

Impervious Surface Area Expansion and Rural Out-Migration in a Typical Mountainous Rural Region, Southwest China: A Case Study of Liping County

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Keywords: Fragmented impervious surface mapping, Rural out-migration, Mountainous region, Remote sensing, Land development, Southwest China

1. INTRODUCTION

Land use/cover and urban/rural population have changed drastically along with urbanization. In China, an expansion of impervious surface areas (ISAs, the artificial surface areas including buildings, roads, etc., through which fluid cannot pass) in rural regions in spite of significant rural out-migration has been discussed recently as an issue of sustainability. There is an urgent need of reliable ISA information in mountainous rural regions to monitor anthropogenic impacts, since such regions maintain abundant ecological services while being sensitive to ISA expansion. However, it is difficult to obtain reliable ISA information in such regions due to the fragmented feature of ISAs, hindering the related analysis of the socio-environmental changes. Hence, focusing on Liping County located in a typical mountainous rural region in southwest China as a case study, the objectives of this thesis are: 1) to provide precise ISA maps by developing a method for fragmented ISA mapping; 2) to estimate the recent time series changes in ISAs and population; and 3) to understand the changes in ISAs and population and propose suggestions for a more sustainable planning.

2. MATERIALS AND METHODS

This study utilized Landsat imagery and developed a local mapping strategy to obtain more reliable ISA information in Liping County. County-level statistics including population were obtained from the local statistical yearbooks. Local development policies and land use plans were obtained from local government. Based on the information of ISAs and population, an individual level questionnaire survey and a land use survey were conducted to understand the ISA expansion and its interaction with rural out-migration. Specifically, the distribution of ISAs was estimated by Random Forests (RF) with incorporating geographic information of towns and villages into the training process. Furthermore, the time series changes of ISAs was analyzed by an integrated algorithm of LandTrendr and RF (LT-RF). Demographic information collected from the questionnaire survey was tested by descriptive statistics and ANOVA to uncover the social situation of Liping County.

3. RESULTS AND DISCUSSION

This study produced a much more reliable ISA map by RF with an overall accuracy of 91% and found that global land cover products overlooked small impervious surface agglomerations in Liping County. Change analyses confirmed that the total ISAs increased from 1,577 ha to 3,308 ha (estimated by LT-RF), whereas the total number of population decreased from 489,600 to 393,000, from 2000 to 2017. The result of descriptive statistics and ANOVA test suggested that the increasing out-migration may contribute to rural residential land expansion. However, it did not indicate that out-migration contributed to ISA expansion, since the land use survey implied the residential area was a small proportion of ISAs. Local land use policies revealed a significant increase of infrastructures and industrial lands, which may essentially contribute to ISA expansion.

4. CONCLUSION

This study produced more accurate ISA maps in Liping County that were difficult to be obtained from global land cover products and local governments. The fragmented ISA mapping strategy proposed in this study could obtain more reliable ISA information in mountainous rural regions. This study shows that ISAs are expanding despite the small population, which implies an excessive ISA development in the study area. It also suggests that ISA expansion in mountainous rural regions in China might be primarily driven by local development policies and plans. This finding may imply a big gap between local land use plans and the reality. Hence this study proposes that a more sustainable land use planning strategy should be based on the real situation of ISA development. Compared to conventional ground-level surveys, using remote sensing approaches could alleviate the cost of obtaining ISA information, which makes land use planners and policy makers acquire real situations more easily and economically.