

# The Future of Urban Expansion: A Network of Villages

The Case of Baki, Sukoharjo, Central Java, Indonesia

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**Abstract** — With unprecedented urbanization, cities in developing countries are projected to expand their footprint dramatically. In the Sukoharjo suburb of Indonesia, more agricultural land is being converted for commercial and industrial uses.

In order to accommodate this expansion, a development framework is crucial to guide the long-term decisions of planning authorities. Using social, economic and environmental impacts as pillars to frame our analysis of observations, this research strives to find an integrated framework for sustainable urban expansion. This general scheme focuses on integrating and extending existing qualities of villages to sustain and diversify future urban expansion. It can then be adapted to other areas undergoing similar growth patterns near Solo City.

Our research framework and methodology comprises an on-site analysis of the suburbanization process in Sukoharjo by identifying development patterns across time in villages and farmland during a 10-day design workshop in 2015, with Indonesian university students from Universitas Sebelas Maret, students from Massachusetts Institute of Technology, Singapore University of Technology and Design and Technische Universität Berlin in the campus of Universitas Sebelas Maret in Surakarta City, Indonesia, as well as a followup 5-day research trip in 2016 held in partnership with students from Universitas Sebelas Maret. The paper closes with a proposal for encouraging maximal growth without compromising on livability factors important to the region: connectivity, community and culture.

**Keywords:** urban expansion, home based enterprises, transport networks, sustainable development in villages

## I. URBAN EXPANSION FRAMEWORKS

The development of urban areas towards the periphery follows spontaneous and organic growth patterns. Majority of the research conditions of urban morphology, urban sprawl and urban expansion are based on European Cities. These studies do not provide sufficient evidence to study the patterns and processes in the rapidly growing urbanization in Southeast Asia. As such, it is useful to have a deeper understanding of the phenomenon of urban expansion in Asia, particularly in Southeast Asia.

### A. Context

Indonesia comprises 34 provinces, which are divided into regencies and cities. Baki, Sukoharjo, is one of the 12 districts in the Sukoharjo regency which lies in the province of Central Java in Indonesia. [1] Our study area within the Baki district (Fig.1), was chosen for its proximity to Solo City, which makes it a prime site where urban sprawl can be observed.



Fig 1. Study Area

### B. Development Process

#### 1) Intersection of villages at Jalan Mangesti Raya (JMR)

The past 20 years have witnessed unprecedented growth Southwest of Downtown Solo. Land uptake by developers, who convert rice paddies into suburban developments, either subdivide the land and sell smaller plots to individuals, or build houses and sell them. Over the years, separate strip developments have been scattered linearly along JMR, creating a packed stretch of gated communities interjected with several self-organized neighborhoods.

#### 2) Waru and Siwal Village

After Indonesia's independence, paddy fields were acquired by workers and farmers, who built the first houses. Densification of plots then followed the expansion of the owner's family (Fig.2).



Fig 2. Densification of plots

#### 3) Typologies

The village consists of mixed-use buildings, such as homes with commercial shopfronts, and varied public facilities (Fig.3).

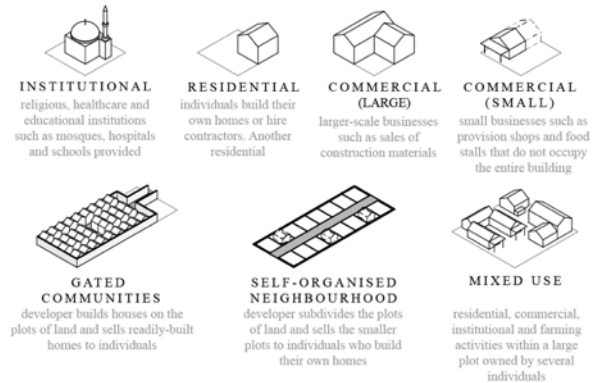


Fig 3. Typologies

### C. Demographics

According to the combined data for Waru and Siwal, labour, farming and Small and Medium enterprise (SME) industries employ the most number of workers Fig.4.



Fig 4. Employment Distribution - Official Statistics obtained from Administrative Offices of Waru and Siwal village during site visit on 3 June 2015

Along the periphery of downtown Solo where industrial activities thrive, most Waru, Siwal, Purbayan and Gentan villagers work in factories. Employment in the region is dominated by labor-intensive production or services, like farming, mechanical repairs and specialized crafts, which are often home-based or located in the vicinity of the village. Within the villages, most people are either farmers, animal breeders, or run home-based businesses, who need to travel to Solo few times a week.

In the area near JMR, most gated community residents are doctors, lawyers, teachers or professionals who commute to Solo City daily.

#### D. Key Players

Land ownership transfers as shown in Fig.5.

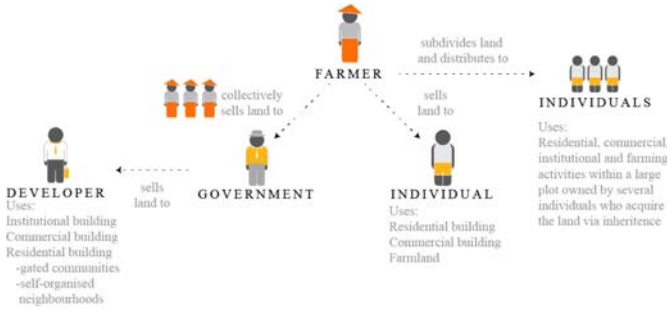


Fig 5. Transfer of land ownership between stakeholders

The national, regional and local planning authorities determine the master plan of a region and oversee the placement of major infrastructure. Provincial and district authorities are also given significant autonomy through the Spatial Planning Law (2007). [2]

In reality, the Village or Sub-District heads possess the information of agricultural land ownership, operating independently of the National Land Agency. This enables national, provincial and district land laws to be overruled - e.g. In allowing people to work the land who are not landowners themselves, and demanding agricultural land taxes. [2]

As formal land laws permit transfer of land ownership without registering rights of the transferor and transferee before or after, it does not ascertain one's rights of ownership. Hence, tenure insecurity is a problem that may not be alleviated by systematic titling. [2]

## II. OBSERVATIONS

Qualitative and quantitative data gathered are categorized by their Social, Economic and Environmental influence. Analysis was made by identifying strengths and weaknesses of the observed situation and analyzing possible opportunities and threats that could arise.

### A. Social

#### a) *Densification of Village*

The growth of the village is explained using an example from Siwal as shown in Fig.6. *Threat: Unsustainable development and increasing traffic congestion.*

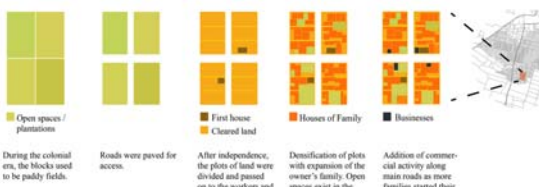


Fig 6. Densification within Plot

#### b) *Rapid Development of Gated Communities*

With private developers seeking profitable land uptake, there is a lack of consideration towards building community between developments and with long-staying villagers. Expansion of inward-looking developments highlighted in orange in Fig.7.

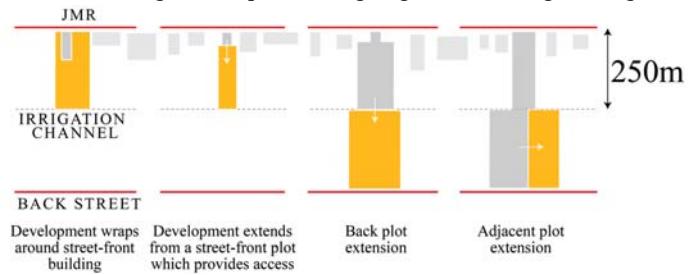


Fig 7. Developers maximizing land area of each elongated plot

An elongated plot breeds a chain of linear developments, leaving minimal horizontal access (red) across the string of developments along JMR (yellow) as in Fig.8.

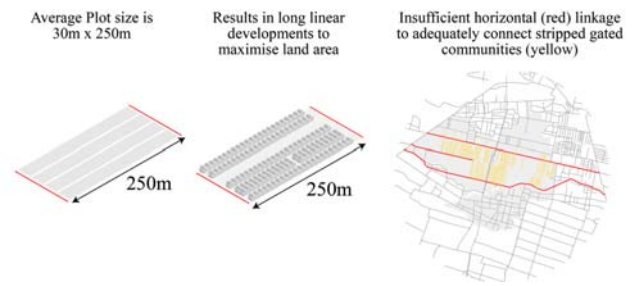


Fig 8. Lack of horizontal access between developments

*Threat: Social segregation bred by a lack of interaction among residents, due to linearly stacked gated communities that permit circulation only to and from Solo. Traffic congestion as cul de sacs bleed directly into a primary road, overloading its capacity.*

#### c) *Strong Village Community Spirit*

The low vertical density of houses facilitates a communal occupation of the street among long-time residents. *Opportunity: Intimate ties between villagers promote commitment in community-led initiatives.*

#### d) *Houses adapted for Mixed Uses and Growing Families*

Many self-employed villagers operate home businesses, including provision shops, batik painting and animal farming. As their families expand, houses grow with additional rooms built. *Opportunity: Social integration by creating connecting streets and open public spaces as vibrant interfaces between different developments. Diversification of development typologies to support the economic potentials of the community.*

### B. Economic

These observations describe the growth of small businesses, employment opportunities and personal income of the residents.

#### 1) *Dependence on Solo City*

There are insufficient transport modes and networks to support the popular commute between Sukoharjo and Solo as shown in Fig 9. As more city workers move into Sukoharjo, it becomes increasingly dependent on Solo for business and daily amenities. *Threat: Worsening traffic congestion with increasing projected city-bound commuters.*

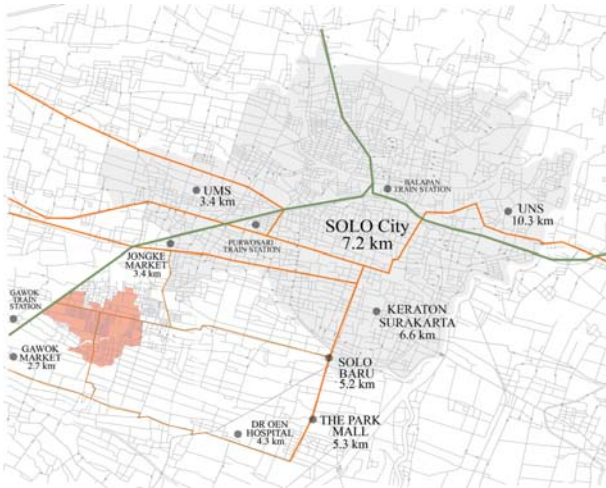


Fig 9. Proximity of facilities in Solo City

1) *High Private Vehicle Ownership*

Although amenities are located within walking distance of developments, residents often commute by motorcycles and cars. *Threat: Air Pollution due to high usage and low passenger capacity of motorcycles, hindering outdoor activity. Opportunity: Provision of public transport can ease congestion while improving accessibility to the village.*

2) *Low Street Connectivity*

JMR's narrow and long plot subdivision (30mx125m) restricts development to linear patterns, creating low street connectivity. Compounded by gated developments maximizing entire plot areas, public circulation spaces are left to a minimum. Although JMR is only equipped as a collector street serving strip developments and localized businesses, it behaves as an arterial road conducting traffic between villages and Solo. Its inefficient transport and poor accessibility impedes business. *Threat: Traffic congestion, social segregation, business slowdown due to poor street hierarchy. Opportunity: Roads dedicated to commercial, mixed use, or purely residential access.*

3) *Home-Based Enterprises (HBEs)*

Low land prices and existing physical infrastructure in the village are conducive for small enterprises. The primary HBEs in Waru and Siwal are provision shops, food stalls and batik workshops. *Opportunity: Growth of Local Industries in which locals possess expertise. Interdependence between villages for local industry.*

D. Environmental

1) *Depleting Farmland due to Urban Expansion*

Sukoharjo's relatively low land prices (Table 1) led to a surge in demand, hence increasing land prices. Rising profitability incentivizes farmers to sell their land, which is replaced by higher-value residences or commercial buildings. *Threat: Loss of agricultural land, green space replaced by highly isolated, built-up areas. Accelerated gentrification.*

Sukoharjo	2 Million IDR/sqm
Solo City	10 Million IDR/sqm
Solo Baru	25 Million IDR/sqm

Table 1. Average Land Prices

(Source: Interview with Siwal and Waru villagers).

Solo Baru is a new housing estate in Sukoharjo, adjacent to Solo City.

2) *Batik pollution*

Industrial pollution due to improper methods of discarding batik dye waste into the canal poses a major environmental problem. *Opportunity: Integrating Urban Agriculture with the batik industry, controlling batik dye waste pollution through natural filtration.*

C. Summary

Table 2 is a summary of Strengths, Weaknesses, Opportunities and Threats (SWOT) collating these observations.

STRENGTHS	WEAKNESSES
<p><b>SOCIAL</b> Availability of public facilities (Religious centres, healthcare) Current low population density Safety Strong community spirit Adaptability*</p> <p><b>ECONOMIC</b> Established minimum physical infrastructure* Proximity to downtown Solo Low land prices compared to city Established home-based enterprises</p>	<p><b>SOCIAL</b> Social segregation due to low street connectivity between developments Unsustainable land subdivision strategies</p> <p><b>ECONOMIC</b> Lack of public transportation Poor hierarchy of circulation network High private vehicle ownership Dependence on Solo city for business &amp; daily amenities</p> <p><b>ENVIRONMENTAL</b> Industrial pollution Improper residential sanitation</p>
OPPORTUNITIES	THREATS
<p><b>SOCIAL</b> Open public spaces Improved street connectivity More vibrant interface between villages</p> <p><b>ECONOMIC</b> Expansion of home-based industry Growth of local industries Provision of Public transportation</p> <p><b>ENVIRONMENTAL</b> Urban agriculture</p>	<p><b>SOCIAL</b> Erosion of village community spirit Gentrification</p> <p><b>ECONOMIC</b> Exacerbated congestion Isolated commercial activities due to decreased connectivity</p> <p><b>ENVIRONMENTAL</b> Rapid depletion of farmland Higher risk of disease Air Pollution</p>

Table 2. Summary of SWOT derived from observations made

III. PROJECTING THE FUTURE

**A Network of Villages**

The proposal envisions a network of villages in the Baki region, through improving street connectivity, empowering the economy through sustenance of HBEs, and encouraging inter-village social interaction as an integrated expansion framework for sustainable growth in the urban fringe.

1) *Learning from the villages of Waru and Siwal*

The diverse street networks in the villages are important drivers for connectivity and sociability. Hence, we recognize an opportunity to extend upon it to connect the Sukoharjo region and beyond (Fig.10).



Fig 10. Street network of Waru-Siwal

a) *Main Access Road, 5.5m wide (Orange)*

Waru villagers commute to and from the city via a busy 2-way road, often used by non-residents providing services to the village, or are en route to other villages. The 5.5m wide unpaved road is used in an unregulated way, making the pedestrian experience dangerous.

b) *Local road, 3.5m wide (Green)*

A 2-way road lining the periphery of Waru and Siwal is frequented by villagers.

c) *Inter-village road, 3.5m wide (Yellow)*

These 2 secondary roads connect adjacent villages and are mostly used by residents to access public facilities like schools.

2) *Extending the Village Road Network*

East-West inter-village roads improve interconnectivity, encouraging interdependence. North-South roads retain accessibility to Solo City.

a) *Main Road*

The main road connects villages to Solo City, creating opportunities for commercial activities, allowing residents to extend their customer base beyond the village.

b) *Peripheral Road*

This road which lies between adjacent villages could be used to redirect traffic from the main road. Integrating dissociated demographics of road users can be achieved by providing shared public facilities as interfaces for social interaction.

3) *Overall Proposed Street Network for Sukoharjo Region*

Fig. 11 shows an overall possible street network of the region, which is a macro grid layout extended from that of Waru into the neighboring villages and developments, providing links between and from villages to the city.

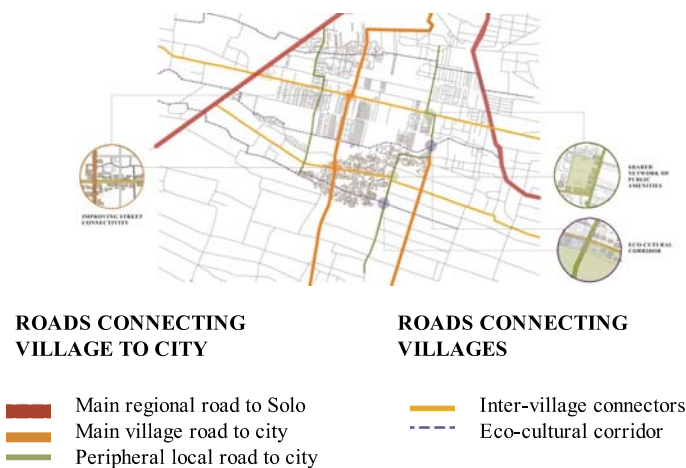


Fig 11. Proposed Street Network

IV. STRATEGIES FOR URBAN EXPANSION

Our proposal is trifold in encouraging diverse and sustainable growth in the urban fringe, comprising 3Cs: Connectivity, Community and Culture.

A. CONNECTIVITY

To develop certain types of existing village roads and extend its road network into the future surrounding developments

1) *Safe and Equipped streets*

The proposal includes the upgrading of existing village infrastructure to better accommodate future expansion and different road functions (ie.commercial activities). Extending the existing village road network avoids uprooting or constructing additional infrastructure. Equipping streets with lamps allows for streetlife, pedestrian safety and public surveillance at night.

2) *Introducing a 3rd Connection to Solo City*

In light of heavy congestion along JMR to the city, a third connection lightens the load on existing infrastructure, resulting in more evenly-distributed traffic.

3) *Improved Connectivity for Future Developments*

Instead of the current linear land uptake which leads to social segregation, more squarish plot subdivision permits greater flexibility of use. Local streets between developments can lighten traffic along JMR. A structured road hierarchy promotes vehicular and pedestrian use of the proposed eco-cultural corridor, improving connectivity for business and social interaction.

4) *Pedestrianized Streets*

Bicycle and pedestrian paths encourage residents to safely commute to facilities while reducing pollution, encouraging roadside businesses and enjoyment of open spaces.

5) *Shared Public Transportation*

Public transport alleviates traffic congestion and encourages cleaner and affordable modes of transport. Placing public transport nodes strategically along the Public Amenities network as shown in Fig. 12, can generate sufficient demand from the adjacent villages. The junctions of the main road, peripheral road, and inter-village roads can become hotbeds for interaction between various developments, marking ideal spaces for public activities and commercial opportunities.



Fig 12. Shared public amenities and public transportation network

B. COMMUNITY

1) *Inter-Village Roads*

*Interdependent economy*

Inter-village roads connect villages with their respective unique industries. This re-thinks the village community as a whole, encouraging trade and barter between villages. Interdependent villages are more economically sustainable by diversifying the economy through cultivating HBEs. Ultimately, this reduces the developments' dependence on Solo and traffic congestion, leading to greater productivity.

## 2) Shared Public Amenities Network

*Encourage inter-village interaction and collaboration*

Despite providing an alternate route to the city, this road, in Fig. 12, which sits on the periphery of 2 villages can become an inter-village interface, providing shared public space, facilities and services.

## 3) Diverse and Flexible Housing Typologies

*Adaptable houses according to street functions*

Except for gated developments, most houses stand 1-storey tall. To avoid social segregation, future typologies could be adapted for community interaction. Houses with commercial programs could adapt a shophouse typology shown in Fig. 13, with a private second level and a semi-private first level. There could be a verandah at the back of the house which opens to the neighborhood while the shop front opens up to the street.

Similar to the houses of Waru, new developments could be designed and built in a flexible manner that could potentially diversify and be adapted to local lifestyles.

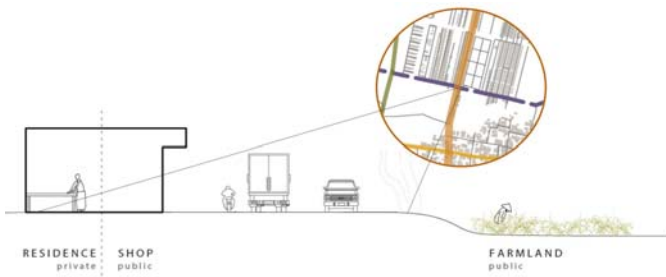


Fig 13. Example of a new shophouse typology

## C. CULTURAL ECONOMY

### 1) Eco-Cultural Corridor

*Eco-tourism through innovative merging of local traditions*

Located beside agricultural land due to proximity to the canal, the local batik industry could tap on the agricultural industry as a natural cleanser for batik dye pollutants.

The village could further develop its identity as a batik village, while becoming an innovative model for eco-friendly industries, creating opportunities for ecotourism and education along the eco-cultural corridor. By increasing their frontage, the economic value of the workshops can be increased. This could innovate the agricultural and batik industries, engaging future generations in the renewal of local traditions.

The proposed eco-cultural corridor is a method of preserving green in the area while allowing for diverse and mixed uses as shown in Fig.14.



Fig 14. Eco-Cultural Corridor

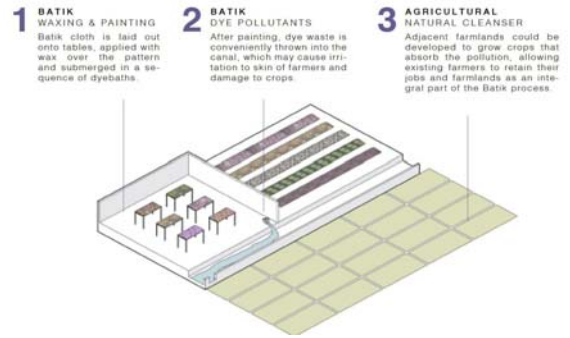


Fig 14. Proposal to mediate waste from batik-dyeing

### 1) Preserving Green Spaces

As the region becomes increasingly built-up, there is a need to preserve the natural landscape for rest, recreation and restoration of man-to-man and man-to-nature relationships, which is crucial in maintaining the wellbeing of residents.

The eco-cultural corridor stretches along the inter-village road, incorporating the adjacent lush tropical agricultural land as a shared green space for communities to enjoy and interact. Along it lies open spaces which remain deliberately unplanned, for villagers to be involved in shaping their own activities.

### 2) Preserving Farmlands for the Eco-Cultural Industry

By allowing farmlands to play a part in the unique local cultural industries. (Refer to Section IV.C.2), they can be better preserved. This strategy complements neighboring Solo City's government's goals of achieving an eco-cultural region which taps on businesses unique to the community. During presentations to Solo government representatives during the workshop, a favorable response was obtained regarding this strategy. With support from the government, the Eco-Cultural corridor is a solution that can likely be implemented across cities and regions.

## V. CONCLUSION

The proposal is meant to be applied to neighbouring villages to form a close-knitted and interdependent network of villages. Instead of multitudes of gated compounds, there is potential for the villages to be connected dynamically with an efficient and people-friendly streets, a network of public amenities and an eco-cultural corridor of unique local industries.

## VI. ACKNOWLEDGEMENT

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