

Chapter 4

Discussion and conclusion

4.1 Digitization

The aim of this study was to analyze land-use change by using a digitized-grid method, a simple technique that can be used for such analysis, and it also presented a methodology to convert GIS data from polygonal data to grid-point data which was implemented in the R program after loading its *sp* library. Then the land-use change was measured and analyzed which was consequently summarized in a cross tabulation, giving area (in hectares) or percentages of land-use categories, from one period to the next, and it also illustrated a graphical thematic map. With the method to compute RS data, this thesis has been constructed from the prototype for the analysis of land-use change in Thailand.

The new data comprises of a square grid of geographical coordinates with land-use codes and plot identifiers as fields in database tables indexed by the grid coordinates. A digital grid-based data structure was constructed which also provides a simple basis for statistical analysis of land-use development over time.

4.2 Land-use change on Phuket Island

The objective of this study was to investigate land-use change in Phuket Island.

The results show the proportion for land-use change from year to year whereas the bubble plots show the simple statistics where the developer, planner, and geographer can understand the result easily. The increase of urban area was quite important for a crowded city, especially in the south of Phuket Island and the popular beaches, such

as Patong, which is allocated as a tourist area; the human activities and commercial projects have impacted locally because of this.

Moreover, surveys of Phuket city in 1967, 1975, 1985, 2000 and 2009 had similar patterns in change, except for the period when land devoted to urban use increased from 1975 to 1985 but then substantially decreased from 1985 until 2000. This occurred because almost all the mining industry ceased and there was a return to agriculture, hence using the land as farm land or letting it grow wild.

4.3 Urbanization of tourism areas on Phuket Island

This study reviewed available approaches to model land-use change and thus identified priorities for future urbanization growth in three Phuket tourist areas. A logistic regression model was fitted separately to predict these outcomes from 1975 to 2009, with those locations and the land-use 8 years earlier as determinants.

Increasing urbanization in Patong, Kamala and Karon, due to the expansion of the tourism, industry was closely correlated with the increase in the number of tourists, corresponding to the report of Tourism Authority of Thailand (Annual report, 2009) where numbers of hotels in the southern part overshadowed the rest of the regions in number by 25%. During the period of study, Patong, Kamala and Karon had been marginally urbanized whereas 10 years later, Patong and Karon had an urban growth which was more than Kamala and this corresponds to the studies of Wong (2008). He said the contribution of travel and tourism to the GDP will increase growth in the ASEAN community.

Moreover, the results corresponded with other findings concerning urbanization by researchers such as Martin and Assenov (2008), Ying *et al.*, (2009), Bagan and Yamagata (2012), Liao and Wei, (2012), Brown (2013), and Masucci *et al.*, (2013). From the results it can be seen that urban growth around the world is important and needs to serious consideration.

4.4 Concluding remarks

This thesis has highlighted a prototype program which analyzes land-use change by using the digitization. This program was used to compute Remote Sensing (RS) data and perform appropriate statistical analysis; there is no other available software that could do this for free. Using commercial software would have cost more than 6,000-8,000 USD.

This research shows an improved method for storing the rich and valuable land-use database, comprising of polygonal shape files of land-use plots, recorded at regular surveys on Phuket Island. As we have seen, the data structure can be improved by gridding, in which the polygons that vary in shape and size are replaced by a regular and unchanging grid of points on which the land-use is defined.

In addition, the benefit of using the digitized data structure is, as you say somewhere, that the framework on which the data are observed at different periods of time remains constant, and only the data change. This is not the case for the polygonal data structure, because for this data structure the framework changes as well as the data.

The outcome from this research shows land-use change of Phuket Island from 1967 to 2009. So, the question is what urban development and planning measures can be applied to manage the future urban expansion of Phuket? Phuket is the largest Island

and the most popular tourist area in Thailand and as a therefore poses the greatest planning burden to the local Thai government. Therefore, incorporating predictive models into planning will transform present prevailing spontaneous planning into proactive, sustainable planning.

The results of this research will not only assist the urban planners or developers in overseeing the urban expansion in Phuket Island but will also serve as a signal to planners in tourist areas as well as other sprawling areas in Thailand that there is an urgent need to control the incessant urban sprawl which has put enormous pressure on the environment, thus causing environmental degradation.

4.5 Technical terms of the computation of R program

Given that grid-digitized data was used to construct binary data, the R program was useful for computation. I am not aware of any free software that can do this. The R program can display high quality graphics and is flexible and user friendly when used to analyze high statistical computation. Another benefit of the R program, albeit slightly more indirect, is that anybody can access the source code, modify it, and improve it. For this reason, the R program is very stable and reliable.

4.6 Suggestions

The researcher developed and improved land-use data structure by the grid-digitized method which can use logistic regression to predict land-use change. Suggestions will be invited, for improvement and future development of the research. The next step will be to develop another function to illustrate graphics, for example, moving changes in a thematic map like ArcGIS. In addition, I hope to develop Graphic User Interface (GUI) in R, and construct tools make it easier to use the program.

4.7 Synthesis

Remote sensing (RS) data, especially shape-files, contain a lot of information on land-use history. Based on computations by the R program from the program commands, RS data have been fully computed and fully graphical displayed. Without the graphical display, statistical presentation can be illustrated by graph and bubble-plots corresponding to a thematic map. This program can be used to analyze land-use change like commercial software. Using the grid-digitized method is basically for statistical analysis to focus on the percentage of change when the outcome at each grid-point is binary. Binary data can be a good representative of investigation from which the logistic regression can be used for analysis, because the specific land-use of interest is binary (urban or non-urban).

In addition, the benefit of grid-digitized data can be applied to another field which investigates change or predicts within the population. Statistical analysis, data from various determinants, such as accessibility or proximity to roads and transport hubs, climate, and population density, epidemiology, can be incorporated into a model based on gridding to predict what change in the present and future at each grid-point.