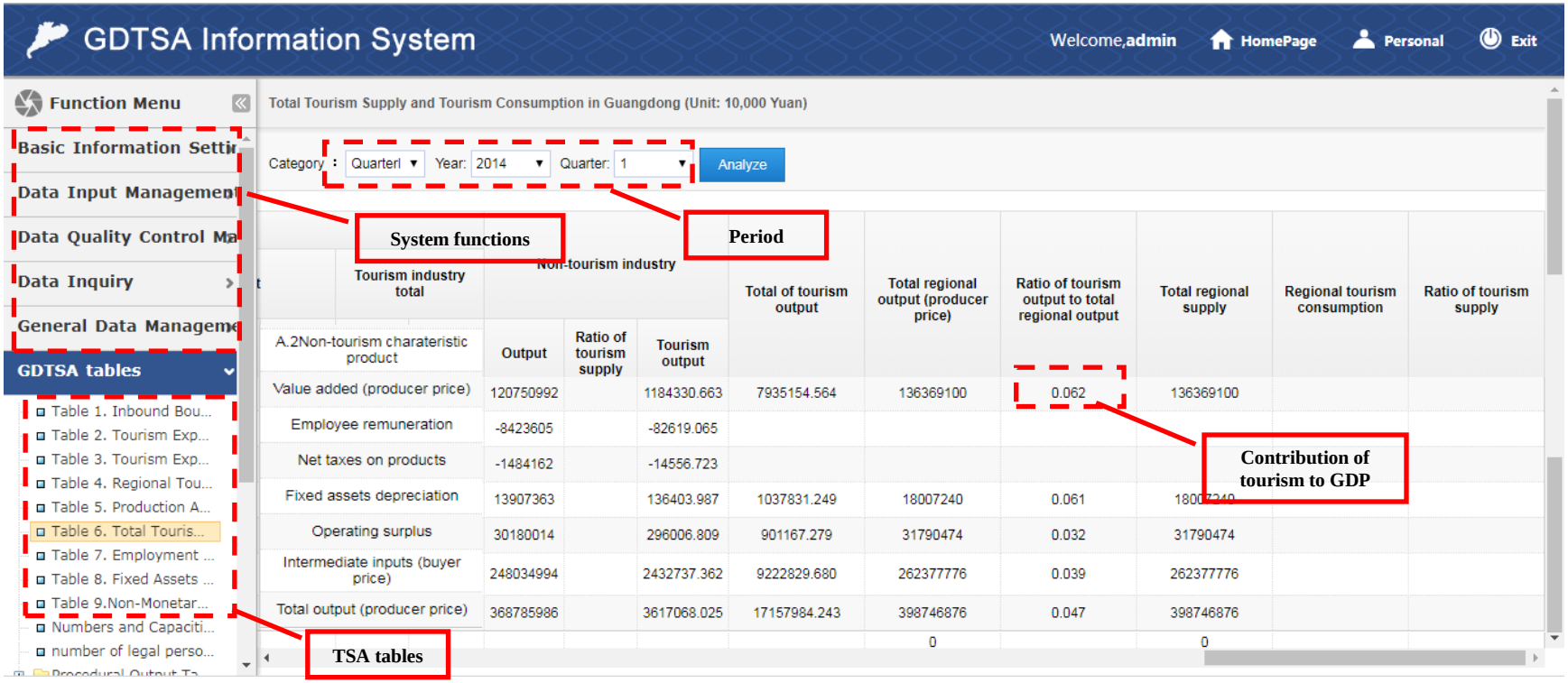
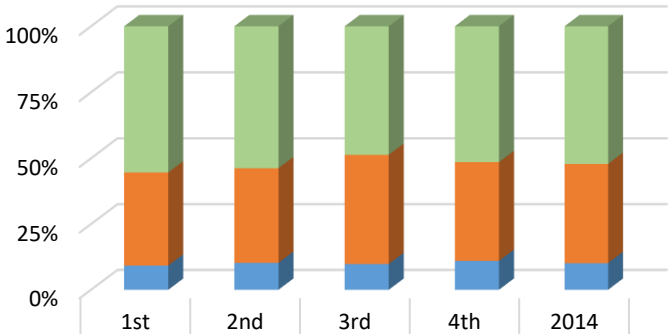


Figure 5. GDTSA Information System Compilation Results



	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	2014 Annual
Guangdong Domestic Visitors	51.95	52.79	52.60	69.77	227.10
Non-Guangdong Domestic Visitors	33.21	35.32	44.86	50.91	164.30
International Visitors	8.61	10.06	10.56	14.89	44.12

Figure 6 Visitor Arrivals to Guangdong Province 2014 (Millions)

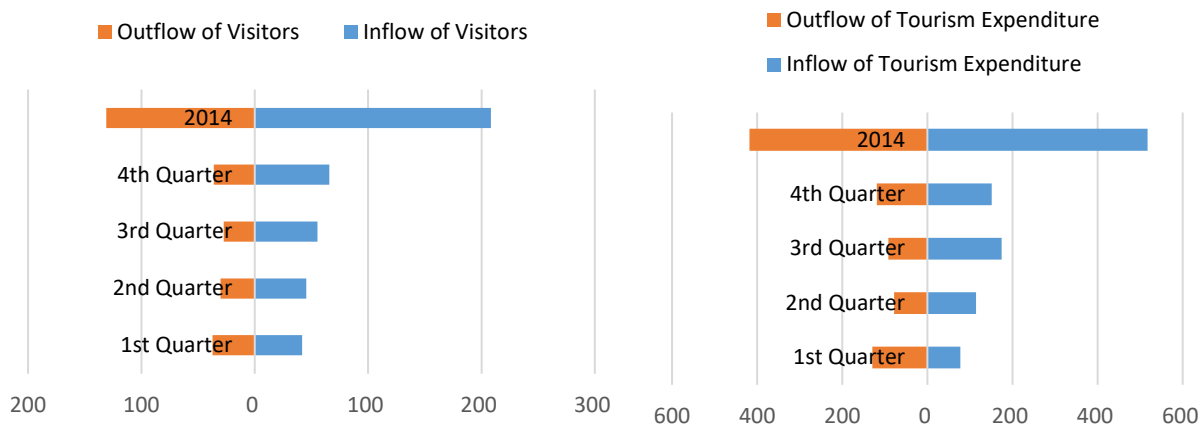


Figure 7 Inflow and Outflow of Visitors and Tourism Expenditure

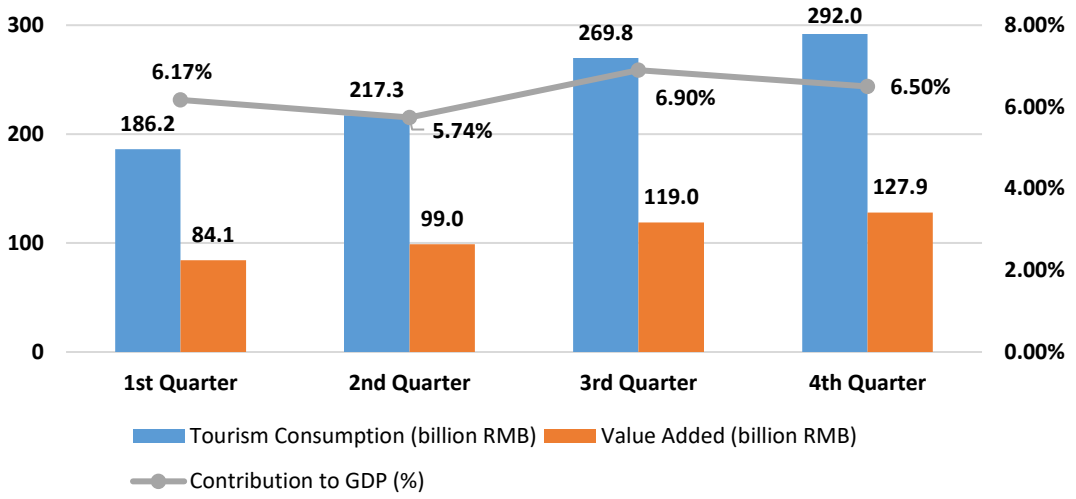


Figure 8 Economic Impacts of Tourism