Advance Journal of Food Science and Technology 11(9): 629-632, 2016
DOI:10.19026/ajfst.11.2740
ISSN: 2042-4868; e-ISSN: 2042-4876

Submitted: August 17, 2015 Accepted: September 14, 2015 Published: July 25, 2016

Research Article

Urban Fringe Agriculture Landscape Garden Space Pattern Qualitative Analysis Based on GIS

Yan Long and Changyou Wu
College of Urban Construction, Wuhan University of Science and Technology, Wuhan, China

Abstract: Based on GIS technology and agriculture landscape ecology theory, the change in Wuhan urban fringe agriculture landscape gardening spatial pattern in terms of agriculture landscape level during 1989-2013 has been analyzed in the thesis, by choosing such the agriculture landscape pattern indicators as PLAND, PD, FRAC-MN and CONHESION. According to the result, the space of Wuhan urban fringe agriculture landscape gardening has had a dramatic change in both PLAND and PD. In terms of PD, growth and stability is the main direction; the higher density produces a higher degree in mixture and fragmentation and thus becomes all the similar to the completed zone and mature.

Keywords: Agriculture landscape, GIS, urban fringe, Wuhan

INTRODUCTION

Currently, urban ecological problem is mainly caused by improper land utilization method and strength, mainly in the cases of substantial loss of natural ecology, worsening loss of water and soil; the increase in agriculture landscape fragmentation; single agriculture landscape structure and low agriculture landscape accessibility. Although there has been no shortage in the research on limitation of agriculture landscape and quantitative analysis, yet the research on the agriculture landscape pattern optimization based on a complete and quantitative analysis by use of RS and GIS remains very little. Trying to make a quantitative analysis on Wuhan urban agriculture landscape pattern by means of GIS and Gragstats, combined with the methods of ecological adaptability, sensitivity, ecological service function, economic level and overall agriculture landscape pattern optimization, the thesis is compiled to explore the spatial channel Wuhan urban ecological regulation, aiming to achieve the goal of urban agriculture landscape pattern optimization, build a reasonable and stable urban natural ecological system, guide the reasonable allocation and use of regional and urban land and space resource, protect the benign circle of regional ecological circle in both urban and rural areas and thus put guarantee on urban sustainable development (Li, 2012). On the whole, it can be seen from the perspective of agriculture landscape index change that the dynamic evolvement urban fringe agriculture landscape space is fast in the sizes and densities of the agriculture landscape patches, while slow in patch shape and distribution.

MATERIALS AND METHODS

Overview of the research zone: The research zone is located at the confluence of the middle section of Yangtze River and Hanshui River on Jianghan Plain. It ranges between east longitude 113°41′-115°05′ and north latitude 29°58′-31°22′, covering an area of 8467 km^2, including 3963.6 km^2 downtown areas, 736.51 km^2 suburbs and 3740 km^2 county area under the administration of the city. It is low and flat in the middle in terms of tectonic structure, with most of the part below 50m; there are hills in the north, the extension part of Dabie Mount; the area higher than 200m altitude account for 5% of the total area and the rest is entirely covered by vast plain. The land is flat and low on the whole, largely dotted by lakes and traversed by rivers represented by Yangtze River and Hanshui River (Fu and Chen, 2001).

Agriculture landscape pattern quantitative analysis method:

Classification of agriculture landscape: Quantitative analysis on agriculture landscape pattern must be made on the basis of agriculture landscape classification. There are different classification systems for agriculture landscapes---classified according to the strength of human impact, the type of land utilization, the degree of nature and the type of vegetation and geography.

Corresponding Author: Changyou Wu, College of Urban Construction, Wuhan University of Science and Technology, Wuhan, China

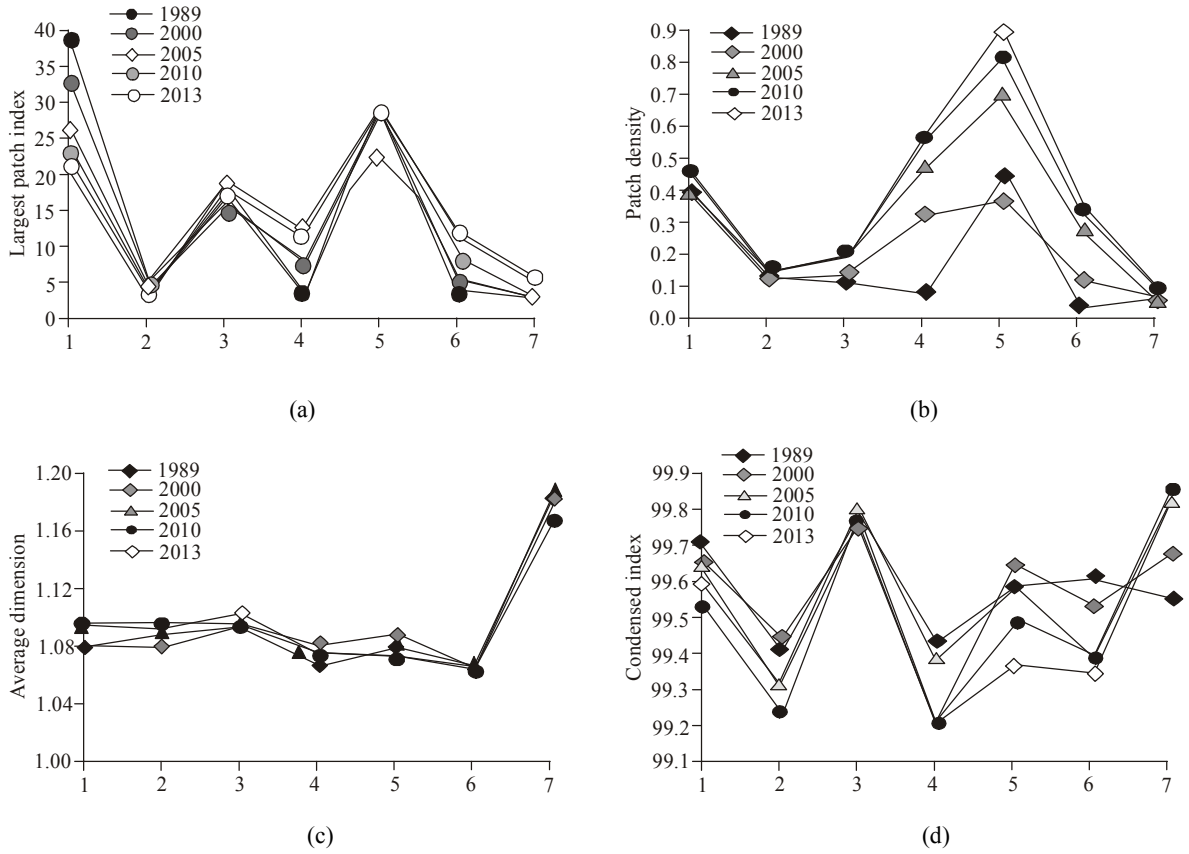

Fig. 1: Patch type spatial pattern index curve (1989-2013); the Fig. (a) to (d) along the horizontal axis respectively represent cultivated land, forest, water, unused land, residence, industrial zone and traffic agriculture landscape patch; data source: spatial pattern data analyzed by the author

The analysis is supported by the remote sensing images and substantial data collected from field investigations of Wuhan City at stage V respectively in 1989, 2000, 2005, 2010 and 2013 and proceeds with such analytical techniques as GIS at macro or middle level, remote sensing imagery interpretation and Fragstats indicator analysis (Wen-ze, 2005).

With Landsat TM image man-machine interpretation results at stage V program of Wuhan City respectively in 1989, 2000, 2005, 2010 and 2013 as the data source and Suggestions for National Land Remote Sensing Investigation Work, Land Remote Sensing Dynamic Monitoring and Technical Specification and National land classification standard as the basis, grade-II classification for the agriculture landscapes on the fringe of the city has been made in the thesis and after that, agriculture landscape classification diagram has also been formed. There are four natural agriculture landscapes patches: Cultivated Land (CL), Water agriculture Landscape (WL), Forest agriculture Landscape (FL), Unused Land (UL); three artificial agriculture landscapes: Industrial agriculture Landscape (IL), Residence agriculture Landscape (RL) and Traffic agriculture Landscape (TL). The patches above are profoundly changing the fringe of the city, either in terms of natural ecology effects or natural environment. Among, UL is particularly worth noting. Urban fringe zone is the starting trip for urban expansion, while UL is the primary zone that the fringe zone turns from natural agriculture landscape patch into artificial agriculture landscape type and also the intermediate stage of the ecological effect from positive to negative. The change is dramatic and typical and therefore incorporated into the research.

Analysis on agriculture landscape space pattern: After processing the agriculture landscape diagram by use of GIS software like ARC/INFO and ARCVIEW, the research transformed land utilization vector data to 100×100m-pixel raster data with the support of ArcView software spatial analyst, used Fragstats and calculated agriculture landscape pattern indicator from the terms of patches, patch types and agriculture landscapes to reveal the characteristics of agriculture landscape pattern in the research zone (Wen-feng, 2007).

Quantitative analysis result: A horizontal comparison has been made for all kinds of agriculture landscape patches. The changing characters of the indicators for

those different types of agriculture landscapes are also drawn as in Fig. 1.

Figure 1 above reflects the dynamic change of the spatial pattern features of the 7 different agriculture landscape patches at 5 stages. It can be judged on the whole that the percentage curve of the patch size is parallel to the average fractional dimension curve during these stages and the patch density and conhension index meet relatively larger fluctuation. Although the agriculture landscapes are quite stable in terms of size ratio and patch shapes, it is a different case for the degree of patch fragmentation and the agglomeration pattern between the patches over time.

RESULTS AND DISCUSSION

(PLAND) patch size percentage: From Fig. 1a it can be seen that over 25 years, the size ratio of cultivated agriculture landscape patch has been in a trend of downturn until 2010; while the patches of residence, industrial zone and traffic agriculture landscape suggest an opposite trend-- declining after lifting up with 2010 as the time node; with 2005 as the time node, the size of unused agriculture landscape patch showed continuous growth before slight decline; and the changes in the sizes of other agriculture landscape patches are just slight. The trend, on one hand, reflected the expansion of the artificial agriculture landscape in the process of urbanization and the erosion of natural agriculture landscape patch and on the other, suggested the gradual strength of the public environment consciousness (Cai, 2012).

(PD) Patch Density: From Fig. 1b, it can be noticed that the change in patch density has a connection with the percentage of the patch size, but it also has its own features. Due to the fact that the traffic agriculture landscape patch is a linear continuous agriculture landscape, the patch density has been at a low value; the unused land, residence and industrial agriculture landscape patch are all basically in dramatic expansion; while the densities of other agriculture landscape patches never show a big change range. The above cases suggest that artificial agriculture landscape patch is the major type guiding the increase of agriculture landscape spatial density and that fragmentation and blending are the transition signs from urban fringe to build-up downtown.

(FRAC_MN) average fractional dimension: What can be seen from Fig. 1c is that the agriculture landscape patches are all subject to small fluctuation in basically stability condition; the fractional dimension of the cultivated land and the forest are just on a minor ascent, compared with the declining and then lifting trend of the unused land, residence and traffic agriculture landscape patch; and water and industrial agriculture landscape patches are basically in a stable condition. the trend above tells us that the adverse effects of human activities on the current agriculture landscape patches is diminishing and artificial agriculture landscape patch is also bouncing in the natural direction after a period of blind growth.

(CONHESION) Conhension index: Cultivated land and forest patches have been in a downtrend until 2010; the unused land, residence and industrial agriculture landscape patches are basically declining all the way; while the traffic agriculture landscape patch is basically in a rising trend; the changes suggest that the natural agriculture landscape patch has partly been restored after erosion and the connected growth brought by traffic agriculture landscape patch has strengthened the degree of mixing of the artificial agriculture landscape patches. To more clearly display the relative change of the agriculture landscape index of different agriculture landscape types, calculate the maximum difference value of the patches based on their types (the difference between the maximum and minimum values). It can be seen that unused land and the industrial agriculture landscape patch rank the first two in the relative change range curve, which suggests that the development of urban fringe zone has the biggest influence on these two agriculture landscape patches. Judging from the dynamic change of the index, the patch size percentage and density has relatively larger amplitude of change, compared with the average fractional dimension and conhension.

CONCLUSION

In terms of size, there has been an entirely opposite trend between the natural and artificial agriculture landscape patches, which can be specifically reflected in the shifting process of the cultivated land, industrial and residential zones. From the earlier stage to 2010, the natural agriculture landscape were hugely eroded while the artificial agriculture landscape developed at a fast pace before bouncing back and ecological restoration effect began to appear (Long and Yanni, 2013). In terms of patch density, increase and stability is the major direction; the degrees of blending and fragmentation increases with density, which suggests that it is more similar to the build-up zone and more mature. While in the angle of average fractional dimension and conhension, the change is not that dramatic and the contradiction of urban development and ecological restoration remains in a constant dynamic change over the 25 years.

REFERENCES

Cai, Q., 2012. Based on the analysis of agriculture landscape ecological pattern of urban space evolution law and ecological security pattern to build. Hunan University, China.

Fu, C. and X.P. Chen, 2001. Urban fringe area agriculture landscape change and the influence of human space differentiation research. J. Geogr. Sci., 21(3): 210-210.

Li, Y.Y., 2012. Research on urban green spatial and temporal evolution and ecological environment effects---taking shanghai as example. Fudan University, Shanghai, China.

Long, Y. and W. Yanni, 2013. The theoretical framework of urban fringe area agriculture landscape space characteristics research study. Proceeding of the Chinese Society of Agriculture Landscape Architecture.

Wen-feng, G., 2007. Natural forest agriculture landscape dynamic process based on RS and GIS songpan and classification research. The Northeast Forestry University, China.

Wen-ze, Y., 2005. Effection research Based on remote sensing image of urban agriculture landscape pattern and its thermal environment. East China Normal University, China.