

# Urban Housing Development in Western China: Case Study of Yinchuan City

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Recently, a boom in urban development has been reported in the inland provincial centers of China. Previous studies focused on housing on a national scale or examined the conditions in east coastal mega-cities, but very few empirically analyze the housing of inner cities with weaker market economy and less local entrepreneurial skills. Our hypothesis is that in 2-tier Chinese cities with weaker market economy the location of public programs, such as social housing and key facilities, directly influence the commercial housing development pattern, which in turn determines the sustainability of the land consumption. Thus, the aim of this research is to assess the impact of public programs on the pattern of housing from the perspective of density, efficiency and spatial equity management, through an empirical study of Yinchuan City, Western China.

The assesment is based on GIS spatial analysis. Moreover, we propose a new method based on Voronoi diagram to assess the spatial equity in allocation of public facilities. The findings are: 1) In the market-oriented period, local governments of inner cities still lead the housing development with allocation of public programs; 2) However, in Yinchuan the distribution of public programs is not consistent with the city's spatial strategy; 3) Moreover, the distribution of public facilities does not promote horizontal spatial equity in the city. In order to efficiently guide the housing development, the city needs to reconsider its strategy in allocation of public programs based on more integral local context research that will include market mechanisms, historic place significance and spatial equity considerations. In China, where there is a massive number of smaller inland cities with unprecedented urban expansion like Yinchuan, the Voronoi diagram method can be a useful modeling tool for adjusting the distribution of public programs to achieve equitable and sustainable outcomes.

## INTRODUCTION

The expansion of contemporary metropolitan regions raise important questions regarding the sustainability of the urban planning, especially in terms of resource depletion and social equity [1]. In this context, the extraordinary urban development in China is becoming significant in understanding the specificities of emerging polycentric urban structures in state-led transitional

economy, where the state is the main entrepreneur in the land development [2, 3, 4, 5, 6]. With the shift to market economy (1978) the large coastal cities became the main development centers while the inland cities progressed at a slower pace [7]. Nevertheless, lately a boom in urban development has been reported in the inland provincial centers as well [8], with some cities tripling their urban land area in less than 20 years. The explanation of this rapid development goes far beyond market forces, namely in the growing power of local states brought by the administrative decentralization and the fiscal reform (1994) that empowered local governments to manage and profit from the urban development of their territories [9]. The major part of this urban land increase is for housing, particularly evident in mushrooming of large gated communities on the peripheries. These proliferating projects are seemingly spreading in an unordered pattern, consuming substantial amount of arable land, inflating housing prices, worsening living conditions among the urban poor and contributing to air pollution and traffic congestion in the city [10, 11, 12, 13]. The aggregated effect of unsustainable housing development in the smaller inner cities can have enormous consequences on the living standard and environmental degradation in Western China. Thus, the 13th Five Year Plan (2016-2020) of China explicitly focuses on a shift in city design strategy from outward expansion to improvement of the quality of municipal infrastructure and public service facilities. Therefore, it is essential to evaluate the impact of public programs on the pattern of housing development in 2-tier western Chinese cities from the perspective of city management.

## LITERATURE REVIEW, RESEARCH QUESTION AND AIM

Factors frequently criticized for stimulating sprawl in developed countries are transportation infrastructure, housing mortgage policies, economic growth as well as planning and zoning. For instance, it was found that land use regulations which mandated low densities have caused sprawl [14]. In the Japanese *Senbiki* system, the Urban Promotion Area drawn by the local planning authority provided lavish expansion room, in addition to public investment projects, thus sprawl was encouraged rather than halted [15]. Wu [4], Wang and Murie [16] and Luo and Shen [17] argued that in China the pro-growth feature of local governments and intercity competition to attract investments, based on rural land acquisition, were the engines behind the rapid expansion. Wu and Phelps [6] discussed that the unprecedented acceleration of urban processes in China has brought

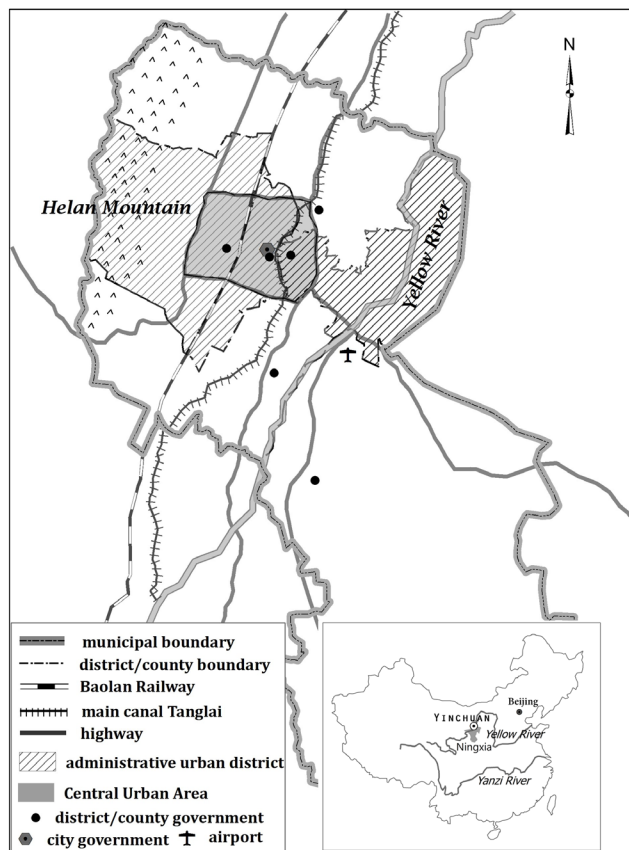


Figure 1. Yinchuan's Central Urban Area. By authors.

simultaneous occurrence of suburbanization and post-suburbanization in large cities.

The housing reform of China was explained thoroughly by Man [18], while Fu [19] saw the weakness of civic territorial organizations as the main issue in housing. The private governance in China was defined by Lu et al [20] to refer to services delivered by private organizations rather than self-governance. Flock et al [21] and Xiao et al [22] identified the commercial housing as main culprit in growing residential segregation and urban fragmentation. These studies mainly analyze the urban housing growth from an aspect of system transition or actors in an institutional and social-economic context, but they do not provide an empirical analysis of the effects of public programs on the housing development. A few studies [23, 24, 25] reviewed the housing development in Yinchuan, however, without an in-depth analysis of the factors that affect the housing development.

Thus, the main questions of our study are: In a period of rapid urban expansion, polycentric restructuring and commodification of housing in China, has the urban housing planning transformed itself in multivalent organizational system that guides and serves the new community of interacting agents? More specifically, in the 2-tier inland cities with weaker market economy and less local entrepreneurial skills compared to the coastal mega-cities, is the housing really expanding randomly?

Finally, what are the effects of public programs on housing development in terms of density, efficiency and spatial equity management? The public programs that we focus on are social housing and key public facilities.

The hypothesis of our research is that in 2-tier Chinese cities with weaker market economy the location of public programs directly influence the commercial housing development, which in turn determine the sustainability of the land consumption in the city. Therefore, the aim of this research is to clarify the effects of public programs on the spatial distribution of housing through an empirical research in Yinchuan City, Western China and assess the implications on density, efficiency and spatial equity management. In the context of China, where there is a massive number of smaller inland cities with unprecedented urban expansion like Yinchuan, these results can have a crucial role in determining the strategy for management of the housing expansion.

## METHODOLOGY

Firstly, we assessed the housing supply in Yinchuan in relation to the population and GDP rate in order to evaluate the sustainability of the housing market. Secondly, we analyzed the development of the modern urban structure and the spatial planning intentions for the city by reviewing master plans from 1983, 1996 and 2007. Afterwards, with GIS spatial analysis we investigated the pattern of public programs and commercial housing to assess the effect public programs have on the spatial distribution of housing and assess the effectiveness in achieving the planned structure. This method is innovative because it analyzes the urban housing development from an aspect of city management in weaker market economy, supported by empirical data. Finally, in order to evaluate the impact of public facility location on spatial equity, we proposed a new method based on a Voronoi diagram that define values for urban areas based on proximity to facilities. At the end, we discussed issues that should be considered in future planning of housing in cities with weaker market economy, based on the lessons learned from Yinchuan.

The data for this study included: public statistical records of Yinchuan's population and GDP (1980-2014); construction year, location and units number for housing projects (1980-2014), obtained from the city's construction archive and Yinchuan housing development chronicle; maps of commercial and social housing projects (2005, 2014) and list of completed projects by the Housing Bureau; and site plans of projects under construction from the Planning Bureau. Moreover, we reviewed Yinchuan's housing policies and plans issued by the city. To establish the conditions of projects without precise data on record, we conducted field surveys (2015, 2016) and reviewed aerial images.

## THE CASE STUDY: YINCHUAN'S CENTRAL URBAN AREA (CUA)

Yinchuan is the capital of Ningxia Autonomous Region and a center for the Hui Muslim minority group that comprise 1/3 of

the city’s population. The municipality is comprised of three urban districts, two rural counties and one county-level satellite city, in an administrative area of 9,025.38 km<sup>2</sup> and a population of 2.13 million (2014). The urban built-up area is 148.6 km<sup>2</sup> (2014). In this study, we focused on the Central Urban Area (CUA) designated by the city’s Master Plan of 2007-2020. The CUA is located on a plain between the Helan Mountain and the Yellow River, delimited by the loop highway in approximately 400 km<sup>2</sup> (Figure 1). It houses more than half of Yinchuan’s population, and it has been under major urban development and planning control in the last few decades.

**MARKETIZATION OF HOUSING AND HOUSING SUPPLY**

Modern housing development in China started after the establishment of the socialist state (1949), where housing was considered a welfare service [18]. Together with workplaces and facilities, housing was allocated to each city in the form of *work units* according to the central economic plan. Thus, the *work units* were self-sufficient developments, usually located on the city periphery for lower cost and with very low social segregation [4]. In 1988, the National Congress legalized the “paid transfer of lands”, allowing private developers to invest in housing based on market mechanisms, thus initiated the commercial housing development (CD). However, in 1997, 73.90% of annual constructed housing in Yinchuan was still public investment. After the 1998 State Council decision to terminate the welfare housing, private investment in urban housing increased 89.5%, while the share of public investment had fallen 26.63%. From this period, less than a quarter of housing came from the public sector as social housing development (SD). After the massive investments in infrastructure by the city’s “Big Yinchuan” plan in 2002, the investment in housing was up 67.81% in 2002 and 69.83% in 2003. In 2014 the annual housing construction area reached 17.86 million m<sup>2</sup> – tripled compared to 2007 and nearly 12 times more than in 1999. Moreover, the volume of housing projects was significantly enlarged – more than 10% of the housing projects have over 2,000 units, accompanied by abrupt increase in housing price (18.22% in 2008 and 23.61% in 2009).

During 1981-2014, the stable increase of urban population was accompanied by a growth of urban housing (Figure 2). However,

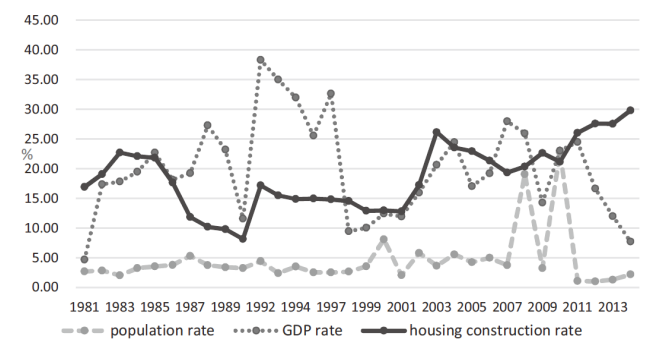


Figure 2. Housing construction, population and GDP rate. By authors.

since 2002, the housing construction rate has a much more rapid growth than the population. The data shows that particularly after 2011, the population increase has been slow while the housing construction kept growing significantly. Moreover, the growth of housing has been consistent with the GDP growth, yet recently the GDP rate is slowing down while the housing is still increasing. Thus, it seems that developed housing have already exceeded the demand for residential space since the new dwellings have consistently outnumbered new households; nevertheless, more houses are under construction. The control of excessive housing seems to be an urgent issue for the city.

**URBAN STRUCTURE AND HOUSING PROMOTION**

In this chapter, we reviewed the urban structure and city’s intentions in the domain of housing promotion by analyzing master and housing plans (Figure 3).

The historic areas of Yinchuan are the “Old Town” (OT, 678 AD)-a traditional trading center located east of the Tanglai canal, and “New Town” (NT, 1739 AD)-originally a defense fort 7.5 km west of OT. In 1958, after the construction of the Baolan railway, a new urban area Xinshiqu was planned west of NT, as an industrial, educational and administrative core to accommodate *work units*. Thus, a Triple Core urban structure was established.

In 1992, a new High-Tech Zone between OT and NT became the “Forth Core”. In 2002, in order to support the rapid urbanization, the districts were enlarged and re-demarcated into West (Xinshiqu), Central (NT and High-tech), and East (OT), separated by the Baolan railway and the Tanglai canal. Thus, the urban structure of the CUA was transformed into a “Triple Agglomeration”. Currently, the West functions as an industrial and education core, the Central is focused on administration and business, and the East is trade and distribution center.

Before 2002, the population of the former East district was slightly larger than in the West (272,783 and 211,114 respectively). However, in 2014 the share of Eastern residents had significantly increased in comparison to the Central and West (725,200 East, 299,200 Central and 349,100 West). In regards to the economy, the West has led the development in this decade, while most recently the Central shows slightly higher GDP growth and likely a greater economic potential.

(I) 1983-2000 Master Plan and the revised plan of 1994: In the Master Plan of 1983, the idea was to distribute new housing in the northern parts of Xinshiqu and surrounding OT and NT. Meanwhile, redevelopment of the historic towns was encouraged. When the plan was revised in 1994, new housing was planned east in the new High-tech Zone (Figure 3, I).

(II) 1996-2010 Master Plan and new designated mix-use zones: In the master plan of 1996-2010, the intention of balancing the housing between East and West is clear: in the east, renovation

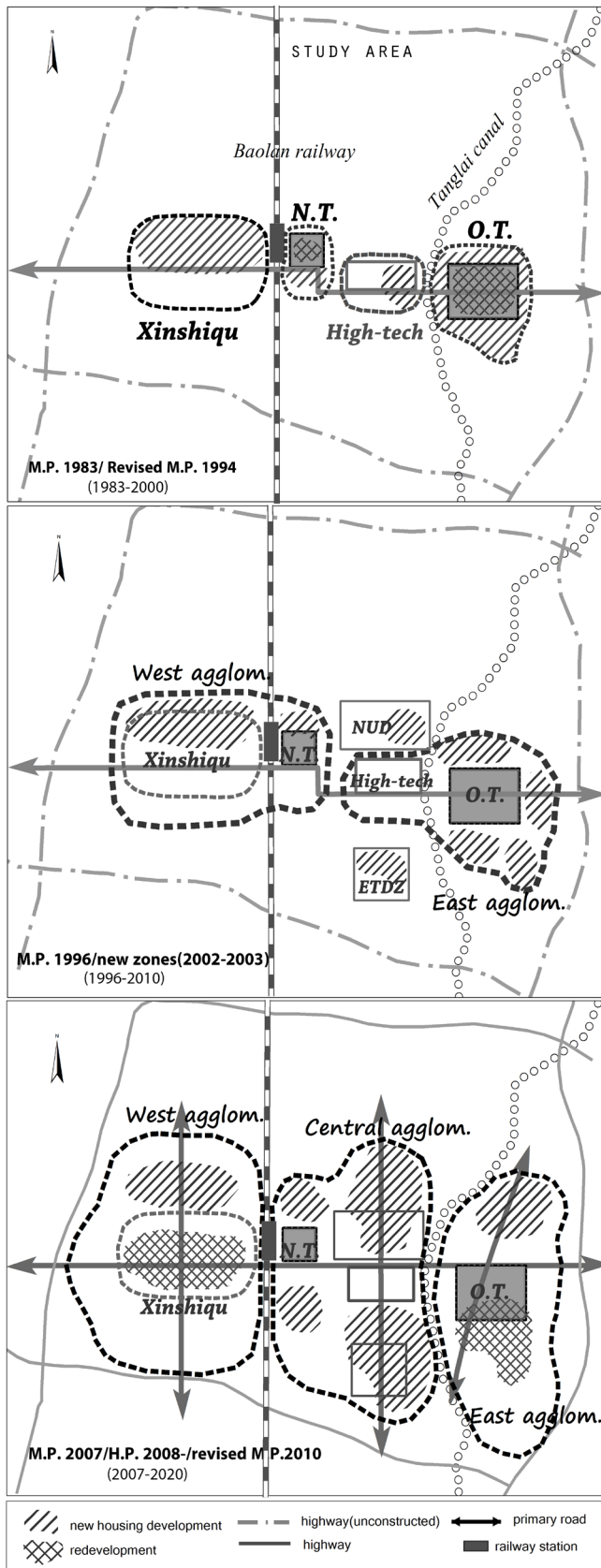


Figure 3. Urban structure and housing promotion in city plans. By authors.

of old housing in OT and four clusters of new housing were planned; in the west, new housing projects were concentrated north of Xinshiqu and NT. In 2002, the city decided to direct new developments into the Central where a New Urban District (NUD) was planned for 90,000 residents (Figure 3, II).

(III) 2007 Master Plan and the revised 2010 plan: According to the 2007-2020 Master Plan, subsequent housing plans and the revised 2010 master plan, the housing strategy was: 1) focus on the Central by promoting new housing in north-south direction; 2) prioritize the West by improving old housing in Xinshiqu and developing new housing in the north; 3) control the East by restraining new developments and promoting redevelopment of the shanty houses in the southern OT (Figure 3, III).

Therefore, from 1983, the plans have continuously targeted a spatial balance of housing between the west and the east.

### EFFECTS OF PUBLIC PROGRAMS ON COMMERCIAL HOUSING DEVELOPMENT

The direct public intervention in housing weakened significantly after 2000. In this chapter, we examined the effects of public programs promoted by local governments, such as social housing and facilities, on the housing expansion in the new market-oriented context.

After 2000, local governments are mainly involved in two types of housing: a) social housing planned and financed by the government with priority in land allocation; b) major investment-invited projects proposed by governments and financed by private developers. The second type is usually a large mix-used complex supported by preferential terms.

We found that after the planning of NUD and ETDZ (2002), large social housing projects were the first to be developed there (Figure 4, Housing 2000-2007), followed by other facilities like schools and public transit, as well as commerce. Considerable proportion of social housing was developed in the east as well, while the west had much less developments. In the east, social projects were mainly located at the frontier as residential clusters with around 5,000 units. Some of these projects were even developed as a leapfrog, which encouraged private projects to infill the area. As social housing progressed in the central and the east, they were followed by private projects in the surroundings (Figure 4, Housing 2008-2016). This indicates that social housing projects lead the commercial housing by signaling to developers that infrastructure and facilities will soon follow.

Similarly, we found that key investment-invited projects have the same impact on promoting commercial housing. For example, one project with 10,000 housing units located in the east, which contains a key primary school, a park and several commercial complexes with offices, is quickly becoming a new urban housing node. However, in the west, both public and private projects were scattered

In 2002, a key high school was relocated from OT to the southern farmlands (1 - Figure 4, Key public facilities 2000-2016). This triggered a massive expensive housing development in its vicinity, called "School District Housing". The trend continued with another two key schools from OT being relocated to the periphery in 2005 and 2008 (3 and 6), while one school from NT was relocated in the southern outskirts in 2006 (4). The relocation of these high schools was a trigger in commercial housing development around the new sites. Moreover, since 2002, the waterways in the city were restored and several large parks were developed around the channels, which spurred development of high-class gated-communities around the new parks.

Majority of key facilities developed after 2008 were located in the east and central areas and, as expected, the highest land prices are found around those facilities. It was revealed that OT, areas around the Lake Park 4, NUD and east of Park 2, had outstanding increase in land price (more than 1800 yuan/m<sup>2</sup>) between 2001 and 2013. Other central areas also experienced substantial rise (more than 1000 yuan/m<sup>2</sup>), while the west saw relatively small increase (less than 800 yuan/m<sup>2</sup>). Thus, the imbalanced distribution of amenities is likely the main reason for the exacerbating gap of housing market prospect between the east and west.

During 1980-1999, all housing was confined to the planned area. In 2000-2007, with the rapid development of the market economy, over 10% of housing was developed outside the planned boundary and mainly in the east. After 2007, only 5.50% of all the projects were developed beyond the planned boundary, however, the revised plan of 2010-2020 expanded the eastern boundary to include developments carried out before. Even though the focus of housing was successfully reoriented to the Central, the idea of controlling the east expansion is not effective. Thus, physical regulation alone may not be sufficient in controlling the housing development.

The public programs spatial distribution undoubtedly had the effect of attracting commercial housing development. It seems that in inner cities with weaker market economy the commercial housing is not led by market mechanisms but by public programs. The problem arises from the fact that public programs were not distributed according to the city's spatial intentions and mostly benefited the east. The obvious preference for the eastern parts might be related to cultural factors, such as the inherent local character of the historic OT that might even be a stronger generator of land value than public programs. For example, even though some leapfrogged housing in the east can only be accessed by unpaved roads, the area is still preferable for developers. While the commercial developments in the central agglomeration have high vacancy rate, the population density of OT is ten times higher than in the Central. We argue that the city needs to reconsider the strategy in allocation of public programs based on more integral local

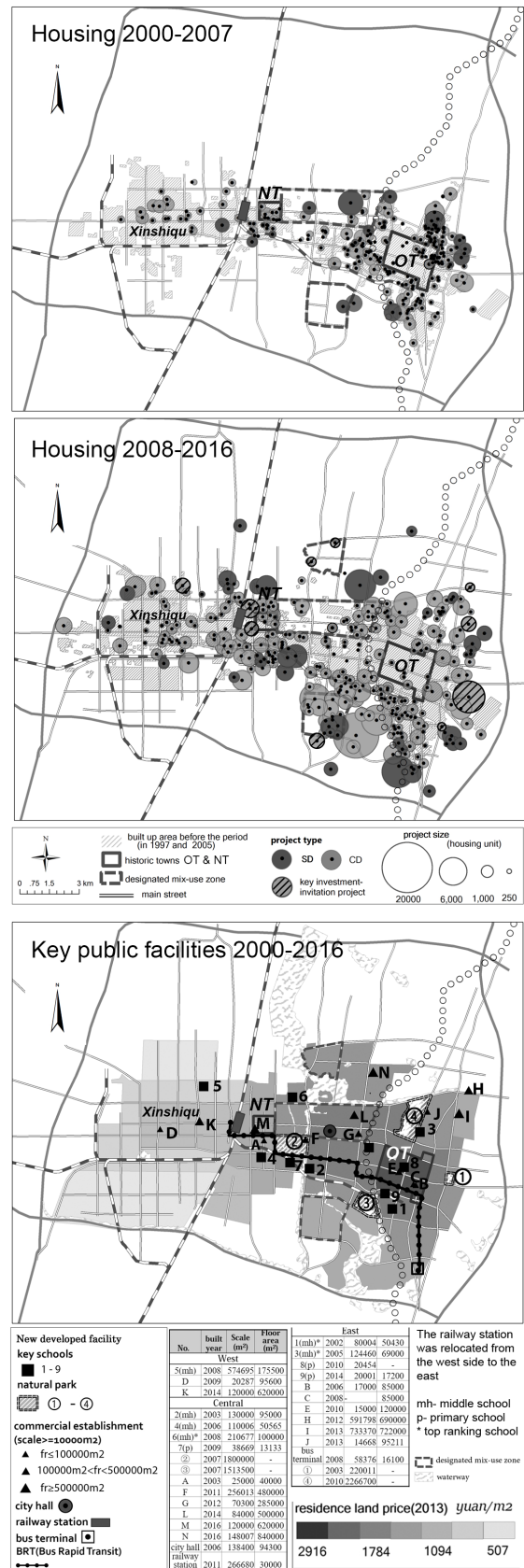


Fig. 4. Spatial distribution of housing and key facilities 2000-2016. By authors.

ment of housing and key facilities 2000-2016. By authors.

context research that considers the cultural preference for certain locations.

Thus, in Yinchuan the planning is not an effective multivalent organization that strategically guides the urbanization. The pattern of urban housing development is still based on the distribution of public programs that are the main providers of amenities. However, the factors guiding the distribution of public programs are not coherent with the planning intentions and most likely follow cultural preferences. Therefore, the public programs were not effective in realizing the intended housing distribution and density.

### IMPACT OF PUBLIC FACILITIES ALLOCATION ON SPATIAL EQUITY

In this chapter we analyzed the distribution of amenities in the city in terms of proximity (Euclidian distance) to housing areas that influence the accessibility and defines the spatial equity. Other studies focused on accessibility to facilities [26, 27] used administrative boundaries to divide the urbanized area; however, we consider the Voronoi diagram based on location of facilities, better suited because the accessibility to amenities is usually not constrained by administrative border. Our preposition is that people would rather use a service that is closer to their home than one that is further away but in the same administrative unit as their house. We found only two studies by Jia et al [28] and Abellanas and Palop [29] that used the Voronoi diagrams in visual urban analytics, however these studies do not focus on facility distribution and spatial equity. The only study in terms of assessing spatial equity using Voronoi diagram was found in Boone et al [30] that assessed the accessibility to parks by different racial groups in Baltimore. However, Boone didn't quantify the areas that were underprivileged in proximity to parks. In this study, we propose an assessment method of spatial equity based on Voronoi diagram that not only identifies but also precisely quantifies the residential urban areas with different proximity to public facilities.

First, we designed a Voronoi diagram of the urban area based on the location of 4 parks and 19 schools, built during 2000-2016, to associate the distribution of these facilities to horizontal spatial equity defined as equal access to public facilities by all (Figure 5, left). For comparison, we also designed a Voronoi diagram based on the 61 commercial establishment built in the same period (Figure 5, right). Afterwards, we calculated the percent of urban area for each polygon related to the total urban area of 2014 and defined it as Voronoi influence areas. The polygons with smallest percent of urbanized area are located in the proximity of many public facilities, thus have high degree of accessibility to services in contrast to polygons with larger percent. This analysis enabled us to identify a trend in high accessibility to schools and parks in the east and central, where the Voronoi influence areas range from 0.82 to 4.34%. On the other hand, the zones in the far-east and west parts, and especially around Xinshigu with striking 18.43%, show very low accessibility to services. The analysis of commercial establishments showed higher accessibility trend in the OT and its

north-south vicinity, as well as along tracts of shopping streets in the central and west, with Voronoi influence areas from 0.01 to 1.63%. The south and north periphery, as well as the west parts of the city however show significantly lower accessibility to commercial services.

The results indicate that the distribution of public facilities did not promote spatial equity because there is a significant mismatch between the distribution of facilities and urban housing area. The limitations of this study consisted in the difficulty to obtain disaggregated data of socio-demographic characteristics and data on political agendas that drive the decision-making processes. In a city like Yinchuan, which has a large minority Hui Muslim group, the overlay of socially vulnerable areas with the Voronoi diagram is especially relevant to promote better planning choices. We argue that the illustrative power of the Voronoi proximity areas method demonstrated in this research can serve as a useful tool to identify discriminated urban parts in term of public programs and quickly verify the impact of future programs on spatial equity by simply inserting the new location in the diagram model. However, more studies are necessary to correlate the Voronoi diagram with other factors that influence the accessibility to services, such as road condition, travel cost, topography, ext., in order to design a more integral modeling tool. Finally, the future goal is to adapt this method to define more precisely the optimum proximity to facilities in different urban context (which will be more relevant than the 10 minute walk concept that does not consider the scale of the urban agglomeration) and provide planning guidelines for projecting locations of future public programs. We believe that the Voronoi influence areas have the potential to provide a more precise assessment of optimum distribution pattern of facilities to promote accessibility and equity in further planning.

### CONCLUSION

In this study, we examined the effects of public programs on the spatial distribution of commercial housing, in terms of density, efficiency and spatial equity management, in the city of Yinchuan, Western China.

The main findings are: 1) In the market-oriented period, local governments still lead the housing development with allocation of large social housing projects and attractive facilities; 2) However, the distribution of these projects in Yinchuan was not consistent with the spatial intentions for housing development but most likely depend on cultural preferences; 3) Moreover, the distribution of public facilities did not promote horizontal spatial equity in the city; 4) In order to efficiently guide the housing development pattern, the city needs to reconsider its strategy in allocation of public programs based on more integral local context research that will include market mechanisms, historic place significance and spatial equity considerations.

This study only explored the effects of the spatial location of the public programs in the housing development and

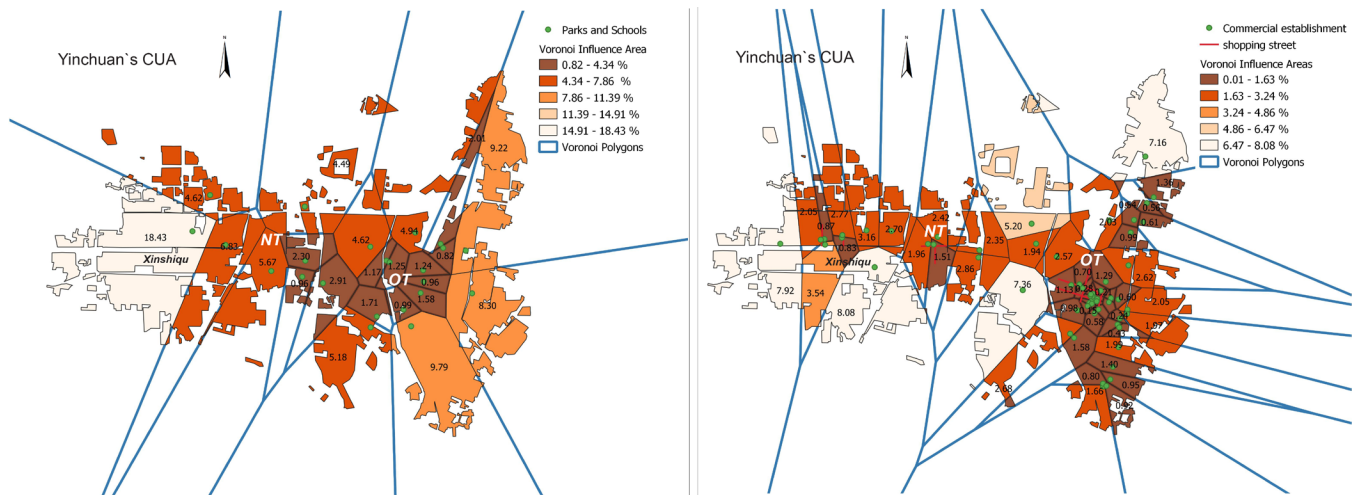


Figure 5. Voronoi influence areas for parks and schools (left) and commercial establishments (right). By authors.

merely evaluated the effectiveness from the viewpoint of urban planning. Further studies are necessary to clarify the decision-making mechanism in site allocation of these public programs. Finally, the Voronoi digram is suggested as a useful tool in adjusting the distribution of public programs to achieve equitable and sustainable outcomes in small and medium cities with weaker market economy.

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## ENDNOTES

- UN Habitat 2015 (Nairobi). International Guidelines on Urban and Territorial Planning. Accessed online 15th of November 2019: [https://www.uclg.org/default/files/ig-utp\\_english](https://www.uclg.org/default/files/ig-utp_english)
- Schneider, A. and C. M. Mertes. 2014. "Expansion and growth in Chinese cities, 1978–2010". *Environmental Research Letters* 9-2, <https://iopscience.iop.org/article/10.1088/1748-9326/9/2/024008/meta>
- Gaubatz, P. 1999. "China's urban transformation: Patterns and process of morphological change in Beijing, Shanghai and Guangzhou, Shanghai and Guangzhou". *Urban Studies* 36 (9): 1495-1521. <https://doi.org/10.1080/0042098992890>
- Wu, F. 1998. "Polycentric urban development and land-use change in a transitional economy: the case of Guangzhou". *Environment and Planning A* 30: 1077-1100.
- Yue, W., Liu, Y. and Fan, P. 2010. "Polycentric urban development: the case of Hangzhou". *Environ. Plann. A* 42: 563-77 <https://doi.org/10.1068/a42116>
- Wu, F. and N. A. Phelps. 2011. "(Post)suburban development and state entrepreneurialism in Beijing's outer suburbs". *Environment and Planning A* 43: 410-430.
- Wang, Ya Ping. 2012. "New Trend of Urbanization in China: Land and Housing Development in Suburban Areas and Small Towns". Cambridge, Massachusetts. Lincoln Institute of Land Policy
- Wang, M., Krstikj, A. and Koura, H. 2017. "Effects of urban planning on urban expansion control in Yinchuan City, Western China". *Habitat International* 64: 85-97, <https://doi.org/10.1016/j.habitatint.2017.04.008>
- Tan, M., Li, X., Xie, E. H. and Lu, C. 2005. "Urban land expansion and arable land loss in China—a case study of Beijing-Tianjin-Hebei region". *Land Use Policy* 22: 187-196. <https://doi.org/10.1016/j.landusepol.2004.03.003>
- Wang, L., Li, C., Ying, Q. et al. 2012. "China's urban expansion from 1990 to 2010 determined with satellite remote sensing". *Chin. Sci. Bull.* 57: 2802, <https://doi.org/10.1007/s11434-012-5235-7>
- Wang, Y. P. and A. Murie. 2000. "Social and Spatial Implications of Housing Reform in China". *International Journal of Urban and Regional Research* 24, 2: 397-417.
- Zhang, Y. 2001. "Detection of urban housing development by fusing multisensor satellite data and performing spatial feature post-classification". *Int. J. Remote Sens.* 22: 3339-55 <https://doi.org/10.1080/01431160010031289>
- Yao, L. 2011. "The Impact of China Housing reform on Residents' Living Conditions". Master Thesis from the Department of Planning, Public Policy and Management at the Graduate School of the University of Oregon.
- Pendall, R. 1999. "Do land use controls cause sprawl?" *Environment and Planning B: Planning and Design* 26: 555-571.
- Hebbert, M. 1994. "Sen-biki amidst Desakota: Urban sprawl and urban planning in Japan", *Planning for cities and regions in Japan*, ed. Shapira, P., Masser, I. and Edginton, D. W., Liverpool Uni. Press
- Wang, Y. P. and A. Murie. 1999. "Commercial Housing Development in Urban China". *Urban Studies* 36, 9: 1475-1494.
- Luo, X. and J. Shen. 2008. "Why city-region planning does not work well in China: The case of Suzhou- Wuxie-Changzhou". *Cities* 25: 207-217 <https://doi.org/10.1016/j.cities.2008.04.003>
- China's housing reform and outcomes. Man, J.Y. ed. 2011. Cambridge, Massachusetts. Lincoln Institute of Land Policy
- Fu, Q. and L. Nan. 2013. "The Weaknesses of Civic Territorial Organizations: Civic Engagement and Homeowners Associations in Urban China". *International Journal of Urban and Regional Research* 38, 6: 2309-2327. [doi:10.1111/1468-2427.12080](https://doi.org/10.1111/1468-2427.12080)
- Lu, T., Zhang, F. and Wu, F. 2019. "The Meaning of "Private Governance" in Urban China: Researching Residents' Preferences and Satisfaction". *Urban Policy and Research* 37, 3: 378-392. [doi: 10.1080/08111146.2019.1578955](https://doi.org/10.1080/08111146.2019.1578955)
- Flock, R., Breitung, W. and Lixun, L. 2013. "Commodity Housing and the Socio-spatial Structure in Guangzhou". *China Perspectives [Online]*, 2013/2: 41-51. <http://journals.openedition.org/chin perspectives/6172>
- Xiao, L., Qiu, Q. and Gao, L. 2016. "Chinese Housing Reform and Social Sustainability: Evidence from Post-Reform Home Ownership". *Sustainability* 8, 1053. [doi:10.3390/su8101053](https://doi.org/10.3390/su8101053)
- Li, J., et al. 2004. "Research on Planning and Development of Real Estate in Xixia District of Yinchuan". *Journal of Ningxia University (Natural Science Edition)* 25, 2: 188-192. (In Chinese).
- Ma, H. and W. Mi. 2003. "The relation, problems existed and its solving measures between city planning and development of housing industry in Yinchuan". *Journal of Ningxia University (Natural Science Edition)* 24, 2: 157-160. (In Chinese).
- Liu, X. and W. Mi. 2002. "Research on the development of urban housing area and their optimization of Yinchuan city in 1990s". *Economic Geography* 22, 3: 327-330. (In Chinese).
- Mashrur, R. and M. N. Neema. 2015. "A GIS Based Integrated Approach to Measure the Spatial Equity of Community Facilities of Bangladesh". *Geosciences* 1 (1): 21-40. DOI: 10.3934/geosci.2015.1.21
- Yuan, Y., Xu, J. and Wang, Z. 2017. "Spatial Equity Measure on Urban Ecological Space Layout Based on Accessibility of Socially Vulnerable Groups—A Case Study of Changting, China". *Sustainability* 9, 1552; [doi:10.3390/su9091552](https://doi.org/10.3390/su9091552)
- Jia, T., Tao, H., Qin, K., Wang, Y., Liu, C. and Gao, Q. 2014. "Selecting the optimal healthcare centers with a modified P-median model: a visual analytic perspective". *International Journal of Health Geographics* 13:42.
- Abellanas, M. and Palop, B. 2008. "Urban Data Visualization with Voronoi Diagrams". *ICCSA 2008, Part I, LNCS 5072*, pp. 126-136. O. Gervasi et al. (Eds.)
- Boone, C., Buckley, G., Grove, M. and Sister, C. 2009. Parks and people: An environmental justice inquiry in Baltimore, Maryland. *Annals of the Association of American Geo-graphers*, 99 (4), American Association of Geographers, Washington, United States of America, pp. 767-787.