Towards a Sustainable and Water-Sensitive Sariharjo, Sleman Regency, Indonesia.

Polycentric Approaches for the Management of Urban Waters.

Baseline Study and Strategy Development

POLYURBAN WATERS

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March 2023

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List of Abbreviations and Acronyms

APBD — **(Anggaran Pendapatan dan Belanja Daerah)**
Local government budget
The regional government and DPRD discussed and approved its annual financial plan and formalized it by regional regulations.

Bappenas — **(Badan Perencanaan Pembangunan Nasional)**
National Development Planning Agency
A ministry of the Republic of Indonesia that has the task to oversee government affairs in the field of national development planning to assist the President in organizing state government.

Bappeda — **(Badan Perencanaan Pembangunan Daerah)**
Local Development Planning Agency
Local (regional) offices of Bappenas.

BJPSDA — **(Biaya Jasa Pengelolaan Sumber Daya Air)**
Water Resource Management Service Fee
One of the types of water resources management financing imposed on users who benefit from water resources per rational calculations and can be clarified and excluded for water resources to meet basic daily needs and irrigation for the people.

BUMD — **(Badan Usaha Milik Daerah)**
Regional- Owned Enterprise
Local government owned enterprise/s, set up on local government initiative, funded by local government capital and managed by local governments. BUMDs can provide such services as water supply, management of market places and provision of tourism facilities, recreation parks etc. BUMDs are generally set up as PDs by local regulation (perda). In Indonesian, they are also generically termed “kekayan daerah yang terpisahkan”.

BUMDes — **(Badan Usaha Milik Desa)**
Village-Owned Enterprises
Business entity of all or most of the capital owned by the Village through direct participation from the separated assets of the Village to manage assets, services, and other business for the greatest welfare of the Village community.

Bupati	**Regent** Head of regency, which one of his/her tasks is to lead the implementation of Government Affairs under the authority of the Regional under the provisions of the legislation and policies established along the legislature.
BPBD	**(Badan Penanggulangan Bencana Daerah)** **Regional Board for Disaster Management** Indonesia's regional board for natural disaster affairs.
BPK	**(Badan Permusyawaratan Desa or Kalurahan)** **Village Consultative Council** A body carrying out the functions of government agencies whose members shall be representatives of the population of the Village based on the representation of regions and elected democratically.
Desa or Kelurahan	**Village** Fourth level administrative division of Indonesia directly administered under a subdistrict. It is also defined as a unit of community that has boundaries with the authority to regulate and manage the affairs of government, interests of the local communities based on the community's initiatives, right of origin, and/or traditional rights recognized and respected in the system of government of the Republic of Indonesia.
DIY	**Daerah Istimewa Yogyakarta**
DLH	**(Dinas Lingkungan Hidup)** **Environmental Department** Responsible for managing and conserving the local environment.
DPRD	**(Dewan Perwakilan Rakyat Daerah)** **Regional House of Representatives** Regional House of Representatives at provincial and regency/ city levels. It has the following functions: legislation, budgetary and oversight.
Dukuh	**Head of sub-village/ sub-village** Dukuh is the head of a sub-village/sub-village. His/her main task is to assist a head of village in organizing and in improving public services.
HH	**Household**
IDR	**Indonesian Rupiah.** Currency exchange rate is 1 US-Dollar = 15.207,55 IDR (27 February 2023) based on oanda.com[1]
IPAL	**(Instalasi Pengolahan Air Limbah)** **Wastewater Treatment Plant** A structure and equipments designed to remove biological and chemical wastes from water to allow the water to be harmless and usable for other activities.

[1] https://www.oanda.com/currency-converter/de/?from=USD&to=EUR&amount=1

IPLT **(Instalasi Pengolahan Lumpur Tinja)**
Faecal Sludge Management & Treatment Facilities (FSM)
Advanced treatment process because the sewage sludge treated in the septic tank is not suitable for disposal to the environment.

Kabupaten **Regency**
Second-level administrative division of Indonesia, directly administered under a province. Generally, a regency comprises a rural area larger than a city and equal in status to cities.

Kecamatan **Subdistrict**
Third-level administrative division of Indonesia, directly administered under a regency or a city.

Kementrian PUPR **Ministry of Public Works and Housing**
A national government level institution responsible for administering government affairs in the field of public works and housing, such as: water resources management; road management; human settlements, including drinking water development system, wastewater and drainage development system as well as solid waste management; housing administration; construction services; public works and housing infrastructure financing.

Kota **City**
Second-level administrative division of Indonesia, directly administered under a province.

KOTAKU **(Kota Tanpa Kumuh)**
City Without Slums Program
The City Without Slums (Kotaku) Program is a strategic effort of the Ministry of Public Works and Housing to accelerate the handling of slums in Indonesia and supports the 100-0-100 Movement, namely 100 percent universal access to drinking water, 0 percent slum settlements, and 100 percent access to proper sanitation.

KPY **(Kawasan Perkotaan Yogyakarta)**
Yogyakarta Urbanized Area
A combination of several regencies in the Special Region of Yogyakarta Province, namely Yogyakarta City, Sleman Regency and Bantul Regency.

KPP **(Kelompok Pemanfaat dan Pemelihara)**
Beneficiary and Maintenance Group
A bottom-up organization who has been given the understanding to run the operation and carry out maintenance on infrastructure activities that have been built. KPP can come from the development/revitalization of existing social institutions or KSM or form new organizational platforms.

KSM **(Kelompok Swadaya Masyarakat)**
Community Based Organization
A bottom up organization established whereas WWTP implemented; representatives elected during community meetings hosted by field facilitators and local leaders. They are responsible for managing funds and executing construction of WWTP and running the operational and maintenance.

Musrenbang	**(Musyawarah Perencanaan Pembangunan)** **Planning Development Consultation** A forum among the stakeholders, in the context of formulating the national development plans and the regional development plans.
Musyawarah Desa	**Village Consultative Meeting** A consultation between the Village Consultative Body, Village government, and community elements organized by the Village Consultative Body to agree on matters of a strategic nature.
Padukuhan	**Sub-village/sub-villages** Administrative division under a village.
PAMDES	**(Paguyuban Air Minum Pedesaan)** **Community Clean Water Provision** Provision of raw water for drinking water organized by independent communities operating in rural areas.
PAMDUS	**(Paguyuban Air Minum Dusun)** **Community Clean Water Provision (Sub-Village)** The equivalent of PAMDES at the sub-village level.
PDAM	**(Perusahaan Daerah Air Minum)** **State-owned Water Utility** A Regional-Owned Enterprise (BUMD) which is engaged in water services, with all or most of the capital owned by the Region.
Perda	**(Peraturan Daerah)** **Local Regulation** Laws and regulations established by the DPRD with the joint approval of the Regional Head (governor or mayor/regent).
Perkada	**(Peraturan Kepala Daerah)** **Local Head of Government Regulation** Regulations set by the local head of government are implementing local regulations (perda).
Permen	**(Peraturan Menteri)** **Ministerial Regulation** The minister determines a regulation based on the content material in the context of implementing certain affairs in the government.
PP	**(Peraturan Pemerintah)** **Government Regulation/ Central Government Regulation** A statutory regulation in Indonesia that the President stipulates to carry out the law as it should.
RPJMN	**The National Medium Term Development Planning**
RPJPD	**(Rencana Pembangunan Jangka Panjang Daerah)** **Local Long-Term Development Plan** The Local Long-term Development Plan is a planning document for a twenty years period.

RPJMD	**(Rencana Pembangunan Jangka Menengah Daerah)** **Local Medium-Term Development Plan** The Local Medium-Term Development Plan is a 5-years development planning document prepared by local government (city/
RPJMDes/ RPJM Desa	**(Rencana Pembangunan Jangka Menengah Desa)** **Village Medium-term Development Plan** The equivalent of RPJMD at the village level.
RKPD	**(Rencana Kerja Pemerintah Daerah)** **Local Government Work Plan** Local Government Work Plan is a breakdown of the Regional Middle-Term Development Plan, produced each year in preparation for APBD and issued by the local head of government regulation (“perkada”).
Renja	**(Rencana Kerja) Perangkat Daerah** **Local government department/ agency work plans/ Working plan document** A document produced by each local government department or agency in the budget planning phase, outlining work plans for the fiscal year ahead.
RT	**(Rukun Tetangga)** **Community Association** The division of villages in Indonesia under Rukun Warga. RT is the lowest administrative division of Indonesia.
RW	**(Rukun Warga)** **Neighborhood Association** The division of regions in Indonesia under the Village or Kelurahan (or under: Dusun or sub-village). Rukun Warga is not included in the division of administration, and the formation of local communities is through consultation in the framework of community service set by the village or villages.
SANIMAS	**(Sanitasi Oleh Masyarakat)** **Community Based Sanitation** Community scale sanitation facilities that were built onsite with average coverage of 50-100 households, whereas managed and operated by communities.
TPA	**(Tempat Pemrosesan Akhir)** **Final Processing Site** A place to safely process and return waste to environmental media for humans and the environment. The significant difference between TPST and TPA is in the policy of the waste management system. TPST carries out activities for collecting, sorting, reusing, recycling, processing, and final processing waste. In contrast, TPA carries out the landfill method, developed into controlled landfills and sanitary landfills.
TPS	**(Tempat Penampungan Sementara)** **Temporary Disposal Site** A place to store waste before it is transported to recycling, processing, TPST, or TPS 3R.

TPST	**(Tempat Penampungan Sampah Terpadu)** **Integrated Waste Processing Site -** A place where collecting, sorting, reusing, recycling, processing, and finalizing waste are carried out. TPST has a more complex waste processing system than TPS 3R because TPST manages waste to the final processing so that it is safe to be returned to
TPS 3R	**(Tempat Pengolahan Sampah - Reduce Reuse Recycle)** **3R Waste Management** The main concept of waste processing in TPS 3R is to reduce the quantity and/or to improve the characteristics of the waste, which will be further processed in the landfill (TPA)
TKD	**(Tanah Kas Desa)** **Village treasury lands/ Village owned land**
UPT	**(Unit Pelaksana Teknis)** **Technical Implementation Unit** An independent organizational unit that carries out technical operational tasks and / or technical tasks from its parent organization under division of department.
WWTP	**Waste Water Treatment Plant**

Introduction

The Indonesian government is committed to mainstreaming the Sustainable Development Goals. The SDG targets are being operationalized in the Medium-Term Development Plans (Rencana Pembangunan Jangka Menengah Nasional or RPJMN).

Indonesia's 2021 Voluntary National Report on the implementation of the SDGs to the High-Level Political Forum of the United Nations outlines the importance of localizing the Agenda 2030, e.g. SDGs have to be anchored in the local development, respective capacities for implementation have to be built up, and action plans have to be developed.

The Government of Sleman Regency is preparing a RPJPD (Long-term Development Plan) covering a period of twenty years. It contains the vision, mission and direction of regional development and refers to the National RPJP (National Long-term Development Plan). Embedded in this strategic document will be a Medium-term Development Plan for a five-year period. It elaborates the vision, missions, and programs of the local government head.

Indonesia's 2014 Law No.6 gives villages, as the lowest level of government structure, a robust mandate to develop their territorial communities. The law gives villages and their sub-villages in Sleman Regency the opportunity to determine urban planning and infrastructure development that is tailored to their local needs and conditions. Here, the Government of the Sleman Regency and the governance structures at the village and sub-village levels want to use these new possibilities for shaping and acting according to their needs and capacities.

Based on a long-standing cooperation, in 2019 BORDA e.V. received a request from the Ministry of Public Works and Transport to develop new conceptual approaches for the management of urban waters in the context of urban development dynamics. The PolyUrbanWaters – a network of civil society organizations, academic institutions and public organizations from Indonesia, Germany and other South-East-Asian nations - was officially invited by the Regent of Sleman on 30 April

2020 to support the strategy development for the water-related urban transformation processes at the village level.

By the elaboration of a base-line study that analyses the water-related challenges for Sariharjo in the context of its urban transformation process, informed decision-making should be supported by stakeholders from local government, communities, private sector, civil society and academia.

Due to Sariharjo's representative characteristics as a village in the peri-urban area of Sleman Regency, it and its 16 sub-villages were selected to elaborate approaches for the development of a water sensitive village. The results and findings are aimed at providing inputs for the elaboration of village development plans and their implementation.

The elaborated models, approaches and instruments for water sensitive development may later be applied to other villages in Sleman Regency helping to localize the Agenda 2030 in Sariharjo by acting as examples of good practice orientation for other villages for their own water sensitive village development.

The project team would like to thank the officials and the communities in Sariharjo and Sleman for their trust and cooperation in the preparation of this study.

March 2023

POLYURBAN WATERS

Executive Summvary

Towards a water sensitive Sariharjo - the overall development context

1. The Regency of Sleman is part of the Yogyakarta Special Administrative Region KPY). Along with Indonesia's dynamic economy, KPY is, as with other secondary cities in Indonesia, an essential crystallization point for the economic and social development of Southeast Asia's largest economy.

2. In future, KPY will most likely be able to significantly strengthen its position as a center for higher education and research and as a center for services in tourism, commerce, and the digital economy, etc. At the same time, small-scale agriculture, which has shaped the region's economy and culture for centuries, is increasingly being marginalized.

3. KPYs urbanization dynamic is accompanied by profound land-use changes and a deep socio-economic transformation. This implies profound ecological, economic, social and cultural transformation processes in the whole region. These developments will translate – if inappropriately managed – in to serious impacts on common and equal prosperity, public health, ecosystems and the livability of human settlements.

4. The 86 villages of the Sleman Regency with its population of 1,125,804 residents (2020) face increasing water challenges in the context of increasingly dynamic urbanization. Water-related basic-needs services, inclusiveness and the livability of these increasingly urban villages must be ensured. The fundamental socio-economic, cultural, and environmental transformation of villages that is a daily experience already require new approaches to village or urban development and the management of local water resources. This is a challenge that will be intensified in view of the impacts of climate change.

5. Located in the Special Region of Yogyakarta and in the Ngaglik sub-district of Sleman Regency, Sariharjo Village exemplifies the process of change in many parts of the Sleman Regency. As with many villages of the Regency, Sariharjo shows how a traditional agrarian social structure and water use patterns will become more urban posing significant challenges for sustainable water management. This dynamizing change has an increasing impact on the villages' water resources. Challenges that may be even exacerbated by climate change impacts.

6. Similar to the whole of Sleman Regency, Sariharjo is experiencing increasing pressure on its water resources. Although significant progress has been made in infrastructure development (roads, electricity supply, etc.) in the last decades, the water-related infrastructural development in Sariharjo (especially water, sanitation, waste) is still

significantly fragmentary and deficient. The challenges for developing effective water-related infrastructure are significant.

7. A concept of water sensitive villages addresses primarily SDG 6 Clean Water, SDG 11 Cities and Communities and SDG 13 Climate Action but also the other targets for a sustainable development in their economic, social and environmental dimensions. In a water sensitive village, water-related basic-needs services (water supply, wastewater and waste management, stormwater management) are effectively characterized by a high level of livability because it has a high degree of community engagement and social inclusiveness, extensive green public and recreational spaces and a well-protected environment.

Sariharjo as representative example of urban transformation in Sleman Regency

1. Characterized once by predominantly agrarian social structures and their water use patterns, the village with its registered 21,438 inhabitants (2020) is today already part of the urbanization process of the metropolitan area. Its production and social structures are increasingly transforming into urban ways of life. This trend will have increased substantially when, according to demographic projections, there will be about 30,000 permanent residents by 2030 and, in addition, a significant number of so-called temporary residents.

2. In addition, a rapidly increasing number of tourists is expected. Given the current per capita water consumption in rural KPY of approximately 60 l/day/capita and the approximately 115 l/day per capita consumption of urban KPY, this demographic development is equal to an exponential growth in water consumption in Sariharjo and directly related to this, an exponential growth in the volume of generated wastewater. These numbers exemplify the need for effective infrastructure development.

3. Not least because of its proximity to Yogyakarta city centre and to leading educational institutions and its climatically and naturally attractive location, Sariharjo is already and will be in future even more attractive for higher-priced residential and commercial areas. It can be predicted that by 2035 Sariharjo will be characterized as a settlement and business area primarily comprised of middle classes, upgraded traditional village centers, and settlement areas in its peripheral zones of lower-income population groups. A considerable number of business places, middle-class settlement areas, hotels and restaurants will significantly shape the village and landscape image. So far, the process of urban transformation and land use change in Sariharjo takes place largely without urban planning guidelines and is driven by a largely

uncontrolled real estate market.

4. Sariharjo is experiencing a dynamic change in land use patterns, in which rice fields and agricultural green spaces are increasingly giving way to settlement areas. Currently 45% or 310 Ha of the total area of 689 Ha of Sariharjo Village is built-up land. Between 2000 and 2015, 35.73% of the paddy-field areas in the Ngaglik sub-district have been converted to built-up land. This process may further accelerate in future.

5. The retreat of agriculture in Sariharjo is largely due to its low productivity, rising production costs, and the rapid increase in land prices. It can be assumed that by 2035 the "traditional" economy based on smallholder production will have been reduced to a few pockets. In 1997, land was valued at 100,000 IDR /m^2, in 2022 it was 10-15 million IDR/ m^2.[2]

6. The smallholder agriculture and the respective community organization played an important role in local water-management. The paddy-fields played an important role in mitigating surface water-run-off, the production of other crops, vegetables and fruits contributed among others to the good maintenance of close riparian zones that play an important role for eco-system services to protect water resources.

7. Such changes may result in a significant loss of blue-green infrastructures that are still largely maintained by local communities and farmers today. These blue- green infrastructures play a major role in the protection of water resources, the functioning ecosystems and the high quality livability of Sariharjo and its neighboring areas.

8. A high degree of sealed area and loss of green space or vegetation will be synonymous with changes in the local climate, potentially an increase of day and night temperatures, especially in the dry season. This trend may be exacerbated by climate change. Therefore, the loss of this “traditional” blue-green infrastructure is accompanied by the loss of knowledge and capacity to maintain it, which poses a particular challenge for the development and management of such new "modern" infrastructures (green spaces, infiltration areas, recreational areas), essential for the livability of Sariharjo.

Dimensions of the provision of clean water

1. In 2021 only 948 out of 5.904 households had been connected to the pipeline system of the water operator, PDAM.

2. Households in Sariharjo are increasingly meeting their drinking water needs from packaged drinking water (PDW). This trend reflects

[2] 6 € or 7 US$ /m^2 1997 & 610 € or – 915 € or 990 US$ /m^2 in 2022.

the income situation and can be observed all over Indonesia. While poorer households mainly boil clean water from wells, middle-class households mainly consume PDW.

3. It can be predicted that with increasing urbanization, i.e. the growth of water users and their comparably higher water consumption, the demand will grow exponentially in the future. The slow growth of PDAM's supply network and the reluctance of users to be connected to a fee-based water supply will lead to further well drilling and pressure on the aquifers if current practices continue. This can result not only in an increase in water stress, but also in increasing water user conflicts

4. Community- based water supply schemes, such as PAMDUS can reach only a small share of inhabitants and because of low technical and organizational capacities, they are not a strategic option for meeting future water supply needs.

5. Thus, a Sariharjo-wide water supply by PDAM is of central importance with regard to the supply of safe drinking water and to the protection of local water resources. Beyond the technical and institutional capacity development of PDAM, water users must also be encouraged to connect to the chargeable water pipeline network. Adequate pricing will be and a reduction of Non-Revenue Water will be crucial for the establishment of the sustainable development of robust business models for water supply. Respective awareness campaigns should be strongly supported by local government agencies.

6. In order to counteract the increased overall and per capita water consumption due to increasing urbanization, an increase in water efficiency and water recycling and a decrease in technical losses from the supply system are of strategic importance. This not only limits water consumption but also the volume of generated wastewater.

7. Large consumers, such as hotels and institutions, should be obliged to implement an environmental management system in a qualified manner. The use of treated grey water, e.g. for the irrigation of green spaces, should be made obligatory within the framework of legal regulations. Incentive schemes for certified eco- hotels, eco-restaurants and eco-business spaces (LEED-certification) may become anchor points for sustainable tourism and neighbourhood-development. Incentives for private and public actors to implement water harvesting structures should be provided.

Wastewater management

1. Increasing water consumption in Sariharjo is directly linked to the generation of higher amounts of wastewater. Already today, there is significant contamination of surface and groundwater, which translates into a threat to public health and ecosystems. This is mainly due to inadequate management of wastewater. Sleman Environmental Agency stated that in 2020, 97.73% of people living in Sleman had access to sanitation, of which only 20.76% (20,294 HH) had access to a toilet with a sealed septic tank or connected to a communal wastewater treatment plant (WWTP) 77.24% had a toilet with soak pit and 1.61% had access to poor sanitation.

2. Soak pits are bottom-less septic tanks, which hardly provide any treatment and may contribute significantly to ground-water and river pollution. In addition, they are rarely emptied professionally, i.e. adequate sludge management is only marginally ensured.

3. Compulsory equipment with improved septic tanks (where it is technically possible) and compulsory safe sludge management at least once a year should be enforced by the local authorities. Sludge-treatment facilities, located not too far from Sariharjo, should contribute to the creation of robust business-models, i.e. the establishment of effective sludge-management schemes.

4. Just as for a sustainable water supply, sustainable wastewater management will require the establishment of a cost-recovery pricing system. Without such a system, sustainable financing of efficient wastewater systems will hardly be possible - especially with regard to the later development of more complex systems, such as centralized sewage systems. Respective awareness campaigns along with WASH (Water, Sanitation, and Hygiene) campaigns should contribute significantly to capacity building at the community and household level.

5. At topographically and spatially suitable locations, the construction of communal WWTP systems should further be examined. A robust operator concept should be ensured from the outset. Especially in areas of special public interest, such as water protection areas, where subsidizing the implementation and operation should be considered. For facilities with high wastewater generation and particularly polluted wastewater, advanced technologies should be examined or made mandatory.

Stormwater management

1. Flooding occurs regularly in some settlement areas of Sariharjo, causing damage to private and public property and endangering public health. A rapidly expanding sealing of surfaces and the loss of green areas has significantly reduced retention capacity of runoff waters that only to limited extent can be compensated by infrastructures, such as infiltration wells. It is predicted that such flooding events will increase in the future. Along with land-use change and climate change, larger scale and frequent flood events may become a new normal in Sariharjo.

2. It is obvious that the existing drainage infrastructure and conventional drainage infrastructure schemes are not sufficient to mitigate existing and upcoming challenges to stormwater management. Furthermore, flooding and uncontrolled drainage contributes to the pressure on wastewater treatment sewage systems that may result in reducing the efficiency of the systems and increasing negative public health impacts. Therefore, stormwater drainage systems should be separated from sewage drainage systems.

3. Integrated approaches that combine grey and green solutions may mitigate flood vulnerabilities. Coordinated, integrated solutions, such as the expansion of grey drainage and water retention systems together with green spaces and green infrastructure development (with a strong emphasis on nature- based solutions) that allow stormwater infiltration surfaces, are essential elements of effective stormwater management in Sariharjo.

4. Along with urban growth, water consumption by households and commercial establishments is increasing. Critical developments are already emerging. The fall in groundwater levels seen at some places and especially during the dry season is likely to be linked to the largely uncontrolled use of water wells on private and public properties. The loss of paddy fields with its decreased capacity to infiltrate surface water may contribute to reduced groundwater recharge and a fall in the water table. This highlights the need to develop infrastructure for the retention of drain-off water, e.g. in the form of water retention basins. The possible infiltration of the water can not only contribute to the protection of the aquifer, but also to flood protection.

5. In addition to the protection and development of strategically important green areas, there needs to be a consideration of the when considering infiltration techniques for road and path construction and the further dissemination of infiltration wells. Infiltration areas should,

for example, become obligatory in parking areas at public and private facilities.

Waste management

1. Between 2012 and 2017, the Sleman Regency recorded a notable increase in waste generation in kgs of around 30%. This may also be a valid approximation for Sariharjo (concrete data are not available). With the change in lifestyles and population growth, the amount of waste will increase both qualitatively and quantitatively.

2. As is the case throughout the Sleman Regency, already in Sariharjo inadequate waste management results in increasing pollution of the landscape, such as rivers and public spaces and the blockage of the drainage systems. Inadequate handling of hazardous waste has a serious impact on the environment and public health. So far, the implementation of the policy of Tempat Pengelolaan Sampah Reduce, Reuse, Recycle (TPS3R) and of initiatives, such as the Waste Banks, have had limited impact.

3. The nearby landfill Piyungan TPA is already exhausted. It is obvious that simply increasing capacities cannot ensure a sustainable waste management.

4. In order to implement the 3Rs effectively, a comprehensive knowledge of waste segregation is needed at the household or "at-source" level. Separation and composting of organic waste is essential to cleanly separate the recyclables and significantly reduce the amount of waste that ends up on the landfill. Without this separation, the capacity of each new landfill will be exhausted within a short period of time.

5. Ultimately, comprehensive waste management will only be achieved by professional service providers who know how to handle large capacities. The responsible government agencies must ensure the development of standard procedures and sound business models through law enforcement and regulations. Villages and sub-villages can support this process through extensive awareness campaigns and cleaning public spaces and sewers just before the rainy season can contribute significantly to improved stormwater management.

Vision for a water sensitive Sariharjo

The village and its stakeholders may elaborate a vision for a water sensitive Sariharjo through a participative consultation process. The following elements may be reference points for the elaboration of a vision

statement and the identification of respective measures that may be the subject of Village Development Plans and budget-planning.

"In a water sensitive Sariharjo both the village government as well as community have a common understanding, perception, goals, and commitment to develop their village based on water sensitive principles, based on positive views and behaviors over water. A water sensitive village means that all residents live and work in an attractive, inclusive, healthy, and resilient environment."

Sariharjo follows several important directions and commitments for a water sensitive village development:

1. Sariharjo has a medium-term village development plan, which is oriented, among other things, to the dimensions of water sensitive development. This plan is specified in the annual village development plan - also at sub-village level - and the corresponding budget plan.

2. At least 30% of the village area is sustainably dedicated to green open spaces. Here, the development of the village treasury land plays an essential role. The spaces are an integral part of strategic planning that develops the village as a recreational and climate change resilient area. The spaces are well- developed with native trees and hedges. Maintenance is ensured by allocation of respective funds and community engagement.

3. Its residents have access to safe water. New residential areas, commercial facilities and progressively private homes are connected to the PDAM services. Community awareness, good quality water services and water conservation measures at public and private buildings contribute to water safety.

4. Its water resources are well protected. All new residential areas, public buildings and private sector facilities are connected at least to improved septic tanks or more advanced technologies. Wastewater treatment is needed for the existing building stock or residential areas will be progressively connected to improved septic tanks and sewerage systems. Awareness campaigns and effective law enforcement contributes to effective fecal sludge management. Its water protection zones are well- protected by effectively implemented Water Safety Plans.

5. Solid and toxic waste is safely managed. Awareness campaigns at the community level have contributed to waste separation at source. Capacities for composting organic waste and managing toxic waste are developed. Standardization of processes and of tariffs have contributed

to a better performance of the waste sector in the village.

6. Integrated stormwater management that combines grey with blue-green solutions contributes significantly to the reduction of flooding risks in the village. Urban planning and village and sub-village levels have specified respective infrastructure developments. Protected public green spaces, enforcement of standards for green spaces at private and public premises and increasing the application of porous surfaces, e.g. on parking lots, ensures high water infiltration. Water retention structures compensate for the loss of buffer zones in the paddy-fields.

To be able to implement such a water sensitive village, several steps should be conducted:

1. The above-mentioned dimensions of a water sensitive village are discussed and specified in participatory processes with stakeholders from public governance structures, communities, the private sector and civil society actors.

2. Capacity building measures for the village community on several issues are undertaken, such as knowledge on water, environmental pollutions, economics, and water sensitive planning.

3. Increasing the effectiveness of the village government, particularly in terms of the management and use of village resources and law enforcement to the benefit of the whole village.

4. Developing networks and collaborations with various stakeholders, including government and private sectors.

5. Creating a model and technical guidelines on how to implement water- sensitive villages.

6. Balancing institutional arrangements, regulations, and financial systems for water sensitive villages.

7. Developing measurable indicators and baselines to monitor and to evaluate the development of water- sensitive villages.

Terminology and Definitions

Adaptive capacity: The combination of the strengths, attributes, and resources available to an individual, community, society, or organization that can be used to prepare for and undertake actions to reduce adverse impacts, moderate harm, or exploit beneficial opportunities (IPCC, 2012).

Baseline/reference: The baseline (or reference) is the state against which change is measured. It might be a 'current baseline,' in which case it represents observable, present-day conditions. It might also be a 'future baseline,' which is a projected future set of conditions excluding the driving factor of interest. Alternative interpretations of the reference conditions can give rise to multiple baselines (IPCC, 2012).

Biochemical Oxygen Demand (BOD): describes how much oxygen is required for the oxidisation of matter, which can be oxidised biologically with the help of bacteria (Ulrich et al., 2009).

Blue Infrastructure: European Commission stated that blue infrastructure is understood as a strategically planned and intensively managed system of natural, seminatural and man-made water-based features such as coastal areas, rivers, lakes, wetlands but also designed elements such as artificial channels, ponds, water reservoirs, retention basins and tanks as well as urban wastewater networks.

Catchment: An area that collects and drains precipitation (IPCC, 2012).

Chemical Oxygen Demand (COD): is the most common parameter for measuring organic pollution. It describes how much oxygen is required to oxidise all organic and inorganic matter found in water (Ulrich et al., 2009).

Climate change: A change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer (IPCC, 2012).

Climate: in a narrow sense is usually defined as the average weather, or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands or millions of years. The classical period for averaging these variables is 30 years, as defined by the World Meteorological Organization. The relevant quantities are most often surface variables such as temperature, precipitation, and wind. Climate in a wider sense is the state, including a statistical description, of the climate system. In various chapters of this report different averaging periods, such as a period of 20 years, are also used. (IPCC, 2012).

Disaster management: Social processes for designing, implementing, and evaluating strategies, policies, and measures that promote and improve disaster preparedness, response, and recovery practices at different organizational and societal levels (IPCC, 2012).

Disaster risk: The likelihood over a specified time period of severe alterations in the normal functioning of a community or a society due to hazardous physical events interacting with vulnerable social conditions, leading to widespread adverse human, material, economic, or environmental effects that require immediate emergency response to satisfy critical human needs and that may require external support for recovery (IPCC, 2012).

Drought: A period of abnormally dry weather long enough to cause a serious hydrological imbalance (IPCC, 2012).

Evapotranspiration: This refers to evaporation (E) from soil, plant surfaces and water bodies and the transpiration (T) through plant canopies. The term is useful in regards agriculture where the actual evapotranspiration relates to the Crop Water Requirements.

Exposure: The situation of people, infrastructure, housing, production capacities and other tangible human assets located in hazard-prone areas ([UNDRR] United Nations Office for Disaster Risk Reduction, 2020).

Flood: The overflowing of the normal confines of a stream or other body of water, or the accumulation of water over areas that are not normally submerged. Floods include river (fluvial) floods, flash floods, urban floods, pluvial floods, sewer floods, coastal floods, and glacial lake outburst floods (IPCC, 2012).

Green Infrastructure: Strategically planned and intensively managed systems of natural, seminatural and man-made land-based features such as terrestrial protected areas, field margins in intensive agricultural land, ecoducts and tunnels for animals, parks and green roofs in cities (Lucius et .al, 2011).

Grey Infrastructure: This term is often used to oppose what is called “Green-blue (or natural) infrastructure”, it refers to any hard structure or traditional engineering solutions (UNEP, 2019).

Greywater: is the total volume of water generat- ed from washing food, clothes and dishware, as well as from bathing, but not from toilets. It may contain traces of Excreta (e.g., from washing diapers) and, therefore, also pathogens. Greywater accounts for approximately 65% of the wastewater produced in households with flush toilets (IWA, 2016).

Hazard: A process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social and economic disruption or environmental degradation ([UNDRR] United Nations Office for Disaster Risk Reduction, 2020).

Hydrological/water cycle: The cycle in which water evaporates from the oceans and the land surface, is carried over the Earth in atmospheric circulation as water vapor, condenses to form clouds, precipitates again as rain or snow, is intercepted by trees and vegetation, provides runoff on the land surface, infiltrates into soils, recharges groundwater, and/or discharges into streams and flows out into the oceans, and ultimately evaporates again from the oceans or land surface. The various systems involved in the hydrological cycle are usually referred to as hydrological systems (IPCC, 2012).

Indicator: A single variable or parameter that quantifies the state of a system (Walz, 2000)

Index: Combination of single indicators in a dimensionless number (Mitchell et al., 1995)

Integrated Water Resource Management: Is a process which promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems (GWP, 2011).

Land use and land use change: Land use refers to the total of arrangements, activities, and inputs undertaken in a certain land cover type (a set of human actions). The term land use is also used in the sense of the social and economic purposes for which land is managed (e.g., grazing, timber extraction, and conservation). Land use change refers to a change in the use or management of land by humans, which may lead to a change in land cover (IPCC, 2012).

Landslide: A mass of material that has moved downhill by gravity, often assisted by water when the material is saturated. The movement of soil, rock, or debris down a slope can occur rapidly, or may involve slow, gradual failure (IPCC, 2012).

Nature-based solutions (NbS): have been defined as “actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits” (IUCN, 2016). NBS are not intended to replace grey infrastructure and technical solutions but rather to integrate with them in order to form resilient combinations that adapt to complex systems and changing environments (Haase, 2015), (Bai, 2018) recommends applying a “kaleidoscope” approach when working with NBS. An approach that connects to the principles of urban ecology and acknowledges existing settings (governance, social systems & infrastructure) while initiating truly creative interconnections that go beyond a grey, blue or green focus.

Polycentric management of urban waters (PUW): The concept of PUW considers the challenges for urban areas and settlements to include "water" as a cross-cutting issue requiring cross-sectoral solutions. PUW brings together security of supply of water-related services (water supply, water and waste management, flood management, etc.), resilience to the impacts of climate change, and the creation of livable and inclusive urban spaces in an integrated approach to sustainable water resource management (IWRM) and participatory urban development planning. The solutions are developed and implemented according to the specific natural and socio-economic characteristics of the respective urban areas, the regulatory frameworks, and the financial and institutional capacities of the towns and local stakeholders.

Progressive Implementation: This principle follows the Agenda 21 of the United Nations Conference on Environment & Development Rio de Janeiro, 1992. Infrastructure development should be guided in accordance with local capacities and the local context in order to ensure sustainable maintenance and operation (UNSD, 1992).

Resilience: The capacity of social, economic and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity and structure, while also maintaining the capacity for adaptation, learning, and transformation Progressive Implementation (Sutton et al., 2011). The ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of a hazardous event in a timely and efficient manner, including through ensuring the preservation, restoration, or improvement of its essential basic structures and functions (IPCC, 2012).

Risk: Potential for adverse consequences for human or ecological systems as a result from dynamic interactions between hazards, exposure and vulnerability of the affected human or ecological system (IPCC, 2022)

Runoff: That part of precipitation that does not evaporate and is not transpired, but flows through the ground or over the ground surface and returns to bodies of water (IPCC, 2022)

SANIMAS or 'Community-Based Sanitation' (Sanitasi Berbasis Masyarakat): The approach provides technical and institutional assistance to poor urban communities to develop sanitation infrastructure, which targets 50 to 200 households in urban areas; and includes decentralised small-scale sanitation systems (SSS), for the collection and treatment of domestic wastewater, or a combination of SSS and a toilet block (MCK).

Urban heat island: The relative warmth of a city compared with surrounding rural areas, associated with changes in runoff, the concrete jungle effects on heat retention, changes in surface albedo, changes in pollution and aerosols, and so on (IPCC, 2012).

Urban Waters: is a concept of sustainable urban water management. Urban waters within the city (including reservoir and aquifer water, desalinated water, recycled water and stormwater) are managed in a way that maximises the achievement of urban livability outcomes and resilience to unexpected social, economic or bio-physical shocks (IWA, 2016)

Vulnerability: The degree to which a system is susceptible to, or unable to cope with, adverse effects of. climate change, including climate variability and extremes (IPCC, 2022). The characteristics and circumstances of a community, system, or asset that make it susceptible to the damaging effects of a hazard (UNEP, 2019)

WASH: is an acronym that stands for "water, sanitation and hygiene". The purposes of providing access to WASH services include achieving public health gains, improving human dignity in the case of sanitation, implementing the human right to water and sanitation, reducing the burden of collecting drinking water for women, reducing risks of violence against women, improving education and health outcomes at schools and health facilities, and reducing water pollution.

Wastewater: is the mixture of Urine, Faeces and Flushwater along with Anal Cleansing Water (if water is used for cleansing) and/or Dry Cleansing Materials). Wastewater contains the pathogens of Faeces and the nutrients of Urine that are diluted in the Flush-water (IWA, 2016).

Water security: is defined here as the capacity of a population to safeguard sustainable access to adequate quantities of acceptable quality water for sustaining livelihoods, human well-being, and socio-economic development, for ensuring protection against water-borne pollution and water-related disasters, and for preserving ecosystems in a climate of peace and political stability (UNU-INWEH, 2013).

Water sensitive urban development: In helping cities transition to ecologically based systems that also address climate change impacts, urbanization, and population growth, the Water Sensitive Urban Design (WSUD) approach has been evolving and implemented in existing and new developments around the world since the 1990s, including Asia through the use of various tools and technical solutions that integrate the natural elements of water, plants and soil while maintaining the natural water cycle. With new designs for building suburbs mitigate water discharge from heavy rainfalls by absorbing, storing

and using stormwater runoff (rather than losing runoff to direct drainage from impervious surfaces to waterways), WSUD can deliver multiple benefits including increased, better-quality water supply, stormwater quality improvements, flood control, landscape amenity, healthy living environments, and ecosystem health. Essentially, WSUD emphasises alternative urban water supplies that reduce the stress on a town's water treatment facilities, re-naturalize water courses and associated riparian areas, and install vegetative technologies that create attractive urban streets while providing much-improved stormwater quality (Sharma et al., 2018). In directly, such improvements to the urban living environment can increase land values and expand tourism and other business opportunities (IWA, 2016).

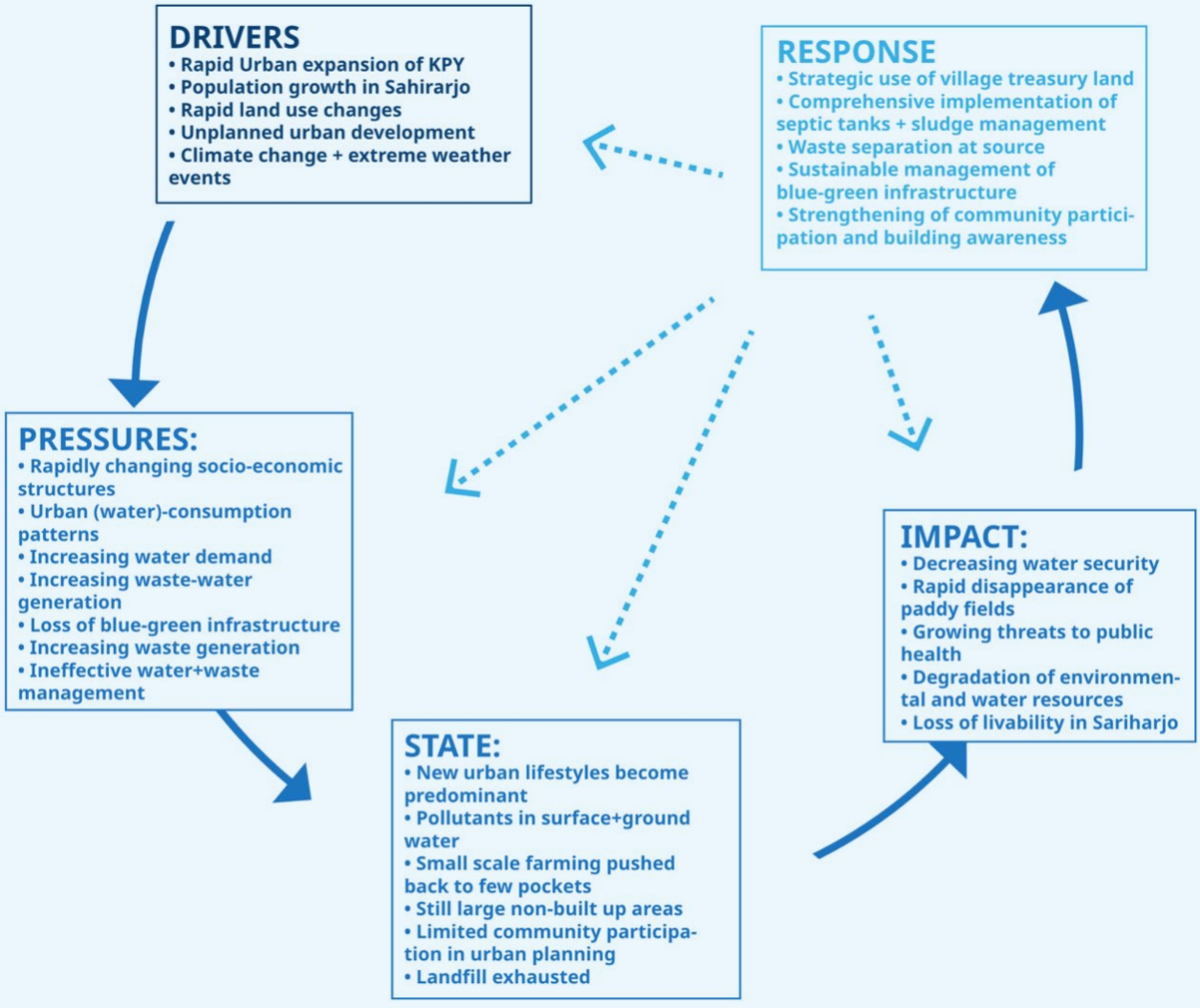
Water sensitive village: In a water sensitive Sariharjo both village government as well as community have a common understanding, perception, goals, and commitment how to develop their village based on water sensitive principles, based on positive views and behaviors over water. Water sensitive village means a village that all village residents live and work in an attractive, inclusive, healthy, and resilient environment. And, a village in which comprehensive basic water-related services are provided.

Methodology

The conceptual framework of the study is based on the **Driving-Force/Pressure/State/Impact/Response method (DPSIR)**. This framework allows a well-structured analysis of natural, social and economic information in the context of an urban transformation process in the villages of Sariharjo in Sleman Regency.

This report follows the structure of this DPSIR-framework:

Figure 1. DPSIR-framework for Sleman Regency with selected indicators
(Source: PUW, 2022)



~ **Driving forces** are defined as "forceful drivers" for demographic, economic, social, ecological and climate changes that induce urban transformation.

~ This driving forces translates into **pressure** on the current situation in the villages: for instance, higher water demand and generation of higher amounts of wastewater, in the generation of higher amounts of waste and new qualities of waste, such toxic waste, and accelerated land sealing.

~ **The state** of a village is captured by information on water quantity and quality (degree of water pollution) or the state of renewable water resources in the water catchment area of Sleman Regency. It can also be captured by information on the state of blue-green infrastructure, built up areas and the amount of sealed areas in a village. Even information on capacities and the effectiveness of governance structures may give important information about challenges to improve water security in the village.

~ **Impacts** give information on pressure induced problems and challenges, such as the deterioration of public health and the environment and the livability of villages: a high level of water induced health problems, insufficient provision of water-related basic needs services, higher vulnerability to climate change or even an overstretch of local governance structures can be the impact of urban transformation.

~ **Responses** indicate measures that can be taken to mitigate pressure or even to improve the given state: a more effective allocation of public funds through well focused village development plans, the development of public spaces in respect of blue-green infrastructure, strengthening the capacities of local governance structures and water operators, public awareness campaigns on waste separation and on the benefit of improved septic tanks that will benefit communities.

Overall, the DPSIR follows the dimensions that apply to water sensitive village development. The provision of water-related basic-needs services is placed in the context of urban development and changes in settlement structure and land use:

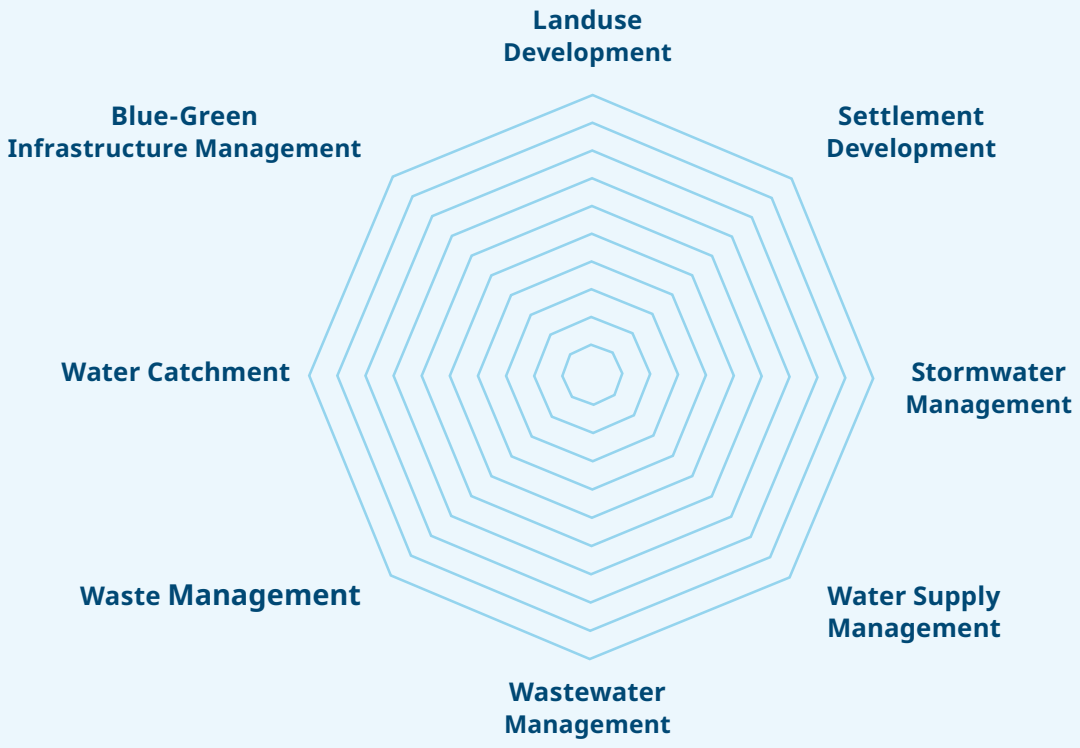


Figure 2. Dimensions of baseline report
(Source: PUW, 2022)

PolyUrbanWaters has chosen the following approach to collect and evaluate data:

~ A comprehensive search for existing data was undertaken. Sources of information including the Sleman Geoportal, census data, studies and publications by experts, scientists and international information, etc. (see references). Secondary data was assessed for relevance and consistency and data gaps were identified.

Quantitative and qualitative data have been collected by the PolyUrbanWaters Team using several methods and instruments of research:

a. Transect walk with sub-village head/community leader in 16 sub-villages of Sariharjo

Transect walk activities aim to understand the context of Sariharjo Village starting from the sub-village level. The local PolyUrbanWaters Sleman team divided into several groups and conducted the activities in 16 sub-villages of Sariharjo. Each group consisted of 2-3 persons meeting with sub-village leaders and mapping the Points of Interest (PoI) in each of the sub-village areas, including public facilities, water related infrastructures, village treasury land (TKD), and natural resources, etc. During the transect walk activities, the team is not only mapping the PoI, but also is gathering information about current development issues from the sub-village leaders.

b. Infrastructure mapping by using Kobo Toolbox

Kobo toolbox (https://www.kobotoolbox.org) is a free and open source toolkit for data collection and analysis for humanitarian works and initiatives. In this research, this tool is used for mapping the infrastructure conditions and assets, natural resources, public facilities, commercial activities and social assets. Kobo Toolbox also collects the location information through geotagging. The information collected from the Kobo Toolbox tools is used as baseline information for further field activities and analysis.

c. Focus Group Discussion (FGD) with village government and sub-village leader

The participatory FGD was conducted by involving the village government and sub-village leaders from 16 sub-villages, to discuss current conditions, issues and problems in the areas as well as the development challenges in Sariharjo. At least two FGDs were conducted during the baseline activities: preliminary and data consolidation FGD.

d. Interview with relevant stakeholders (government and community) at the city and village levels

Although the pilot area of the project is at the village level, the relevant data and information at the city level is important to better understand the context and as the complementary data for the pilot area. The key stakeholders involved in this process include the Planning Agency, Environmental Department, PDAM, Public Works, Agriculture Department, Land and Spatial Agency, and other relevant stakeholders.

e. Ecosystem Services Mapping

Led by TH Köln and TU Berlin consortium, the local Sleman team conducted a comprehensive natural resources mapping in 16 sub-villages. Kobo Toolbox was also used for mapping the natural resources and biodiversity in Sariharjo. This process aimed to better understand the distribution of ecosystem services and

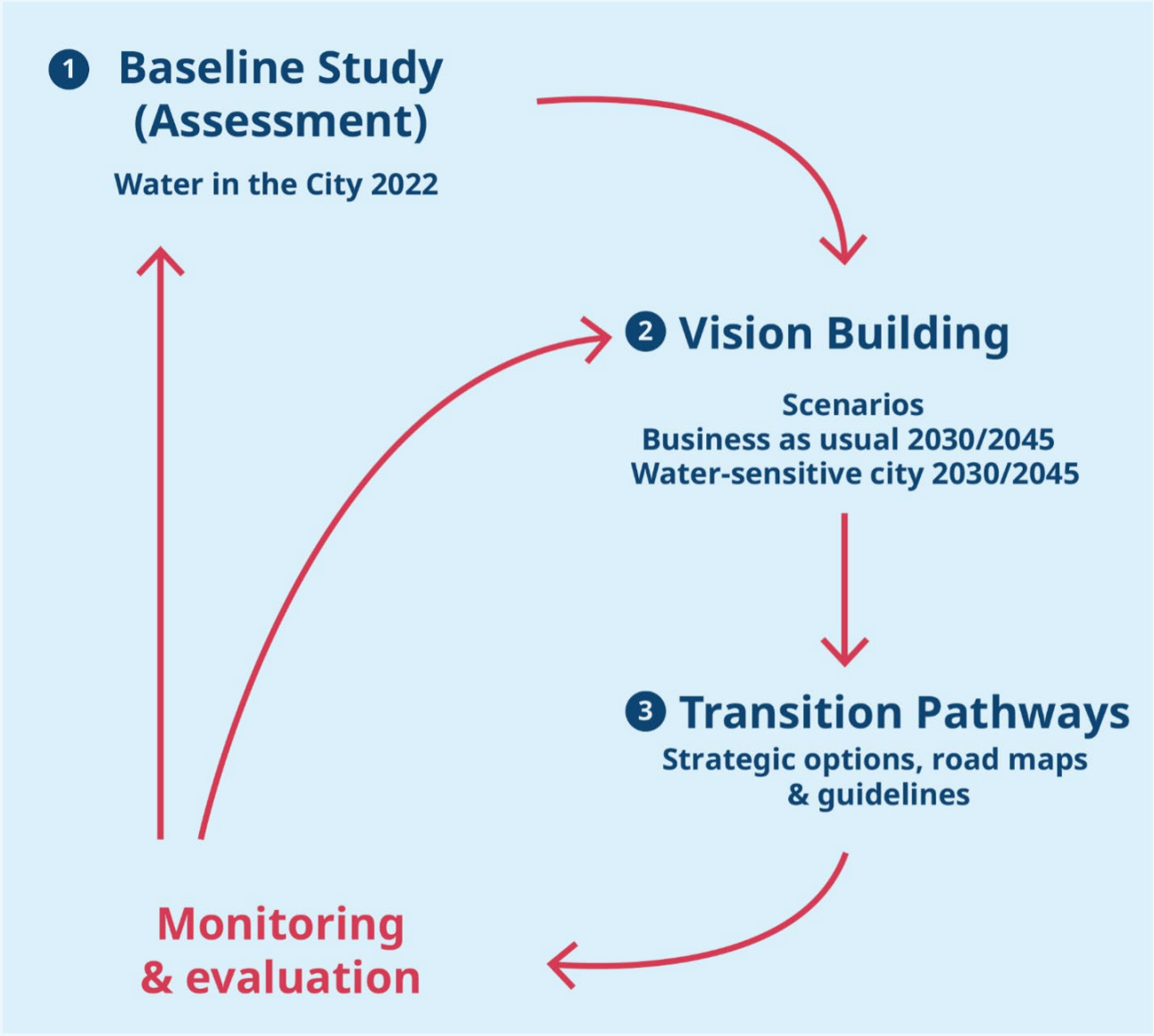
biodiversity as well as understand the value and benefits of nature.

f. Participatory Workshop

Participatory workshops conducted at the village level, invited participants including the village head, sub-village head, and female cadres from 16 sub-villages of Sariharjo. This workshop aims to verify the information from the field, and build the preliminary vision with local stakeholders. A one-day full workshop divided into two sessions; 1) Business as Usual (BaU) workshop to simulate the current dynamic and development challenges in the area, as well as the impact of uncontrolled development, and 2) Vision Building workshop process to simulate the future conditions with Nature-based Solutions (NbS) applied to the local context.

The elaborate database was subjected to a comprehensive interpretation by the Indonesian and the international project team in accordance with the conceptual framework above.

The results of this Baseline Assessment and the respective information will contribute to the vision building process in Sariharjo and its sub-villages that will start in March 2023. This vision building process will guide the elaboration of village development plans, including financial action planning.



A. Policy framework to localize / planning with SDGs

In the Voluntary National Report 2021 on the implementation of the SDGs to the High-Level Political Forum of the United Nations, the Government of Indonesia outlines that the 2030 Sustainable Development Agenda provides a historic opportunity to prepare a population that will grow and develop in a sustainable, inclusive, prosperous, and resilient manner. (Republic of Indonesia, Indonesia's Voluntary National Review (VNR) 2021)

The commitment of the Government to the implementation of the "2030 Agenda: Sustainable Development Goals" is regulated by the enactment of Presidential Regulation No. 59 Year 2017. Under the mandate of the Regulation, Indonesia has mainstreamed the targets and indicators for sustainable development in the 2015-2019 and 2020-2024 Medium-term National Development Plan (RPJMN), localizing sustainable development at the subnational level.

Presidential Regulation Number 59/2017 includes 94 SDGs targets that are mainstreamed in the 2015-2019 RPJMN. In the 2020-2024 RPJMN, the number of SDGs mainstreamed targets are 124. The government has established a national secretariat for SDGs, led by the Ministry of National Development Planning/National Development Planning Agency (Bappenas) that facilitates the coordination with other related ministries.

Policies related to Goal 6 "Clean Water" include:

- Provision of access to safely managed and improved drinking water services is implemented with the following policies: (1) Improving institutional governance for the provision of safely managed and improved drinking water services; (2) Increasing the capacity of drinking water providers; (3) Development and management of SPAM: Sistem Penyediaan Air Minum/Drinking Water Supply Systems; and (4) Education to the public.

- For a sustainable sanitation service system, the Program for the Acceleration of Housing Sanitation Development (PPSP) realizes this through the following policy directions: (1) Increasing institutional capacity in sanitation management services; (2) Increasing commitment of regional governments; (3) Development of settlement sanitation infrastructure and services; (4) Increasing changes in community behavior; and (5) Development of cooperation and funding patterns.

- The policy directions for sustainable groundwater and raw water management are: (1) Accelerating the supply of raw water from protected water sources; (2) Enhancement of integration in drinking water supply; and (3) Utilization of technology in raw water management. Policies related to Goal 11 "Sustainable Cities and Communities" include:

  Policies in waste management: (1) Waste management from upstream to downstream with the principle of reduction and reuse; (2) Strengthening waste reduction campaigns; (3) Strengthening the capacity of local governments, regulations and waste management institutions; and (4) Monitoring, evaluation and law enforcement.

The Government of Indonesia has put in place a comprehensive policy on climate change. In this context, by 2030, Indonesia envisions achieving archipelagic climate resilience as a result of comprehensive mitigation and adaptation and disaster risk reduction strategies.

In achieving the adaptation goal, Indonesia focuses on three areas of resilience, namely economic resilience, social and livelihood resilience, and ecosystem and landscape resilience. Key programmes, strategies and actions for each area of resilience have been identified. The 2020-2024 National Medium-Term Development Planning (RPJMN) includes adaptation under the 6th development agenda (Enhancing the environment and resilience to natural disasters and climate change impacts) with a focus on water, agriculture, health, and coastal and marine ecosystems. In general, the key programmes, strategies and actions on adaptation aim at:

- Reducing drivers of vulnerability to climate change impacts;

- Responding to climate change impacts and managing risks;

- Enhancing capacity of communities and sustainability of ecosystem services;

- Enhancing engagement of stakeholders at all levels in building climate resilience.

Each regency in Indonesia, including Sleman Regency, has put efforts into implementing the SDGs by integrating them into Sleman Regency's Medium-term Development Plan. Agencies and departments in Sleman Regency implemented almost all of the SDGs goals in their respective organization, except two goals, i.e. Goal number 7 (Affordable and Clean Energy), which is under the Provincial Government's authority, and Goal number 14 (Life Below Water) as most of Sleman's geographical area is primarily land although fishery activities are

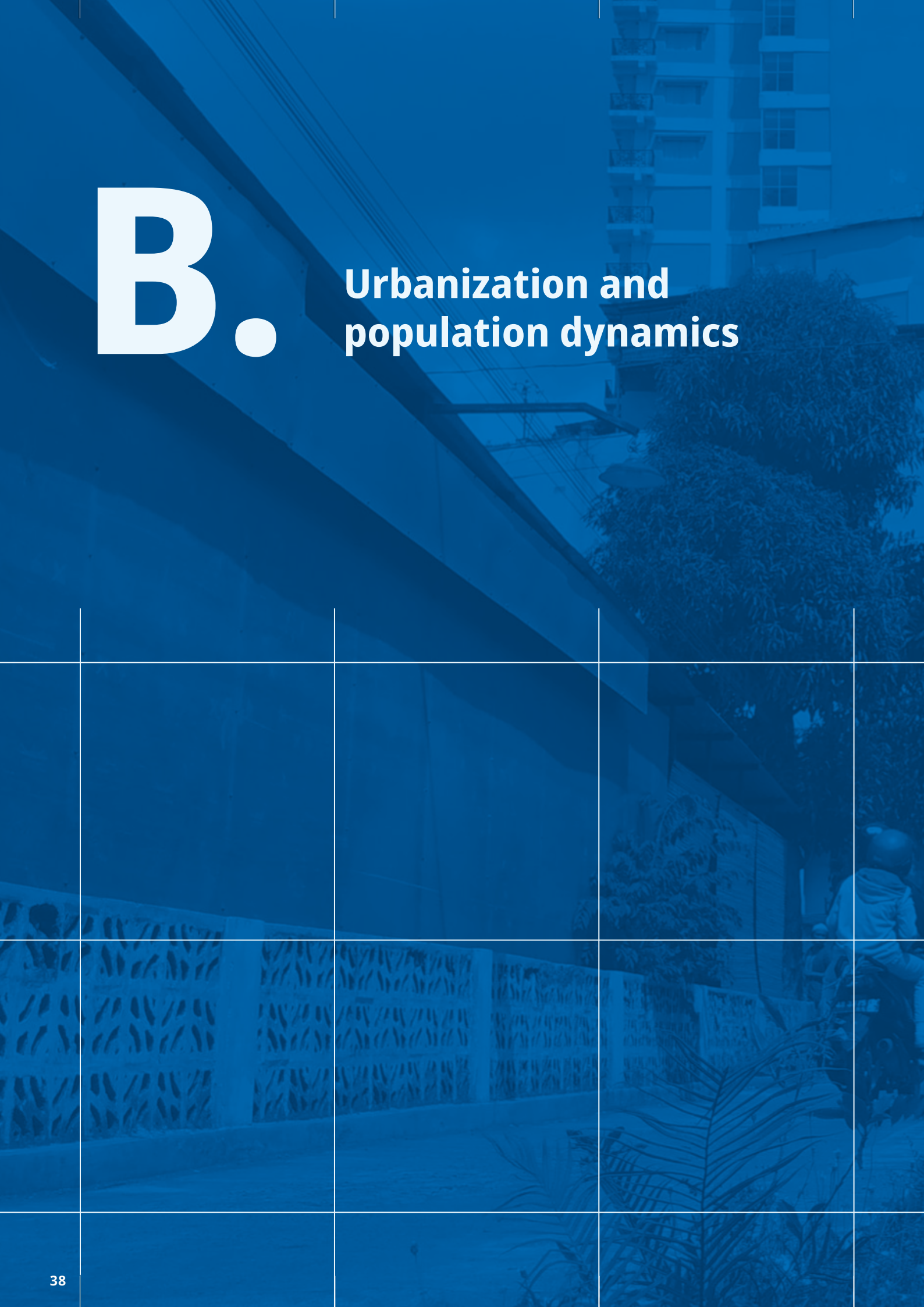
acknowledged by Sleman Government.

According to the development planning cycle in Indonesia, the 5-year Medium-Term Development Plan has also been evaluated to provide advice for the next planning process. This includes the SDGs accomplishment in Sleman Regency. Further studies need to be conducted on the impact of the SDGs' implementation in Sleman Regency at the village level and to the village community.

A review of Sleman Regency regarding implementation of the SDGs (2018) indicates that targets that have not been achieved both in Sleman Regency and in Sariharjo Village are Goal 1 (No Poverty), 6 (Clean Water and Sanitation), and 11 (Sustainable Cities and Communities).

The 86 villages of the Sleman Regency with its population of 1,125,804 residents (2020) face increasing water challenges in the context of increasingly dynamic urbanization. Water-related basic-needs services, inclusiveness and the livability of these increasingly urban villages must be ensured. The fundamental socio-economic, cultural, and environmental transformation of villages that is a daily experience already require new approaches to village or urban development and the management of local water resources. This is a challenge that will be intensified due to the impacts of climate change.

Indonesia's 2014 Law No. 6 gives villages as the lowest level of government structure a robust mandate to develop their territorial communities. The law gives Sleman Regency's villages and its sub-villages the opportunity to determine urban planning and infrastructure development tailored to the local needs and conditions. Here, the Government of the Sleman Regency and the governance structures at the village and sub-village level want to use their new possibilities for shaping and acting according to their needs and capacities.



B. Urbanization and population dynamics

Key Messages of Section

As part of Yogyakarta Urbanized Area (KPY) the Sleman Regency and its villages undergo a comprehensive socio-economic and cultural transformation where **rural communities once dominated by small-scale agriculture are dynamically urbanized**.

These transformation processes are exemplified in the village of Sariharjo, located on the border with Yogyakarta city. **"Traditional" agriculture is rapidly being replaced by "modern" forms of urban farming**. This transformation process has a significant impact on social structures and land use patterns.

The **increase in land value** is a strong indicator of the attractiveness of Sariharjo for commercial and residential purposes. At the same time, this development increasingly holds the risk of social segregation.

In the course of this transformation process, the necessities and challenges for **sustainable management of local water resources are fundamentally changing**.

Regency, village and sub-village governance structures are facing significant challenges and are insufficiently prepared in guiding this transformation towards sustainable development. **Urban growth is largely unplanned** and infrastructure/basic-needs services are in deficit to corresponding development plans.

Sariharjo is challenged to use its essential assets, i.e. especially the **village owned lands (TKD)** strategically for the sustainable development and livability of the village.

Besides the realization of the actual values and sustainable management of these extensive areas, they should be partly used for the benefit of the communities for the **development of a water sensitive village and as recreational areas**.

Urban development in Indonesia

Indonesia is rapidly becoming an urbanized country. In 2020, about 150 million people lived in urban areas. While the population of Indonesia is estimated to grow from 272 million people in 2020 to 298 million people in 2030, the average urbanization rate is expected to increase from 56.6 % in 2020 to 62.8% by 2030.

The urban population of Indonesia lives in hundreds of small, medium, and big cities, and in metropolitan areas. There are 98 cities, 416 regencies, 7,246 sub-districts and 83,813 villages in Indonesia (Statistical Yearbook of Indonesia 2020). The major concentration of the urban population is located in major cities, such as Medan, Palembang, Pekanbaru, and Padang in Sumatra Island; Jakarta, Bandung, Surabaya, Semarang, and Yogyakarta on Java Island; and Makassar and Manado in Sulawesi Island (Roberts et.al., 2019).

In the course of the decentralization policy that has been promoted since 1996 by the Government of Indonesia, the role of small and medium-sized cities, and especially secondary cities, is to be strengthened in order to guide urbanization trends toward a more sustainable growth.

Overall, the governance structures of the KPY reflect to a certain extent the challenges that the World Bank sees as characteristics for effective decentralization in Indonesia: Coordination, capacity, and financial resources. “Decentralized decision-making has made urban planning and management a more inclusive affair, but it has also increased the complexity of coordinating across different sectors, levels of government, and jurisdictional boundaries. Both vertical and horizontal fragmentation create challenges in integrating public services: (1) The vertical coordination of government agencies working across different tiers or levels of hierarchy (how central government agencies work with subnational governments); (2) The horizontal coordination of neighboring jurisdictions, especially within multidistrict metro areas; and (3) The horizontal coordination of national ministries and subnational departments across sectors.” (World Bank 2019)

These framework conditions for sustainable village development especially in peri-urban areas should give an indication of why complex urban planning processes are very costly, especially in their implementation. For this, flexible instruments, such as polycentric approaches to the management of urban water resources and a model of water sensitive village development, can contribute to reducing complexity and stimulate greater effectiveness in the implementation of Indonesia's 2014 Law No. 6.

Yogyakarta Urbanizing Areas

The city of Yogyakarta is categorized as an emerging secondary city. The population in this city according to the Yogyakarta Municipality is 373,589 as of 2020, while the population of KPY is over 1 million, a number that indicates a big city. The area of KPY consists of the administrative city of Yogyakarta, part of Sleman Regency in the north of the city, and part of Bantul Regency, at the southern border of the city of Yogyakarta.

In 2020, the Sleman Regency had a population of 1,125,804 (Census 2020), in 2000 the population was 901.400 (Census 2000).

KPY is characterized by strong growth from the City of Yogyakarta northward into Sleman Regency, a once predominantly rural area and to the southern areas (Bantul Regency). Today Sariharjo is located in a peri-urban zone. Growing density and growing urban sprawl are the main characteristics of this dynamic urban growth.

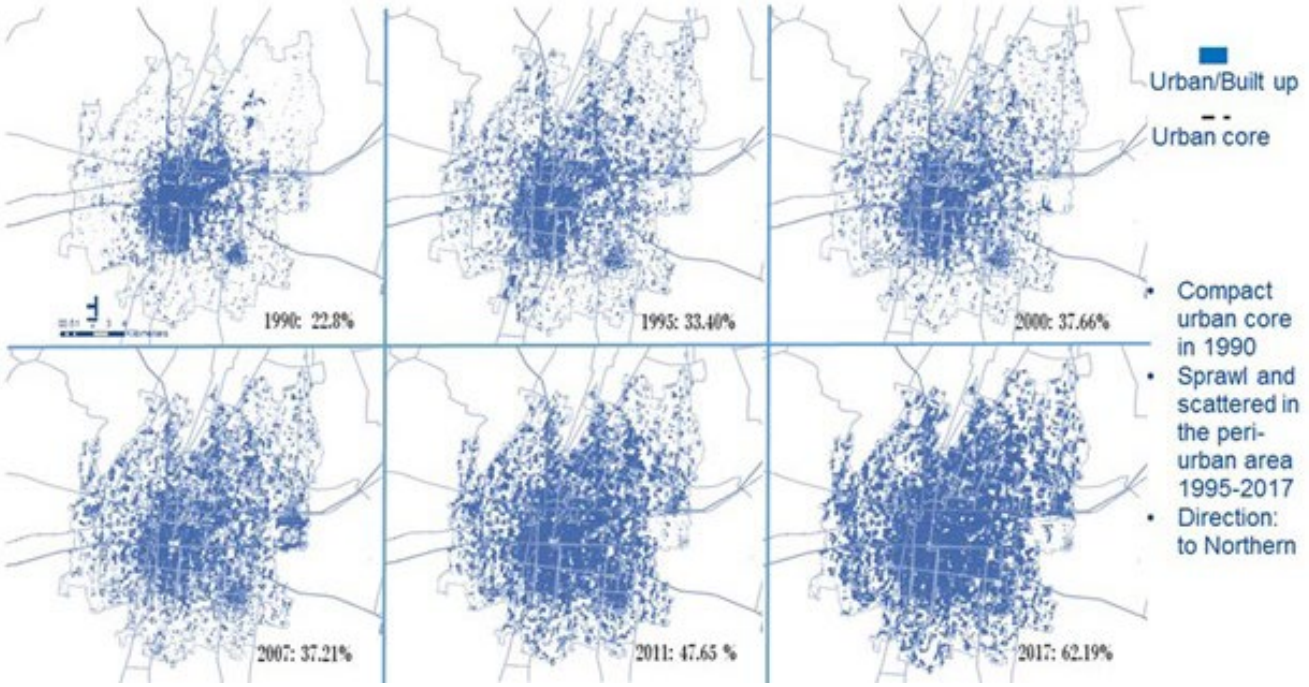


Figure 3. Urban Density in the Yogyakarta Urbanized Area from 1990-2017 (Source: Rozano & Yan (2018) modified)

The development of the Yogyakarta peri urban areas is largely unplanned and ineffectively managed. This growth is largely driven without planning by the real estate market. One result of this development – among others – is a structural undersupply of basic-needs services and insufficient water infrastructure.

This is despite the fact that considerable effort has been made in the region with Kartamantul, a cooperation of the three local governments of Yogyakarta city, Sleman Regency and Bantul Regency. One aim was to ensure consistent planning and development of the metropolitan region as part of the decentralization policy implemented since 1996.

Considering the size of the city, urbanization rate, and economic development within the KPY area, Yogyakarta to some extent represents the challenges faced by many secondary cities in Indonesia and in Southeast Asia. Several physical urban form characteristics can be highlighted as representative:

~ Organic/unplanned/uncontrolled development, meaning that most areas are developed naturally over time beyond formal plan;

~ Urban form bias (linear or ribbon form along the road, combined with sprawl at some spots);

~ Mixed-use, where land use for urban development combines unsegregated and a multitude of economic activities and residential uses;

~ Predominant informal housing, including slum areas with significant undersupply of infrastructural and basic-needs services;

~ Absence of a clear urban boundary as a result of the kotadesasi process respectively that frays the urban-rural transition zones;

~ Uncontrolled conversion of agriculture land and water catchment areas;

~ Strong pressure on eco-systems and natural resources;

~ Inefficiency of urban resources usage, including vacant lots;

~ Social and spatial segregations;

~ Urban crime issues.

Urbanization process in Sariharjo Village

Sariharjo Village, which has been selected in this baseline assessment, is a fast-growing area in the northern KPY. This village is located about 7 km from the city of Yogyakarta and 3 km from the Sleman Regency capital. This village is dissected by a ring road, an arterial road that connects the City of Yogyakarta to other cities on Java Island. This village is also divided by Palagan Tentara Pelajar road, a collector road that serves movements between Sleman Regency and the City of Yogyakarta. Further, this village has good regional and local accessibility. The proposed elevated toll road to be built along the ring road would allow better accessibility and connectivity.

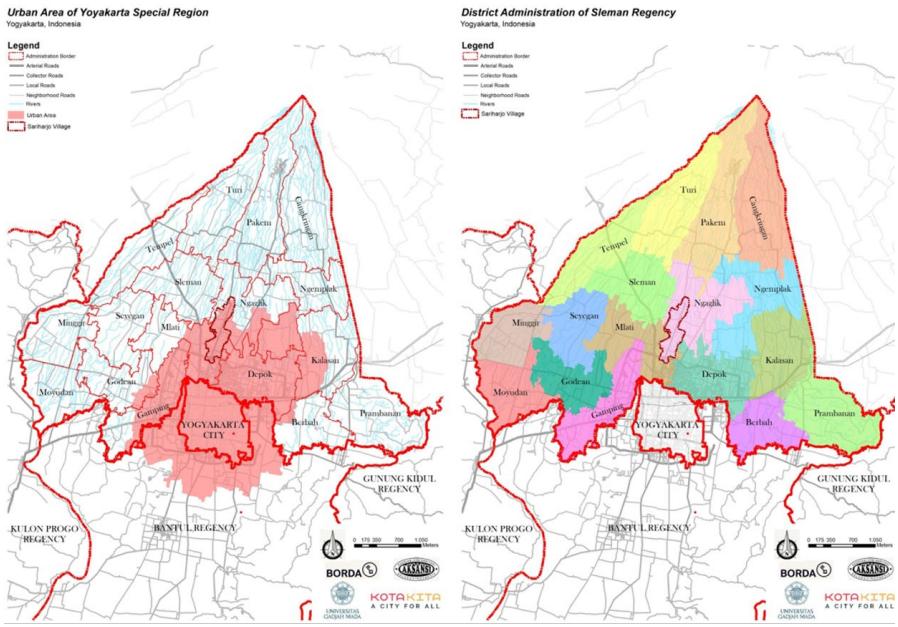


Figure 4. Location of Sariharjo within the Urban Area of Yogyakarta Special Region and within the District Administration of Sleman Regency

(Source: After MURP UGM, 2021)

Demographic transformation of Sariharjo Village

In 2020, the PolyUrbanWaters' pilot village, Sariharjo, had a population of 21,438 registered residents (5.904 households). The total number of residents (including non-registered residents) can be estimated at 26.000. Given an assumption of 3% annual population growth and using a linear projection, the total population number in 2030 can be projected to be approximately 34,000 residents.

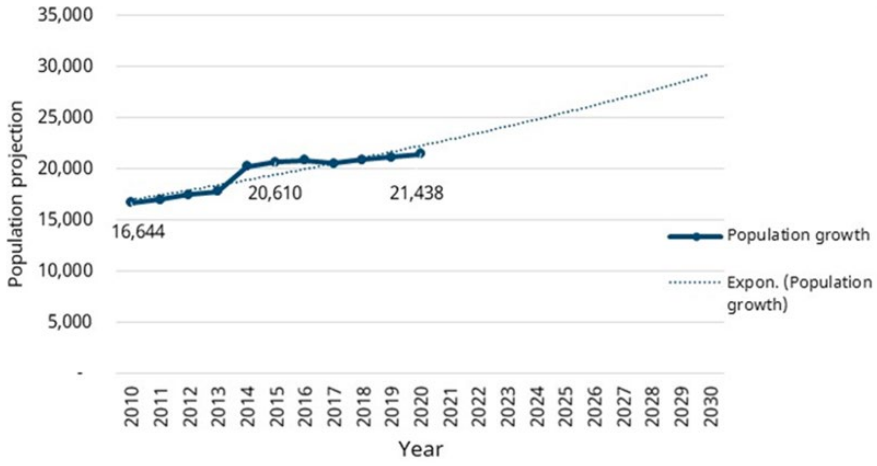


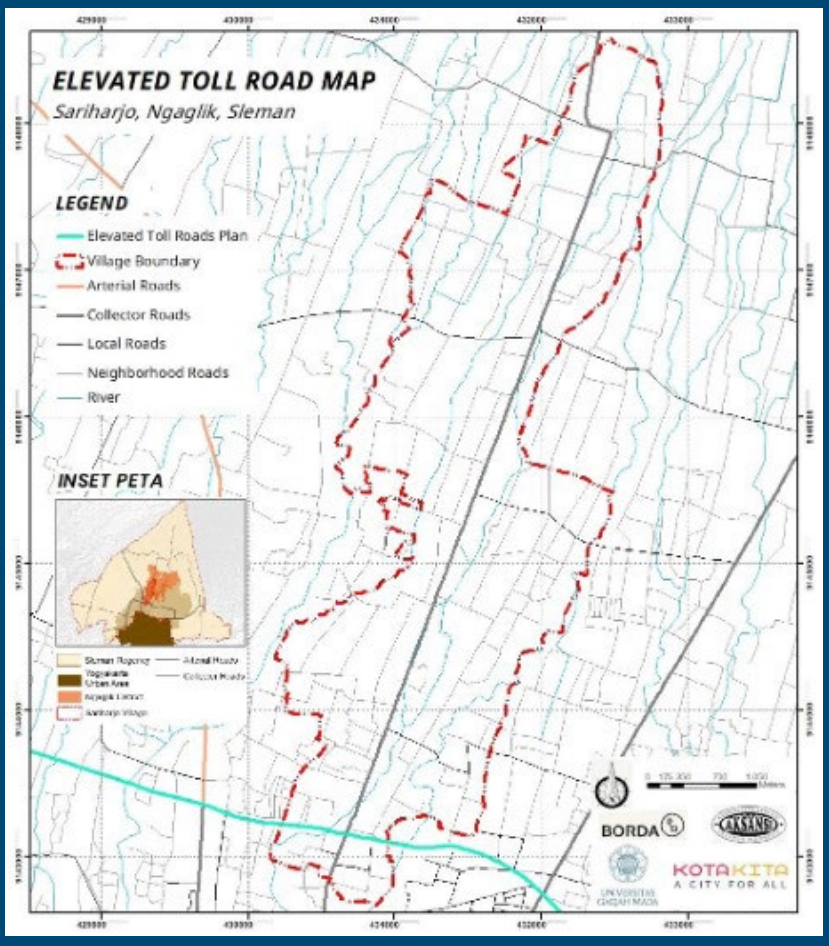
Figure 5. Linear Population Projection of Sariharjo Village

(Source: MURP UGM, 2021)

Water in the Town – Story 1

Toll Road: Blessing or disaster for the livability of Sariharjo?

The planned construction of the Solo Toll Road aimed at connecting the three important cities of Semarang, Yogyakarta and Solo is expected to have a major impact on the urbanization process of Sariharjo. This toll road is a central government project to improve regional connectivity on the island of Java. Currently, an inventory of the owners of the land where the road will pass through has been carried out. The price of land acquisition has been determined. Planning for the road is made without any participation, consultation and consistent information for Sariharjo and its residents, a planning procedure that is broadly practiced throughout Indonesia. This new infrastructure may have major impacts on the village: its physical presence at a height of 9 metres will change the visual landscape completely, especially on the south side of the village. With the existence of an elevated toll road as high as this, the physical and visual face of this village will completely change. Furthermore, environmental impacts, such as significant noise and air pollution is expected. Though the exit of the road will be 1-2 km away from Sariharjo, it can be expected that the improved connectivity will contribute further to urbanization, increasing land and property values and brining new economic activities. To what extent the local residents will benefit, or the livability of village will be negatively affected is not yet clear.



(Source: GIS of Indonesia Toll Road Authority (BPJT) (2021), modified)

The population density in Sariharjo Village is increasing every year from 2,991 people/km^2 in 2015 to 3,111 people/km^2 in 2020. Using the growth projections above, the population density may be expected to be about 4,200 people/km^2 in 2021 (the City of Yogyakarta is 12,000 people/km^2 in 2021).

This population development is accompanied by a dynamic urbanization process for Sariharjo, which was strongly rural only a few decades ago but is now increasingly characterized by urban and peri-urban features (the classification is based on building density, land use, building type by user/character occupancy, building type by structures (multi-storey), and accessibility).

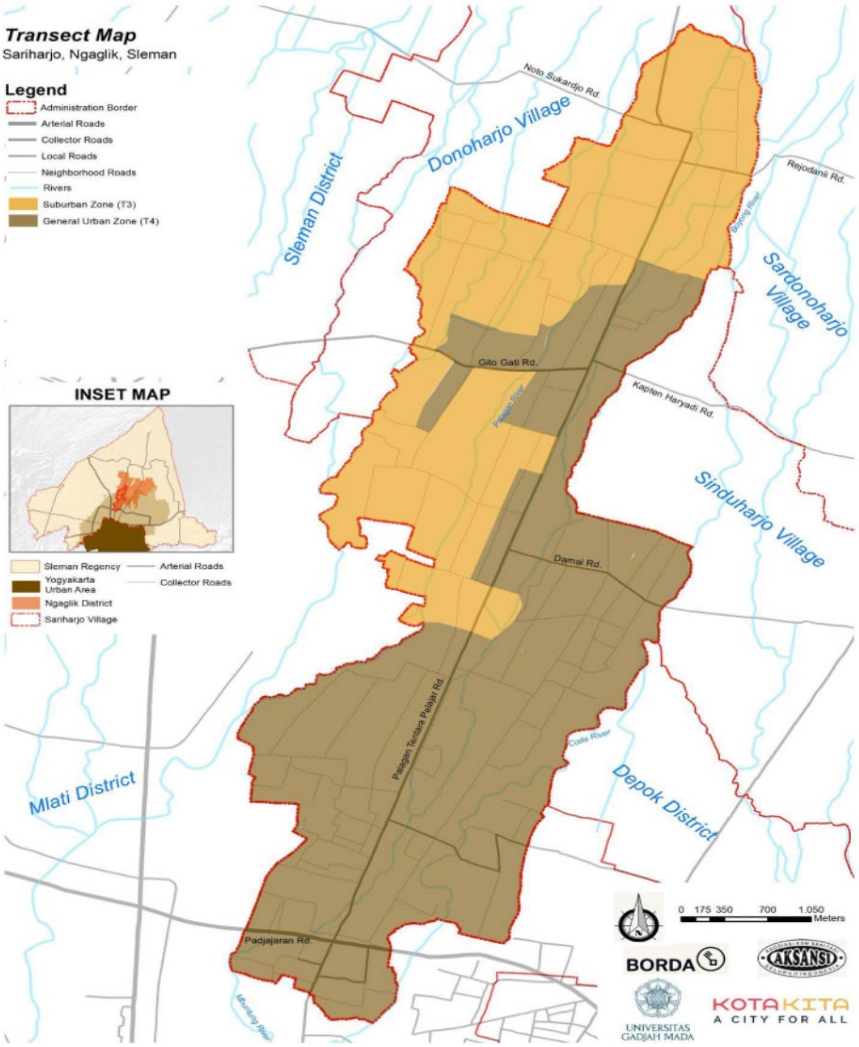


Figure 6. Transect Map for Classification of Urban and Peri-urban

(Source: After MURP UGM, 2021)

Residents of Sariharjo Village can be categorized by local residents, local migrants, and temporary residents:

1. Local residents of Sariharjo Village are defined as residents living in the village for at least two generations: those who were born and live in the village. Local residents' houses are commonly distributed in several sub-village centers.

2. Local migrants are defined as those who were not born in Sariharjo Village, but currently live in the village. This group of residents are especially those who live in newly built settlements, built by both property developers and by individuals.

Both local residents and migrants living in Sariharjo commonly have KTP (identity card) and legally become part of the formal community units. With that,

they have the same responsibility and obligations as local residents, especially in the community participation process in their neighborhood. (What are these obligations?)

3. The third category is local migrants who live briefly in Sariharjo Village as temporary residents for about 2-5 years, such as university students and workers. These temporary residents are not well registered, but it is believed that the number is significant. They might come from neighboring regencies/cities in this province, from cities in other provinces on Java Island, or from other cities outside Java Island. Since they do not have KTP and are not part of a community unit (RT/RW), they do not have to be actively involved in the community.

Data obtained from the population registry of the Special Region of Yogyakarta Province's website reveal that 70% of the total population are of working age (15-64 years old). The education structure in Sariharjo is dominated by residents who have completed high school at about 28%, followed by 15% of its residents who hold a bachelor's degree, 12% who have completed middle school and 3% who a have higher education degrees(masters and doctoral).

As in Indonesia as a whole, in Sariharjo household income is quite complex. Although there are standards for minimum wages and salaries (for civil servants and private employees), families, including those living in Sariharjo Village have different income sources, particularly from the informal sectors. Thus, a fixed household income is difficult to determine because of fluctuating incomes.

Indonesian families usually receive income from multiple sources. Particularly household income and spending patterns in Sariharjo among the lower-middle classes is fairly multiple and dynamic. The husband and the wife, as well as the children may bring in additional income from various temporary sources. The wife can receive additional income from different temporary jobs, such as laundry work, house cleaning, babysitting, shop keeping, restaurant work, and day laboring. The husband adds income from different informal jobs (non-permanent jobs). Some families have small home based enterprises that produce food, snacks, drinks, and household cleaning tools (brooms, dustpans, etc.). The wife produces and supplies snacks to traditional markets, food stalls or shops in their neighborhoods.

The following table on Average Monthly Household Expenditures in Sleman Regency in 2020 gives an overview of the socio-economic stratification and classification that may reflect the situation in Sariharjo as well.

Category	Expenditure Group*			Average ExExpenditure
	40% Lower income	40% Middle income	20% Upper income	
Food	IDR 1,648,664 (101 € or 109 US$)	IDR 2,821,916 (172 € or 186 US$)	IDR 4,467,480 (273 € or 295 US$)	IDR 2,681,420 (164 € or 177 US$)
Non-food	IDR 1,082,532 (66 € or 71 US$)	IDR 3,797,208 (232 € or 251 US$)	IDR 12,705,792 (775 € or 838 US$)	IDR 4,490,228 (274 € or 296 US$)
Total	IDR 2,731,196 (167 € or 180 US$)	IDR 6,619,120 (404 € or 437 US$)	IDR 17,173,276 (1,048 € or 1,133 US$)	IDR 7,171,648 (438 € or 473 US$)

Table 1. Average Monthly Household Expenditures in Sleman Regency in 2020
(Source: Welfare Statistic of Sleman Regency, 2020)

*Data per capita converted into per household, based on the assumption of 4 people per household

Economic transformation of Sariharjo

Limited robust official data on the economic structure of Sariharjo are available yet. In general terms, the economic structure can be classified as follows:

~ A "traditional" sector with agriculture, animal husbandry, fishery, and mining. Agriculture was for centuries the dominant economic activity because of land fertility and water resource availability. The seasonal agricultural products from this village are rice, chilies, corn, and sugarcane. In some cases, aquaculture in this village is also practiced in paddy fields and ponds. The agricultural production sector is comprehensively embedded in the traditional community organization of the village. The communities and villages have rich knowledge, mechanisms, and regulations in the management of water resources (for instance for irrigation of paddy fields) and water related ecosystems, such as green spaces, and riparian areas, etc. (See Chapter D. Green and lue infrastructure)

~ "Modern" sectors are industry and services. Common types of industry are home-scale industries that produce several types of food and beverages, batik, and garments, etc. Service activities are operation of and employment in restaurants/cafés, shops, and food stalls, etc., tourism services (hotels, travel agents, boarding houses) and in education and healthcare. The relevant stakeholders in these sectors are water consumers with very limited knowledge and interest in water management. (See Chapter D. Green and lue infrastructure)

The population registry of KPY shows that in 2021 4% of the village's residents were still working in agriculture/animal husbandry/fishery. People who work in the government/public sectors, public and private companies, and entrepreneurs (modern sector) account for about 78% of the total labor force.

However, these numbers may not capture the whole economic structure because there is obviously a high degree of informality that is not captured by official statistics and a large number of residents may still work as part-time farmers. Nevertheless, these percentages indicate this profound socio-economic and cultural change that Sariharjo, which was once dominated by agricultural production, has been undergoing for several decades.

The loss of the economic and cultural importance of agriculture in Sariharjo is representative of the socio-economic transformation of many peri-urban areas in Indonesia and Southeast Asia. In Sariharjo itself, the following major factors for this change can be identified:

~ Due to low productivity, small acreages (0.25 - 0.5 hectare), rising prices for agricultural inputs, such as costs for fertilizers, pesticides, wages, and fluctuations in market prices for agricultural products, smallholder production - despite government support - is hardly competitive or viable.

~ With economic growth in KPY and rising education levels, new income opportunities are opening up for residents, leading to a labor shortage given the relatively low-income opportunities in the labor-intensive smallholder economy.

~ The main factor contributing to socio-economic change and the massive loss of agricultural land is the rising price of land for residential and commercial buildings. For example, land prices increased from IDR 100,000/m^2 in 1996 to approximately 10-15,000,000/m^2 by 2022.[3]

[3] 6 € or 7 US$ /m^2 1997 & 610 € or – 915 € or 990 US$ /m^2 in 2022.

Water in the Town – Story 2

Mbah Kerto: Challenges dealing with Market Fluctuation

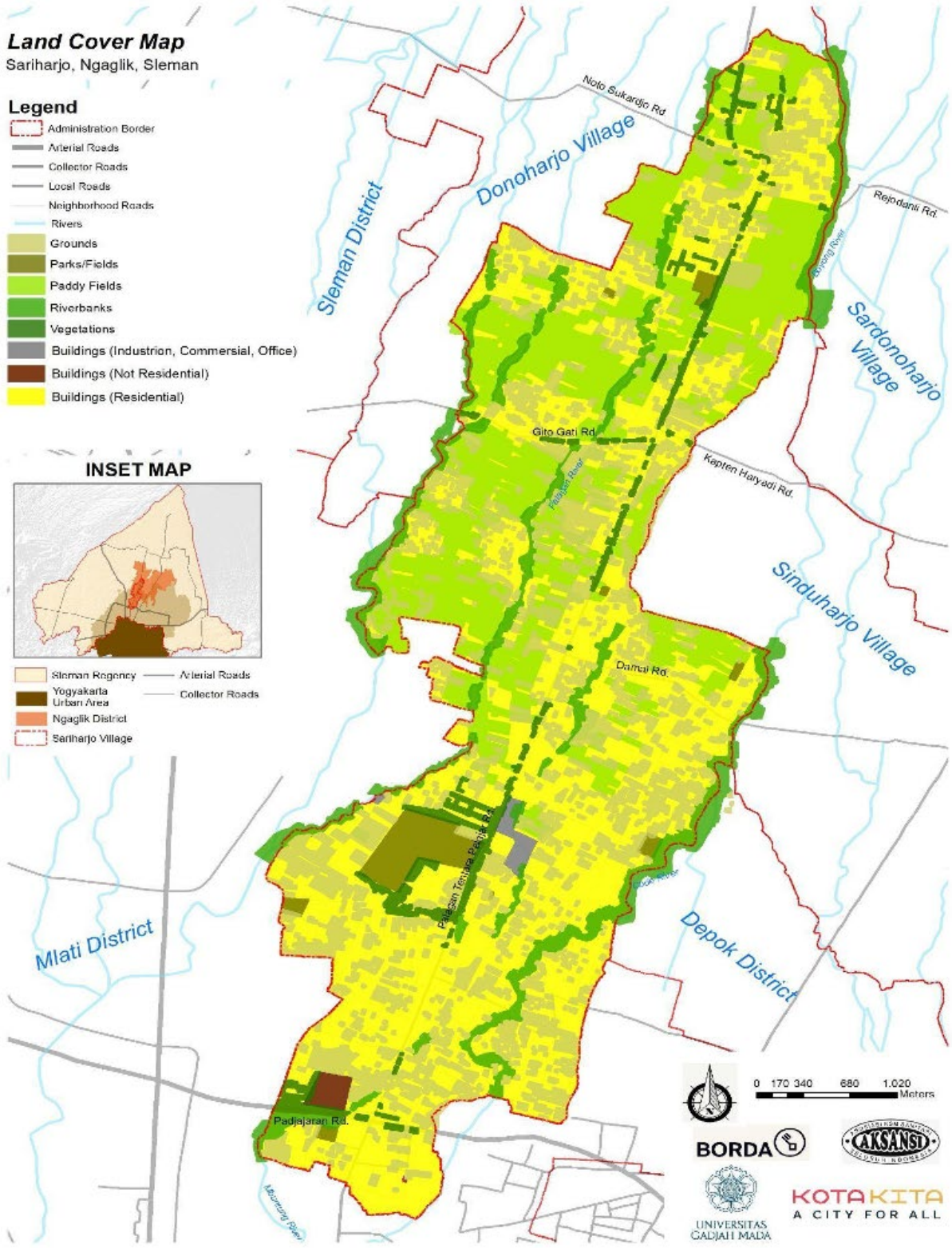
Mbah Kerto is a local resident of Sariharjo Village, whose family has lived in the Mudal Sub-village for three generations. She has three children who are married and living outside the city. She lives in a simple house inherited from her parents with her two grandchildren . In early 2021, following the increased price of red chili in the region, she changed her paddy field to growing red chili. At that time one kilogram of red chilies were sold for at least 90,000 Rupiah. During harvesting time in May 2021, the price dropped to 15,000 Rupiah per kilogram – a price that barely covers the costs for the inputs.

(Source: Field visit, 2021)

In view of this increasingly dynamic socio-economic development, it can be assumed that the small-scale farming economy in Sariharjo will increasingly disappear until 2045 or will still be pursued as a part-time or subsistence activity. Agriculture will then be practiced only in a few pockets in Sariharjo as a whole.

The following map on land use patterns gives an indication of the socio-economic transformation process in Sariharjo. Agricultural land and green spaces that have – among others – an important value for the management of local water resources increasingly give way to built-up areas for commercial and residential uses.

Figure 7. Land use map of Sariharjo
(Source: After MURP UGM, 2021)



Water in the Town – Story 3

Kelompok Petani Subur: The Enduring Local Farmer Spirit

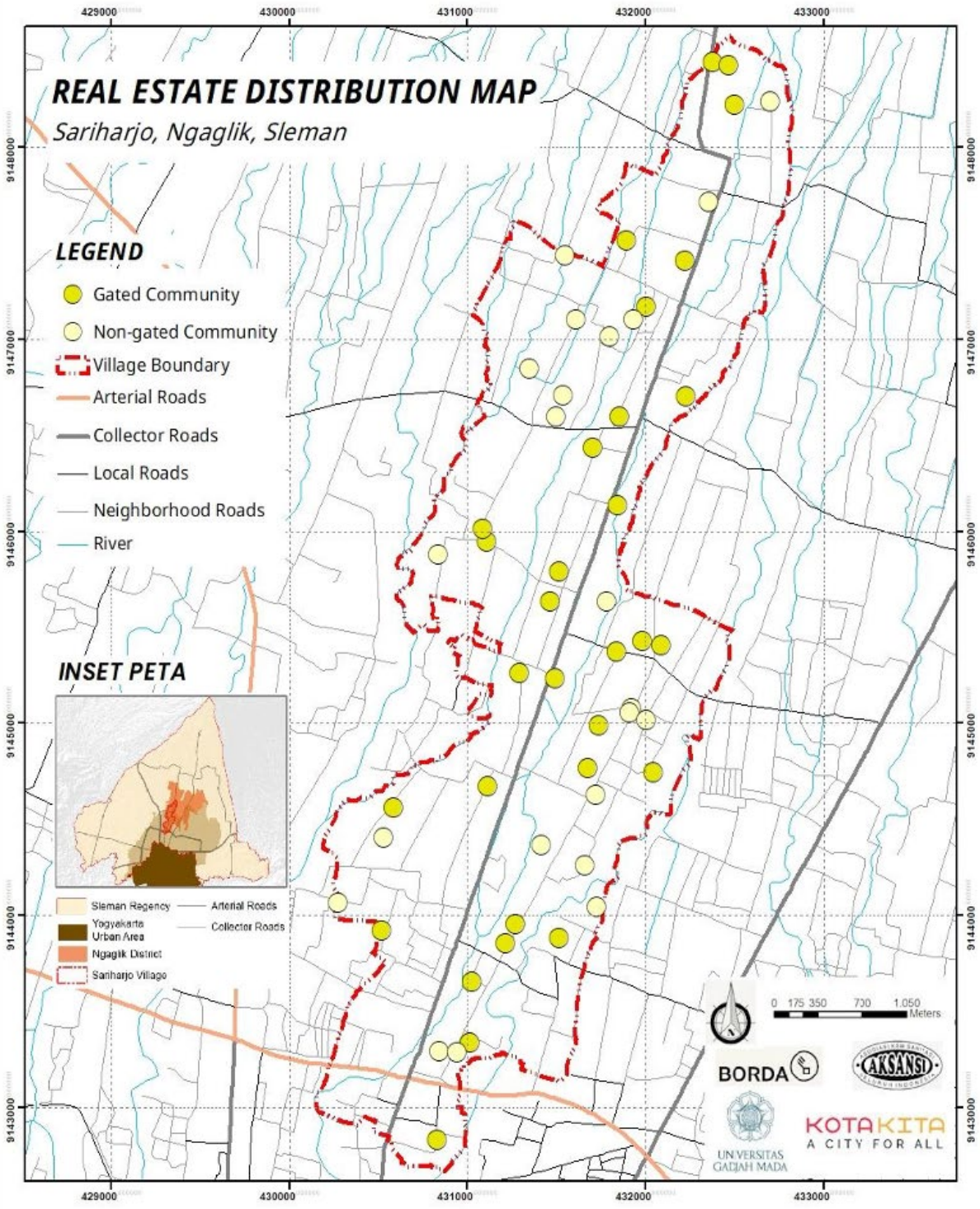
(Source: MURP UGM Field visit, 2021)

The Subur Farmer's Group with its current 47 workers in the sub-village of Wonorejo shows extraordinary enthusiasm and resilience to continue with agriculture in Sariharjo. Taking opportunity of the rich soils and water resources, the group established on 3000 m^2 Village Treasury Land area a sustainable business practicing the following activities in collaboration with different partners including Gadjah Mada University: Production of organic fertilizer (even exported to Sumatra), production and processing of agricultural outputs and providing training packages for fellow farmers on organic agriculture (here the group accepts at least 30 trainees each year).

The increasing differentiation of the social structure in Sariharjo is evident not least in the construction projects that have already been realized and those that are planned. The conversion of agricultural land predominates in areas deemed as attractive locations in the foothills of Mount Merapis, where high-priced construction areas are being built in a climate that is still pleasant. Thus, so-called gated communities are increasingly being created, i.e. settlement areas closed off from the daily life of Sariharjo, in which wealthy new residents live.

This trend toward segregated residential areas, with its implied anonymizing of life in Sariharjo where once everyone knew everyone else at least in the sub-villages, may intensify in the future.

Figure 8. Real Estate Distribution Map
(Source: Google Map and Field visits, 2022)



Robust data on scope, structure and investment of the “modern” sector in Sariharjo are not available yet. Investors in Sariharjo Village tend to come from outside the village, respectively inside and outside the KPY. Such investments are made in the development and operation of hotels, apartments and apartment blocks, rental houses/boarding houses/inns, restaurants, cafés, shops, minimarkets, and wholesale retailers, etc.

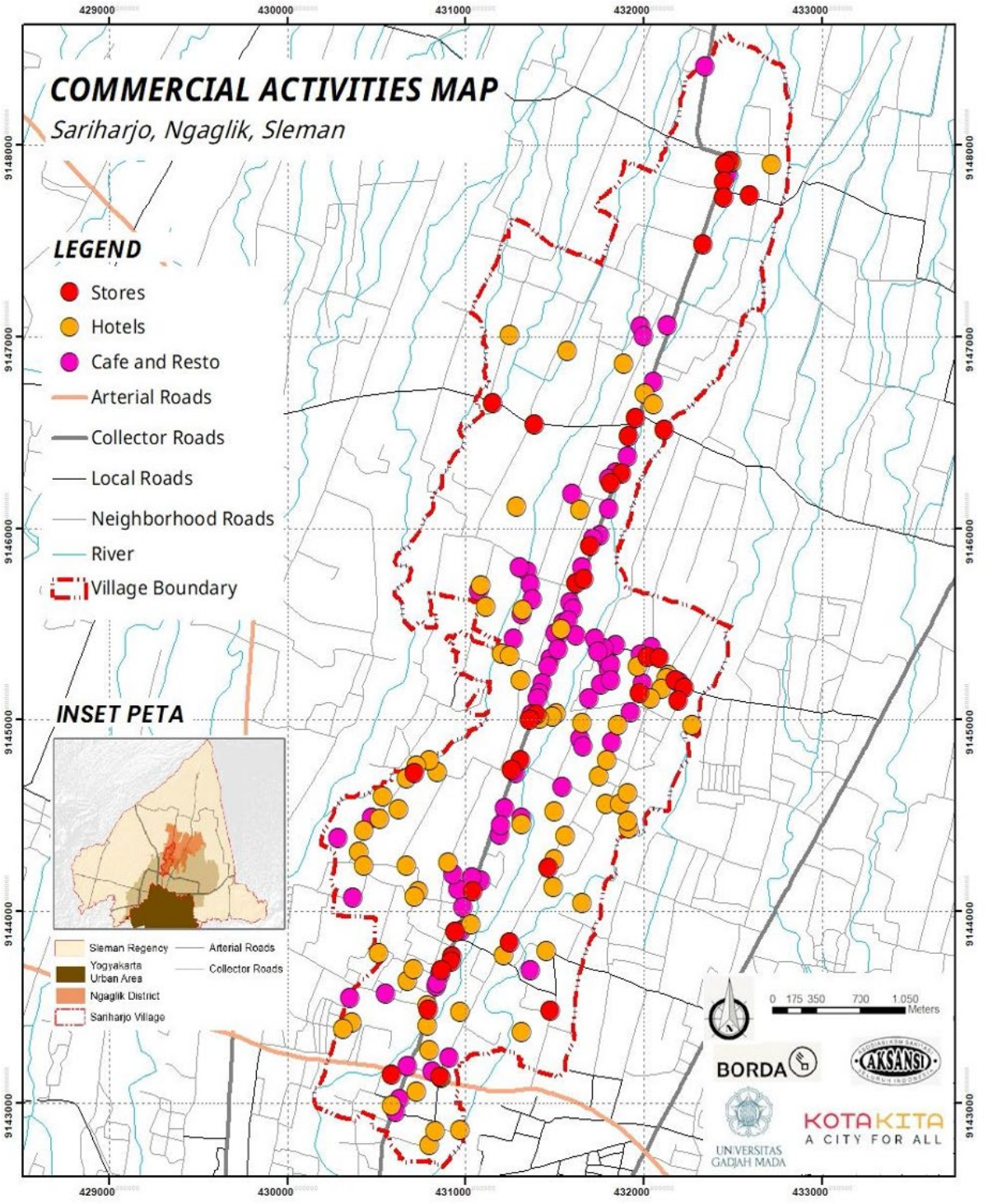
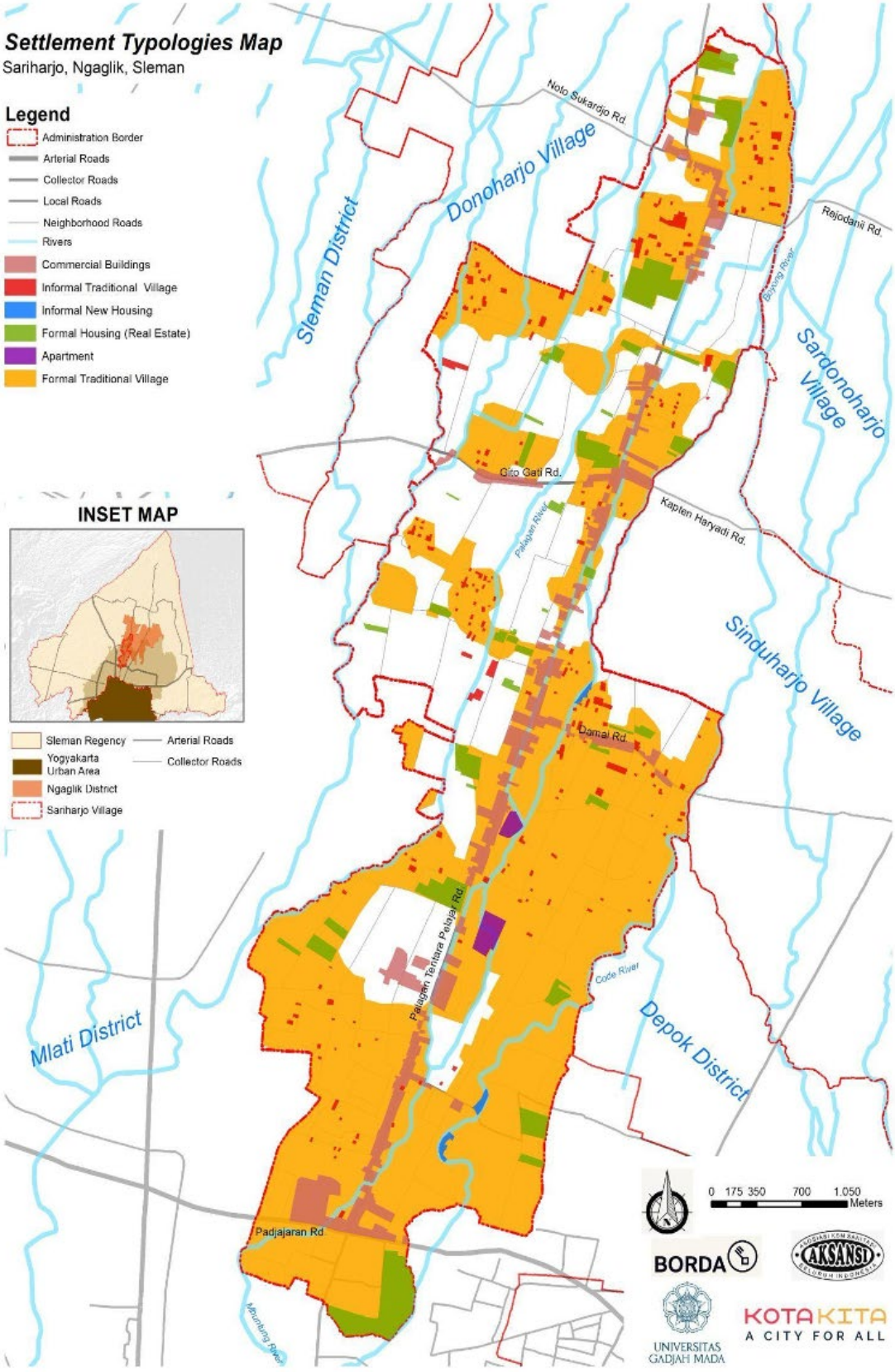


Figure 9. Commercial Activities Map
(Source: After MURP UGM, 2021)

The types of settlements and their distribution provide a good indication of the quality and extent of urbanization in Sariharjo. Settlement typologies in Sariharjo can be categorized by six types: commercial buildings (hotels, restaurants); apartment building/blocks; formal housing/real estate; formal single housing/ scattered housing; informal traditional village housing/kampung (compound); and informal new housing especially along the riverbanks.

Figure 10. Settlement Types Map in Sariharjo
(Source: After MURP UGM, 2021)



	Settlement Type	Brief Description	Illustration
1	Commercial buildings (shops, restaurants, hotels, etc.)	Profit-oriented investments primarily by private stakeholders. Degree of land sealing > 70%	
2	Apartment blocks	7-8 story high-rise complexes, with a large number of apartments. So far in Sariharjo only a few blocks, information about planned further projects are currently not accessible. Degree of land sealing > 70%	
3	Formal housing (Real Estate)	Housing complex (a group of single-family homes built by the same developer). These small-sized housing clusters have 6-10 homes; the medium sized-clusters have between 10-20 homes. Clusters are often developed as gated communities with physical boundaries and controlled entrances.	
4	Formal individual/sprawled housing	Housing built by individuals, sprawled in some areas of Sariharjo	
5	Informal traditional village	Group of houses that belong to the original village. Located at the center of kampung or sub-village, there are still several houses with traditional Javanese architecture styles (joglo, limasan, kampung). This type of housing usually has a quite large size with a house yard. In Sariharjo, some of these informal housings may be considered as slums areas.	
6	Informal new housing	Informal new housing, especially along the riverbank. Some parts of the housing area have already been improved by the government through the KOTAKU program.	

Table 2. Settlement Types in Sariharjo
(Source: MURP UGM Field visit, 2021)

Tourism industry as main driver for socio-economic transformation of Sariharjo

The greater area of Yogyakarta, including Sleman Regency is the second largest tourist destination in Indonesia after Bali. The rich history and culture of the area, infrastructure developments, such as the new International Yogyakarta Airport, the new toll road, and the government's decision to select Borobudur as the 'super priority' area, will strengthen tourism as one of the regional development flagships.

Tourism contributes 24.42% to the total Sleman Regency's revenue. Tourism in Sleman is classified into three major groups, i.e., natural tourism, cultural tourism, and man-made attractions (Kabupaten Sleman, 2018).

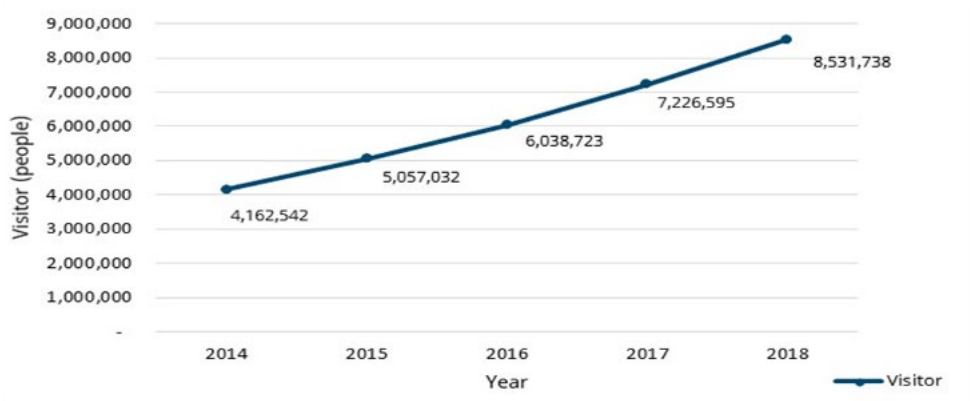


Figure 11. Number of Visitors at Sleman Regency 2014-2018

(Source: Kabupaten Sleman., 2018)

According to the Sleman Tourism Development Master Plan 2015 - 2025, Ngaglik subdistricts, where the village is located, is designated as recreational and culinary based urban tourism. The plan is to develop supporting areas of Jogja Kembali Monument and the areas of Kaliurang, Damai and Palagan streets as recreational and culinary attractions. Closely related with the tourism development of Sleman Regency, the amount of accommodation and restaurants in Sariharjo is increasing and with it significant water consumption.

Year	Star hotels	Inns	Others	Restaurants/ Food
2016	2	4	-	-
2020	12	7	11	40

Table 3. Number of Accommodations and Restaurants in Sariharjo

(Source: Number of Homestay by Types by Villages and Number of Economic Facilities and Infrastructure by Village and Types, Ngaglik Subdistrict in Figures, 2017 and 2021)

Village owned land as a strategic asset for sustainable socio-economic development

Sariharjo village is a fairly prosperous village, due to the size and quality of TKD. Based on the existing records (2021), the total Village Treasury Land (both certified and uncertified) reached 83.98 hectares (about 12% of the total Sariharjo area). TKD play an important role in village development and village finances and TKD is a crucial asset for strategic sustainable village development.

So far TKD – mainly fertile land - in this village has been used for agriculture, predominantly rice fields, either by the village apparatus themselves or to rent

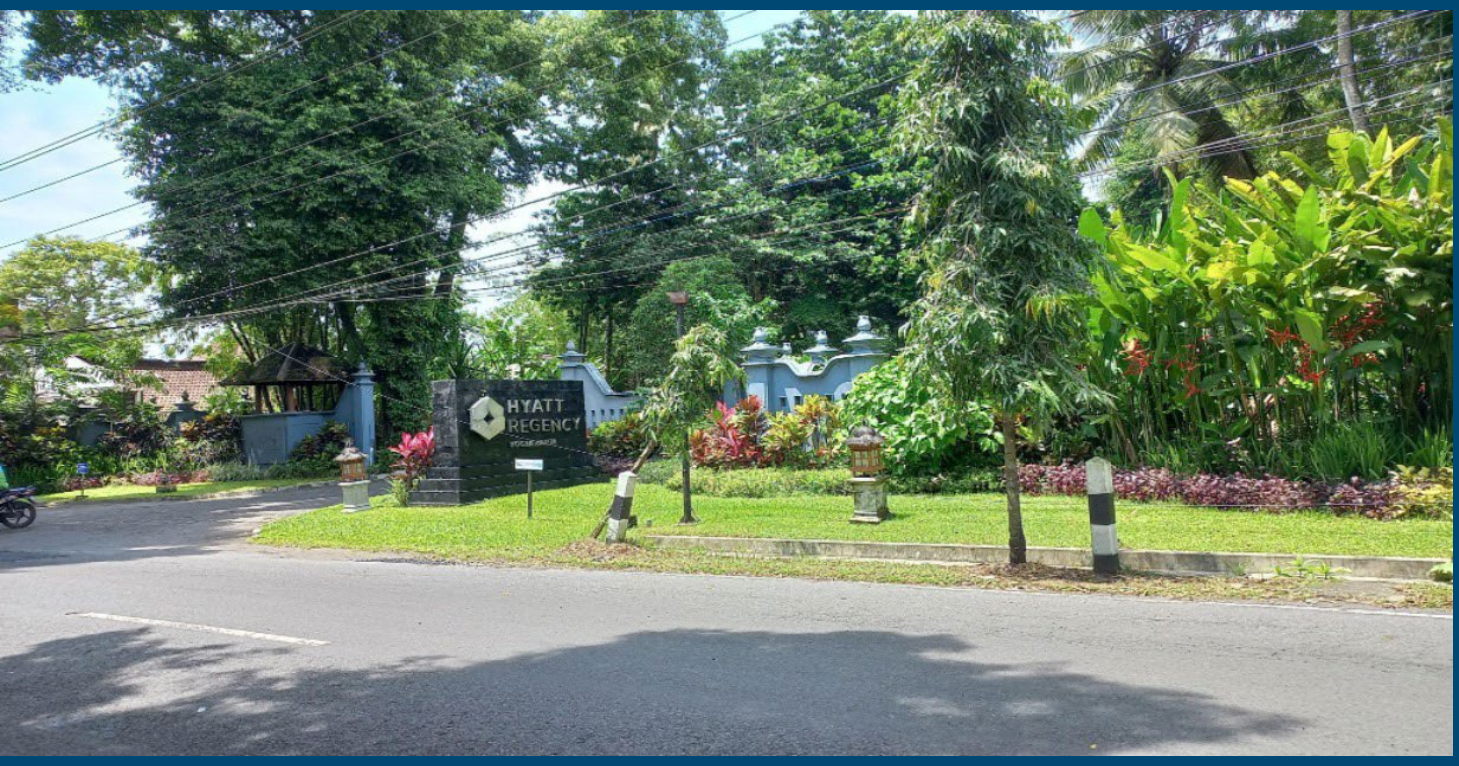
Water in the Town – Story 4

Hyatt Hotel
Living Monument

One of the important moments that marked the transformation of Sariharjo Village was in 1997 with the construction of the Hyatt, the first five-star hotel in Yogyakarta. The brand name and image of the Hyatt Corporation contributed to developing Yogyakarta as a main tourist destination in Indonesia. With a beautiful view of Mount Merapi, an architectural form that replicates the shape of the famous Borobudur temple stupa, and a golf course on the northern side, this hotel was seeb as a new icon for the city of Yogyakarta at that time. It changed the landscape of Sariharjo Village, which was originally simple, into a rather glamorous one.

According to existing village records, the land where the hotel is located was originally Village Treasury Land. The process of selling this vast Village Treasury Land was carried out in accordance with applicable legal procedures. The income from the land sale was also to be used to purchase compensatory areas to become Village Treasury Land. The sale of Village Treasury Land demonstrates the importance of these assets: 1) Will it be sold at an adequate price? 2) Does the sale limit the strategic value of the land for sustainable community development?

(Source: Field visit, 2021)



to Sariharjo residents who are not landowners. Furthermore, it has been used as public infrastructure e.g. community hall, sport fields, playgrounds and graveyards.

TKD is rooted in the history, culture and socio-economic formation of the village itself. Villages in Indonesia are a traditional community unit that has existed long

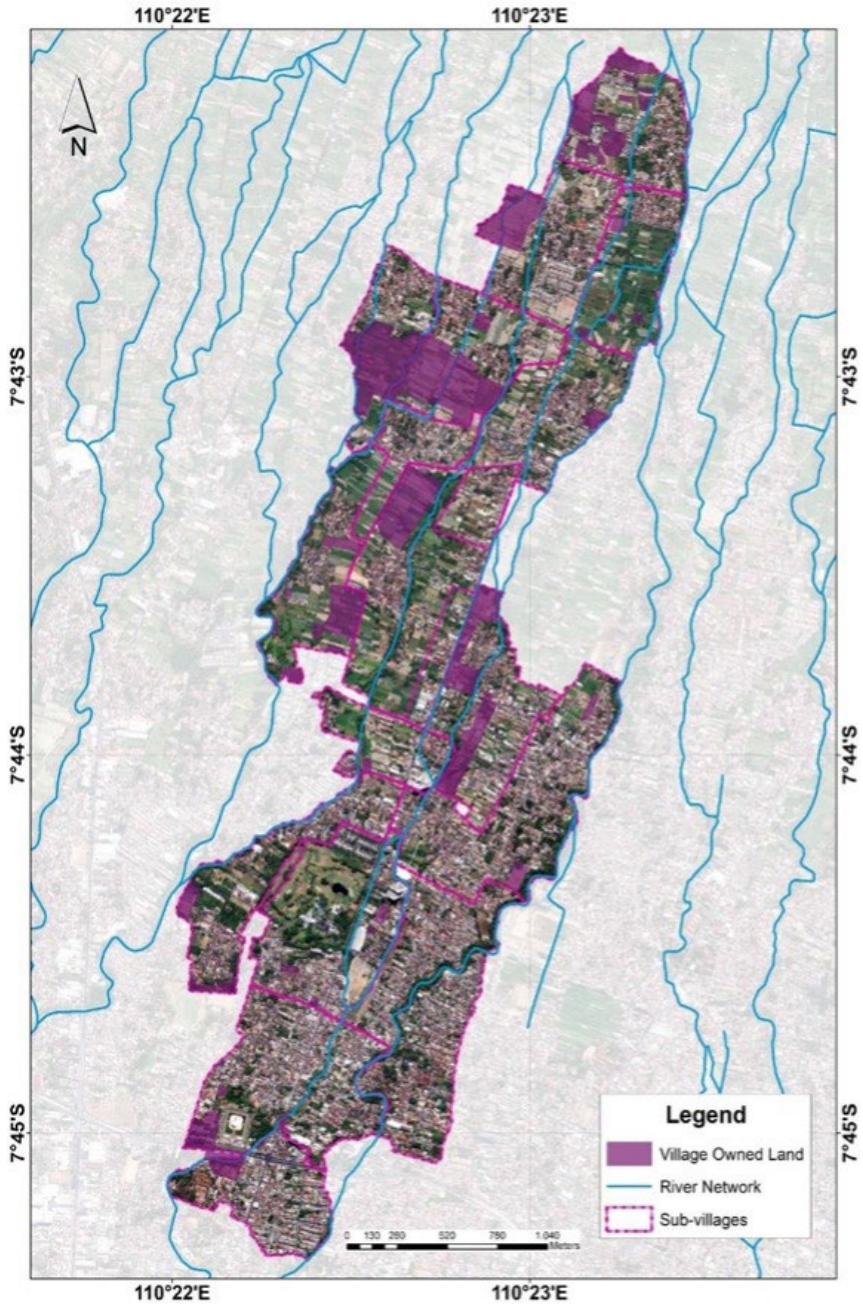


Figure 12. Village-Owned Land Map

(Source: Interviews were conducted by the Sleman team and processed by ITT TH Köln, 2022)

before the Republic of Indonesia was formed. In Indonesia, villages are autonomous and independent social units that have their own resources or assets, territory and governance systems.

Although there is no detailed and valid historical data on the history of the formation of Sariharjo Village, it can be assumed that Sariharjo Village was formed after the Yogyakarta kingdom was established in 1754/1755. Thus, it was formed and developed on the land ownership rights of the Yogyakarta Kingdom with anggaduh status or management rights. Anggaduh is a customary right granted by the Kasultanan or Kadipaten to manage and collect products from Kasultanan Land or Kadipaten Land on non-Kasultanan land or Dede Keprabon land for the kalurahan to administer the kalurahan government for as long as it is used.Per

[4] 6 € or 7 US$ /m² 1997 & 610 € or – 915 € or 990 US$ /m² in 2022.

Water in the Town – Story 5

Kebon Ndeso: Good Practice of TKD Use

A “good practice” of the use of TKD for the socio-economic and cultural benefit of Sariharjo and its communities is "Kebon Ndeso", a recreational area, located in the Wonorejo Sub-village. Because of stringent leadership from the Head of the Wonorejo Sub-village, a clear minded development model, site planning and support from local government and the private sector, the management succeeded in transforming a TKD area formerly used for agricultural purposes into a recreational area with a swimming pool, a community meeting building, and a restaurant that is widely used by the communities in Sariharjo. Children can access the pool with an entrance fee of only 5,000 IDR[4] (pool entry fee at a nearby five star hotel equals 100,000 IPR). A beautiful meeting hall can be rented out for a variety of social and private events, such as for family gatherings and weddings.

(Source: MURP UGM Field Survey, 2021)

regulation, the TKD must be used for the benefit of village development and its residents. TKD in Sariharjo is a major income source for its finances. Income from TKD is mainly used to run the government respectively to cover the salary of village and sub-village apparatus plus incentives for village heads, village officials, and hamlet heads. Furthermore, income is used for village development activities.

The Village Government rent the TKD, and the rate varies depending on the location of land. The fee is negotiated between the renter and the Village Government. The general guideline from the provincial government in renting the TKD land is below:

- IDR 15.000-20.000/sq meter/year (land located at village road),
- IDR 25.000-30.000/sq meter/year (land located at regency road,
- IDR 30.000-35.000/sq meter/year (land located at provincial road).

Although there are some patchy examples that succeeded in developing models that shape a sustainable transformation, Sariharjo so far does not make effective use of its TKD:

~ TKD have significant value for the sustainable development and livability of Sariharjo. TKD are central to a comprehensive green space and infrastructure development and also the development of recreation areas for the KPY. While there are isolated approaches on how to use the TKD for the common good of the village, yet currently there is no strategic and comprehensive planning of what the future TKD will look like compared to today's fundamentally changing Sariharjo.

~ TKD is of interest as rental opportunities by the private sector to be used for the establishment of hotels, cafes, restaurants, shops, and gas stations, etc. because of its attractive location, long term leases (20 years) and the low rental prices. Once the private sector acquires the green light from the spatial agency and permission from the governor cum King of Yogyakarta as the owner of the land, the private sector have the right to operate as long as they pay the rent. The rental prices defined in the village regulations do not reflect the market price. Once signed, these leases are very difficult to renegotiate.

~ The village also misses out on substantial income opportunities when TKD is sold because the real value and potential future value of the land is often poorly realized.

There are many reasons for this situation, which exemplifies the challenges for the effective implementation of Law No. 6 of 2014:

~ Insufficient institutional and technical capacities at the village level;

~ Fragmentation of decision-making powers at the vertical and horizontal levels;

~ Absence of strategic planning with corresponding priority setting and village development planning;

~ Competition between immediate income generation and long-term investments, which only pay off for the community and the village government in the long term;

~ The development potential at the sub-village level is insufficiently tapped so far.As an inverse conclusion, the following potentials for action can be identified:

Water in the Town – Story 6

“The Secluded”: TKD Development in Collaboration with the Private Sector

To meet this challenge, the Sariharjo Village government began to cooperate with several parties, including the private sector. One of the interesting cases of public-private cooperation is the establishment of the Café and Resto “The Secluded”. 2 ha of formerly poorly used Village Treasury Land has been transformed into a recreational area in the form of restaurant, café and glamping (glamorous camping), to meet the demand for alternative recreational venues in the city.

This cooperation model, as with others, needs to be closely evaluated to meet the interests of both parties respectively and that the Village Treasury Land is used for the benefit of the community.

(Source: MURP UGM Field visit, 2021)

~ Long-term planning of the use of the TKD-areas for a sustainable infrastructure development, which does not necessarily generate income immediately, but in the long term.

~ Capacity development at the village level, including strategic planning for TKD use and use of the TKD at real values.

~ Use of TKD as managed compensatory land to counteract the rapid sealing trend and increasing vulnerability to flooding events and changes in the village climate.

~ Identification of strategic and economically robust measures at sub-village level. Whose planning and implementation should be done with the participation of communities and the private sector.

Local economic development plan and village budgeting

The community-oriented development programs (RPJM Desa Sariharjo 2015-2020) are:

1. Agriculture revitalization;
2. Strengthening animal husbandry activities;
3. Supporting micro and small enterprises;
4. Co-operatives and employment;
5. Trades;
6. Empowering village marketplaces;
7. Creating a business-enabling environment;
8. BUMDes development.

The other villages receive funding from government sources: Village Fund (Dana Desa) from the central government and Village Allocation Fund (Alokasi Dana Desa) from the regency government:

Table 4. The Amount of Village Fund (DD) and Village Allocation Fund (ADD) at Sariharjo Villages from 2015-2020

(Source: https://dinpmk.slemankab.go.id/besaran-dana-desa/2015-2016-2017/ and https://dinpmk.slemankab.go.id/dd-2018-2019-2020/)

	2015 (in IDR)	2016 (in IDR)	2017 (in IDR)	2018 (in IDR)	2019 (in IDR)	2020 (in IDR)
DD	322,568,000 (19,687 € or 21,287 US$)	714,385,000 (43,599 € or 47,143 US$)	916,059,000 (55,907 € or 60,452 US$)	849,352,000 (51,836 € or 56,050 US$)	1,015,561,000 (61,980 € or 67,018 US$)	1,170,518,000 (71,437 € or 77,244 US$)
ADD	1,374,520,647 (83,888 € or 90,706 US$)	1,435,718,000 (87,622 € or 194,745 US$)	1,462,717,000 (89,270 € or 96,526 US$)	1,019,957,000 (62,248€ or 67,308 US$)	1,557,889,480 (95,079 € or 102,807 US$)	1,414,406,822 (86,322 € or 93,338 US$)
Total	1,697,088,647 (103,574 € or 111,993 US$)	2,150,103,000 (131,222 € or 141,887 US$)	2,378,776,000 (145,178 € or 156,978 US$)	1,869,309,000 (114,085 € or 123,358 US$)	2,573,450,480 (157,059 € or 169,825 US$)	2,584,924,822 (157,759 € or 170,582 US$)

Water in the Town – Story 7

BUMDES Sariharjo: Local Village Enterprise for Increasing Village Revenue

The Village Government Law No. 6/2014 gives each village in Indonesia the mandate to form a Village-Owned Enterprise, which is abbreviated as BUMDES. In order to generate additional income for the benefit of the village, BUMDES is entitled to operate as existing business village assets. Since the law entered into force, many BUMDES operate across Indonesia successfully. The BUMDES in Sariharjo Village was formed in 2018.

One activity of BUMDES is the production and distribution of bottled water. Water from village land is processed by a water filtering unit and filled in gallon-sized water bottles. The water bottles are sold at 60% below market price to families and stalls in the village. Due to limited production and management capacities, the current limited daily output cannot meet the demand and the market potential cannot not be tapped yet.

(Source: Field visit, 2021)

Those two sources, along with other village fund sources, will be used to set the priorities, programs, activities, and the needs of the village community, such as primary needs, basic services, and community development. According to the RPJM Desa Sariharjo' reports, funding allocated for water related infrastructures in Sariharjo Village range between 20 and 30% of the total annual village development plan (RKP Desa) or about 25% on average. Types of water-related infrastructure proposed in the RKP Desa are infiltration wells, drainage, agriculture irrigation canals, rainwater channels, and stormwater drainage.

Water in the Town – Story 8

Zero Slum Program KOTAKU: Settlement along the Riverbank

In the context of SDG 11 Cities and Communities to make cities and settlements inclusive, safe, resilient, and sustainable, the government has developed the so called “100-0-100 program” that targets for 2024 100% clean water, zero slum housing, and 100% sanitation. One of the programs to reduce slum housing in various cities in Indonesia is carried out through the KOTAKU or “City Without Slums” program. This program has been running since 2015 and as of 2018, it had succeeded in reducing 23,594 Ha of slum area, and the 2019 KOTAKU Program slum reduction target was13,704.03 Ha of slum housing in various cities in Indonesia, including in Sleman (source: http://kotaku.pu.go.id).

In Sariharjo Village, in 2019 the KOTAKU program was implemented in the Longkang Sub-village covering about 1 ha, especially focused on upgrading informal housing along the Buntung river and infrastructure with a drainage network system, clean water interventions, dikes and footpaths. Following the provincial policy, namely ‘3 M’, Mundur (setback), Munggah (vertical), and Madep Kali (facing the river), the housing structure has been improved so people perceive the river as a front yard that should not be polluted. Overall, the health conditions and accessibility of the slum area have been improved. Learnings for future programs are: 1) conventional river dyke techniques can change the morphology of the river. Potential environmental impacts should be taken into account for development of effective infrastructure. 2) Solutions are needed for effective wastewater management in this densely populated areas. 3) Water sensitive planning that integrate green infrastructure should become planning standards for KOTAKU programs.

(Source: MURP UGM Field visit, 2021)

C. Natural characteristics

Key Messages of Section

Sleman Regency and Sariharjo have been endowed with rich natural resources that have deeply shaped its economy and culture.

The water resources abundant for centuries are coming under increased pressure along with land use changes and the urbanization trends in the Regency. In general, there is a fall in water tables and a deterioration of observed water quality .

In Sariharjo, the loss of fertile land, and the increasing pollution of ground and surface waters threaten public health and environment, and a fall in water tables at some locations may indicate a trend in the overuse of groundwaters.

These pressures on water resources may be exacerbated by climate change impacts. With the conversion of today's green areas into sealed areas, especially the paddy fields with their water induced cooling effect, the local climate of the village and sub-villages may change with higher temperatures.

Natural disasters, such as eruptions of Mount Merapi and earthquakes are present in the memories and daily life of the population of Sleman Regency. As the rapidly evolving Sleman Regency requires adequate disaster preparedness and response mechanisms, relevant mechanisms are also needed to permanently ensure the water security of the Regency and its settlement structures.

This includes the establishment of effective structures for the efficient management of water catchment areas at the village level and the development of a water management infrastructure that also includes appropriate water monitoring systems.

Climate

According to its physiographic and climatic features, Sleman has abundant water resources. Typically, the higher rainfall is distributed in the northwestern part of the region whilst the lower rainfall occurs in the opposite direction. Particularly on the slopes of Mount Merapi, Sleman experiences an orographic effect that eventually results in greater precipitation (Pratiwi et al. (2012); Sofia et al. (2018))

Sleman Regency has a tropical monsoon climate. Intense solar radiation throughout the year favors intense cloud formation and precipitation. Classified as a tropical monsoon climate with typically high precipitation, the annual precipitation is 2283.6 mm and most rainfall is in January with 349.8 mm. According to the climate classification by Koppen, Sleman Regency has an Am climate type which has characteristics of the short dry season with the precipitation in the driest month at less than 60 mm. Sleman Regency has a long rainy season, which generally starts in October and ends June. The dry season is between July and September. The average annual temperature during 1990-2019 was 26.5 °C. The coldest month of the year is January at 26 °C and the warmest months are April and October at 27 °C.

From an evaluation of precipitation data from Poton that is located close to Sariharjo, the average annual rainfall can be estimated as less than 2.000 mm.

Weather and climate anomaly phenomena in the Indian and Pacific Oceans, such as the Indian Ocean Dipole Mode (IOD) and El-Nino Southern Oscillation (ENSO) are some of the variables that affect weather conditions in Sleman. The presence of IOD and ENSO potentially cause extreme weather, especially during the rainy season (Kurniadi et al., 2021). The increasing presence of El Niño may lengthen the dry season and shorten the rainy season, and this may have impacts on the hydrology of the Regency in tems of decreased groundwater supply, flow rate, and the number of wells, etc.

Sleman Regency is experiencing an increasing trend in climate change for several indicators, including wind speed, temperature, and precipitation (Priyanto et al., 2021). Though detailed data are not available yet, these trends may have major impacts on the Regency's water resources and can contribute to higher water stress.

It can be assumed that the land use changes associated with urbanization, i.e. the loss of the currently existing green areas, will significantly change the local climate in the villages and sub-villages. Increased temperatures, even at night, may also replace the pleasant climate that is still experienced on the hoothills today if the innumerable rice fields with their water-induced cooling effect are converted largely into sealed surfaces.

Topography

The Sleman Regency has a diverse terrain. Some parts are characterized by flat topography with a a slope angle around 0-8 %, including Sariharjo (Figure x). The other parts of Sleman, located in the south-eastern half of the Prambanan sub-district and a portion of the Gamping sub-district are categorized as moderate steep to steep slopes. Because its position correlates with the slopes of Mount Merapi, which has a slope of more than 45 %and a height of 2880 MSL, the topography of the Sleman Regency region ibecomes steeper to the north. However, some areas in Pakem, Cangkringan, Prambanan, Godean, Seyegan, Minggir, and Moyudan sub-districts, which cover 1.5 % of the Regency, have steep slopes. The altitude of the territory in Sleman Regency ranges from 38 to 2880 meters above sea level. Sariharjo Village is located between 100 to 300 meters above sea level.

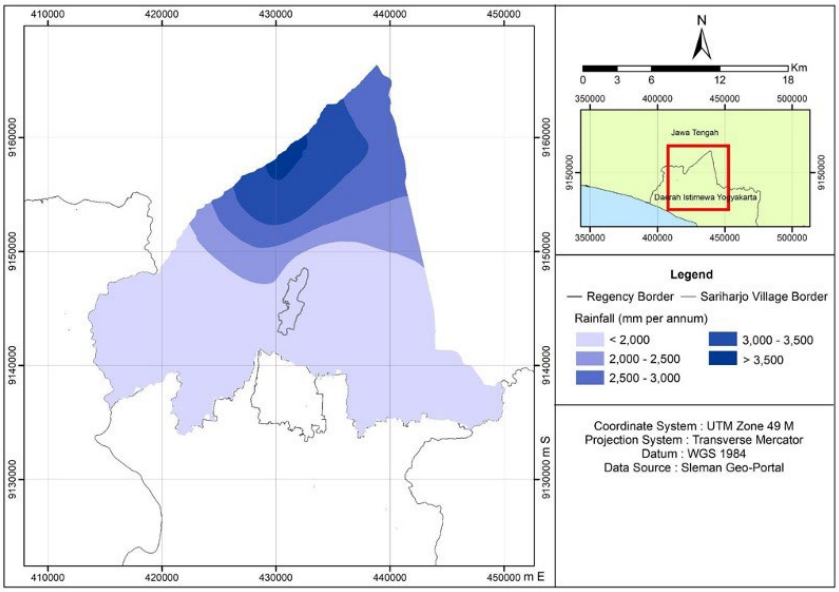


Figure 13. Rainfall Map Distribution

(Source: Sleman Geo-Portal)

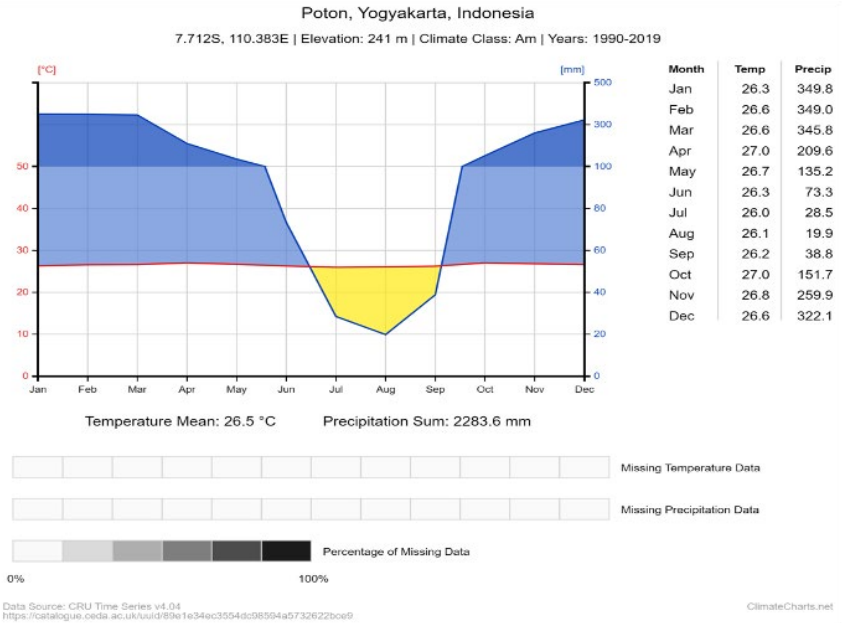


Figure 14. Temperature and Rainfall Average Value from 1990-2019

(Source: Zepner et al., 2021)

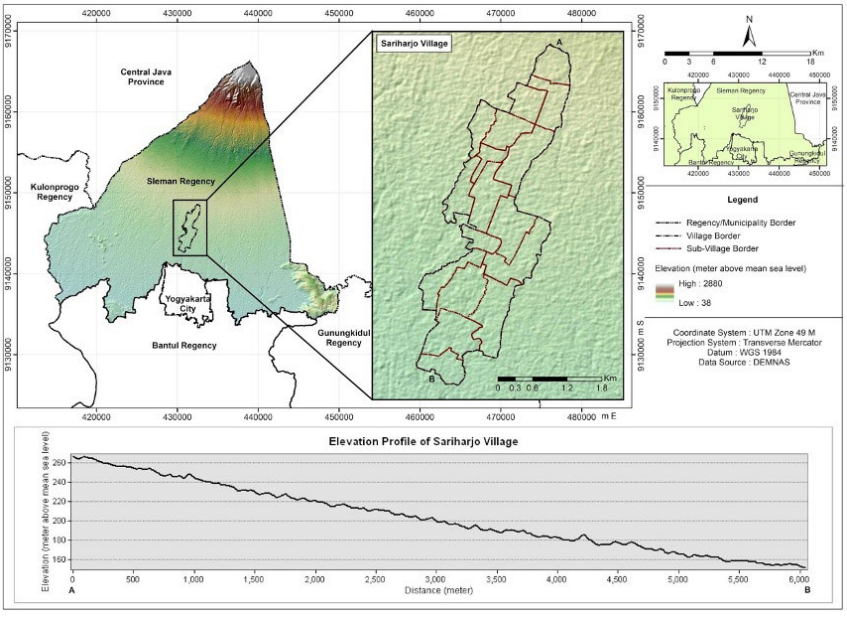


Figure 15. Elevation Map

(Source: Sleman Geo-Portal, 2022)

Risks of natural disasters

Droughts

Drought has the potential to strike the Sleman Regency in several regions (Figure 16). A drought is defined by IPCC as a period of abnormally dry weather long enough to cause a serious hydrological imbalance. Shortage of precipitation during the growing season impinges on crop production or ecosystem functions in general (due to a soil moisture drought also termed agricultural drought), and during the runoff and percolation season primarily affecting water supplies (also termed hydrological drought). On the whole, droughts in Sleman Regency, in general, are most common in Prambanan District.

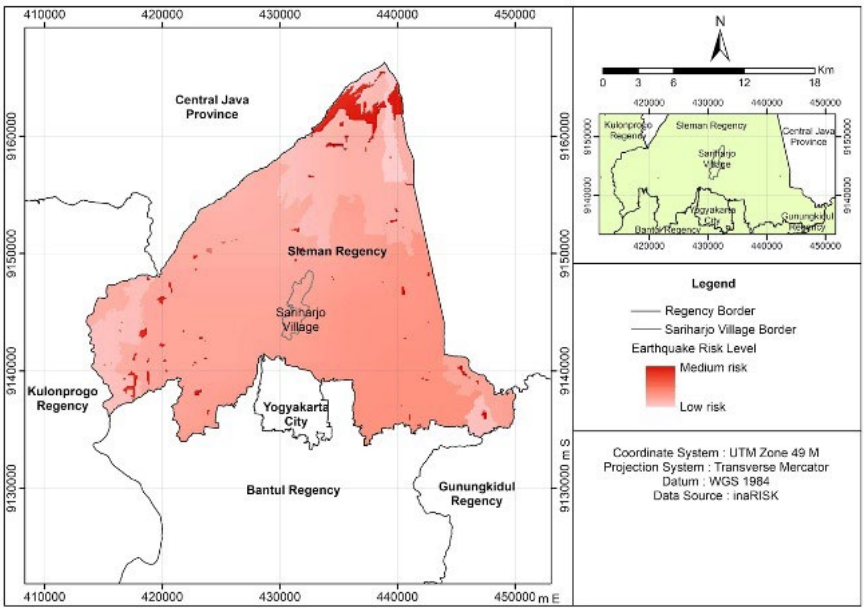


Figure 16. Drought Risk Map

(Source: Sleman Geo-Portal)

Flooding

Low to moderate flood disasters are common in Sleman Regency. Flood-prone locations in Sleman Regency include areas along the banks of rivers such as the Code River, Boyong River, Opak River, and other rivers in the region. Floods frequently happen along the banks of the Opak River in Prambanan Subdistrict, occasionally in central Sleman, such as in Sariharjo Village, Ngaglik Subdistrict, and Depok Subdistrict. The Sleman Regent Regulation Nr. 7.2/2020 with respect to the Disaster Mitigation Plan for 2018-2022, activities for flood mitigation should be: a) The implementation of biopore infiltration holes or infiltration wells; b) Protection and conservation of recharge areas; c) Stream restoration; and d) other types of water infrastructure revitalization.

Figure 17. Flood in Palagan Street Km 9.5 Sariharjo, Ngaglik on March 3rd 2020 by BPBD Sleman

(Source: Setyawan, P.,2020, March 3)

Water in the Town – Story 9

Merapi Eruption: 2010 Living in Harmony with Disaster

On 5 November 2010, a major eruption on Mount Merapi had devastating effects on the whole area around the volcano. At least 277 people died in the Special Region of Yogyakarta and 109 people died in Central Java (source: Liputan6.com) despite the high warning levels that had already been declared for over a month. Thick volcanic ash covered the city of Yogyakarta, including Sariharjo.

However, such eruptions are the source of the abundant richness of the nature in Sleman Regency. Thanks to these volcanic eruptions, the rich soils in the area and the sand, gravel, stones that are used as building materials have been the backbone of the local economy for a long time.

As a country said to be in the 'rings of fire', Indonesia is challenged to look at disasters from a holistic perspective, prepare a comprehensive disaster management system, reduce risks, and continue to develop the spirit of living in harmony with disaster – including the village of Sariharjo.

(Source: https://geologi.co.id/2010/10/27/foto-letusan-gunung-merapi-oktober-2010/)

Volcanic eruption and Lahar flows

Mount Merapi is one of the most active volcanoes in the world. Regular eruptions severely affect settlements and the environment. Especially Lahar flows pose significant risks because of their mix of slurry of pyroclastic material, rocky debris and water that flow at an extremely high speed down from Mount Merapi.

Sariharjo Village is classified as a low risk zone for direct impact from a volcanic eruption. However, the Boyong River, which runs through Sariharjo Village, is a tributary of the Code River that receives regularly strong Lahar flows, making such riparian areas risk zones. The lava-induced flood that occurred in 2012 in Sariharjo Village damaged public and private building structures, ponds and inland fisheries. (Source: Liputan 6.com. (2012, January 2).

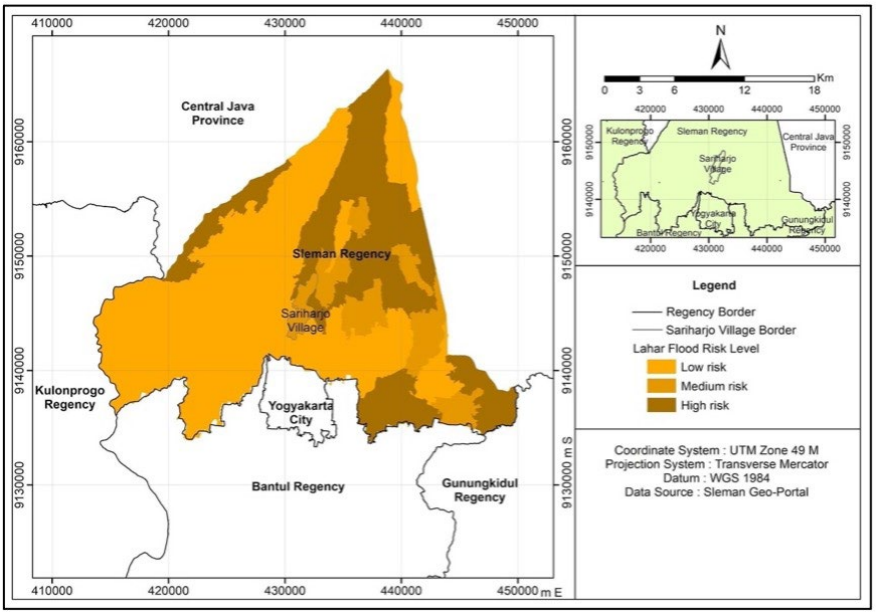


Figure 18. Lahar Flood Risk Map

(Source: Sleman Geo-Portal)

Earthquakes

The settlement of Sariharjo has a moderate risk of earthquakes, both tectonic and volcanic. Since Sariharjo has been rapidly developing its built-up areas, it is more vulnerable to physical damage. Cracks and building collapses may occur. Standards for earthquake resilient construction and the prohibition of building activities close to cliffs and steep river valleys should be mandatory.

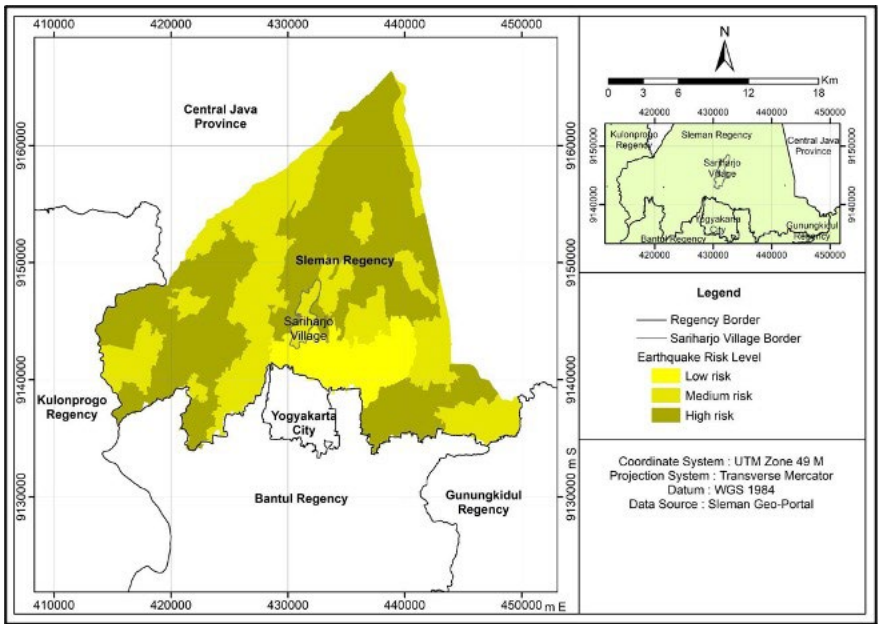


Figure 19. Earthquake Risk Map

(Source: Sleman Geo-Portal)

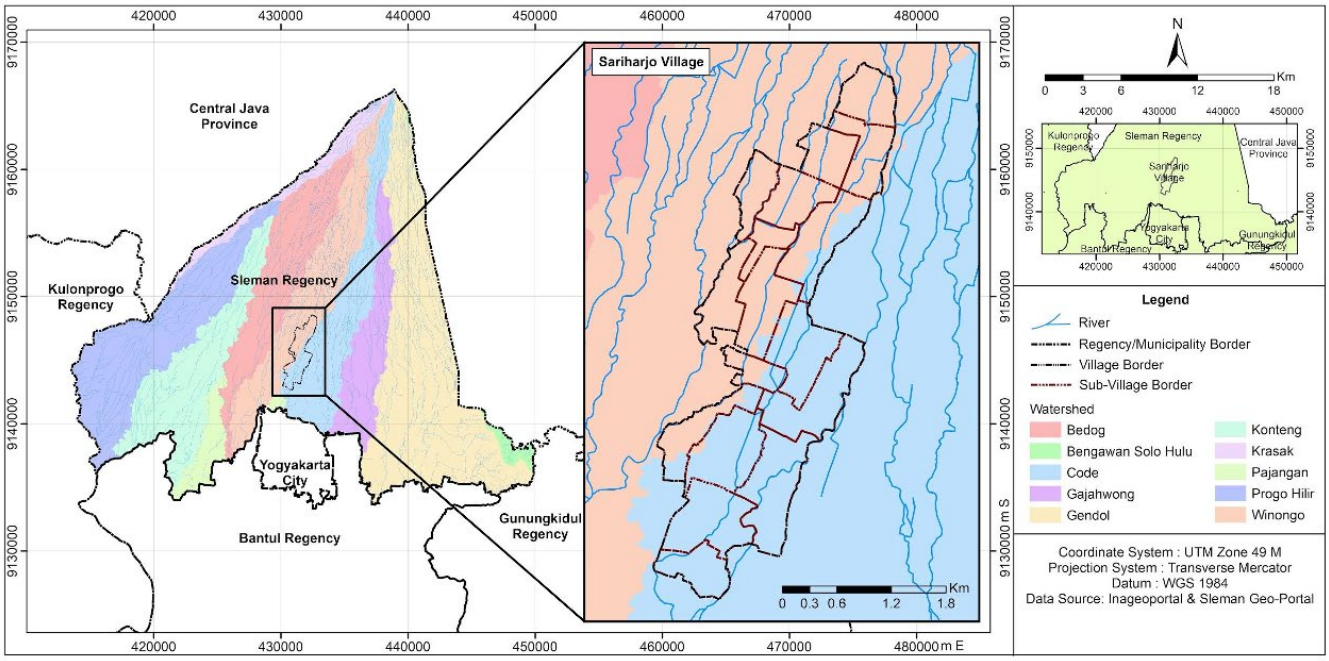


Figure 20. Watershed Map of Sleman Regency Area and Sariharjo Village

(Source: Inageoportal and Sleman Geo-Portal, 2022)

Watershed and water resources in Sleman Regency affecting Sariharjo Village

Sleman Regency has three major watersheds, namely Code, Winongo, and Gajah Wong. Sleman's rivers originate from several springs on Sleman's highest peak and flow southwards as sub watersheds, which lie in Sleman, including the Code River, Bedog River, Winongo River, Gajah Wong River, Gendol River, and Konteng River. The Code River and Winongo River flow across the three regencies: Sleman Regency, Yogyakarta City, and Bantul Regency. The Gadjah Wong River starts from Sleman's highest peak and meets the Opak River in Bantul Regency becoming the Opak River. The village is located in the Winongo Watershed and Code Watershed.

Land use in the Sleman Regency was categorized as: built up area (non-settlement), built up area (settlement), dry farmland, forest, open space (greenery), open space (no greenery), paved surface, plantation, rice field, shrubland, and water body. Genearlly, settlement, plantation, and rice fields are the three dominant land use types in Sleman. However, the upper parts of the watershed are dominated by forest and greenery. The upstream area of the watersheds serve as a water catchment area. The upper parts of the Code and Winongo watersheds are exposed to rapid settlement growth that may affect water discharge in terms of pattern, magnitude, and runoff.

Surface water resources

Sleman Regency in the vicinity of the slopes of Mount Merapi has a relatively homogenous geological formation consisting of Merapi volcanic deposit and igneous rock. It covers and extends over more than 90%of the Sleman area.

In terms of the geological formation, its texture and porosity are a favorable medium for water transfer or widely-known as an aquifer system (Purnomo et al., 2007). The homogeneous and loose aquifer material favors rapid water caused erosion resulting in seepage and easy run-off for streams and river formation. In total the Sleman Regency with its 17 rivers has an average debit of 160 m^3/s (Government of Sleman Regency, 2014).

The Boyong River, which rises on the southern slope of Mount Merapi and runs

for 38 kilometers, is the source of surface water in the village in Ngaglik District. The Boyong River with a discharge of 2-3 m^3/s throughout the year is classified as a perennial river (Adaptian et al., 2019). Intense sand mining and land use change affect the quantity and quality of water in the Boyong River. These developments underline the need for consistent watershed management in the overall area.

The available quantity of surface water and its quality is – especially during dry season – insufficient to be the basis of the local water supply. It is mainly used for agriculture, especially for rice cultivation, and aquaculture activities. In the course of the urbanization process, a further decline in rice farming and thus water consumption associated with agricultural production is to be expected in Sariharjo.

Groundwater resources

The Yogyakarta-Sleman aquifer zone is part of the Merapi aquifer system and comprises a large part of the Sleman Regency, Yogyakarta City, and part of the Bantul Regency. It is formed by the fluvial-volcanic sediment deposit and covers most of all parts of Sleman, including Sariharjo Village. The village, which is part of Ngaglik Subdistrict, is categorized as a transition zone (22%) between limited recharge areas (5%) in the northern part (Cangkringan, Pakem, and Turi subdistricts) and a much larger discharge area (73%) in the southern part of the Yogyakarta-Sleman Groundwater Basin. Non-aquifer layers are observed in the southwest part of Sleman while a minor category of 'no groundwater basin' exists in the southwest and southeast part of Sleman. It is understood that both the non-aquifer and no groundwater basin category are part of the structural hill landforms.

Volcanic landforms have potentially abundant groundwater resources (Santosa, 2006). Each volcanic landform is composed of different materials and is ruled by the buckling of the slopes. The presence of slope buckling in volcanic landforms causes the volcanic aquifer to intersect so that springs appear (Ratih et al., 2018). Springs in Sleman Regency are likely to emerge in changes in landform units, extremely-steep volcanic slopes, gentle volcanic slopes, and flat volcanic slopes. The springs that appear in the extremely-steep volcanic slope and gentle-volcanic slope units are governed by a relatively significant slope factor while in the flat volcanic slope units, there are also many springs as a result of differences in slopes due to morphological changes resulting from changes in rock texture from rough to fine (Santosa, 2006). In Sariharjo Village, which is situated on a flat volcanic slope unit, one spring has developed, namely the Mudal Spring in Mudal sub-village.

While the Sleman Formation is a deep aquifer, the Yogyakarta Formation is a shallow aquifer. The groundwater flow of the Yogyakarta-Sleman aquifers follow the topography from North to South (Hendrayana et al., 2020).

The total consumption of groundwater in the Sleman Regency rose from 84.672.337 m^3 in 2013 to 100.608.062 m^3 in 2018 equal to an increase of 18.82 %. The highest consumer of groundwater usage in Sleman Regency that is located in the Yogyakarta-Sleman Groundwater Basin (CAT) is the domestic sector, with a total consumption of 53,968,812 m^3 in 2013 and 61,988,198 m^3 in 2018 (Hendrayana et al., 2020). In the Ngaglik Sub District, where Sariharjo is located, the groundwater usage increased from 6.799.380 to 8.237.848 in 2018, which is equal to an increase of 21.16%. Overall, the total groundwater storage (dynamics) is around 129 million m^3/year. The total groundwater consumption was estimated at 8 million m^3/year in 2018, indicating a low level of renewable water uses.

The depth of the groundwater level shows an increasingly shallower groundwater level following this topography. Monitoring well data shows that the average groundwater depth in Sleman Regency is 9.15 m, in Yogyakarta city, it is 7.72 m, and in Bantul Regency, it is 2.80 m. (Impacts of Precipitation, Land Use Change and Urban Wastewater on Groundwater Level Fluctuation in the Yogyakarta-Sleman Groundwater Basin, Indonesia Wahyu Wilopo, Doni Prakasa Eka Putra Heru Hendrayana, 2021).

The aquifers show significant changes in the water tables. While between 2011 and 2017 annual decreases in the groundwater level in the Sleman Regency in the range of 0.1– 0.26 m/year was observed, an increase of groundwater level of 0.21–0.25 m/year was observed in Yogyakarta City.

These changes may be to a large extent contributing to the urbanization processes and their impacts: changing water use patterns, intense land use changes and urbanization processes. Higher groundwater consumption, loss of vegetation and less infiltration in Sleman Regency results in higher stormwater run-off stormwater and used water flowing towards Yogyakarta City where groundwater bodies are increasingly recharged.

The fall of groundwater tables correlates with statements made by some communities in Sariharjo to the PolyUrbanWaters team. These communities had to deepen their shallow wells by up to 2 meters every year to obtain usable clean water. In the sub-villages of Mudal and Nglempongsari where apartment blocks and hotels have been built since 2012, the communities complain that they have deepened their wells by 18-22 meters to access the usable clean water. Previously, they had accessed water from the wells with only 13-15 meters depth. Such a trend could intensify in the future.

Water quality

Based on Governor Decree Number 20/2008 on Water Quality Standards in the Special Region of Yogyakarta, there are four classifications of water quality as follows:

- Class I: drinking water and or other designations that require the same water quality as drinking water;
- Class 2: infrastructure/facilities to support water-based recreation, freshwater aquaculture, animal husbandry, water to irrigate crops and or other designations that require the same water quality;
- Class 3: freshwater aquaculture, animal husbandry, water to irrigate crops and or other designations that require the same water quality;
- Class 4: water to irrigate crops and or other designations that require the same water quality.

There are still limited capacities to monitor the state of water resources. The Environmental Agency of Sleman Regency has conducted monitoring of river water quality in 2019 and 2020. The agency monitors 17 parameters in accordance with the Governor Decree, especially for Class II water quality for eleven rivers in Sleman Regency, including the Blotan River, Progo River, Kruwet River, Kuning River, Gajah Wong River (Pelang), Tepus River, Boyong River (Code), Konteng River, Bedog River, Denggung-Winongo River and Opak River.

Significant coliform water pollution have been detected in 2020 presumably caused by household wastewater (IKPLHD, 2020). Furthermore, there were two sample location points close to Village's east border along the Code River, which shows the unusually high value for Cyanide (Sianida/CN). The value exceeds the

water quality standards and could be categorized as an extremely harmful pollutant. The pollutant's sources are still unknown since mining and/or extensive industry are not visible in the surrounding area.

The Public Works, Housing and Settlement Department of Sleman Regency conducted data monitoring of 31 reservoirs located in Sleman Regency. The highest reservoir volume is 600,000 m^3 in Tambakboyo Reservoir with an area of 8.8 ha and the lowest reservoir volume of 2,000 m^3 is in Gadung Reservoir. In 2019, the Agency carried out water quality monitoring of 25 reservoirs. This survey results show that there are only four reservoirs that fulfill water quality standard Class 2 according to the Governor Decree's requirements. Those reservoirs are Karang Geneng in Purwobinangun, Pakem; Letis Suruh in Donoharjo, Ngaglik; Sempu in Pakembinangun, Pakem; and Temuwuh in Balecatur, Gamping. Until recently, there were no reservoirs located in Sariharjo Village. The closest reservoir is Lembah UGM Reservoir located in Caturtunggal, Depok.

Being located at the headwaters of the tributaries to Yogyakarta City, water pollution not only has its public health and environmental impacts in Sariharjo itself, but also in those urban areas located in the lower reaches. The results of clean water testing conducted on three residents' wells in Randugowang sub-village may indicate the quality of many residents' wells located in Sariharjo. While in two of the wells E-coli levels significantly exceeded the legally permitted limits, for Coliform all three wells exceeded the limits.

Figure 21. Quality of Well Waterin Sariharjo Village
(Source: Sleman Environmental Department, 2021)

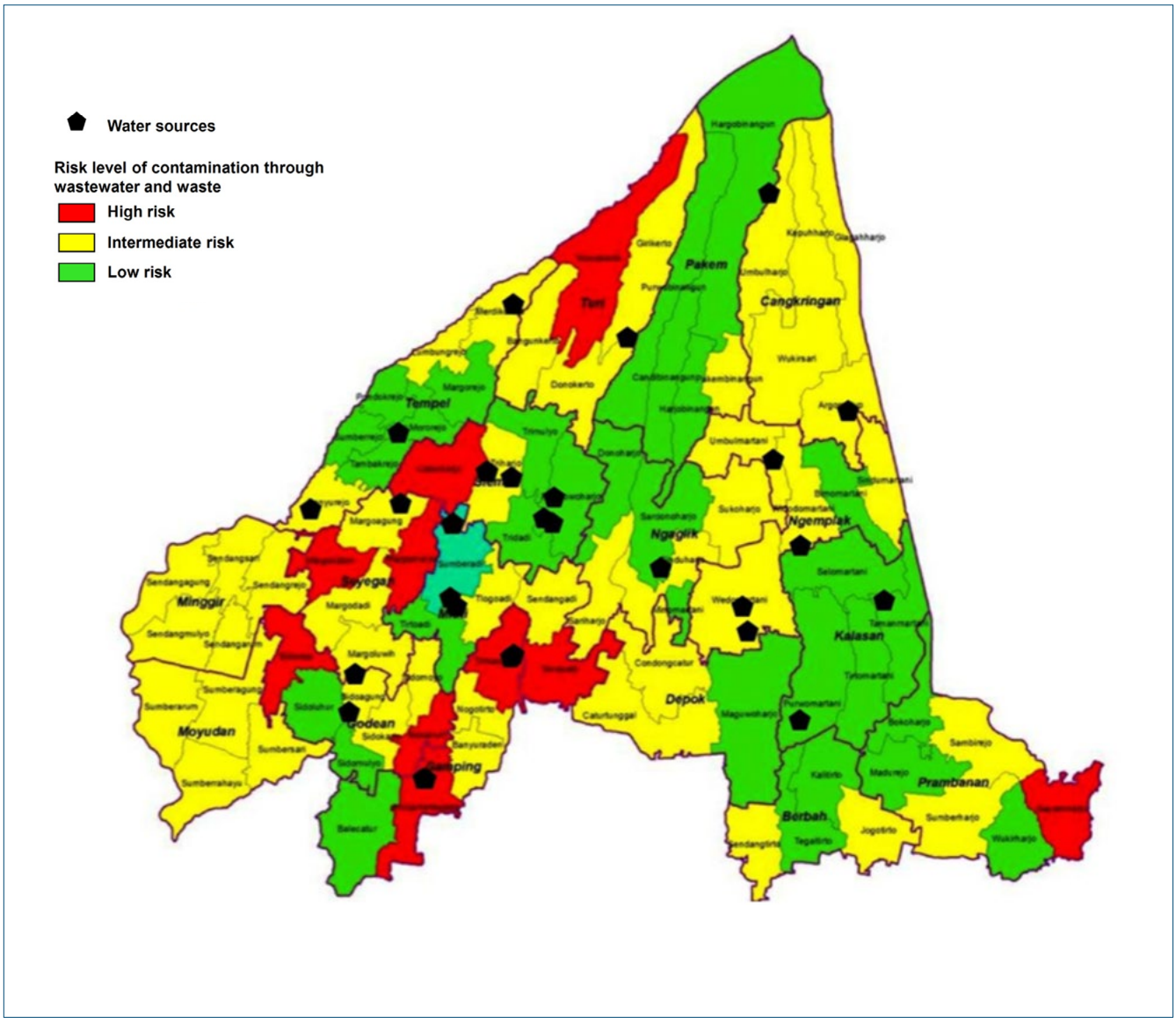
Location of Well (Owner)	Taste	Smell	pH	Color (Ptco Scale)	Turbidity (NTU Scale)	Iron (Fe) Total (mg/L)	Detergent (mg/L)	MANGAN (Mn) Total (mg/L)	NITRAT (NO3+) (mg/L)	NITRIT (NO2+) (mg/L)	Temp. ˚C	TDS (mg/ L)	E. COLI (CFU/ 100ml)	TOTAL COLIFORM (CFU/ 100ml)
Maximum amount allowed (Ministry of Health Regulation No. 32 Year 2017)	**Doesn't have taste**	**Doesn't smell**	**6,5-8,5**	**50**	**25**	**1**	**0,05**	**0,5**	**10**	**1**	**±3˚ C Air temp.**	**1000**	**0**	**50**
Dug well water tap Mr. Sutarjo RT 1 / RW 28, Randugowang, Sariharjo, Ngaglik	Doesn't have taste	Doesn't smell	7,05	0	0,14	<0,0001	<0,01	0,003	6,957	0,004	22,0	191	200	616100
Dug well water tap Mr. Sagiman RT 1 / RW 15, Randugowang, Sariharjo, Ngaglik	Doesn't have taste	Doesn't smell	7,23	0	0,18	<0,0001	<0,01	0,0667	0,470	<0,001	22,0	181	0	1660
Dug well water tap Mr. Sukri RT 1 / RW 15, Randugowang, Sariharjo, Ngaglik	Doesn't have taste	Doesn't smell	7,05	0	0,22	<0,0001	<0,01	<0,0001	<0,001	0,003	22,0	193	140	2940

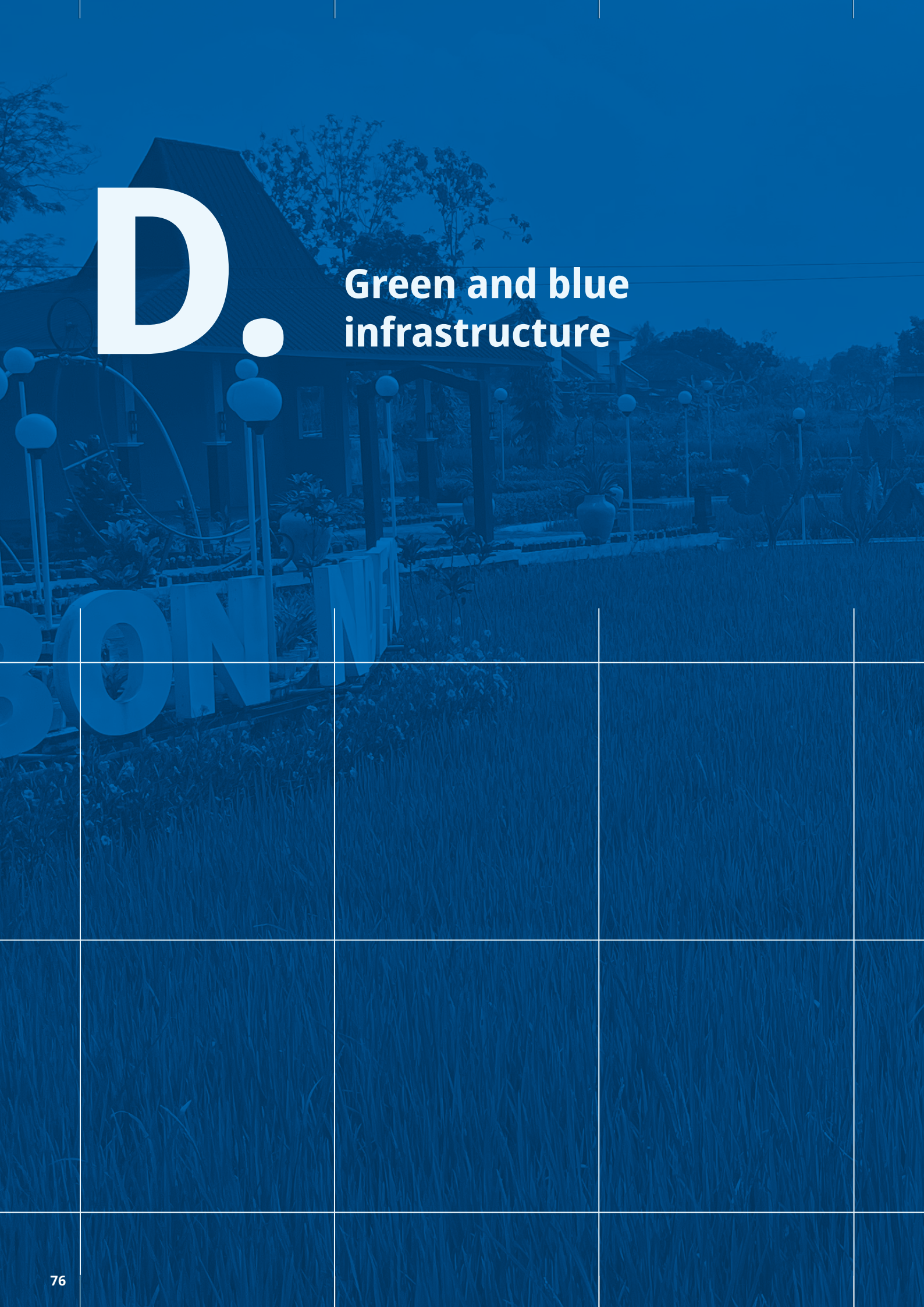
Sariharjo in general is categorized as a zone of intermediate risk of contamination from wastewater and waste. The main pollution sources in Sariharjo are:

- Channels/Rivers: overflow and infiltration of surface debris (waste), greywater and upstream pollution;
- Agriculture: Infiltration of fertilizer chemicals;
- Settlements: Unsealed septic tanks (infiltration/overflow of untreated wastewater); solid and toxic waste.

Figure 22. Risk level of Contamination Through Wastewater And Waste

(Source: BORDA, Government of Sleman Regency with BORDA Indonesia, 2019: Integrated Sanitation Planning)





D. Green and blue infrastructure

Key Messages of Section

Sariharjo retains its rich green-blue infrastructure. This infrastructure has a major function in ensuring the livelihoods of its residents, provision of water services, the livability and its overall resilience to climate change.

The increasing settlement and urbanization pressure in Sariharjo is increasingly effecting the green-blue infrastructure, which can only be compensated to a limited extent by grey infrastructure development. The loss of green infrastructure has major impacts on water security in the village.

Ultimately, a public investment policy that focuses exclusively on the expansion of grey infrastructure and neglects green-blue infrastructure will lead to exponentially rising direct costs of implementation and maintenance and indirect costs resulting from environmental damage and detrimental impacts to the health of communities.

The planning and sustainable management of blue-green infrastructure should thus be placed at the centre of Sariharjo's urban and infrastructure development planning.

A process of informed decision-making at village and sub-village-level should develop a multi-criteria catalogue answering questions such as:

- Which existing blue-green infrastructures are of strategic importance for Sariharjo? What kind of green-blue-infrastructure should be developed? Here, parameters such as referring to water security, livability and the development of recreational outskirts of the KPY should be considered.
- How can Village Treasury Land be used to develop the blue-green infrastructure? How can these areas be sustainably maintained?
- What funds can be allocated from public sources? What can be the contribution from communities to maintenance? How can the private sector be involved in integrating their developments into broader green-blue-infrastructure developments?

Urban planning approaches should support participatory decision-making processes that consider long-term planning but should identify measures that can be implemented in the short-term in village development plans and respective budget planning.

The existing green-blue network in Sariharjo and its ecosystem services

Sustainable development and resilience are more crucial than ever in Sariharjo Village, which is experiencing increasing environmental, economic, and social challenges. Existing and future blue and green infrastructure are considered as possessing tremendous potential to support the urban transition to sustainability and reach numerous SDGs. They have the potential to deliver many benefits across a variety of urban sustainability concerns, including that of regulating floods, promoting improved health outcomes, and establishing areas for social interaction and recreation.

Urban green areas, urban forest, street trees, riparian strips, and rivers and streams are critical components of sustainable urban management. Despite recent improvements, it is difficult for local decision-makers, such as urban planners and water engineers, to incorporate the benefits of blue and green infrastructure into their plans.

Sariharjo Village is rich in green and blue networks. These blue and green networks play an important role in the livability, the resilience and the protection of the village's water resources.

~ Sariharjo's green network is characterized by riverbanks, rice fields, public parks and sports fields, grounds, and road-side vegetation.

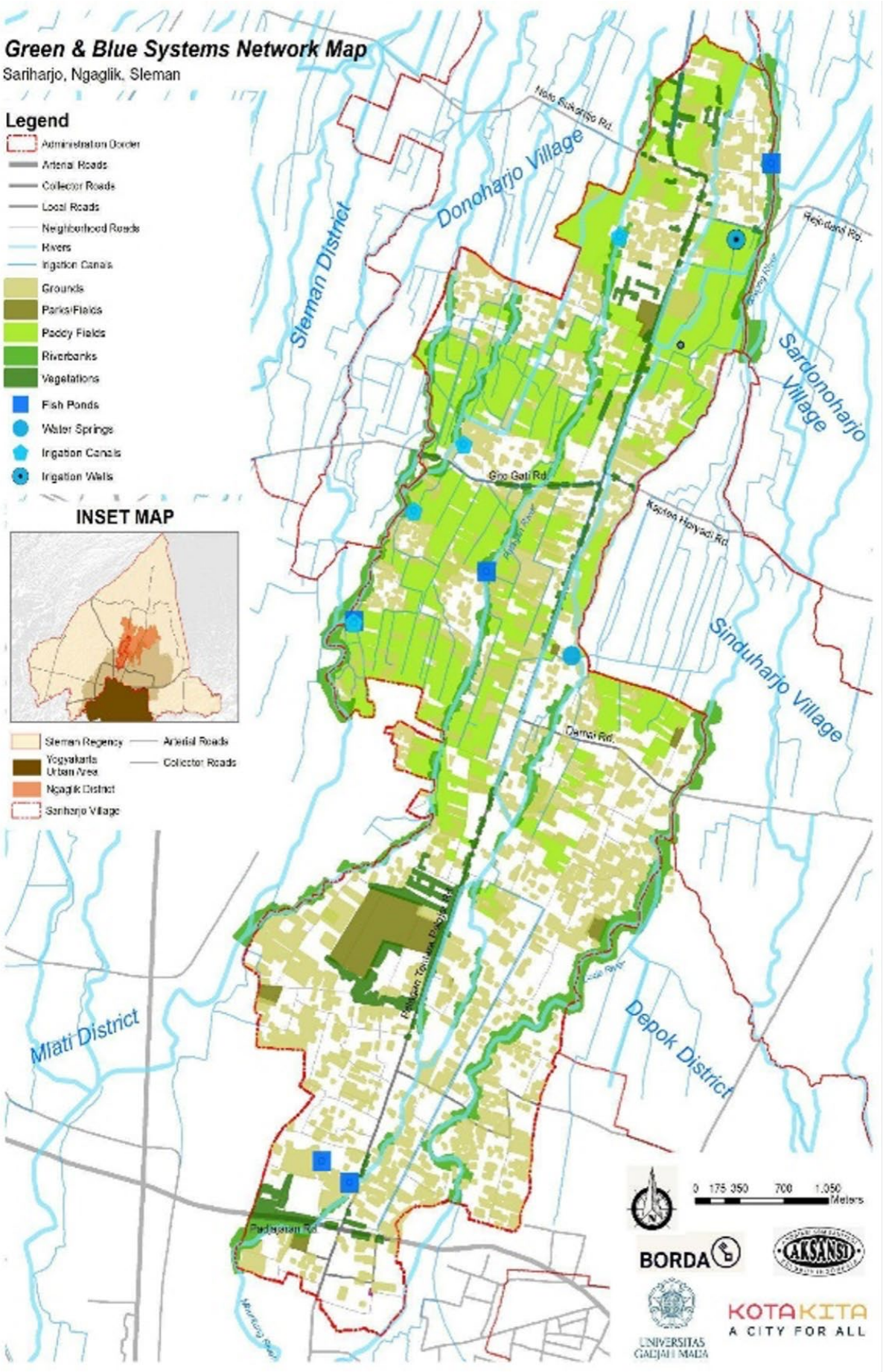
~ Its blue network consists of rivers, spring waters, irrigation canals, ponds, irrigation wells/agricultural irrigation wells, and fishponds.

In its interconnectivity, the network provides multiple benefits, so-called ecosystem services (ES). With the urbanization process, the networks' blue and green infrastructure comes under increasing pressure. The development of built-up areas and grey infrastructure and the discharge of wastewater in water bodies have consequences, such as a decrease in water quality, loss of biodiversity, and decrease in recreational areas. Comprehensive urban planning measures, as well as strong maintenance and operation models, are required to establish blue and green infrastructure that has traditionally been handled mostly by communities. Now, in the context of Sariharjo's urbanization, it is necessary to adapt to a new framework and approach.

To improve and manage natural ecosystems in a more sustainable way, a clear understanding is needed about the linkages between the natural and socio-economic systems (Guerry et al. 2015). Most people tend to appreciate and directly quantify benefits (ecosystem services) of blue and green networks, but some of them are less evident, especially regulating and maintaining services, such as maintaining the quality of water, providing flood control, etc.. (Grizzetti et al. 2016). To achieve the goal of havinggood ecosystem ecological status, a thorough understanding of the relationship between pressures, conditions and services is required (Grizzetti et al. 2016).

Figure 23. Green and Blue Systems Network in Sariharjo

(Source: After MURP UGM, 2021)


Green & Blue Systems Network Map
Sariharjo, Ngaglik, Sleman
Legend
Administration Border
Arterial Roads
Collector Roads
Local Roads
Neighborhood Roads
Rivers
Irrigation Canals
Grounds
Parks/Fields
Paddy Fields
Riverbanks
Vegetations
Fish Ponds
Water Springs
Irrigation Canals
Irrigation Wells
INSET MAP
Sleman Regency
Yogyakarta Urban Area
Ngaglik District
Sariharjo Village
Arterial Roads
Collector Roads
Sleman District
Donoharjo Village
Sardonoharjo Village
Sinduharjo Village
Mlati District
Depok District
Gito Gati Rd.
Kaliurang Rd.
Damai Rd.
Padasan Rd.
0 175 350 700 1,050 Meters
BORDA
AKSANSI
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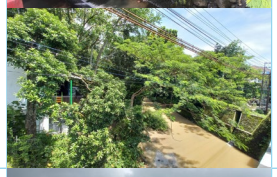
KOTAKITA
A CITY FOR ALL

No.	Type of Green Open Spaces	Percentage	Brief Description	Pictures	Examples of ecosystem services*
1	Riverbanks	8.5%	Land with a lot of trees along the edge of the river. Notes: Riverbanks at some places are for fish ponds. Types of vegetation: trees, shrubs, and grass.	 	Improving water quality, mitigation of flood risks, biodiversity
2	Paddy/agricultural fields	24.1%	Paddy plant Notes: As agricultural lands to supply basic needs such as rice, chili, corn, beans, etc. Types of vegetation: paddy, chili, corn, beans.	 	Groundwater recharge, biodiversity, flood control, production of non-rice foods, culture and landscape, support of ecosystem and biodiversity
3	Parks and fields	2.1%	Open area for green space and sport areas Notes: As recreational, sports, and social gatherings areas. Types of vegetation: trees, grass.	  	Recreation, decoration, cultural value, groundwater recharge
4	Ground	17.7%	Vacant land (or unoccupied land) Notes: Utilized lands are for orchards, such as bananas, rambutans, mangoes, or papayas. Can be in the backyard. Underutilized lands or vacant lands, with tall grass or bushes	 	Recreation, microclimate regulation, air filtering, biodiversity
5	Road vegetation	2.1%	Trees along the roads	 	Air filtering, microclimate regulation, rainwater drainage, shading, biodiversity

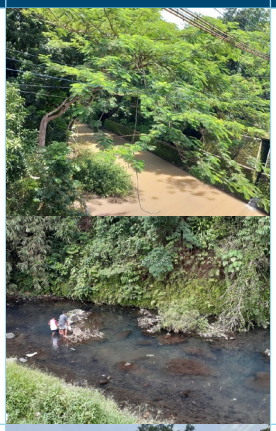
No.	Type of Water Network	Brief Description	Pictures	Examples of ecosystem services*
1	Rivers	Natural stream of water flowing to sea, lake, or fluvial systems Notes: As water sources for agriculture, irrigation and fishery.		Nutrient cycling, water for consumptive and non-consumptive use, maintenance water quality, recreation, tourism
2	Ponds	A small body of still water formed naturally or man-made Notes: Fishery to increase household income.		Water supply, recreation, wildlife habitat
3	Spring water	Water taken from underground natural spring Notes: As domestic clean water sources.		Water supply, water purification, drought attenuation
4	Irrigation network	Canals that supply water to rice fields Notes: As canals for agricultural purposes.		Rainwater disposal, maintenance of biodiversity, aquifer recharge
5	Irrigation well/agricultural irrigation well	A well that is used for supplying water to rice fields Notes: To support water needs for watering the plants, especially during the dry season.		Provide water during dry season

Table 5 (left). Types of Green Open Spaces in Sariharjo Village

(Source: Böck, et. al., 2018 and Field visist, 2022)

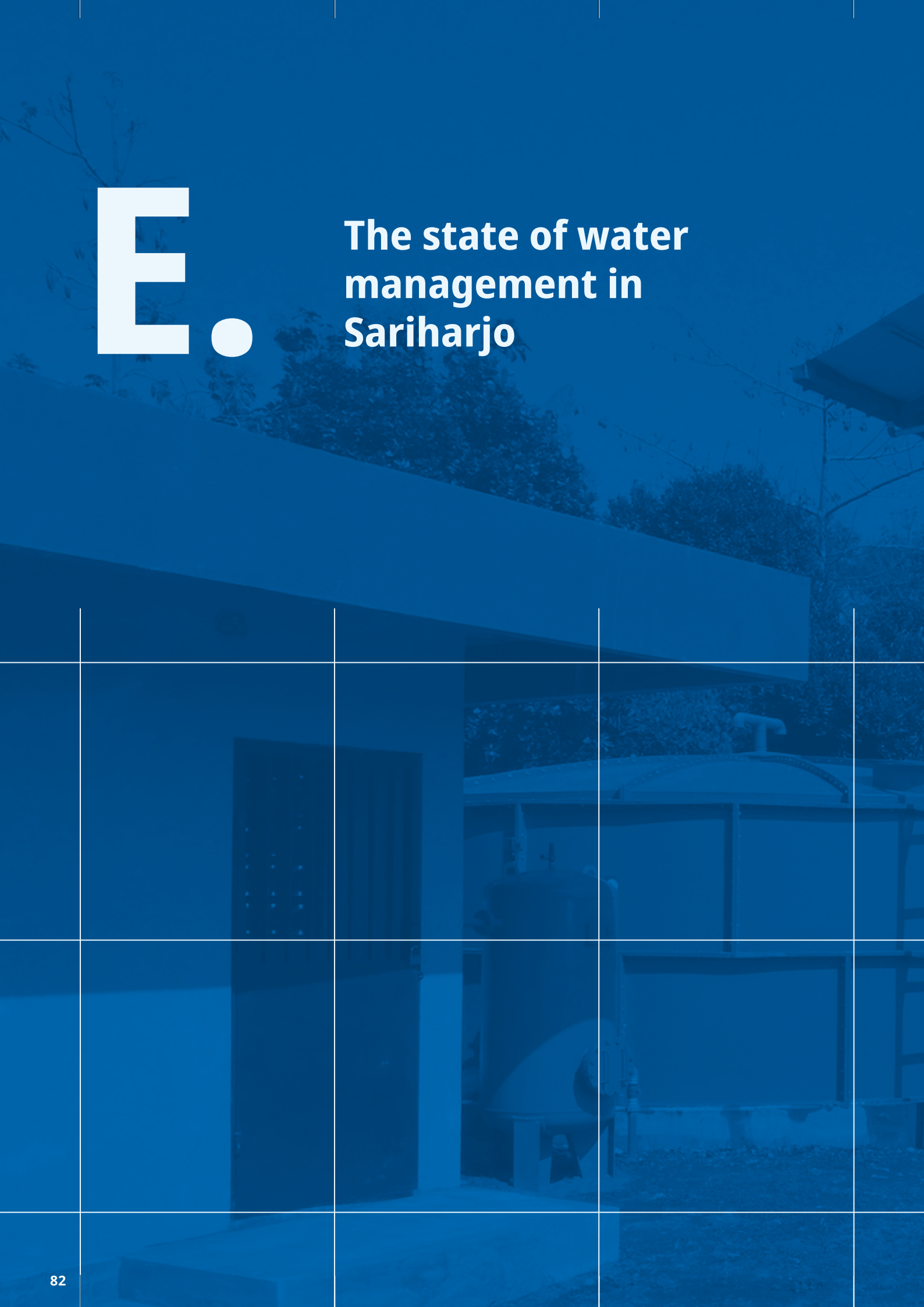
Table 6 (top). Types of Blue Network in Sariharjo

(Source: Böck, et. al., 2018 and Field visit, 2021)

*examples provided are taken from secondary sources and do not precisely reflect ecosystem services in the Sariharjo, but it is close enough per field observation

E.

The state of water management in Sariharjo



Key Messages of Section

Stormwater management systems

Flooding events are increasingly observed in Sariharjo.

Existing drainage infrastructure and conventional drainage infrastructure schemes are not sufficient to address existing and upcoming challenges for effective stormwater management.

A rapidly expanding sealing of surfaces and the loss of green areas has significantly reduced retention capacity of run-off waters in Sariharjo and its catchment.

Compensation for land use changes by infrastructures, such as infiltration wells, is limited.

Flooding increases the pressure on wastewater treatment sewage systems.

Integrated approaches that combine grey and nature-based solutions may mitigate flood vulnerabilities significantly.

Coordinated, integrated solutions, such as the expansion of grey drainage and water retention systems, green space development, and surfaces with water infiltration structures, should address the multi-dimensionality of effective stormwater management.

Water supply in the context of a growing demand for clean water

With Sariharjo's population growth, increasing adoption of urban lifestyles, and the proliferation of commercial establishments, such as hotels, restaurants, and commercial spaces, the demand for clean water and drinking water will increase dynamically.

In 2021, only 948 out of 5,904 households had been connected to the pipeline system of the water operator PDAM. This is a strikingly low level of coverage for public infrastructure.

Households in Sariharjo are increasingly meeting their drinking water needs from packaged drinking water (PDW). This trend reflects the income situation. While poorer households mainly boil clean water from wells, middle-class households mainly consume PDW. However, Indonesia-wide quality problems with PDW are observed.

The current clean water supply structure, which is primarily based on the use of shallow wells, cannot ensure the long term sustainable development of Sariharjo.

- In some places, the groundwater table is already falling, and the expected demand for clean water may reach a critical threshold.

- The compulsory connection of new housing developments to the PDAM network shows the direction in which a public clean water supply must go. Successively, most of the households will have to be connected to the network.

- However, there are significant obstacles to overcome along the way. So far, with the shallow wells, most households can access a free supply of clean water. Extensive awareness campaigns by local government agencies involving village and sub-village structures and a much improved regular supply of high-quality clean water are essential elements in overcoming these reservations.

- Accompanying measures must counteract the increasing demand for water. These include water harvesting structures in private and public facilities and water recycling, which includes the consistent reduction of technical losses and non-revenue water within the PDAM network.

- Households that continue to draw water from shallow wells should also be addressed in community-level awareness campaigns on the careful use of clean water and, where appropriate, on water recycling options.

- Due to institutional, technical and financial constraints, a community based clean water supply has a very limited scope to meet future demands for clean water in Sariharjo.

Stormwater management systems

Flood vulnerability in the context of Sariharjo's urban development process

Already today, flooding occurs regularly in some settlement areas of Sariharjo, causing damage to private and public property and endangering public health. It is predicted that such flooding events will increase in the future. Along with land-use changes and climate change, larger scale and frequent flood events may become a new normal in Sariharjo. With the loss of blue-green infrastructure, the increased sealing of surfaces, inadequate layout and insufficient quality and maintenance of drainage systems, and the poor solid waste management response measures, drainage system extensions and infiltration are hardly adequate to address the challenges.

Figure 24. Road Conditions at Tegalwaras after the Rain; Some Roads were Flooded

(Source: Field Survey, 2021)

Predominant approaches to water drainage

The predominant drainage concept used in Indonesia is to drain excessive surface water (mainly stormwater) to the nearest waterbody that ultimately will end up in nearby rivers and finally in the sea. The Government categorizes the drainage based on the road status, such as Primary Road (Jalan Primer/JP), and Secondary Road (Jalan Sekunder/JS), and on the settlement statuses, such as Primary Settlement (Permukiman Primer/PP) and Secondary Settlement (Permukiman Sekunder/PS). Drainage constructions are under the responsibility of the Public Works, Housing and Settlement Department of Sleman Regency. The village government runs drainage construction along village road networks and in tertiary settlements.

In 2020, the total drainage volume in Sleman Regency reached 198.813,83 m^3. Sariharjo, a part of Ngaglik sub-district, has a total built drainage of 16.234,44 m^3 (8.16% of the entire drainage in Sleman). However, almost half of the drainage is in a poor condition (75%), with 93.442,5 m^3 (47%) heavily damaged and 55.667,87 m^3 (28%) moderately damaged (Drainage Channel Data by Public Works, Housing and Settlement Department of Sleman Regency, 2020).

Limited drainage capacity, unequal development of drainage systems throughout the village area, a planning layout that insufficiently takes into account the flow regime of water, poor connectivity between different drainage systems, absence of main drainage channels, blockage of drainage systems through structural modifications (often by residents) and blockages by mud, plastic waste, wood/leaves, and volcanic eruption dust are widely observed. Furthermore, in some areas drainage with a pollution load is channeled to the agricultural irrigation systems causing contamination of the paddy fields.

Figure 25. The Drainage System along the Main Road

(Source: Field Survey, Kota Kita, 2021)

Built-up locations in the peri-urban areas of Yogyakarta have increased by 15.22% or 1,292.16 Ha between 2007 and 2017 (Devi et.al. 2020). As a village located in the peri-urban areas of Yogyakarta, Sariharjo Village is likely experiencing a similar development.

Currently the built-up area of Sariharjo accounts for about 45%. Based on the population projection in 2030 and also the development trend of commercial buildings, such as hotels, restaurants, and shops, in the past 10 years, it is predicted that in 2030 the built-up area of the village will be around 60%. According to Law No. 26/2007 concerning Spatial Planning, any cities or urban areas should have at least 30% given to green open spaces.

Regency Regulation Number 11/2020 on Green Open Spaces states that at least 30% of Green Open Spaces must be public and 10% must be privately held in urban areas. The minimal extent of public green open space has not yet been fulfilled, for example, because trees beside the road were cut down for road

Figure 26. The Drainage System along neighborhood streets

(Source: Field Survey, Kota Kita, 2021)


ercam

expansion. According to the aforesaid rule, green open space is defined as follows:

Green Open Space is an elongated/path and/or clustered area that is generally used for outdoor functions; it is an area where vegetation develops naturally or purposefully.

Even though the fact that 40% of non-built up areas would be still below this 30%, the future land uses will have a significant impact on the livability of the village and the effective provision on water-related basic-needs services, such as storm-water management. Moreover, the water infiltration capacity of the overall water catchment in Sariharjo will decrease significantly during the coming years.

Non-built up areas are defined as areas with a low degree of surface sealing and a relatively high permeability of surfaces: permeable areas that allow water to infiltrate into the soil. For this report, non-built up areas are categorized as green open spaces (as previously classified into six types under the green network discussion).

Built-up areas are characterized as areas with no or low permeability. For this report, built-up areas include settlement and non-settlement building. In general, the total of these areas is Sariharjo Village is 45%.

Sleman Regency Regulation Number 11/2020 regarding "Green Open Space" mention the requirement of green open space for residential yard. It is divided into 3 types:

- large size lot (>500 sq meter),
- medium size lot (200-500 sq meter),
- small size lot (<200 sq meter).

Minimum green open space is the land area (sq meter) minus the base area of the building (sq meter), and each size is required to plant trees (large area minimum 3 trees, medium area minimum 2 trees, small area minimum 1 tree) and other ground coverage plant.

Currently, Sleman Regency does not have FAR/BCR[5] ratio for the whole region due to these regulations are stipulated at the detailed spatial plan only. Hence, there is no clear ratio of minimum base area of the building to the yards.

Figure 27. Built-Up Area in Sariharjo

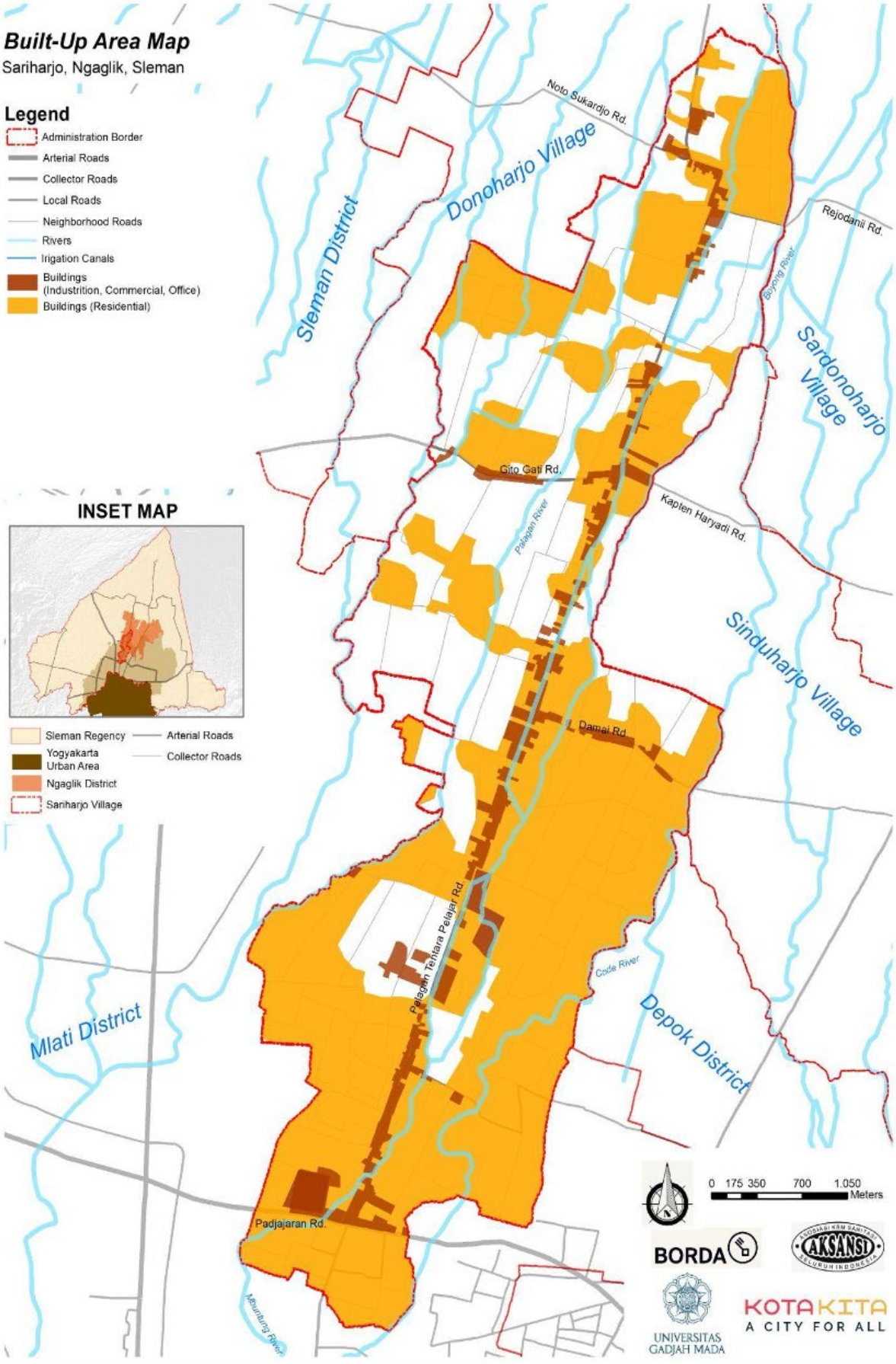
(Source: After MURP UGM, 2021)

[5] Sariharjo village is part of Sleman Regency, which the government of Sleman is currently developing the detailed spatial plan of Sleman Regency. The information regarding FAR/BCR will become public information in the future.

Table 7. Land Use Classification in Sariharjo

(Source: MURP UGM, 2021)

No	Category	Land Use	Areas (Ha)	Percentage	Total
1	Non-Built-Up Area (Natural and green spaces)	Riverbank	59.12	8.5%	377.62 (54.3%)
2		Rice fields	166.47	24.0%	
3		Parks and Fields	14.69	2.1%	
4		Undeveloped land	122.22	17.6%	
5		Road Vegetation	15.12	2.2%	
6	Built Up Area (settlement and non-settlement)	Building (Industries, offices, commercials)	14.88	2.1%	317.38 (45.7%)
7		Building (Non-residential e.g. museums)	3.04	0.4%	
8		Building (residential)	299.67	43.1%	
Total			695	100%	695 (100%)


Built-Up Area Map
Sariharjo, Ngaglik, Sleman
Legend
Administration Border
Arterial Roads
Collector Roads
Local Roads
Neighborhood Roads
Rivers
Irrigation Canals
Buildings (Industrition, Commercial, Office)
Buildings (Residential)
INSET MAP
Sleman Regency
Yogyakarta Urban Area
Ngaglik District
Sariharjo Village
Arterial Roads
Collector Roads
Noto Sukardjo Rd.
Donoharjo Village
Sleman District
Rejodani Rd.
Boyong River
Sardonoharjo Village
Gito Gati Rd.
Kapten Haryadi Rd.
Pelagan River
Sinduharjo Village
Damai Rd.
Pelajar Rd.
Code River
Depok District
Mlati District
Padjajaran Rd.
Mountung River
0 175 350 700 1.050
Meters
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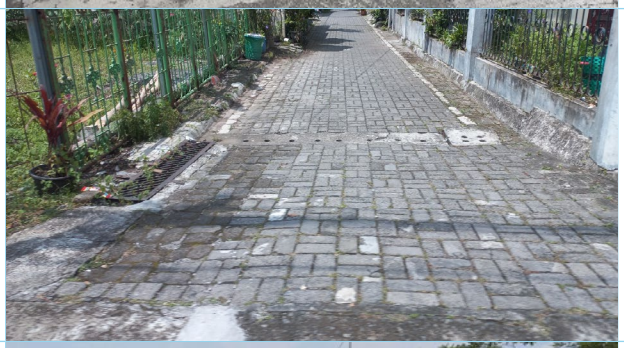
No	Category	Land Use	Areas (Ha)
		Built-up	
1	Building Coverage		Mainly located along the (main roads) of the southern part of the village. Surfaces with dense building cover and low water permeability.
2	Asphalt Roads		Mainly main roads are constructed with asphalt (arterial and collector roads). Usually equipped with drainage channels with culverts on the road-side.
3	Concrete Covered Surfaces		Pavement (often for pedestrians) constructed from concrete with no water permeability.
4	Concrete Block Roads		Generally neighborhood roads (such as roads around housing) with water permeability
5	Graveled Field		Some of the surfaces and roads in Sariharjo are still constructed with gravel mixed with sand. These surfaces have water permeability.

Table 8. Illustration of Built-up and Non-Built-up Areas in Sariharjo Village

(Source: MURP UGM Field visit, 2021)

New approaches to urban drainage

In recent years, there is a progressive shift in approaches from meeting rainwater and stormwater challenges in Sleman Regency and in Sariharjo towards more integrated approaches. Currently, the Ministry of Public Works and Public Housing is campaigning for rainwater management with the concept of conservation by harvesting, infiltrating, draining, and maintaining – known as TRAP (Ministry of Public Works and Public Housing, 2013). TRAP (Tampung-Resapkan-Alirkan-Pelihara) is an effort to absorb stormwater for groundwater reserves and reduce inundation, flooding, and other environmental hazards. The main goal of this approach is to achieve "zero run-off":

Figure 28. Biopore Creation by the Community in Padukuhan Nandan

(Source: Kota Kita, 2022)

Figure 29. Integrated Infiltration Well and Drainage Channel in Rejodani I

(Source: Kota Kita, 2022)

~ Campung/ Collect

The first step of stormwater management is to collect and store stormwater with a specific capacity to be processed into raw water ready for use (Ministry of Public Works and Public Housing, 2013). Rainwater harvesting can be carried out at the household and regional scales. Stormwater storage can support the fulfillment of daily water needs, such as watering plants, washing cars, and other activities. The Banyu Bening Community in the nearby Sardonoharjo village is engaged in nature conservation and campaigns for rainwater usage and protection by tree planting. This community created a Stormwater School in 2019 to teach the characteristics of stormwater. This practice can be a model for Sariharjo where no similar activities have been implemented yet.

~ Resapkan/ Infiltrate

The Environmental Department of Sleman Regency promotes a program that green open spaces should cover at least 20% of the land in the villages. However, Sariharjo has missed this target so far due to massive changes to land use surfaces in the green open spaces, such as parks, cemeteries, fields, and rivers banks.

With support of the government, infiltration wells are built in drainage channels, roads, and house yards. The village government primarily funds the construction; a part of the cost is borne by the community or by private initiatives in Corporate Social Responsibility (CSR) (Tegalwaras sub-village). Currently there are thousands of infiltration wells in the village. Each sub-village has hundreds of wells, varying from a depth of 1.5 meters to 5 meters or more.

~ Pelihara/ Maintain

Sleman Regency Government, through the Public Works, Housing and Settlement Department, conducts drainage maintenance works periodically, such as removing waste and sediment that clogs the drainage . In addition, the communities perform monthly services to clean the environment and drainage systems.

Water supply in the context of a growing demand for clean water

Drinking water consumption in Sariharjo

PDW is already the most widely used source of drinking water in Indonesia. In general, PDW is offered in containers, which can be refilled or as un-refilled bottled water. The current consumption share of water from refilled containers is 29,1% of total drinking water consumption in Indonesia, while bottled water is 10.2%. The higher proportion of refilled containers is probably due to lower cost. It is expected that by 2026, the share of PDW of total drinking water consumption will be beyond 50%.

The increasing consumption of PDW is closely linked to the improved income situation of households. Especially younger generations prefer PDW. But the Ministry of Health of Indonesia revealed that 67% of the refilled water was contaminated. In general, it cannot be assumed that PDW is fully safe. (see: Analysis of packaged drinking water use in Indonesia in the last decades: trends, socio-economic determinants, and safety aspect, Arman Nur Ikhsan; Morrin Choirunnisa Thohira; D. Daniel, 2022).

For Sariharjo no specific data on sources of drinking water consumption are available. Field observations from PolyUrbanWaters suggest that poor or lower middle-income Households consume boiled clean water for drinking. In case of problems with water quality they use water from refilled containers. Middle-class families consume mainly water from refilled containers (gallons). It is estimated that a 4 members family consumes 8-12 gallons per month. 1 gallon is sold for 18.000-20.000 IDR/each.

Clean water use in Sariharjo

No robust data on water use in Sariharjo are available yet. As the estimate for groundwater use increases from 6.799.380 m^3 to 8.237.848 m^3 in 2018 for the Naglib sub-district, this may apply to Sariharjo as well where there will be an increase in the use of groundwater as the major source for clean water.

Recent studies found that domestic water consumption in Indonesian urban areas is ranging from 89 to 244 l/c/d (mean 169 ± 44 l/c/d) and in rural areas from 34 to 194 l/c/d (mean 82 ± 45 l/c/d) (Rani et al. 2022). The utility PDAM calculates a per capita consumption of its household customers in Sariharjo as 115 l/day.

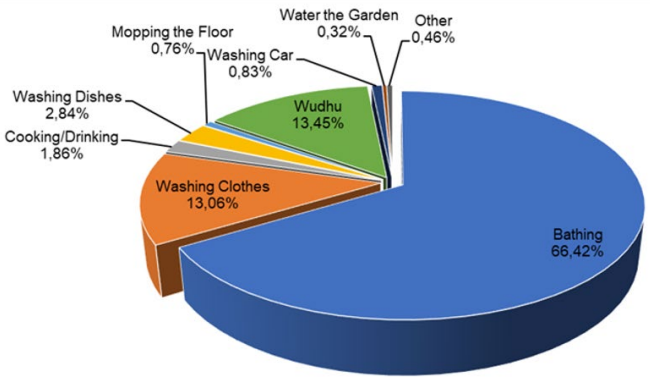


Figure 30. Clean Water Use Pattern of a "Typical" Household in Sariharjo

(Source: Modified from Syahputra, 2012)

By National Law No. 17/2019 on the Management of Water Resources, the calculated minimal need of 60 liters of clean water/person/day and in rural areas has to be covered . However, based on the law, domestic water use for.

With Sariharjo's population growth, increasing urban lifestyles, and the proliferation of commercial establishments such as hotels, restaurants, and commercial spaces, the demand for clean water and drinking water will increase dynamically.

The current clean water supply structure, which is primarily based on the use of shallow wells, cannot meet this fundamental change.

Structure of clean water provision in Sarihajro

Clean water in the village is generally supplied through three main resources:

Groundwater is by far the most important source of clean water for households and communities.

a. Almost all households from 16 sub-villages in Sariharjo own private shallow wells that have a depth between 9 and 22 meters.

b. In 2021, only 948 households out of the 5908 (17%) in Sariharjo have been connected to the waters supply system of the public utility/water operator PDAM.

c. Community-based clean water provision in Sariharjo is organized in three sub-villages; Wonorejo, Rejodani I, and Mudal.

Water supply from PDAM

PDAM intends to expand its service coverage significantly in Sleman Regency until 2025 . No figures are available for Sariharjo itself.

Table 9. Projection of Clean Drinking Water Need
(Source: PDAM, 2021)

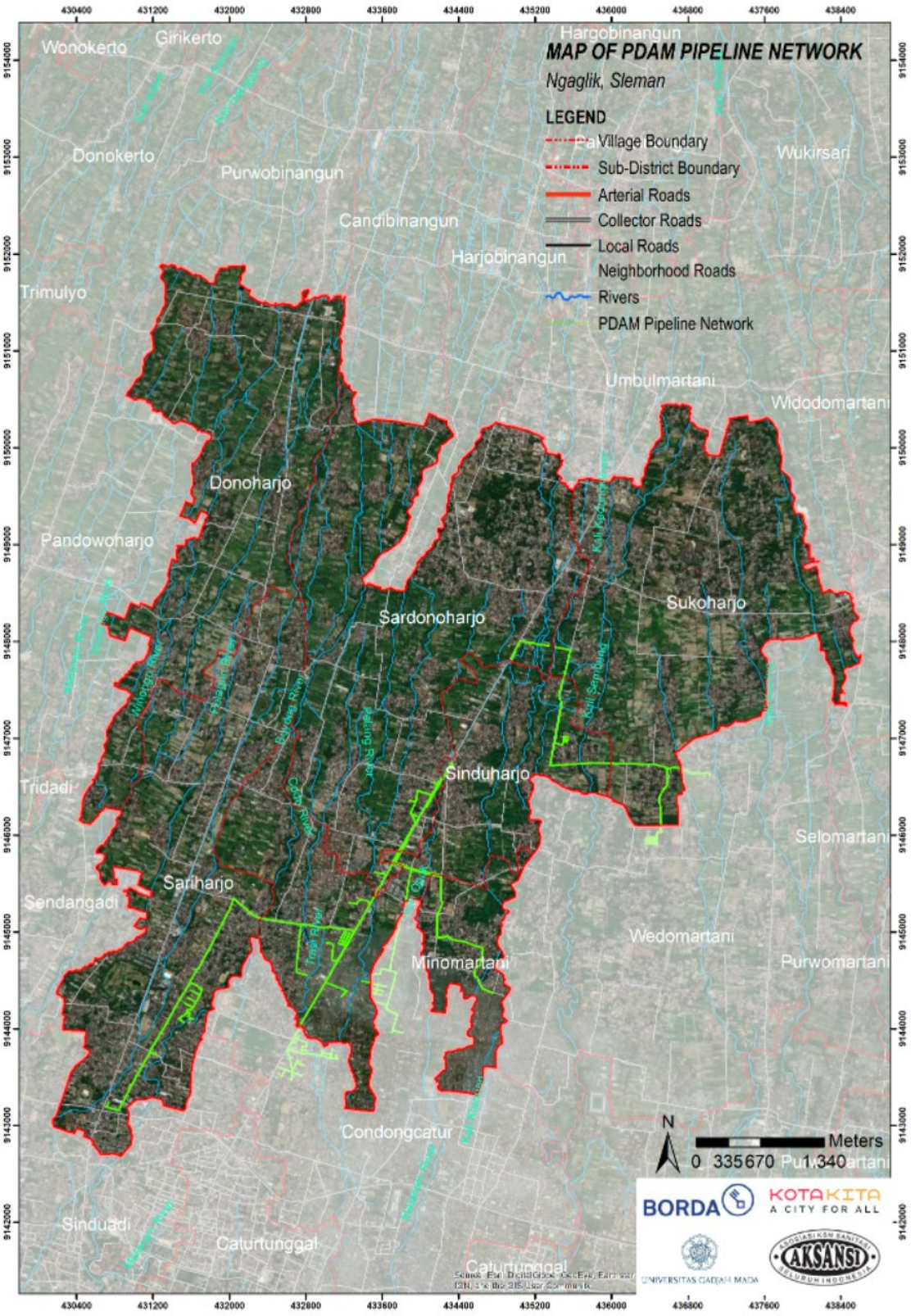
Projection of Clean (Drinking) Water Need							
Description	**Unit**	**2020**	**Target Achievement Towards 100-0-100 clean water sector**				
			2021	**2022**	**2023**	**2024**	**2025**
Number of persons served/ targeted	person	158,924	174,816	192,298	211,528	232,681	255,949
Consumption of water	l/person/ day	115	115	115	115	115	115

In Sariharjo PDAM connections are located along the main roads (Jl. Lempongsari Raya and Jl. Kranji). Supplied water is supplied to households for 3,450 IDR -4,450 IDR /m³ (PDAM data, 2022):

The PDAM services in Sariharjo are supplied from Ngaglik's deep wells, which provide clean water to the villages in Ngaglik sub-district. Water production differs significantly from water distributed in the system and from water finally metered.

Figure 31. PDAM Pipeline Network of Ngaglik

(Source: PDAM, visualized by Kota Kita)



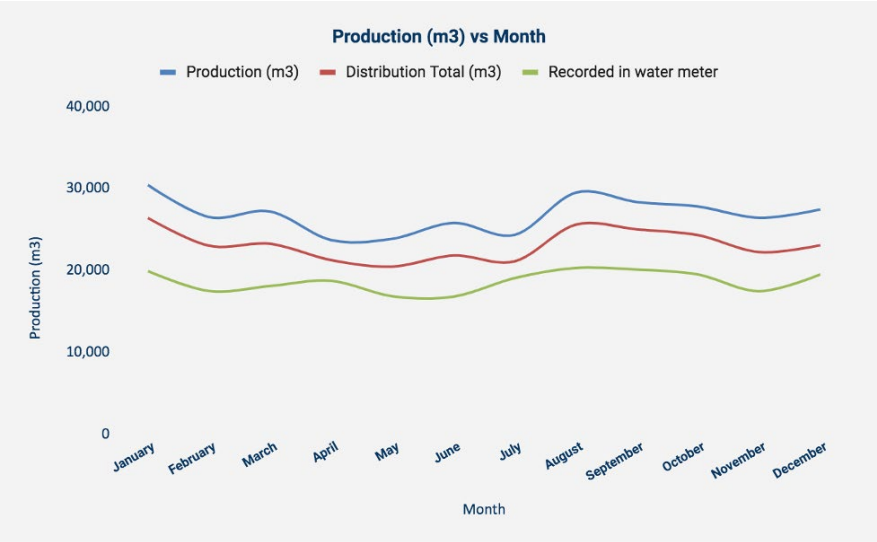


Figure 32. Water Production and Distribution of Ngaglik Deep Wells

(Source: PDAM Sleman, 2021)

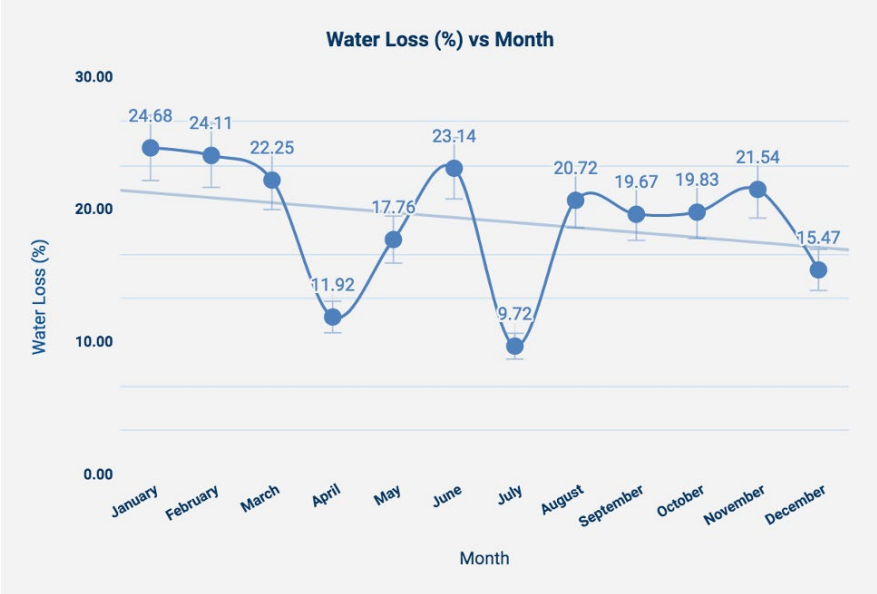


Figure 33. Water Loss per Month of Ngaglik Deep Wells

(Source: PDAM Sleman, 2021)

Technical losses and non-revenue water losses differ significantly over the year.

Though there is general agreement among decision-makers in Sleman Regency and at the village level that a rapid expansion of good quality PDAM water services is urgently needed to meet the requirements of the rapidly urbanizing Sariharjo and to respond to increasing pressure on water resources, there are major challenges:

~ The government obliges commercial units such as hotels, apartment blocks and new settlements to be connected to the PDAM-network. This regulation has to be efficiently implemented so that even commercial units refrain from using their own ground wells. Connection of homes to the PDAM-network may become progressively mandatory for private homes as well.

~ So far, most Households supply themselves with groundwater that is free of charge. Any connection to the PDAM piping system would meet significant costs, because PDAM has to operate to cover costs. Strong awareness-building measures are needed to convince households to get connected.

~ Some Communities complain that the PDAM services are not reliable, are not available seven days a week and water is often smelly and with an unpleasant color. As long as good quality services cannot be assured, households will hesitate to get connected even when the network is expanded.

~ The slow growth of the PDAM's supply network and the reluctance of users to be connected to a fee-based water supply may lead to further well drilling and pressure on the aquifers and water stress if current practices continue.

~ Apart from mitigating technical losses in the supply systems and a strict limitation of financial losses (non-revenue-water) through sound metering, increased water efficiency measures and water recycling should reduce water demand for PDAM services and overall groundwater consumption. Water harvesting structures in homes and in commercial and institutional units and practices, such as the reuse of grey water for the irrigation of green spaces, may be incentivized by the government and may become a common practice.

~ Water Safety Plans (WSP) and Sanitation Safety Plans (SSP) should be implemented in the local watersheds to protect the PDAM's water resources and the quality water services in Sariharjo. For this, effective management and operation systems have to be developed where the PDAM may have a major role to play.

Community-based clean water provisions

Community-based clean water provisions in Sariharjo cover a limited number of households and are organized by communities in three sub-villages. Due to their limited institutional capacities, they are barely in a position to be a strategic option for comprehensive water supply management in Sariharjo: PAMDUS Wonorejo's pumps groundwater to water tanks and distributes water to 105 households.

- The pipeline in Rejodani connects 40 households to spring water.
- The spring water pipeline connection in Mudal connects 22 HH.

Figure 34. PAMDUS Wonorejo's Reservoir and Pipelines

(Source: Field Survey, Kota Kita, 2021)

Water in the Town – Story 10

Mudal: A dukuh with Spring Water

In Javanese tradition, a place or location which has a spring is usually called a ‘mudal’. Apart from providing drinking water, in Javanese culture, mudals are commonly utilized for washing and bathing as well. Mudal is the only sub-village in Sariharjo where a spring is still operating today. The spring is located in a building with several shower cubicles. Urination and defecation are not allowed, because it potentially pollutes the water quality. A pump lifts water to a reservoir and distributes water to 20 households. However, the use of groundwater for irrigation, ponds and fisheries and the loss of green spaces results in a rapidly decreasing spring capacity. Effective steps for water conservation have to be undertaken to protect this ecologically and culturally valuable source of water.

(Source: PolyUrbanWaters, 2021)

F.

Wastewater treatment

Key Messages of Section

Inadequate sanitation infrastructure already has a negative impact on public health, the environment, and water resources in Sariharjo.

With the rapidly increasing use of clean water, the volume of generated wastewater will increase proportionally. To meet this challenge, not only a systematic expansion of wastewater infrastructure is required, but also the robust business models associated with sustainable operation.

The soak-pits that are still widely used today do not meet the needs of an increasingly modernizing village and the national standards.

The mandatory installation of improved septic tanks and decentralized sewerage systems may be perceived as essential elements of a step-by-step approach for progressive development of sanitary infrastructure that eventually combines decentralized and centralized solutions.

Any efficient sludge management system is dependent on fee-based regular septic tank emptyingservice. In addition to comprehensive awareness-building campaigns, consistent enforcement for this will be essential.

This may include communal gravity-managed decentralized WWT systems as far as the topographical situation allows. To ensure sustainable maintenance and operation, clarification of mandates and sustainable financing must be ensured from the outset.

Decentralized wastewater treatment can also be implemented as a cluster solution to water protection zones. Here, too, a maintenance and operation system must be ensured from the outset, and be, if necessary, under the management of the water operator and with the financial support from the public sector.

The situation of wastewater infrastructure development in Sariharjo

The following information should give a comprehensive picture of the development of wastewater and sanitation infrastructure in Sleman Regency and the related challenges:

~ In 2020, 97.73% of people living in Sleman Regency have access to sanitation, of which 20.76% have access to a toilet with a sealed septic tank or connected to a wastewater treatment plant, 77.24% of households rely on a bottomless soak pit and 1.61% have access to poor sanitation (assessment and evaluation of different data sources, includes. data from Sleman Environmental Agency).

~ 92% of the households (5.405 households) in Sariharjo still use soak pits. Improved septic tanks are not used. Therefore, fecal sludge is not safely managed.499 HH (8%) are connected to five communal water treatment plants: IPAL Dan Tirta, Wonorejo sub-village, IPAL Tirto Mili, Longkang sub-village, IPAL Tambakrejo Bersih, Tambakrejo sub-village, IPAL Randugowang, Randugowang sub-village, and IPAL Wonokerso Sehat and Tegalwaras sub-village. Monitoring data from the Department of Environment show significant removal of precipitating solids, easily degradable organic solids, hard to degrade solids, digestible solids and a mass of active bacteria. Futhermore, total coliform discharge standards are not met because of insufficient tertiary treatment where ultraviolet treatment or chlorination may be used in future.

~ Sariharjo is not connected to any centralized sewerage/wastewater treatment system.

~ The local government implemented a sealed septic tank or communal septic tank that connects between 5 and 10 households.

~ Assessments made by PolyUrbanWaters show that residents in Sariharjo:

- are unaware that domestic wastewater consists not only of black water but also of greywater that can affect the quality of groundwater in shallow wells.perceive the bottom-less soak pits as septic tanks.
- no general awareness is given that improved septic tanks should be used in order to protect their own water resources.
- have little awareness that soak pits should be regularly desludged.

~ Public investments in wastewater infrastructure have a lower priority compared to infrastructure investments, such as infiltration wells and drainage.

Governance framework and wastewater infrastructure development

Indonesia has no specific and comprehensive current wastewater management law. The most important legal instrument that governs wastewater management at the local level is Law No. 23 of 2014 on Local Government, which attributes to provincial, regency, and/or municipal administrations the responsibility to cover, on a mandatory basis, the so-called basic services that include health, public works and spatial planning. Nevertheless, the wastewater sector is highly fragmented respectively limited in its development.

Sleman Regency implements progressive regulations, such as the Environment

and Forestry Ministerial Regulation P.68/Menlhk/Setjen/Kum.1/8/2016 regarding Domestic Wastewater Quality Standards. For instance, through local regulation 04/2019 the Sleman Region specifies the regulation 2/2013 on Domestic Wastewater Management for the Special Region of Yogyakarta.

Scholars question whether the high standards defined in the Ministry of Environment and Forestry's regulations or more intermediate technical solutions may be promoted that are more appropriate to the current situation and that can follow progressive development of an effective sanitation infrastructure.

A task force was created that includes the wastewater infrastructure development sector in the housing and residential settlement sector. This task force aims to connect communities, academia, practitioners and local departments within the local government to address and provide solutions to the infrastructure related to residential areas in accordance with Decree 01/Kep.Ka.POKJAPKP/V/2022.

The Government of Sleman Regency aims to reach 100% universal access for the sanitation by 2025, with 33.50% having access to safely managed sanitation, 66.50% having access to improved sanitation and 0% accessing poor/unimproved sanitation.

The Regency of Sleman issued the obligation that new settlements have to install sealed septic tanks as stipulated in the National Standard SNI on Septic Tanks 2398-2017.

In order to improve the situation of sanitation, the Sleman Regency has supported and implemented different measures:

~ Provision of “improved” sealed septic tanks to 4,157 HH so far.

~ Every year, every district of Sleman Regency builds 1000 sealed individual septic tanks for low-income households based on the Septic Tank Grant which was part of by Public Works Ministry program.

~ Establish 170 gravity-based Communal Water Treatment Plants that serve 12,156 households (between 50 and 100 households each).

~ Two offsite wastewater treatment plant systems, namely the Berbah Subdistrict Wastewater Treatment Plant serving 583 households and the Depok Sub-district Wastewater Treatment Plant serving 96 households. A centralized sewerage system at Sewon sub-district in Bantul Regency serves 3,398 households.

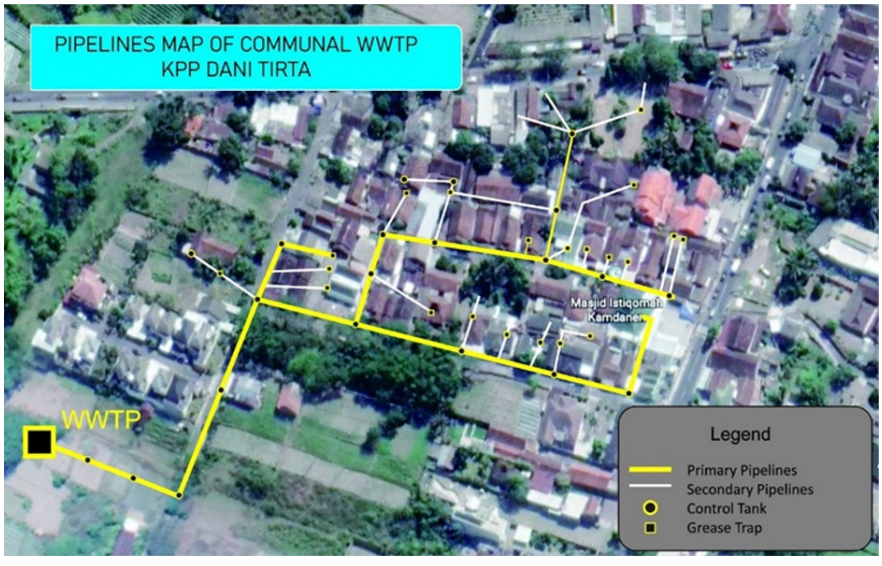


Figure 35. Communal Wastewater Treatment Plant Pipeline Network of KPP Dani Tirta

(Source: Sleman Monev book 2021 by Aksansi and DLH)

The fragmentation of institutional responsibilities and the challenges for sustainable infrastructure development are exemplified in the implementation of the municipal wastewater treatment plant:

~ Constructed by the government and built on community land, it is not well defined who is the owner of the asset

~ Among others, this has implications for costs for long term repairs and maintenance of the systems.

~ Maintenance and operation are done by the Community-Based Organizations without any financial compensation and without a well-defined legal mandate. As a result, those CBOs are not entitled to collect tariffs from households, even when they have a willingness to pay.

~ Communal wastewater treatment plants need robust operation schemes that may be framed by public utilities for sustainable effectiveness. Technical and organizational capacities of CBOs differ significantly having in some cases negative impacts on the technical performance.

Fecal sludge management

One Fecal Sludge Management (FSM) facility exists in Madurejo village, Prambanan District, which covers Eastern and Central Sleman. Treatment capacity is 25 m^3/day, equivalent to treating sludge generated by 12,500 households or 50,000 people. The daily operations are managed by the Department of Environment's wastewater division. FSM operators understand that the capacity of the plant should be 100 m^3/day to realize the upcoming market potential for FSM treatment.

Figure 36. Fecal Sludge Management (FSM) facility in Madurejo Village

(Source: Local team survey, 2019)

Water in the Town – Story 11

IPAL Komunal: Communal Wastewater Treatment Plant as an Integral Part of Integrated Community Development

The community based organisation Tirto Mili was established in 2016. A communal wastewater treatment plant with an investment volume of 400 million IDR was built under the nationwide SANIMAS scheme that connects 100 households. Due to strong leadership and effective operations, they aim to extend the services to 400 households by using joint community funds and KOTAKU funds. Entitled to use Village Treasury Land, a community garden was developed where more than 20 varieties of perennial crops and fruits are cultivated and partly sold to restaurants. It is planned to use the effluent from the treatment plant for aquaculture activities implemented by a fishery community group.

(Source: Aksansi's Aerial photography of CBO Tirto Mili)

G. Solid waste and hazardous waste management

Key Messages of Section

The current performance of the solid waste management sector only meets to a very limited extent the good management standards required by Indonesia's legislation. Threats to public health and the environment are acknowledged by the Government of Sleman Regency and governance structures in Sariharjo. Already, the disposal capacities at the landfills are exhausted. Solid waste pollution is increasingly visible along riverbanks, in public places, and on agricultural land, etc.

In future, residents, commercial and institutional facilities in Sariharjo will generate significantly larger volumes of solid waste as the population grows. In addition, the consumption habits of an increasingly urbanized population will generate new qualities of solid waste (e.g. composites, hazardous waste, etc.).

Improved regulation and new conceptual approaches to solid waste management, such as the 3R approach (reduce-recycle-reuse), have so far been only partially successful in restructuring the sector, which has grown organically over decades.

The sector continues to be characterized by a high degree of fragmentation between state actors, private service providers and scavengers, insufficiently defined and implemented standard procedures and a low level of awareness of the need for waste separation.

An efficient waste management system requires standard operational procedures adapted to the conditions of Sariharjo, which define in detail the tasks and duties of the actors active in the sector. The development and implementation of these procedures must be supported by appropriate capacity building activities and incentive schemes.

Waste separation at source respectively at the household level is key for successful implementation of the 3R-approach. Therefore, comprehensive awareness-campaigns at village, sub-village and household level should be conducted.

Organic waste in particular should be separated and treated by an efficient composting system. For this purpose, a financing system should be developed and implemented accordingly, which realistically estimates the market potential of generated compost.

In accordance with Sleman Regency Regulation 9/2018, a tariff system binding on all service providers should be introduced.

In the future, effective waste management will only be possible through extensive standardization and corresponding capacities.

In the short term, a strategic plan should be developed and implemented to enable the successive establishment of such a system. For example, models could be developed in selected sub-villages to test target group-oriented awareness and capacity building measures, standard procedures, new tariff systems and new technologies for later dissemination throughout the village.

There is an urgent need to develop and implement the safe collection and disposal of hazardous waste, such as batteries, chemicals, and medical items. Currently, there is little or no awareness among communities about the dangers of hazardous waste and the need for its management. Facilities for the safe management of hazardous waste do not exist.

The current waste management situation in Sariharjo

Indonesia as a whole is faced with a dynamically developing volume of waste. This development reflects the transformation of an emerging economy into a consumer society. These waste volumes are confronted with insufficient management capacities, which manifest themselves in the pollution of landscapes and an increasingly urgent overstretch of the existing waste dumps with their associated hygiene problems, the pollution of groundwater and the generation of significant amounts of Green House Gas emissions. Between 2012 and 2017, the Sleman Regency recorded a strong increase in solid waste generation.

In Depok and Ngaglik sub-districts daily solid waste generation per capita is 0.315 kg (Prima et. all 2018). The waste composition is organic waste = 45%, plastic = 18%, paper = 15%, polymers materials, such as diaper = 7%, glass = 6%, clothing waste = 4 %, hazardous and toxic materials (B3) = 3% and metal = 2%. Per capita generation of hazardous solid waste (batteries, electronic materials, pesticides, bleach, aerosol, unused medicines, contaminated masks, thermometers, etc.) in Sleman Regency is 2.44 gr or approximately 0.49% of domestic waste (Iswanto et. al., 2016).

Solid and hazardous waste generation in Sleman Regency, including Sariharjo, is already a serious threat to public health and the environment . It will increase significantly with population growth and new urban lifestyles that will generate high quantities and new qualities of waste in the future.

Table 10. Total weight of waste each year (2012-2016)
(Source: TPST Piyungan)

No	Waste producing area	Total weight of waste each year (Kg)				
		2012	2013	2014	2015	2016
1	Yogyakarta Municipality Government	71,316,347	64,286,172	53,222,836	51,867,590	65,278,911
2	Sleman Regency Government	41,715,669	43,824,419	40,357,808	48,146,670	55,020,910
3	Bantul Regency Government	13,668,456	15,880,509	15,522,800	17,241,210	21,335,040
4	Yogyakarta Municipality Non-Government	677,063	13,553,969	18,323,719	22,723,512	11,013,872
5	Sleman Regency Non-Government	2,110,080	5,249,530	7,155,015	5,708,855	3,664,115
6	Bantul Regency Non-Government	1,338,080	5,016,450	4,646,915	3,226,260	932,975
Total		**130,825,695**	**147,811,049**	**139,229,093**	**148,914,097**	**157,245,823**

A strong visual indicator of the urgent need to address the solid waste challenges is the exhaustion of the nearby Piyungan TPA landfill, resulting in the increasing pollution of open spaces, such as river banks, vacant lots, sand blockages of drainage systems and the still widespread practice of burning waste. Waste is one of the serious problems that faces Sleman Regency because of the public health and environmental problems caused by landfills, their capacity needs for a large aream and the emission of Greenhouse-Gases.

In Sleman waste management is under the authority of the Department of Environment through the waste management division. The infrastructure provided by the Department of Environment, such as waste disposal sites, loading transportation, and sorting and processing technology. Under control of the Department, 33% of the solid waste is disposed of at the Piyungan TPA and 15% is processed by the TPS3R and the Waste Bank. 52% of solid waste that is still not managed under government control, is managed by the community itself or is disposed of illegally. Separated solid waste at source, i.e. at the household level, is not a common practice in Indonesia.

Every morning, residents dispose of unsorted waste in front of their house in a trash can, later collected by a private waste service and transported to the nearest Temporary Disposal Site/TPS garbage depot. There, public servants execute simple sorting of valuable waste that can be sold, such as metal, paper, glass, and plastic. Some private waste services do sort before disposal at the TPS. As elsewhere in Indonesia, the informal sector (scavengers) has a strong stake in the sector of waste management in Sariharjo.

Currently, 28 private waste services operate in Sariharjo charging households between 40,000 and 50,000 IDR /month for households and between 300,000 and 500,000 IDR for commercial interests. The private waste services pay. 35,000 IDR /m³ to the Department of Environment for waste disposed at the TPS .

Figure 37. Conventional Waste Management System in Sleman Regency and Sariharjo

(Source: PolyUrbanWaters, 2021)

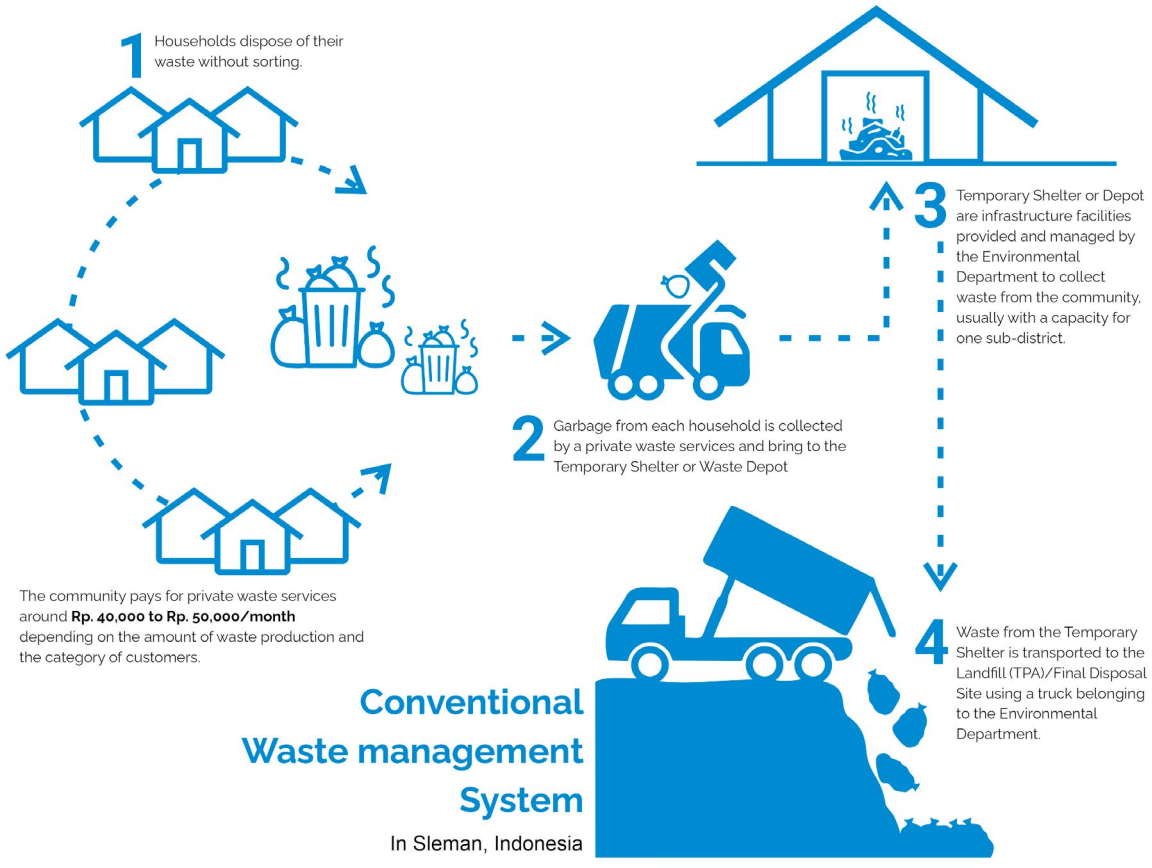


Figure 38. Temporary Disposal Site in Sariharjo (Covers the Ngaglik District)

(Source: Field Survey, 2021)

Strategies to address the challenges of effective solid waste management

The National Law No. 18/2008 on Waste Management intends to change the paradigm of waste management away from an end-of-pipe understanding where the generated waste ends up at a final disposal site (TPA). By reducing, reusing and recycling (3R), the quantities of waste finally disposed are being reduced and, therefore, the pressure on the environment and land can be mitigated. Starting at the community level with higher awareness of the potential for recycling and the need for waste separation, the whole waste stream is supposed to make use of 3R practices and appropriate/advanced technologies.

The municipal government is legally responsible for the management (i.e. waste collection and disposal). As per Sleman Regent Regulation No. 80 of 106 concerning Position, Organizational Structure, Duties and Functions, and Work Procedures of the Environmental Service, waste management is one of the duties and functions . A Waste Technical Service Unit UPT has the task of carrying out operational technical activities and supporting technical activities, especially in operational activities related to the facilitation of solid waste services in the Sleman Regency area (RENSTRA DLH 2017-2022, Technical Service Unit).

Waste management falls under the responsibility of the Environmental Departments that has a budget to provide solid waste infrastructure (Temporary Waste Disposal (TPS)) and to ensure services, such as transporting waste from settlements to landfills.

Currently there are several programs in Sariharjo to address the challenges for effective solid waste management in Sleman Regency. Policies have been formulated as a legal basis to sove waste problems in Sleman. In addition, the government also issued a circular to reduce the use of plastics in the Sleman district government.

In Sleman (incl. Sariharjo), there are comprehensive efforts to implement Indonesian Law No. 18/2008 on Waste Management. In this, waste management is defined as a systematic, comprehensive, and sustainable activity that includes waste reduction and handling. Though there are multiple technical, institutional, financial and governance challenges and inefficiencies, Sleman Regency aims to establish and implement the following waste management scheme.

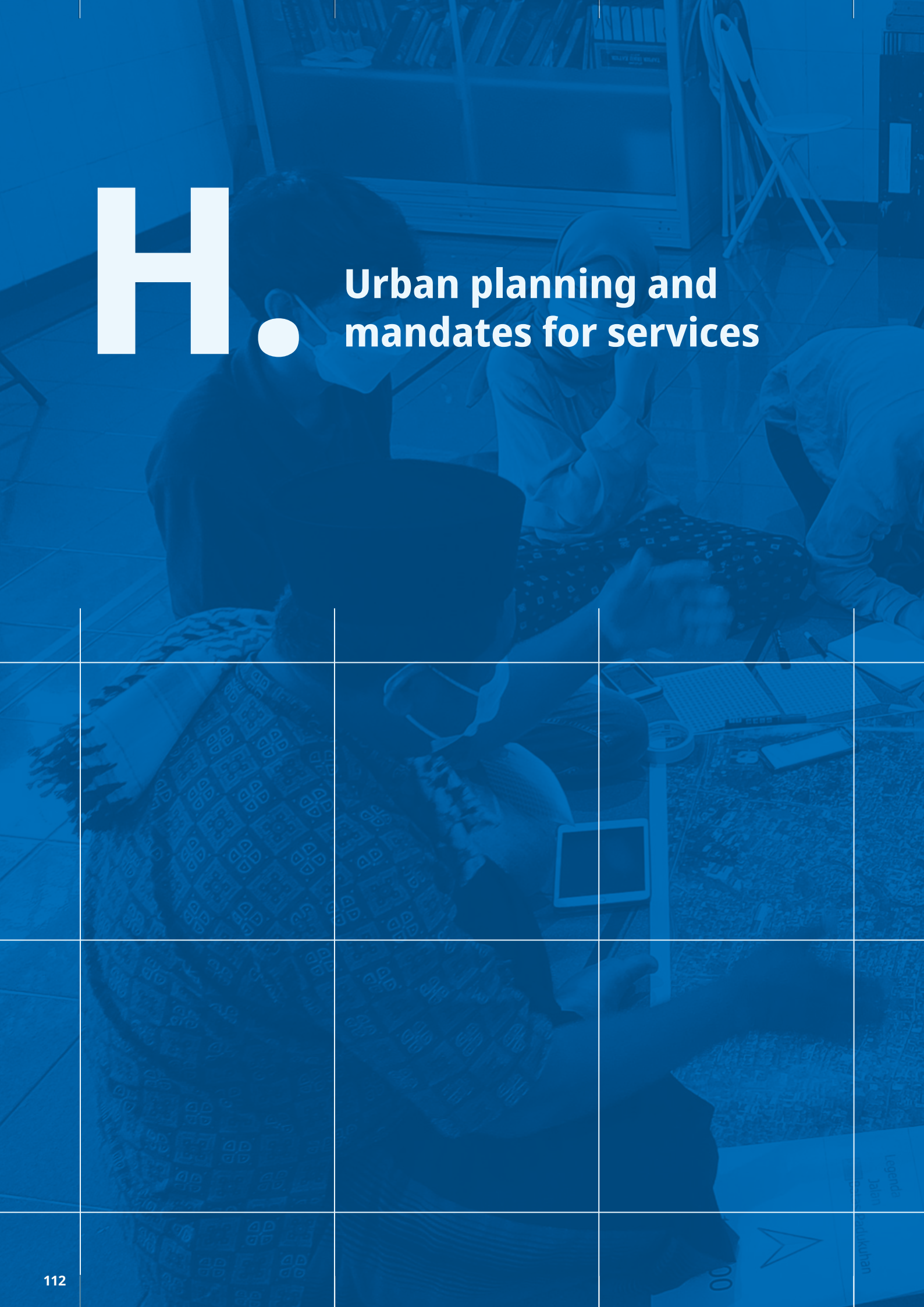
No	Description
Solid Waste Collection Management	
1	The following agencies are responsible for waste collection: LPSM (Lembaga Pengelola Sampah Mandiri/ Independent Solid Waste Management Agency), producers, PJPS (Penyedia Jasa Pengelolaan Sampah/Waste Management Service Provider), and Local Government
2	Solid waste collection is sent to TPS (Tempat Penampungan Sementara/Temporary Waste Storage), TPS 3R (Tempat Pengolahan Sampah dengan prinsip 3R/Solid Waste Treatment Site with 3R principles), and TPST (Tempat Pengolahan Sampah Terpadu/Integrated Solid Waste Treatment Site) into TPA (Tempat Pembuangan Akhir/Final Dump Site) from its sources, while maintaining waste separation according to its type.
3	LPSM, producers, and PJPS has the obligation to provide TPS, TPS 3R, TPST and/or waste separator equipment in their respective area of responsibility.
4	Local Government has the obligation to provides transfer depo and/or transfer station, TPS, TPS 3R, TPST at public facilities, social facilities and in the area which managed by LPSM.
Solid Waste Transportation Mechanism	
1	Domestic solid waste transportation to depo and/or transfer station, TPS/TPS 3R/TPST become the responsibility of LPSM
2	Solid waste transportation from transfer depo and/or to transfer station, TPS/TPS 3R/TPST managed by LPSM to TPA are the responsibility of Local Government Agency
3	The transportation of solid waste in the area managed by producer of PJPS from its sources to transfer depo and/or transfer station becomes the responsibility of producer or PJPS
4	Local government agency manages solid waste transportation: a. at public facilities from the sources, transfer depo and/or transfer station, TPS/TPS 3R/TPST into TPA b. aside from public facilities, solid waste is transported from transfer depo and/or transfer station, TPS/TPS 3R/TPST up to TPA.

Table 11. Waste management scheme in Sleman Regency

(Source: Sleman Regency Regulation Number 4/2015 concerning Domestic Solid Waste Management and Solid Waste Similar to Domestic Solid Waste)

Waste Banks initiative managed by communities

The waste banks managed by communities are primarily aimed at separating recyclables from the total waste at source and commercializing them. Households can separate these wastes from household waste and bring them to a so-called waste bank The countervalue is credited to a credit book or paid out in kind or in grocery goods. This system is also intended to encourage community members to separate their waste at source. The system has been stopped for the time being due to management problems, which have been aggravated by COVID19.



H. Urban planning and mandates for services

Key Messages of Section

According Indonesia's regulatory framework, public entities have a strong mandate to determine urban planning and its implementation.

Historically, communities have had a strong role in developing their territories and to manage their assets through community organisations. In fact, due to rapid urban development and changing socio-economic structures, the stake of communities especially in peri-urban areas is increasingly weakened.

In many places, the private sector vested interests dominate urban development often not following urban development guidelines.

With Law No. 6/2014 the role, mandate and position of villages and sub-villages is strengthened. There are well defined planning and budget procedures that give communities a strong mandate in village development.

Due to weak capacities and inconsistencies in administrative procedures, in practice the role of communities in village development is very limited.

Until today, communities play an important role in the (informal) management of blue-green infrastructure and therefore play an important role in the development of a water sensitive village. Though no comprehensive role as service providers for water-related basic-needs services, such as water supply and sanitation, can be expected, the participation of communities in village planning in respect of the use of Village Treasury Land and for awareness building at the household level for effective sanitation, water supply, wastewater management and sustainable management of green open spaces is crucial.

Consistent leadership on village- and sub-village level is needed in regard the mandate, capacities and interests of local communities, and this includes the allocation of sufficient funds for the implementation and maintenance of measures for water sensitive development.

In recent years, a comprehensive legislative framework has been created to improve women's active participation in decision-making processes, including at the village level. This still needs to be implemented. To this end, women should be strongly represented at the technical-administrative level. Both are essential, not least for anchoring water sensitive transformation at the community level and identifying realistic utilization concepts for green-blue infrastructure development.

Mandates for services provision

In Indonesia, government agencies have a strong mandate for urban planning. The government's role in the planning process is defined in laws and regulations for urban development concerning land use, infrastructure development, economic activities, and water management. Urban planning is implemented by agencies and institutions at the central, provincial, and regency/city level.

A high degree of fragmentation between concerned public entities, limited capacities and low enforcement tend to make urban planning effective to only a limited extent. In developing and providing basic infrastructure, government entities have a strong role to play but are not always very effective at implementation. In many places, many real estate market players dominate the development of residential and commercial areas without following urban planning guidelines. Therefore, these developments are primarily driven by vested economic interests without or with little consideration for public welfare, including social and ecological aspects.

In the case of Sariharjo, for at least ten hotels with star ratings and more than 30 restaurants have been built without significant influence from government agencies. Some of the investments in this village are even suspected not to follow the existing spatial planning already enacted, including building permits. The role of local communities at the village and sub-village levels is weak and passive, in some cases they are victimized by such market forces. Largely, despite the new regulatory framework of National Law No. 6/2014, village and sub-village government often are not in the position to influence significantly the urban transformation due to vested interests and limited capacities. Villages have two major documents that indicate the urban development direction. The Village Medium-term Development Plan is a planning document for a six-year period. This document should be determined by a Village Regulation and should be the only village planning document. Both Village Medium-term Development Plan and Village Annual Work Plan are the guidelines for proposing the Village Budget and Expenditure, as regulated officially by the government. The village government must inform village members about the implementation of the development plan, the budget and expenditure through the public information services and reporting in Village Consultative Meetings.

Figure 39. RPJM Desa and RKP Desa Planning Process

(Source: Regulations of the Ministry of Home Affairs Number 114 of 2014 concerning Village Development Guidelines, article 7 and article 30)

The Village Government prepares the Village Development planning in accordance with the authority with respect to the development planning of the regency/city. According to the regulations of the Ministry of Villages, Development of Disadvantaged Regions, and Transmigration, No. 21/2020 concerns the General Guidelines for Village Development and Village Community Empowerment with village development also aiming at accelerating the achievements toward the SDGs' goals. The implementation of the village development plan is done by the village government, involving the entire village community. The implementation process could be facilitated by a) official entities of the regency/city that carry out government affairs in regard community development, b) a professional village facilitator, c) village community empowerment cadres, and/or d) third parties.

According to the Law No. 6/2014 concerning village budgets and expenditures, sources of village budget comprise the following:

a. The village owned revenue from operations, results of assets, self-help and participation, mutual aid, and other village revenues.

b. Allocation of the State Budget.

c. Part of the local taxes and levies of the regency/city.

d. Allocation of village funds that shall be part of the equalization funds received by the regency/city.

e. Financial assistance from the Provincial Budget and Regency/City Budget.

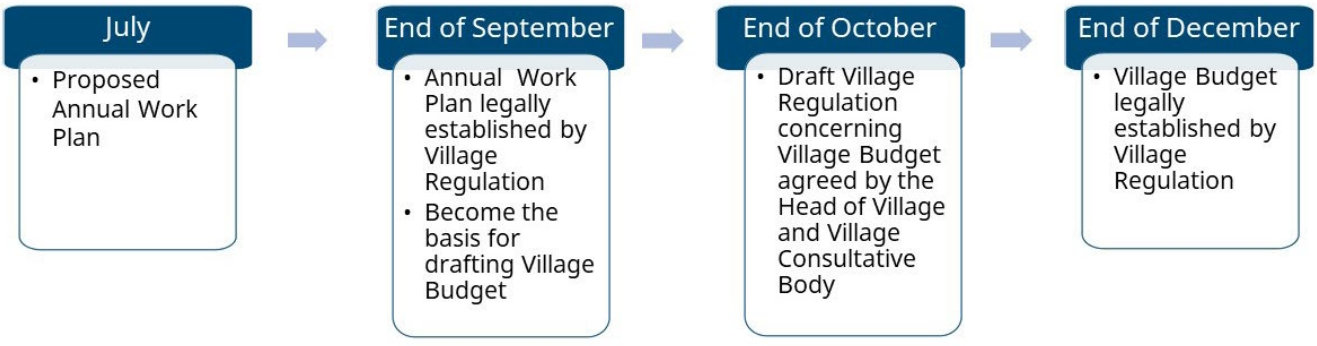
f. Grants and donations shall not be binding on third parties.

g. Other legitimate village revenue.

The budget implementation at village level is set for a one year budget period, starting on January 1st and ending on December 31st of the same year.

Figure 40. Time Allocation for Village Planning and Budgeting

(Source: Government Regulation No. 43/2014 concerning Implementation of Law No. 6/2014 concerning village planning and budgeting)



Village governance

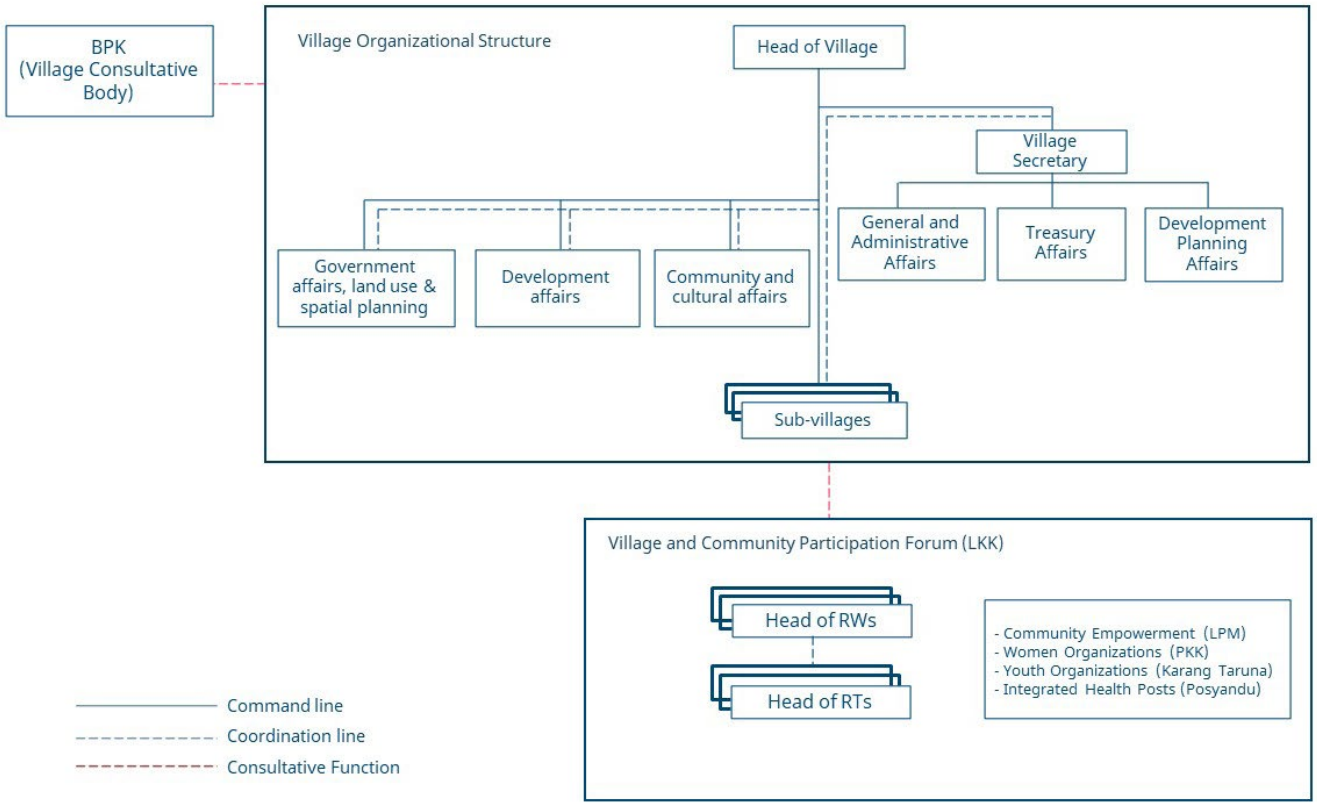
In Sleman Regency:

~ The village government is structured with a Village Consultative Body (BPK), Village Community Participation Organizations (LKK), sub-villages, RW (neighborhood associations) and RT (community associations). Each village has a village consultative body (BPK), that conducts administrative functions with its members acting as representatives of the village members.

~ Heads of sub-villages work closely with the heads of the RWs and RTs to communicate and coordinate any activities occurring in their areas. Village community participation organizations (LKK) work as the village government's partner in development planning and implementation as well as improving public services.

Figure 41. Village Organization Structure and Related Organizations

(Source: Sleman Regent Regulation No. 2.9/2020 and Sleman Regent Regulation No. 44.2/2020, modified)



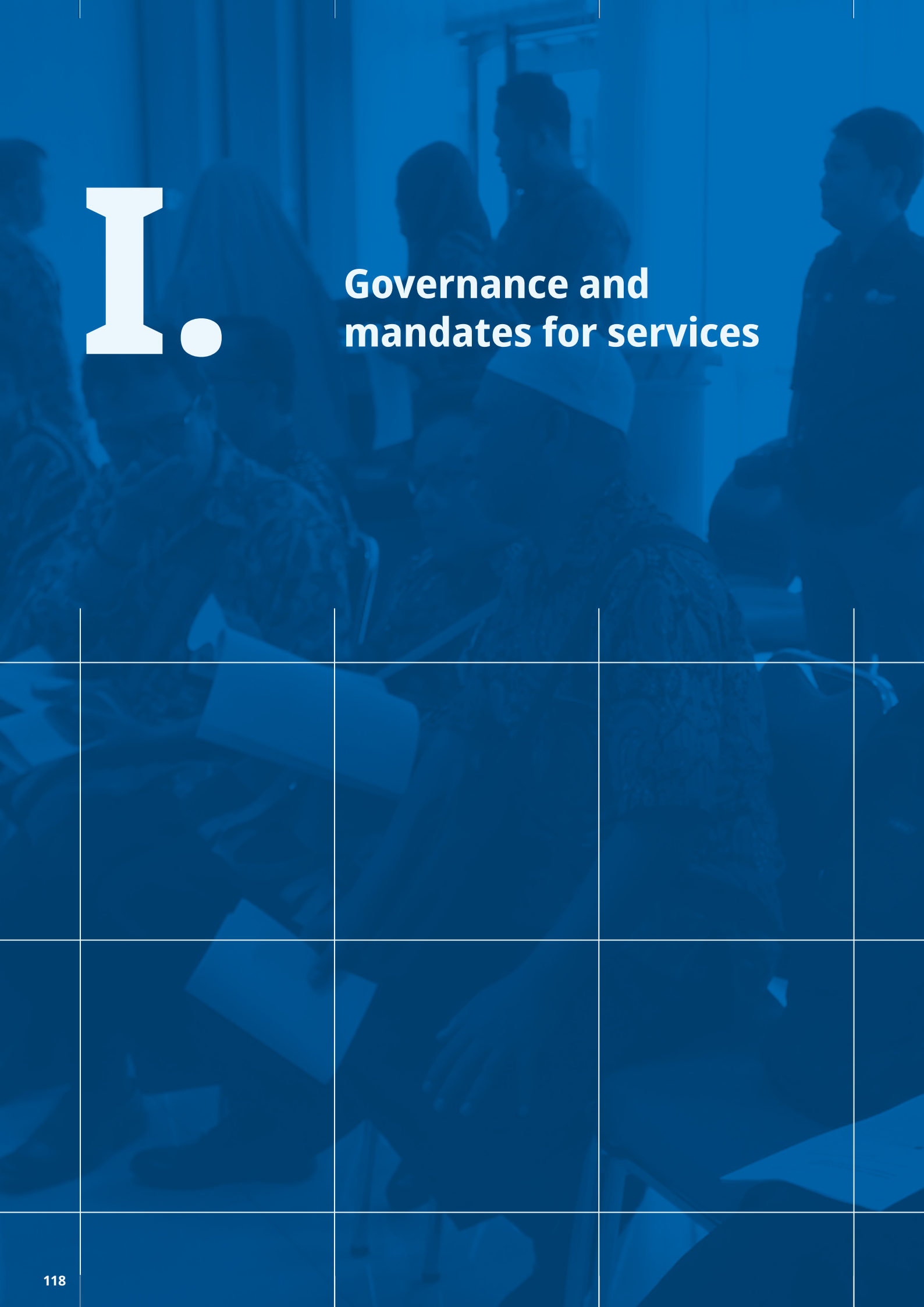
The community involvement takes place through stakeholders' participation in the Village Development Plan Consultative Meeting (Musyawarah Perencanaan Pembangunan Desa or Musrenbang Desa). The community is represented by village officials, BPK, and representatives of the community members. The meeting decides priorities, programs, activities, and the need for village development (whether this will be funded through village budget, village community, and/or regency/city budget). Once the stakeholders in the meeting have reached an agreement, the result is stated in an Official Document, which will become the RPJM Desa and RKP Desa.

Historically, Indonesian communities have had a long tradition within the context of community development. Indonesian communities have or had traditions, strength, and capacity to manage effectively their developments in terms of

social, economic, and environmental dimensions. Organized in various community institutions, they work in many fields of agriculture, water management, solid waste and wastewater management, and other social issues. However, in many places, in the course of urban and socio-economic transformations, the capacities of communities are progressively weakened.

Today there are communities' organizations at sub-villages such as the RWs and RTs that operate as farmer groups, water user groups, cattle farmer groups, petty traders groups, waste management groups, women's groups, and youth groups.

Development processes tend to focus on formal processes/procedures, as such, community's interests are often neglected. At the same time, local communities need to improve the capacity and skills for them to be able to be involved actively in the development process, and not become victims of the development process.



I.

Governance and mandates for services

Mandates for urban water systems

In Indonesia, the urban water cycle, including clean water sources, wastewater, drainage, and stormwater as well as solid waste, is managed by different institutions and different levels of government. Each institution has different regulations. Limited coordination between government entities from the national and provincial to the city/regency levels potentially leads to a fragmentation of the water management structure.

At the national level, for instance, several line ministries work on clean water sectors, including the Coordination Ministry of Economics, National Planning Agency, Ministry of Public Works and Housing, Ministry of Environment and Forestry, Ministry of Health, and Ministry of Home Affairs. Each of these actors have different specific roles and functions. The same fragmentation applies to the city level where government entities have different tasks and responsibilities in managing the water. Significantly improved coordination is one of the key elements for improving water governance in Indonesia.

According to Law No. 17/2019, water resources in Indonesia have to be used for the greatest prosperity of the people. Article 64 of the Law states that Water Resources Management emphasises cross-sectoral and cross-regional interests that require integrated actions to maintain the continuity of the functions and benefits of water and the water resources. Respective key roles of government at central, provincial, and city/regency level are described in Article 9 paragraph (1).

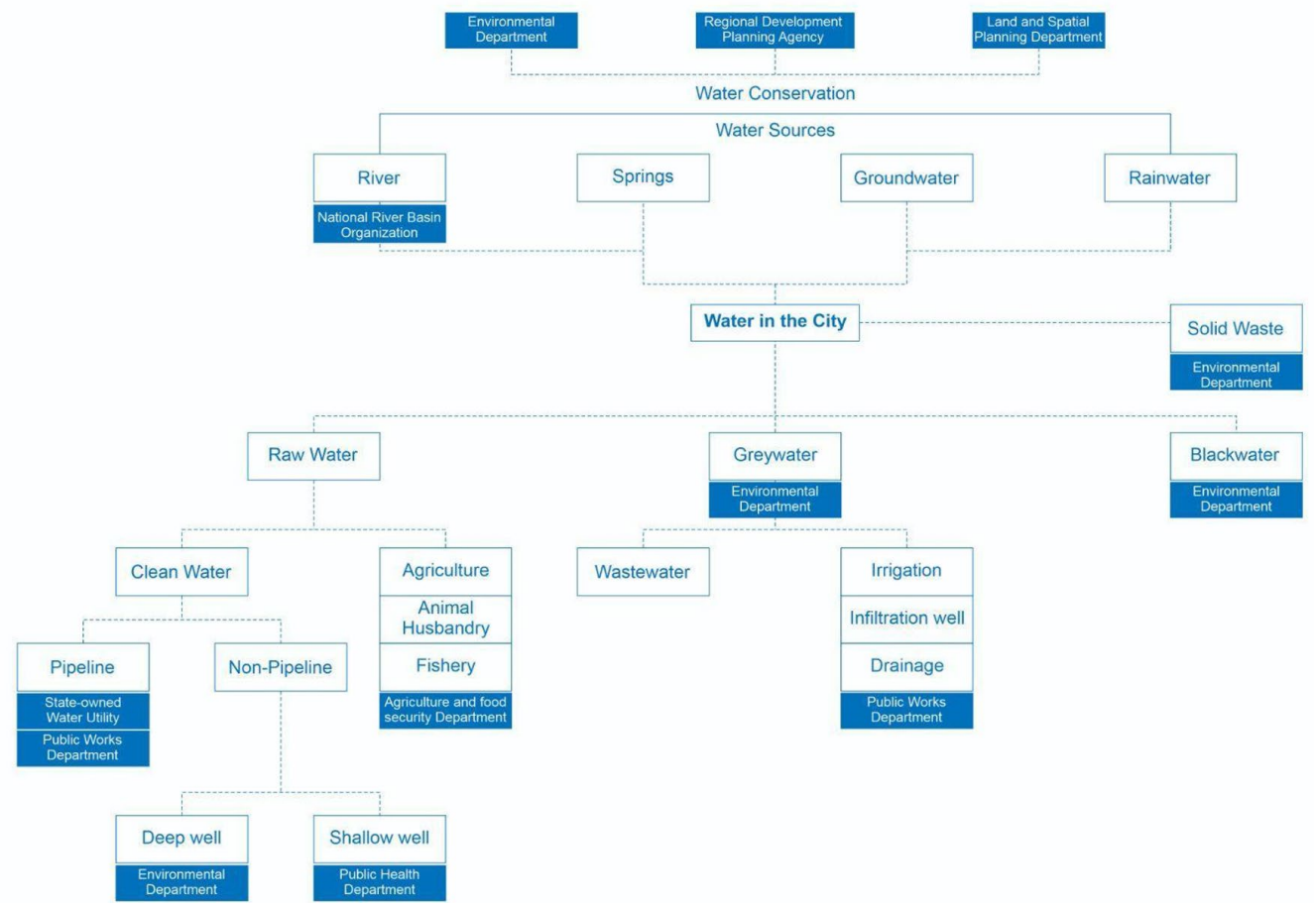


Figure 42. Roles of Government at National, Provincial, and City/Regency Level

(Source: PolyUrbanWaters, 2022)

The stakeholder mapping below discloses the power and interest in water resource management of each involved party from Yogyakarta Province, Sleman Regency, to the village government level-

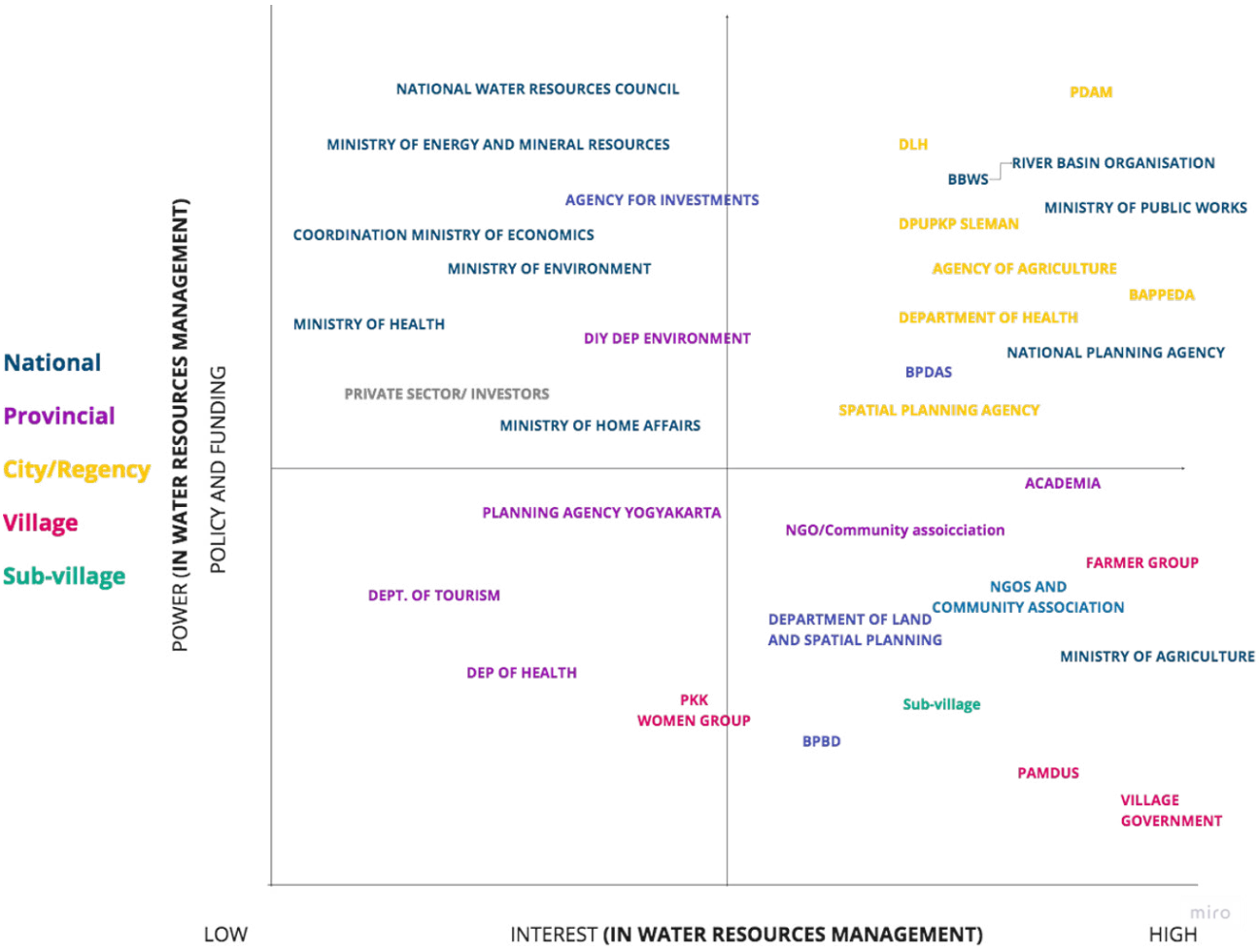


Figure 43. Water Resources Management Stakeholders in Indonesia

(Source: PolyUrbanWaters Team, 2022)

Powerful institutions highly interested in the management of water resources are located in quadrant I (right above), while those with a low interest and low capacity and power are located in quadrant III (below left). The power, financial capacity, and interests determine the institutions' location. The map shows that the local government (provincial - city level) basically has a high interest but they lack the financial capacity, especially when it comes to providing difficult infrastructure with high maintenance and development costs. While the community and CBOs have high interest, they have little influential power and have low capacity.

Water resource management at village level

Law No. 17/2019 regarding Water Resources regulates the water resources at national, provincial and city/regency levels and also mandates to the village government level to:

a. assist the national and regional (provincial and regency) governments to manage water resources in the village area;

b. encourage community participation in water resources management at the village level;

c. participate in maintaining the effectiveness, efficiency and quality of the implementation of water resources management;

d. assist the regency government in providing daily minimum basic water needs for the villagers.

There is a potential for decentralization of urban water management at the village level through community-based water management. Community-based organizations, well known as Kelompok Swadaya Masyarakat (KSM), has been organizing the provision of clean water and sanitation at the village areas, including Sleman and in Sariharjo Village.

Aside from the water management used for domestic needs, the government is also prioritizing the agricultural rights of communities. In Sleman Regency, the mandates for the irrigation water management are regulated through Regent Regulation No. 74/2016 regarding Task and Function of the Agriculture, Food, and Fisheries Department related to water, including fostering and developing land use and the crop water as well as crop irrigation. The irrigation water systems and management also involve the village government as per the following division of authority:

Table 12. Roles of Village Governance in Irrigation Water Systems

(Source: Regent Regulation No. 74/2016)

No	Institution	Scope of Works
1	Agriculture, Food, and Fisheries Department Section for Food Crops Infrastructure and Facilities	• Mentoring and development of land use and water crop use • Mentoring and development of crop irrigation
2	Village Government	Small scale agriculture infrastructure construction, such as irrigation channels

Women's participation in village governance

SDG 5 'Gender equality' with the objective to achieve gender equality and empower all women and girls is also an integral part of SDG 6 and SDG 11. Since the Republic of Indonesia's Presidential Instruction (Inpres) No. 9/2000 on Gender Mainstreaming in National Development was published, all ministries, institutions, and local governments have been required to adopt gender equality. The RPJMN II (2010–2014) Gender Equality and Women's Empowerment became inherent to the Medium-Term Development Plans. In 2012, a National Strategy for the Acceleration of Gender Mainstreaming through Planning and Gender Responsive Budgeting (NPPRG) was introduced to speed up the implementation of gender mainstreaming. The significance of gender equality and women's empowerment in village development and governance is stated in Law No. 6/2014 on Villages. Government Regulation (PP) No. 43/2014 Article 121 Paragraph 1 (as an implementation rule of Law No. 6/2014) states that the implementation of village development activities is determined by considering gender justice as well as the Inter-Village Cooperation Agency must consider gender representation and justice in the membership composition of village community leaders. (Siscawati et al. 2020)

However, the number of women in politics and governance is still low despite there being no legal restrictions on it. Although a quota was imposed requiring

women to make up 30% of political candidates, regarded as the minimum necessary for women to seriously engage in politics, available data and discussions in Sariharjo suggest that women have had little involvement in decision-making processes for water infrastructure development for water infrastructure development and water governance. In other words, little progress has been made in implementing the legal requirements. Women are likewise underrepresented at national and regional levels, as well as in technical administrative structures (Hoxha 2022).

This not only indicates a lack of participation in political/technical decision-making processes, but it also overlooks women's particular experience perspectives and capabilities. For example, women have specific experience not only in water management at the household and community levels (hygiene, effective water use, etc.), but also in the management of blue and green infrastructures in the village economy and in agriculture. Engaging such capabilities for infrastructure development, and in terms of behavioural changes, it is essential for a sustainable water sensitive transformation (Hoxha 2022).

This also applies to an increasing transformation towards an urban-based social structure. Women often have different perceptions of the design of water sensitive green spaces, which is essential for the development and implementation of sustainable use concepts for the benefit of the communities. Accordingly, while the participation of women in decision-making processes should be ensured, this also applies to their strong presence in the technical-administrative apparatus or decision-making bodies.

Community involvement related to agriculture

As mandated in the Agriculture Ministerial Regulation No. 67/PERMENTAN/SM/050/12/2016 regarding Farmer Institutional Guidance, the government establishes a farmer organization, usually called Kelompok Tani (POKTAN). POKTAN is an association of farmers and planters established by farmers based on common interest, common social, economic, and resources environment, common commodity, and solidarity. This association's objective is to increase and develop businesses owned by the members. One of the issues that they have to collectively manage is water distribution for agriculture and fisheries. Their responsibilities include:

~ utilization of irrigation water to support agriculture activities;

~ maintenance and protection of infrastructure;

~ conducting planning based on community needs and contribute to the aspirations of the village government.

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Annexes
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Annex I.
Population Number and Population Density in Comparison to Other Villages in Ngaglik Sub-district in 2020

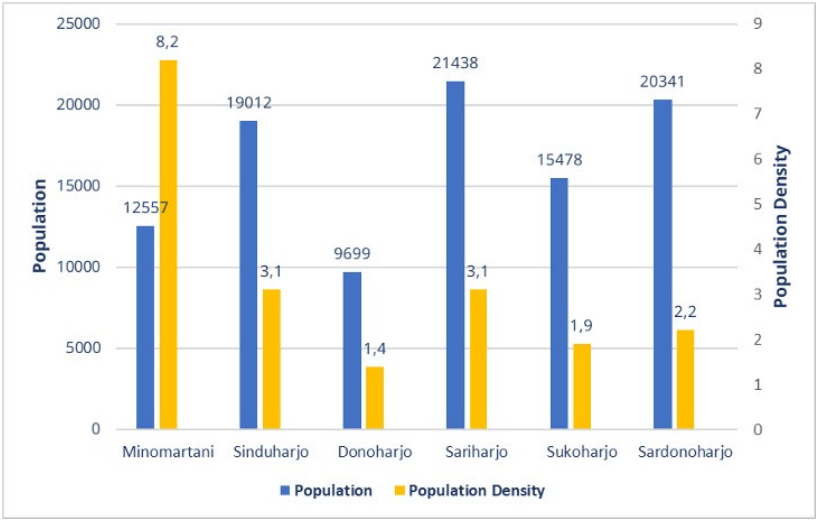


Figure 44. Population number and density comparision in Ngaglik sub-district in 2020

(Source: https://kependudukan.jogjaprov.go.id/ and Ngaglik Subdistrict in Figures, 2021)

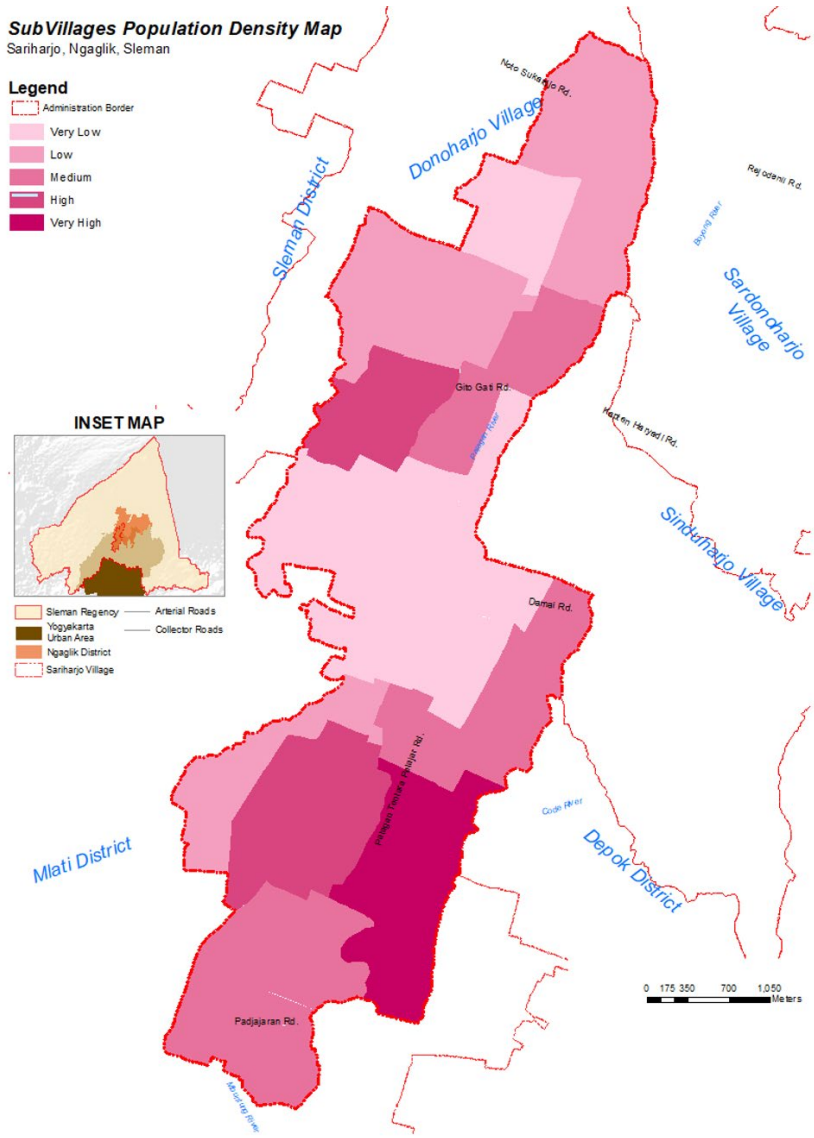


Figure 45. Population Density in Sub-villages

(Source: After MURP UGM, 2021)

There are 16 sub-villages (smaller administrative areas under the village) in Sariharjo Village. According to Sleman's Regent Decree No. 62.5/Kep. KDH/A/2020, names of sub-villages in Sariharjo Village are as follows:

1. Rejodani I
2. Rejodani II
3. Ngetiran
4. Wonorejo
5. Tegalrejo
6. Tambakrejo
7. Tegalweru
8. Randugowang
9. Karangmloko
10. Mudal
11. Sumberan
12. Nglempongsari
13. Tegalwaras
14. Sedan
15. Jongkang
16. Nandan

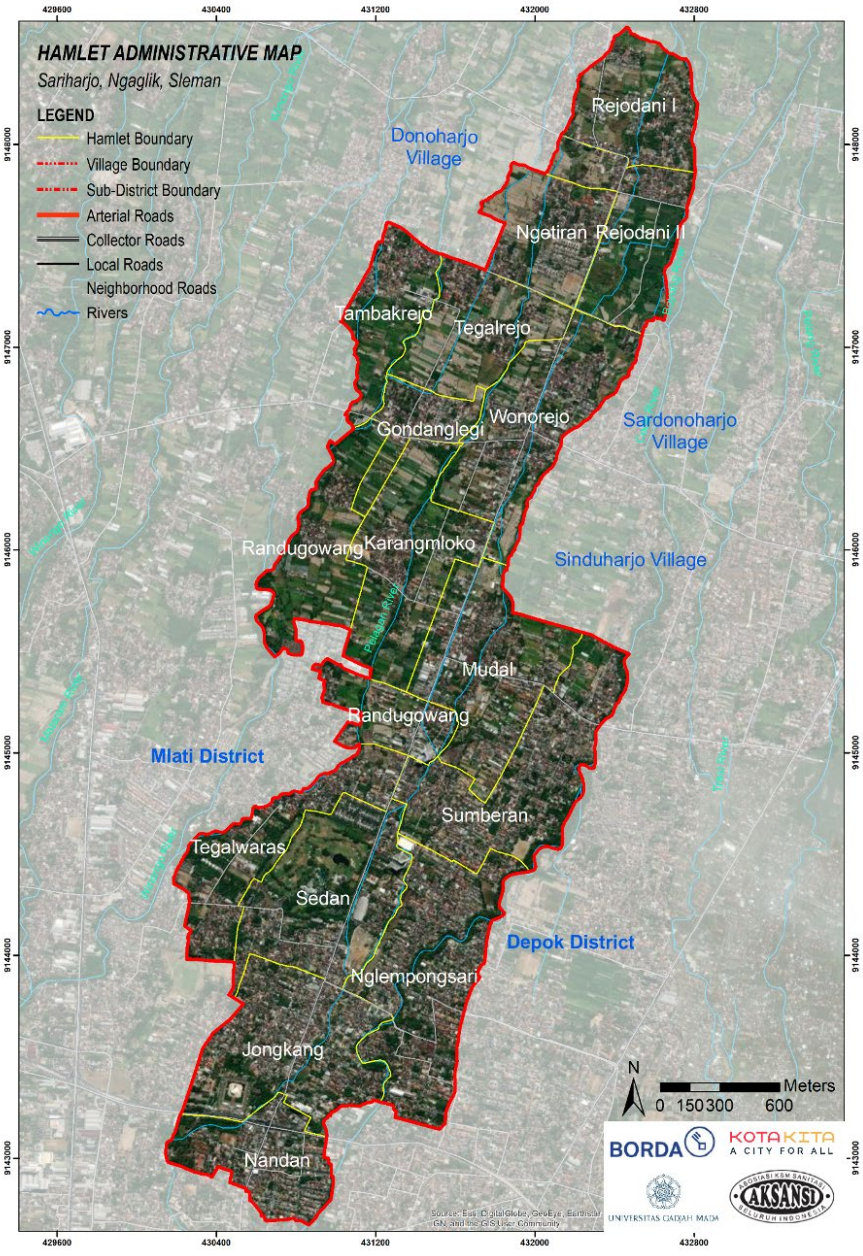


Figure 46. Map of Sub-village Administration Boundary

(Source: Kota Kita, 2021)

Annex II.
Population Density in Sariharjo's Sub-Villages

No	Name of Sub-village	Population	Area (Ha)	Population Density (person/Ha)	Category
1	Karangmloko	742	56.1	13	Very low
2	Randugowang	597	35	17	Low
3	Mudal	866	47.27	18	Low
4	Rejodani I	541	29	19	Low
5	Ngetiran	700	37	19	Low
6	Rejodani II	553	20	28	Medium
7	Tegalrejo	672	23	29	Medium
8	Tambakrejo	651	20	33	Medium
9	Tegalwaras	1,221	37	33	Medium
10	Jongkang	2,031	43	47	High
11	Nandan	1,572	31.32	50	High
12	Wonorejo	1,284	24	54	High
13	Sumberan	1,685	27	62	High
14	Tegalweru–Gondanglegi	938	13	72	High
15	Sedan	1,422	18	79	Very high
16	Nglempongsari	3,453	25	138	Very high

Table 13. Population density in Sariharjo's sub- villages
(Source: Evaluation, and Population Census 2020)

In terms of population density in each sub-village, Nglempongsari and Sedan fall under the category of having a very high population density. Longkang, Nandan, Wonorejo, Sumberan, Tegalweru-Gondanglegi fall under the category of having a high population density and are considered sub-villages with urban characteristics. Karangmloko has the lowest population density. Randugowang, Mudal, Rejodani I and Ngetiran have a low population density. While Rejodani II, Tegalrejo, Tambakrejo and Tegalwaras have a medium population density. Except for Tegalwaras, these sub-villages have peri-urban characteristics. It seems that sub-villages with urban characteristics tend to have higher population numbers and density than sub-villages with peri-urban characteristics.

Annex III.
Investments in Sleman Regency 2016-2020

No	Indicator	2016	2017	2018	2019	2020
1	Number of national scale investors					
	PMDN (Domestic investment) (unit)	60	77	88	119	219
	PMA (Foreign investment) (unit)	66	70	80	100	107
2	Amount of national scale investment					
	PMDN (IDR million)	3,370,881	3,893,334	5,584,260	6,475,060	6,983,225
	PMA (€ /US$)	205,726,216 € or 222,447,808 US$	237,611,731 € or 256,925,004 US$	340,809,622 € or 368,510,902 US$	395,175,502 € or 427,295,684 US$	426,189,015 € or 460,830,001 US$
3	Labor absorption ratio	174.103	167.257	161.307	123.973	89.089
4	Increasing/ decreasing PMDN realization (%)	6.69	15.49	43.43	15.95	7.85
5	Increasing/ decreasing PMA realization (%)	596.32	0.75	(-17.64)	8.02	1.31

Table 14. Investment in Sleman Regency 2016-2020

(Source: Investment and One Stop Service Sleman Agency, 2021 in the RPJMD Sleman Regency 2021-2026)

Annex IV.
Road Networks

According to Law No. 38/2004, roads in Sariharjo are classified by functions, administrative status, and surface. By functions, the roads in Sariharjo Village are classified into arterial roads (serving long distance transport movements), collector roads (serving collection/distribution movements for medium distance), local roads (serving short distance movements), and neighborhood roads (serving short distances within neighborhoods).

Based on administrative status, road networks are classified by:

~ **National roads** (connecting provincial capitals, strategic roads, toll roads, together with other strategic national roads),

~ **Provincial roads** (connecting provincial capital with regency/city capitals, between regency/city capitals, and together with other strategic provincial roads),

~ **Regency/city roads** (primary local roads that connect regency/city capital and sub-district capitals, sub district capitals, sub district capitals and local centers of activity, local centers of activity, and together with other strategic regency/city roads),

~ **Village roads** (connecting areas and settlements within villages and their neighborhoods).

The responsibility of the development and maintenance of roads in this classification falls under each local government level. Budget for regency/city roads' maintenance, for example, will be the responsibility of the regency/city government. By surface, the roads in Sariharjo Village are classified into asphalt, concrete, paving blocks, and dirt roads. Illustrations of some road sections can be seen below.

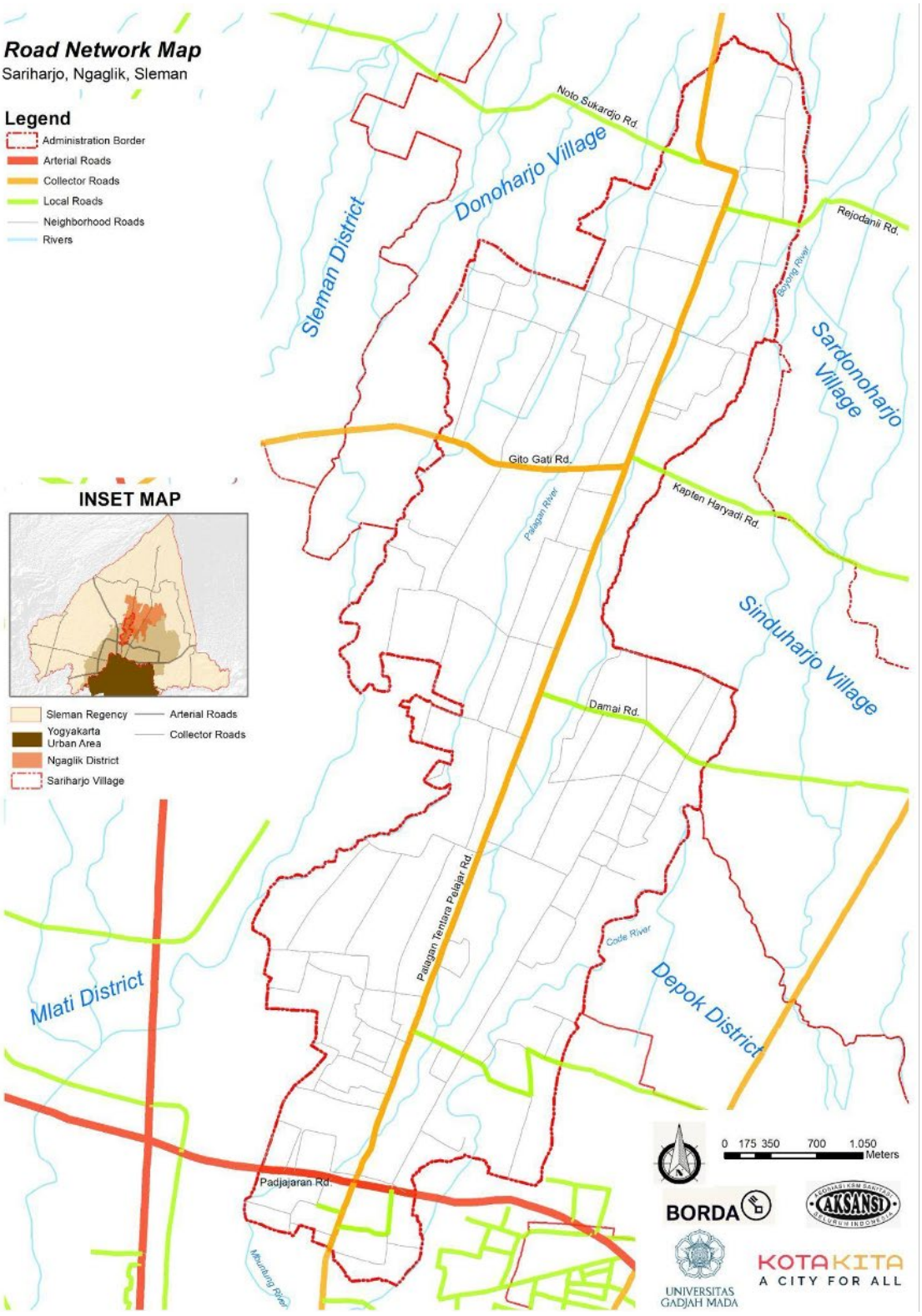
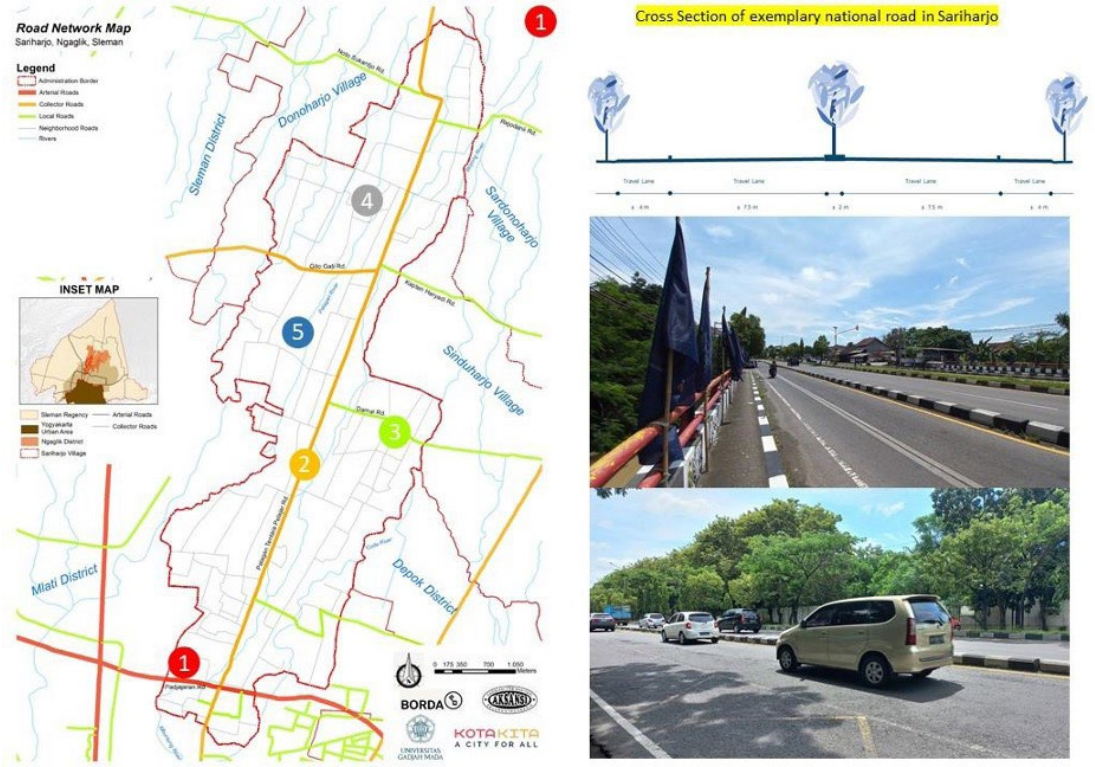


Figure 47. Road Networks Map in Sariharjo

(Source: After MURP UGM, 2021)

Cross Section of Some Exemplary Roads in Sariharjo

a. Cross section of exemplary National Road in Sariharjo



b. Cross section of exemplary Provincial Road in Sariharjo

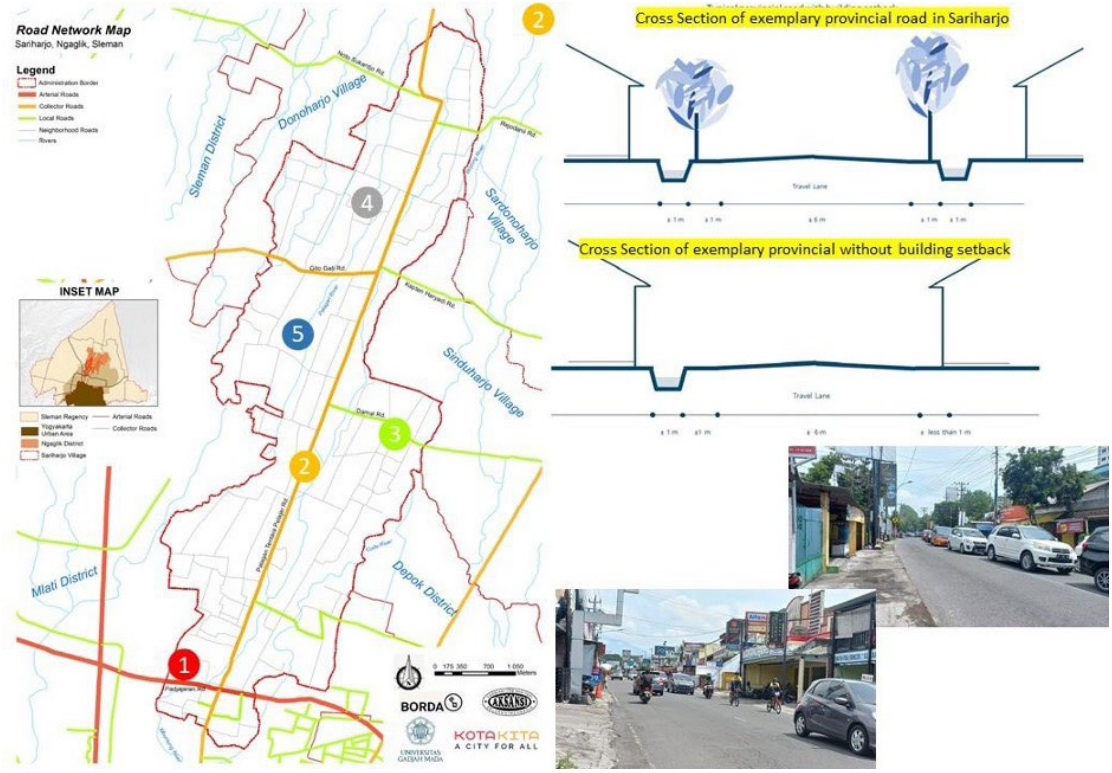


Figure 48-49. Exemplary road network sections in Sariharjo

(Source: MURP UGM Field Survey, 2021)

c. Cross section of exemplary Regency Road in Sariharjo

d. Cross section of exemplary Village Road in Sariharjo

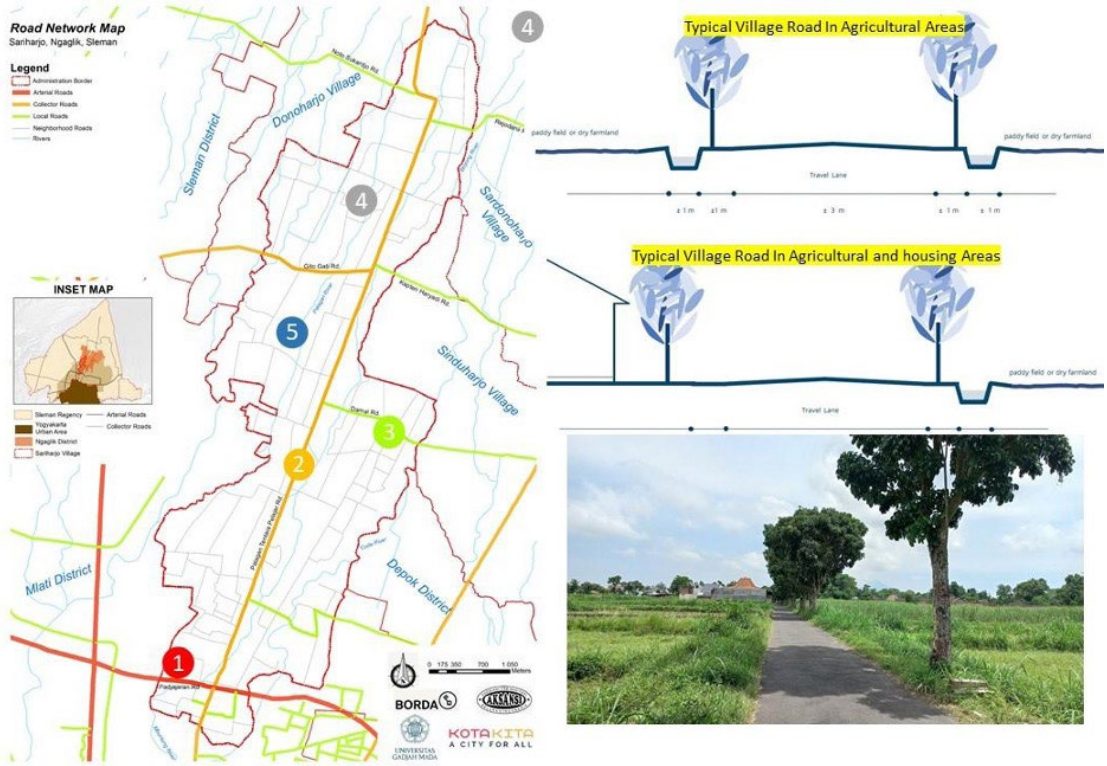


Figure 51-52. Exemplary road network sections in Sariharjo

(Source: MURP UGM Field Survey, 2021)

e. Cross section of exemplary Typical Riverside Path Upgrading in Sariharjo

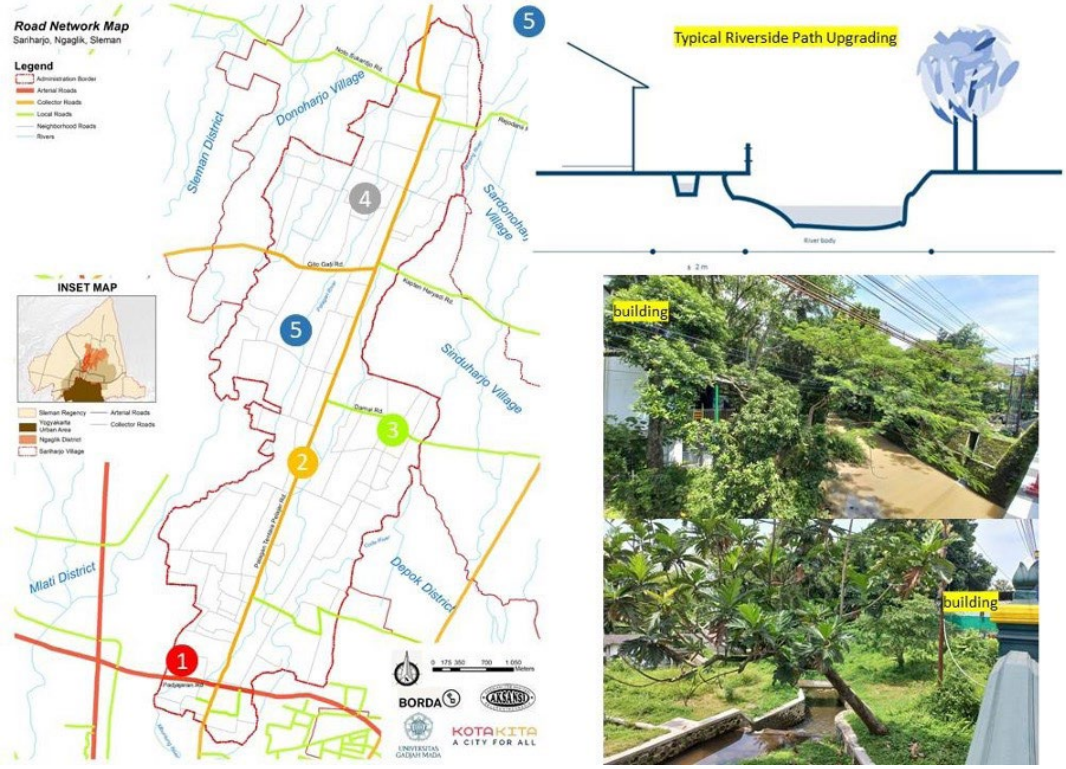


Figure 53. Exemplary road network sections in Sariharjo

(Source: MURP UGM Field Survey, 2021)

Table 15. Water quality test of shallow wells in Ngaglik sub-district

(Source: Sleman Environmental Department 2021)

Annex V.
Water Quality Test of Shallow Wells

Location of Well (Owner)	Taste	Smell	pH	Color (Ptco Scale)	Turbidity (NTU Scale)	Iron (Fe) Total (mg/L)	Detergent (mg/L)	MANGAN (Mn) Total (mg/L)	NITRAT (NO3+) (mg/L)	NITRIT (NO2+) (mg/L)	Temp. ˚C	TDS (mg/L)	E. COLI (CFU/100ml)	TOTAL COLIFORM (CFU/100ml)
Maximum amount allowed (Ministry of Health Regulation No. 32 Year 2017)	**Doesn't have taste**	**Doesn't smell**	**6,5-8,5**	**50**	**25**	**1**	**0,05**	**0,5**	**10**	**1**	**±3˚C Air temp.**	**1000**	**0**	**50**
Dug well water tap Mr. Sutarjo RT 1 / RW 28, Randugowang, Sariharjo, Ngaglik	Doesn't have taste	Doesn't smell	7,05	0	0,14	<0,0001	<0,01	0,003	6,957	0,004	22,0	191	200	616100
Dug well water tap Mr. Sagiman RT 1 / RW 15, Randugowang, Sariharjo, Ngaglik	Doesn't have taste	Doesn't smell	7,23	0	0,18	<0,0001	<0,01	0,0667	0,470	<0,001	22,0	181	0	1660
Dug well water tap Mr. Sukri RT 1 / RW 15, Randugowang, Sariharjo, Ngaglik	Doesn't have taste	Doesn't smell	7,05	0	0,22	<0,0001	<0,01	<0,0001	<0,001	0,003	22,0	193	140	2940

Annex VI.
Water Governance at the Village Level

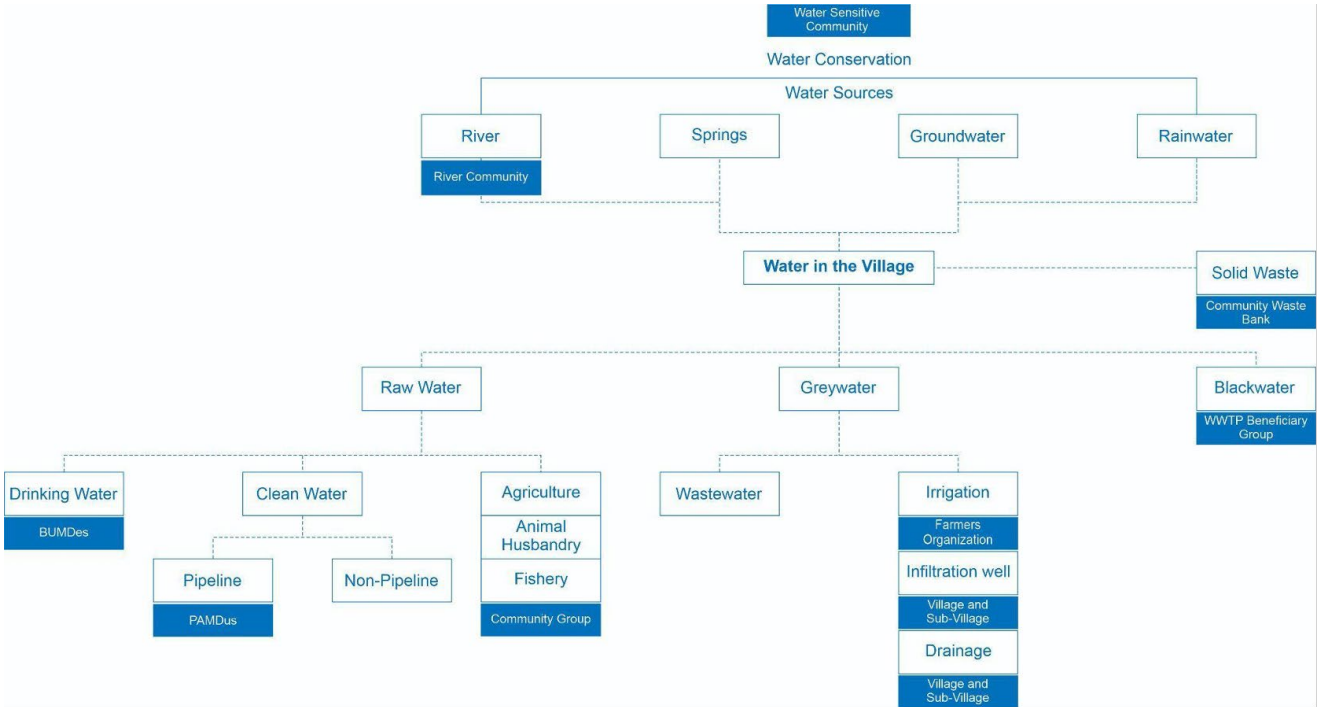


Figure 54. Water Governance at the Village Level

(Source: PolyUrbanWaters, 2022)

Annex VII.
Water Resources Coordination, Task and Function

Water-related Aspect	Central Government	Provincial Government	City/Regency Government
Authority/ Responsibility	**National, trans-provincial**	**Provincial - City/ Regency Level**	**One city/regency**
Provide Regulation on Water Resources Management	✓ (national regulation)	✓ (provincial regulation)	✓ (city/regency regulation)
Planning and Implementation of Water Resources Management	✓ (transnational, trans-provincial, and national strategic)	✓ (cross-regency/ city)	✓ (one regency/city)
Establish a coordination forum for Water Resources Management in the River Basin area	✓ (national regulation)	✓ (provincial regulation)	✓ (city/regency regulation)
River Basin Management	✓ (transnational, trans-provincial, and national strategic)	✓ (cross-regency/ city)	✓ (one regency/city)
Water Resources Protected Area/ Water Conservation Area	✓ (transnational, trans-provincial, and national strategic)	✓ (across-regency/ municipal river areas)	✓ (one regency/city)
Water Resources Utilization Permit Process	✓ (transnational, trans-provincial, and national strategic)	✓ (cross-regency/ city)	✓ (one regency/city)
Provision of Raw Water	✓ (cross-country, cross-provincial, and nationally strategic)	✓ (cross-regency/ city)	✓ (one regency/city)
Drinking Water Supply System	✓ (cross-provincial and national strategic)	✓ (cross-regency/ city)	✓ (district/city area)

Determining, collecting, and using water resources service fees	✓ (cross-country, cross-provincial, and nationally strategic)	✓ (cross-regency/ city)	✓ (district/city area)
Irrigation area and irrigation management	✓ (under the authority of the central government)	✓ (under the authority of the provincial government)	✓ (under the author-ity of the district/ city regional government)
Maintain the effectiveness, efficiency, quality, and order of the implementa-tion of Water Resources Management (governance aspect)	✓ (cross-provin-cial and national strategic)	✓ (cross-regency/ city)	✓ (district/city area)
Technical assistance and techni-cal guidance on Water Resources Management	✓ (provincial and district/municipality government)	✓ (regency/city local government)	✓ (village government)
Monitoring and Evaluation	✓ (provincial and district/municipality government) - Water Resources Management - Drinking water supply system - Irrigation system	✓ (regency/city local government) - Water Resources Management	✓ - Irrigation system
Facilitating dialog/resolution related water-resources and management	✓ (cross-provincial)	✓ (cross-regency/ city)	✓ (one regency/city)
Developing technology related to water resources	✓	-	-

Table 16. Water Governance at the Village Level

(Source: PolyUrbanWaters, 2022)

Mandates for Water Supply

Water Supply Mandates at the Regency Level

Table 17. Institutional Scope of Works of Water Supply at the Regency Level

(Source: Several Regulations)

No	Institution	Scope of works	Sources from several regulations
1	Regency government	~ Arrange policy and planning of water resource management and development. ~ Ensure the supply of raw water for minimum daily fulfillment of the community.	~ Law No. 17/2019 regarding Water Resources, Article 13
2	Public Works, Housing and Settlement Department (Dinas Pekerjaan Umum dan PKP)	~ Responsible to provide non-piped infrastructure for water, particularly for village areas (PAMSIMAS, PAMDES). ~ Arrangement, implementation, guidance, and supervision of implementation technical policies, guiding, and supervision of development and maintenance of clean water infrastructures, as well as drainage areas and residential areas (Facilities and Infrastructure of Basic Settlement Division).	~ Regulation of Sleman Mayor No. 36.1/2018 ~ Regional Policies and Strategies for the Implementation of the Sleman Regency Drinking Water Supply System
3	Environmental Department (Dinas Lingkungan Hidup)	~ Conduct monitoring of river water quality annually.	~ Sleman Regency Local Regulation No. 80/2016 about Position, Organization ~ Composition, Task and Function, and Working Procedure of the Environmental Department
4	Health Department (Dinas Kesehatan)	~ Conduct monitoring of clean water quality.	~ Sleman Regency Local Regulation No. 56/2016 about Position, Organization ~ Composition, Task and Function, and Working Procedure of the Health Department
5	PDAM Sleman	~ A state-owned company assigned to provide clean water and drinking water services for the urban community in Sleman Regency. ~ Establish development, operations, and maintenance of water sources. ~ Collect and accept Water Resource Management Service Fees (BJPSDA) from users, with note that the fee is not profit-oriented.	~ Law No. 17/2019 regarding Water Resources ~ Sleman Regency Local Regulation No. 10/2016 about Sleman's Local Drinking Water Company ~ Sleman Regency Local Regulation No. 28/2012 about Local Drinking Water Company Service Fees in Sleman

Water Supply Mandates at Village Level (Sariharjo Village Government)

In addition to the task and authority given to the Central Government and Regional Governments to regulate and manage Water Resources, including the task of meeting the daily minimum basic needs of water for the community, the Law also gives the authority of Water Resources Management to the village government to assist the government in Water Resources Management and to encourage the initiative and participation of village communities in Water Resources Management in their area.

Table 18. Institutional Scope of Works on Water Supply at the Village Level

(Source: Several Regulations)

No	Institution	Scope of works	Sources from several regulations
1	Village government	~ Help the Central Government and or Local Government in managing water sources in village areas, based on the general benefit principle with regard to other villages' interests. ~ Encourage initiatives and participation of village communities in managing water sources in their area. ~ Participate in maintaining the effectiveness, efficiency, quality, and order of the execution of Water Resource Management. ~ Help the Local Government in fulfilling the community's minimum water needs.	The replacement from Law No. 17/2019 about Water Resources
2	PERPAMDES (Persatuan Paguyuban Air Minum Perdesaan)	An umbrella organization of community's drinking water management in Sleman Regency that manages the distribution of non-PDAM drinking water independently, means from, for, and by the community. The organization was declared in 2008 with the support of 144 PAMDES and inaugurated by the Special Region of Yogyakarta (DIY) Province Governor under SK No. 24/KEP/2008.	SK Bupati Sleman No. 308/ Kep.KDH/A/2009

Mandates for Wastewater Treatment

Central Government

The Ministry of Environment and Forestry specifically issued a regulation regarding wastewater, which is Environment and Forestry Ministerial Regulation No. P.68/Menlhk/Setjen/Kum.1/8/2016 regarding Domestic Wastewater Quality Standards as a Follow-Up to Government Regulation No. 82/2001 regarding Water Quality Management and Water Pollution Control. The regulation specifically regulates wastewater quality standards , which includes the parameter or the level of pollutant and/or the amount of pollutant contained in the wastewater disposed in a water source. This regulation is set as a reference for the provincial government and city/regency government in wastewater management in their respective areas.

Table 19. Institutional Scope of Works on Wastewater Treatment in Sleman Regency

(Source: Several Regulations)

Sleman Regency Government

The DIY Province Government then issued the Special Region of Yogyakarta Local Regulation No. 2/2013 regarding Domestic Wastewater Management that is set as a reference for the Sleman Regency Government in their wastewater management stipulated in the local regulation No. 04/2019.

No	Institution	Scope of works	Sources from several regulations
1	Sleman Government	Domestic wastewater management includes at least three system: ~ A community, areal, urban and regional scale centralized system WWTP. ~ Local WWTP. ~ Sludge Treatment Installation (IPLT).	Special Region of Yogyakarta Local Regulation No. 2/2003 and Sleman Local Regulation No. 04/2019 regarding Domestic Wastewater Management.
2	Sleman Environmental Department	Plan, conduct, guide, and control the management, construction, and maintenance of waste, wastewater, landscape gardening, and green open spaces.	Sleman Regent Regulation No. 80/2016 regarding Position, Organization Composition, Task and Function, and Working Procedure of the Environmental Department.
3	Wastewater Management Sub-division under the Sanitation and Green Open Space Management Division (Bidang Kebersihan dan Pengelolaan Ruang Terbuka Hijau)	~ Compose Wastewater Management Division working program. ~ Formulate policy for wastewater facility and infrastructure management, construction, and maintenance technicalities. ~ Guide and control wastewater management. ~ Plan, conduct, assist, and control wastewater facility and infrastructure construction. ~ Plan, implement, assist and control the infrastructure and maintenance of wastewater facilities. ~ Services for wastewater disposal network customers. ~ Evaluate and arrange a report for Wastewater Management Division execution.	Section 2 Sleman Regent Regulation No. 80/2016 regarding Position, Organization Composition, Task and Function, and Working Procedure of the Environmental Department.

No	Institution	Scope of works	Sources from several regulations
1	Sleman Environmental Department (the solid waste section under the division of Cleanliness and Green Open Space Management)	~ Plan, execute, mentor, and control the management, construction, and maintenance of waste, drainage, gardening, and Green Open Spaces.	Article 10 of Sleman Regent Regulation No. 80 of 106 concerning Position, Organizational Structure, Duties and Functions, and Work Procedures of the Environmental Department
2	Sleman Environmental Department (Waste Management Section)	~ Compose Waste Management Section working plan. ~ Formulate policy regarding waste management technicalities, construction, and maintenance of the waste facility and infrastructure. ~ Mentor and control waste management. ~ Plan, execute, mentor, and control waste facilities and infrastructure construction and maintenance. ~ Evaluate and arrange/compose reports for the Waste Management Division execution.	Articles 12-13 of Sleman Regent Regulation No. 80 of 106 concerning Position, Organizational Structure, Duties and Functions, and Work Procedures of the Environmental Department
3	Waste Technical Service Unit	Carry out operational technical activities and supporting technical activities, especially in operational activities related to the facilitation of solid waste services in the Sleman Regency.	Environmental Department Strategic Plan (RENSTRA DLH) 2017-2022 on Technical Service Unit

Table 20. Institutional Scope of Works on Solid Waste and Hazardous Waste in Sleman Regency

(Source: Several Regulations)

Since the Republic of Indonesia is using a unitary system, the budget cycle of the central government and the local government are in the same fiscal year. Local governments start to propose the annual work plan two years prior to implementation. The process starts in January and it ends in December. At the same time in January, the local governments of both provincial and regency/city, implemented the budget and programs they had proposed two years earlier.

At village level, budget implementation is set for a one year budget period, starting on January 1st and ending on December 31st of the same year. The village government proposes the annual work plan one year prior to the implementation. The planning of the annual village budget, which is legally established by village regulation is illustrated in the figure below.

Figure 55. Planning/ Budgeting Process

(Source: Ministry of Home Affairs Regulation No. 20/2018 concerning Village Budgeting)

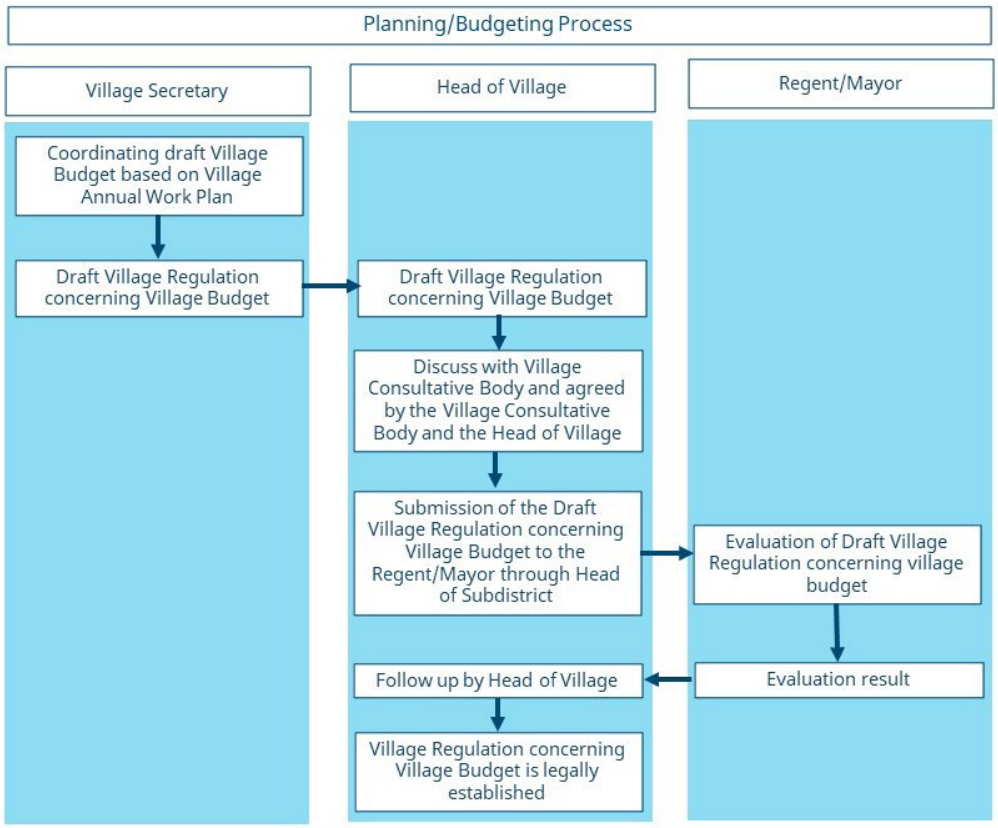


Table 21. Roles of Village Governance in Irrigation Water System

(Source: Regent Regulation No 74/2016)

No	Institution	Scope of works
1	Agriculture, Food, and Fisheries Department Section for Food Crops Infrastructure and Facilities	~ Mentoring and development of land use and water crop use. ~ Mentoring and development of crops irrigation.
2	Village Government	Small scale agriculture infrastructure construction, such as irrigation channels.

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Profile of PolyUrbanWaters

PolyUrbanWaters is a research and project network funded by the German Federal Ministry of Education and Research (BMBF) that consists of academic institutions, municipalities, local and national government agencies, civil society and private-sector stakeholders from Indonesia, Cambodia, Laos, Thailand, Vietnam and Germany.

PolyUrbanWaters responds to the strong need to generate deeper, transferable and scalable know-how for the effective localization of polycentric approaches to urban water resources management in secondary and tertiary cities of the SEA region.

The project intends to demonstrate the importance of polycentric approaches to the management of urban water resources, contributing to the water-sensitive transformation of secondary and tertiary cities in SEA towards resilient, inclusive and livable urban areas, thus contributing to the fulfillment of national and global sustainability agendas.

In order to do this, the project will elaborate an empirically proven conceptual framework for these approaches with: a) development of relevant instruments for its implementation and scalability; and b) a sustainable contribution to the systematic emergence of a new interdisciplinary practice-oriented research and economic-academic cooperation context.

The PolyUrbanWaters international research collaboration focuses its research activities around three Living Labs located in Sleman (Indonesia), Sam Neua (Laos) and Kratié (Cambodia), which provide a representative cross-section of the challenges faced by fast-growing secondary and tertiary cities in the SEA region in diverse governance contexts.

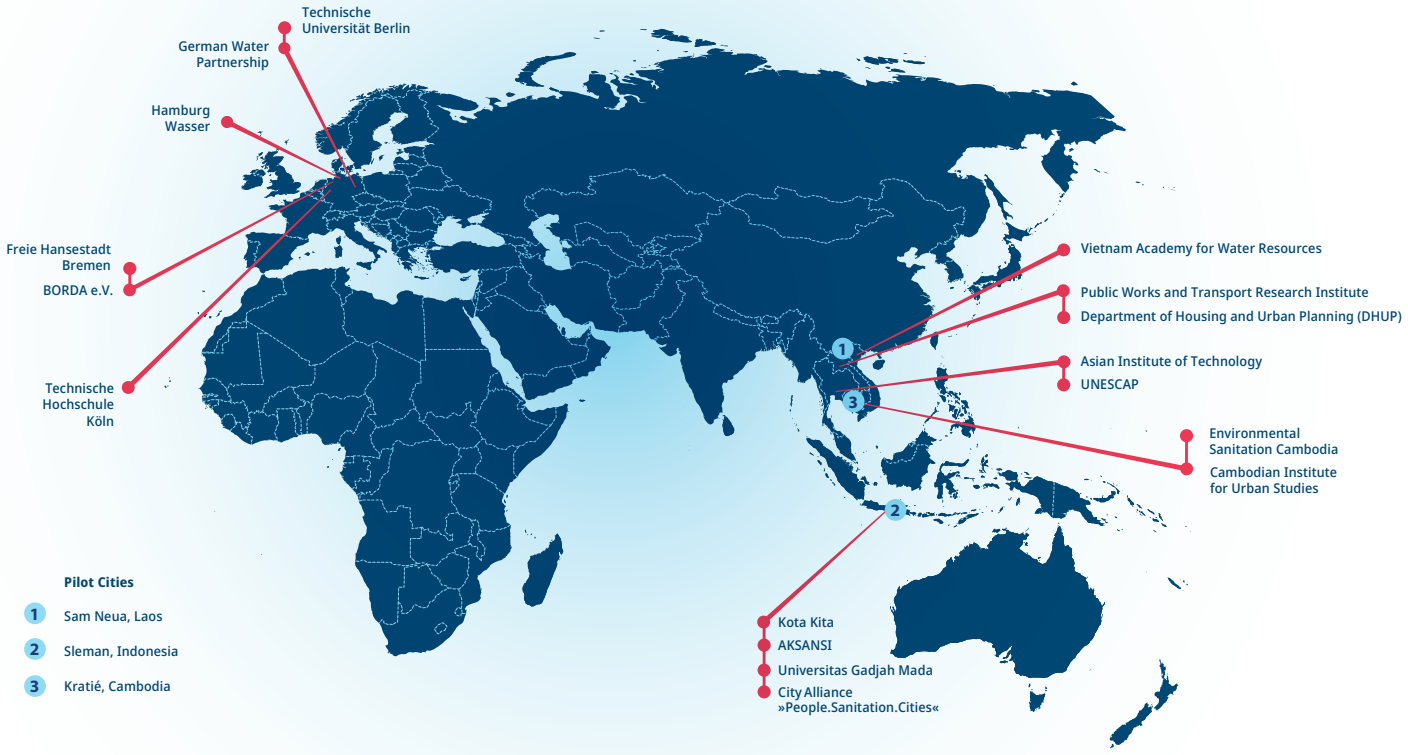
Within this framing, PolyUrbanWaters pursues the following core questions:

1. How can a diverse set of stakeholders contribute to building an inter- and transdisciplinary local knowledge base on water and urban development-related challenges in the SEA region? How can this knowledge be systematized, scaled and regularly updated to serve as a basis for inclusive and future-oriented municipal planning approaches across the region?

2. How can effective and sustainable water-sensitive urban development be fostered through a combination of centralized and decentralized technical and social-ecological innovations – including nature-based solutions, participatory strategic planning and effective water management structures – as an integral part of a systemic polycentric nexus approach (water, waste, energy, housing, IT, food, community development, etc.) and innovative financing schemes for the management of urban waters?

3. How can “water” serve as a strategic entry point to integrated, inclusive and resilient urban development that is guided by the SDG framework? Which polycentric, intersectoral and participatory governance approaches are required to plan, develop, sustainably operate and finance integrated, water-sensitive development with the capacity to evolve further in line with dynamic urbanization processes?

4. How can local innovation processes inform new practice-oriented pedagogies, capacity building approaches and research agendas to strengthen a network of academic institutions in the region?



The PolyUrbanWaters-Partnernetwork and Pilot Cities

The urbanization dynamic of Sleman Regency is accompanied by profound land-use changes and a deep socio-economic transformation. This implies profound ecological, economic, social and cultural transformation processes in the whole region. These developments -if inappropriately managed- would likely result in degrading natural ecosystem, liveability, public health, loss of biodiversity threatening long-term growth.

polyurbanwaters.org

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