Jurnal Muara Sains, Teknologi, Kedokteran, dan Ilmu Kesehatan
Vol. 8, No. 2, Oktober 2024: hlm 221-228

ISSN 2579-6402 (Versi Cetak)
ISSN-L 2579-6410 (Versi Elektronik)

THE CHALLENGES OF JAKARTA'S DEVELOPMENT AND MANAGEMENT AND PROSPECTS OF DRONE TECHNOLOGY UTILIZATION

Nadia Ayu Rahma Lestari[1], Erwin Fahmi[2], Erlando Sulistia[2], Kim Doo Pyo[3], Kwak Jae Ha[4]

[1]Undergraduate Program of Urban Planning and Real Estate, Universitas Tarumanagara Jakarta
Email: nadiarahma@ft.untar.ac.id
[2]Graduate Program of Urban and Real Estate Development, Universitas Tarumanagara Jakarta
[3]Department of Digital Urban Construction Engineering, Changshin University, South Korea
[4]Department of Geoinformatics, Busan Institute of Science and Technology, South Korea

Masuk: 21-10-2024, revisi: 27-10-2024, diterima untuk diterbitkan: 4-11-2024

ABSTRAK

Pengembangan dan pengelolaan kota Jakarta menghadapi berbagai tantangan, mulai dari infrastruktur yang belum memadai, meningkatnya ekstrimitas cuaca, pertumbuhan penduduk, hingga perubahan pola tempat tinggal, pekerjaan, dan berbelanja. Upaya untuk mengatasi tantangan ini sering kali terhambat oleh keterbatasan finansial, kelembagaan, dan teknologi. Kemajuan teknologi *drone* yang berkelanjutan menawarkan pengumpulan data yang *real-time* dan hemat biaya untuk digunakan dalam inspeksi, pemantauan, serta penyelesaian tantangan sehari-hari yang ditemui dalam manajemen perkotaan. Penelitian ini menggunakan sebuah studi kasus sederhana di Pulau Panggang yang terletak di lepas pantai Jakarta sebagai ilustrasi, untuk mengeksplorasi prospek teknologi *drone* dalam mengatasi tantangan yang dihadapi Jakarta. Studi ini menerapkan metodologi kualitatif dengan menggabungkan studi pustaka, dan tinjauan literatur, serta studi kasus. Hasil dari penelitian menunjukkan bahwa prospek penerapan teknologi *drone* dalam pengembangan dan pengelolaan kota sangat jelas dan kuat.

Kata Kunci: pengembangan kota; teknologi drone; Kota Jakarta; pengelolaan perkotaan

ABSTRACT

The development and management of Jakarta confront numerous obstacles, including inadequate infrastructure, increasing weather extremity, population growth, and shifts in residential, occupational, and shopping habits. Attempts to tackle these difficulties are often restricted by financial, institutional, and technological constraints. The ongoing improvement of drone technology provides real-time and cost-effective data collecting for inspection, monitoring, and addressing daily challenges in urban management. This paper used a straightforward case study on Panggang Island, located offshore from Jakarta, to explore the prospect of drone technology in addressing the challenges faced by Jakarta. The study employs a qualitative methodology, combining desk study, literature review, and a case study approach. The findings indicate that the prospects for this application are evident and robust.

Keywords: *city development; drone technology; Jakarta City; urban management*

1. INTRODUCTION

The Challenges of the City of Jakarta

The challenges of developing and managing the City of Jakarta have been voiced by various parties, including Jakarta governor's candidates in every local election. Of course, every voice represents unique views and interests of the candidate or the commentators. However, by summarizing the findings of almost 30 years of continuous research on the City of Jakarta and its metropolitan region conducted by researchers and students associated with the Universitas

Tarumanagara, Fahmi (2024) loosely formulates 4 groups of challenges in the development and management of the City of Jakarta. These findings may also represent that of other researchers.
First, the challenges relate to the island ecosystem and its geographical position. Island ecosystem (vis-a-vis the continent) is indicated as vulnerable to large-scale and drastic ecosystem changes (Chandler & Pugh, 2021; Nadarajah & Grydehøj, 2016; Fahmi, 2023). In addition, the Indonesian archipelago is also surrounded by the ring of fire, which makes it vulnerable to earthquakes, tsunamis, and volcanic eruptions. The intensified incidences of seasonal flooding and droughts in the City of Jakarta, beside caused by weather extremity, are also indications of such changes to the ecosystem. This group of challenges requires city development and management to be sensitive to the characteristics of an island ecosystem and its potential for disasters.
Second, the challenges in the forms of Jakarta's lack of comfort, safety, and competitiveness as a human settlement (Santoso, 2008). These qualities are particularly important for a city that has a high stake: an aspiring global city, national capital, home to millions of inhabitants. UN-Habitat has clearly shown Jakarta's position relative to other world cities in terms of sustainable competitiveness, i.e. Jakarta is not included in the ranking of the 200 best cities, while Singapore (no.1), Kuala Lumpur (no. 60) and Bangkok (no. 174) are included; and economic competitiveness, ie. Jakarta is ranked 102, below some other Southeast Asian cities, such as Singapore (ranked 2) and Kuala Lumpur) (ranked 6). This assessment seems to repeat the notes of Asiaweek magazine, about 25 years ago: out of 40 Asia Best Cities (or best places to live), Jakarta is only ranked 35, below Kuala Lumpur (ranked 9), Seoul (ranked 24) and Bangkok (ranked 26).
Third, the challenges relate to increasing weather extremes, and transformation in patterns of residing, working, and shopping. Coupled with the development of information and robotics technologies, and such shock as the COVID-19 pandemic, urban life patterns have been transforming drastically relatively recently (Tanoto, 2024).
Finally, the last challenges relate to the unfulfilled needs, such as the problems of housing backlog and slums, decent city transportation, and inadequate health facilities, due to, among other things, limited institutional innovation. Institutional innovation facilitates available resources, albeit limited, to meet urgent demands, and can include: 1. interpretation of existing rules-in-use; 2. formulation of new schemes; and/or 3. addition of new elements to old rules-in-use (Fahmi, 2024). In other words, the lack of institutional breakthroughs results in various needs (demands) not being met and the potential losses in the community's economy are relatively high.
The various challenges above require answers through cost efficient and effective, and sometime also real- time, public decisions which subsequently require adequate data/information support. This is where drone technology (or unmanned aerial vehicle, UAV) as one of the increasingly important instruments, is needed for inspecting, and collecting data for projects/programs monitoring and evaluating purposes. Drone technology and application has increasingly been used widely in various fields, from mapping to delivering logistics (eg. medical supply), in time of emergency to remote areas, from the field of urban management to urban agriculture and forestry, from civil to military uses (27). To address these wide ranges of challenges, a review of the utilization of drone technology will be conducted.

2. METHODOLOGY

This study employs a combination of desktop surveys and literature review to explore potential utilization of drone technology in addressing the challenges of development and management of the City of Jakarta. A simple case study from our own experience in Panggang island in the offshore of Jakarta, was also used to illustrate a cost-effective early use of drone technology in mapping the island's infrastructure services and critical ecosystem. The desktop survey method was employed to gather secondary data from various existing studies, reports, and publications related to urban development and the use of drone technology. A relevant literature review was

https://doi.org/10.24912/jmstkik.v8i2.33495

ISSN 2579-6402 (Versi Cetak)
ISSN-L 2579-6410 (Versi Elektronik)

also conducted. The insights gained from this desktop survey and literature review provided the foundation for the potential role of UAV technology in addressing those challenges.

3. RECENT DEVELOPMENTS AND PROSPECTS OF DRONE TECHNOLOGY

Remote sensing[1] technology has been used in Indonesia for almost a century. One of them is in the planning of the new city of Kebayoran (+730 ha) in 1948; here, the city design was compiled on a map of aerial photography on a scale of 1: 500. Although the aerial photography was not accompanied by ground checking, its results were considered adequate; the land contour mainly relies on estimates from planners and engineers (Soesilo, 1986; Fahmi, 2021). On a limited scale, this technology may have also been applied before[2].

In addition to aircraft, aerial photography technology has also used other technologies such as balloons, satellites, and, recently, drone technology. Unlike previous technologies, drone technology has several prominent characteristics, such as a wide range of technological sophistication, relatively cheap (both capital investment and operating costs) , ease of operation, and reliability. With these conditions, there is an opportunity to utilize drone technology both as a citizen's device and as complex organizational work equipment. As a citizen's device, drone technology meets the following characteristics:

1. **Relatively affordable capital investment and operating cost.** Drone technology requires relatively affordable drone aircraft and does not require special infrastructure, such as an airport. Remote sensing equipment that goes with drone technology includes a computer that records and directly stores the resulting images. All of the above initial investments can be used repeatedly so that the return on investment is relatively high.
2. **Relatively easy to operate**. Drone operation requires training and a license that is relatively easy to obtain, fast to process, and inexpensive for prospective pilots. Drone technology can be used for a wide range of needs, from engineering to public health inspections, from business to recreation needs, and from study to solving daily urban management.
3. **Technically reliable and practical**. Rapid development of drone technology and other related technologies (communication and recording technologies) allows drone aircraft to overcome weather dynamics (wind, humidity, brightness) that have the potential to interfere with image quality in previous conventional technologies.

In addition, drone technology also overcomes the complexities associated with two main aspects of conventional remote sensing technology, namely data collection and interpretation. In conventional remote sensing technology (with airplanes, balloons, or satellites), the flight altitude is relatively high, from above 1500 m (small airplanes) to several thousand km (satellites); therefore, the objects captured need to be interpreted. In the drone technology usage, its flight height is 'only' a few tens of meters to 150 meters (Hernina et al, 2019), so the objects are unlikely to be interpreted. This practicality earns drone technology a wide application, including various aspects of urban and real estate development.

The utilization of drone technology in Indonesia is showing rapid growth along with increasing demand from various sectors. The potential of drone market in Indonesia in 2028 is estimated to

[1] Remote sensing is a technology for collecting data through photo or image media about one of a number of objects, or phenomenon, in the earth's surface, in space, or in outer space, using certain tools, without having to physically touch or physically be in that place. "Pengertian Penginderaan Jauh, Komponen dan Contoh". Media Indonesia, 9 May 2023

[2] In Europe, the pioneering of aerial photography technology began in the mid-19th century, namely in the form of taking aerial photos using balloons. The development of aerospace technology in the 20th century, satellite technology in the mid-20th century, and drone technology in the early 21st century pushed aerial photography technology more affordable, easier, and more reliable

reach US$93 million out of a total US$48.6 billion potential market in the world (Junida, 2023). The main sectors driving this growth include mapping, disaster management, construction, and infrastructure inspection.

4. THE UTILIZATION OF DRONE TECHNOLOGY TO ADDRESS CHALLENGES OF JAKARTA: PAST EXPERIENCES AND FUTURE PROSPECTS

Initial utilization of drone technology started with the mapping of a settlement or a region. That is also the case with a study on settlement planning at the Island (or Pulau) Panggang in the offshore of Jakarta in 2017/2018 (Rahardjo et al, 2019). The study uses drone technology to expedite the availability of relevant maps at affordable costs. By using the stitching/stepping zone technique, the results of the mapping are further processed using digital image software (Kesuma et al, 2019; Suryadjaja et al, 2019). The results of the mapping enabled the study: a). to have better views of the whole island and its surroundings; b). to estimate basic infrastructures (road, water supply, drainage, etc), their networks, and their level of service; socio-economic facilities, such as sea wharf, schools, kiosks, etc; c). to calculate number and location of available and needed houses, infrastructure, socio-economic facilities for future development; and d). to map out the existing ecosystem and its potential crisis In short, the results of such drone mapping became the base maps in creating a settlement planning map on Panggang Island.

Picture 1. Aerial Photography of Panggang Island in 2017 (left) and 2019 (right).
Beside settlement pattern and its infrastructure, the picture also shows changes in the coastline.
Source: Suryadjaja et al, 2021

Further use of drone technology does not only enable experts to map the existing situation in a one-time mode. With the relative affordability of the technology, it also enables users to map the progress of a certain trend, like happened in the Island of Panggang.

In a more positive way, this mode on drone application is used in a study to map the performance of an urban forest management. By utilizing drone technology, the study team was able to monitor the distribution, density, and even dominance of certain species over time (Wibowo et al, 2017). The results of this monitoring are useful for forest management to plan further interventions to improve the urban forest.

The advancement of drone technology in recent years demonstrates the breadth, depth, and detail of drone applications in urban development (Lee, 2000; Im, 2016; Kim, 2015). The scope shows that drone technology has become one of the most important instruments in various technical applications of urban development and management, such as:

- Land mapping: drones equipped with high-resolution cameras and LIDAR sensors are capable of creating accurate and detailed topographic maps, which are very useful in spatial planning as well as technical planning of architecture and construction;

https://doi.org/10.24912/jmstkik.v8i2.33495

ISSN 2579-6402 (Versi Cetak)
ISSN-L 2579-6410 (Versi Elektronik)

- Monitoring the progress of construction, whether civil construction, irrigation, or others, and anticipating obstacles that may be faced;
- Monitoring city development, such as land development, health of parks and urban forests, ensuring compliance of various parties with the city plan, and detecting potential problems that may occur;
- Infrastructure inspection, such as bridges, buildings, and other public installations to detect potential structural damages or problems, allowing for quick and efficient remedial actions;
- Traffic management: drones can monitor traffic in real-time, assist in managing congestion, and respond more quickly to traffic incidents; and
- Security surveillance and disaster management, including search and rescue, anticipation of subsequent disasters, and post-disaster damage assessment; and
- In times of disaster, drone technology can be used to deliver most needed logistics, from medical supplies to drinks and foods.

If the potential for utilization is juxtaposed with the challenges of developing and managing the City of Jakarta as identified earlier, the following matrix can be obtained:

Tabel 1. Jakarta City Development and Management Challenges Matrix and Potential Utilization of Drone Technology to Answer Them

Challenges of City Development and Management	Examples of Potential Use of Drone Technology to Support Decision Making
Challenges I: The island's ecosystem and its geographical position on the ring of fire	- Monitoring changes in land use and land cover in the Ciliwung and other upstream river basins. - Identification of potential damage due to disasters (floods, earthquakes, tsunamis, or others) in settlements, and formulation of mitigation measures; - Emergency assistances in times of disaster (Muricho and Conrad, 2002).
Challenges II: Jakarta not being comfortable, safe, inclusive, and not being competitive as a human settlement	- Real-time monitoring in handling disruptions to urban systems (traffic, security, riots, or others); - Mapping of social segregation in settlements and potential solutions; - Mapping of environmental conditions, such as that is conducive to the breeding of *aedes aegypti* mosquitoes (Valdez-Degaldo et al, 2023).
Challenges III: Increasing weather extremes and changes in living, working, and shopping patterns, as well as advances in information technology and robotics.	- Monitoring the distribution and intensity of floods and droughts every year - Daily and periodic monitoring of traffic patterns (traffic) from home to work, home to recreation areas, home to shops, and vice versa;
Challenges IV: The gap between demand and supply and limited institutional innovation to address them.	- Regular mapping of the distribution and handling of uninhabitable settlements; - The use of urban photography to portray existing inhabitable and new developments - Mapping of the distribution, area, and intensity of use of city parks; - Potential use of drones to sense emissions in the environment, including the health of soil and parks, and hazardous gases from various activities (Pan et al, 2019; Page et al, 2020; Heinonen, 2011; Moreno-Armandariz, 2019)

The expansion and deepening of the utilization of drone technology applications is possible due to several factors, including:

1. Technological advances: increasingly sophisticated drone technology developments with improved technological reliability and quality of results;
2. Increased need for real-time data collection and monitoring: more and more sectors require accurate and advanced data for better decision-making in city planning, development, and management;
3. Supportive government policies: The government of the City of Jakarta is increasingly supporting innovation and the utilization of cost-effective technology through regulations and policies.

To support these advancements in the use of drone technology, the Government of Indonesia have issued related policies, such as. Regulation of the Minister of Transportation No. PM 37 of 2020 concerning the operation of unmanned aircraft in airspace served in Indonesia. This regulation regulates the use of airspace for drone activities, including flight permit application procedures and limitations on the use of drones in certain areas.

Therefore, to legally operate a drone in Indonesia, operators must have a license issued by the aviation authority. The following are the general procedures for obtaining a drone license: a. Training and certification: prospective operators must undergo training organized by an accredited institution and obtain a certificate of competency; b. Submission of license application: submit a license application to the Directorate General of Civil Aviation by attaching a training certificate, identity documents, and technical specification about the drone to be operated; c. Practical and theory exams: prospective operators must pass practical and theory exams held by the aviation authority; and d. Issuance of license: after satisfactorily meeting all requirements and passing the exam, a license will be issued by the aviation authority.

5. CONCLUSION

The prospects for utilizing drone technology for urban development and management in Jakarta are clear and strong. Various aspects of urban development and management, such as data collection for planning, monitoring and inspection for decision-making related to infrastructure development, environmental management, and urban transportation, as well as monitoring the development of dynamic city factors such as soil health and emissionst, can be carried out (Noor and Hashim, 2023; Rakte, 2021). The application of drone technology in Jakarta has shown its capability to tackle diverse urban development and management issues, including mapping, infrastructure monitoring, disaster response, and environmental surveillance. A case study on Panggang Island demonstrated the effective utilization of drone technology for settlement planning, infrastructure evaluation, and environmental monitoring, yielding significant insights for wider applications in Jakarta.

The advancing complexity of drone technology, along with the rising need for real-time data, renders it an essential instrument for enhancing decision-making in urban planning and administration. Moreover, favorable government policies, including legislation governing drone operations, promote its incorporation into urban networks. Given Jakarta's ongoing complex urban difficulties, the growth and development of drone applications present intriguing ways to improve sustainability, efficiency, and resilience in the administration and development of the city. The possibility for utilization will undoubtedly expand alongside the progression of drone technology and related advancements.

https://doi.org/10.24912/jmstkik.v8i2.33495

ISSN 2579-6402 (Versi Cetak)
ISSN-L 2579-6410 (Versi Elektronik)

REFERENCES

Chandler, D., & Pugh, J. (2021). Anthropocene islands: There are only islands after the end of the world. *Dialogues in Human Geography*, *11*(3), 395–415.

Fahmi, E. (2024). *Bringing Research (in)to Public Policy: Tantangan Pembangunan dan Pengelolaan Kota Jakarta untuk Mencapai Tujuan SDG*. National Seminar on Research and Community Enggagement (SENAPENMAS) Universitas Tarumanagara, Jakarta, Indonesia.

Nadarajah, Y., & Grydehøj, A. (2016). Island studies as a decolonial project (Guest Editorial Introduction). *Island Studies Journal*, *11*(2), 437–446.

Fahmi, E. (2023). Berpikir Dalam Kerangka Pulau: Mengamati Pengubahan Ekosistem Skala Besar di Kabupaten dan Pulau Sumbawa 2001-2021. Elex Media Komputindo, Jakarta

Santoso, S. (2008). *Kolonialisasi, Globalisasi & Perkembangan Kota* [Slide show].

Pengfei, N., & Kamiya, M. (2021). Global Urban Competitiveness Report (2020-2021): Global Urban Value Chain: Insight into Human Civilization over Time and Space. In *UN-Habitat*. National Academy of Economic Strategy, CASS | UN-Habitat. https://unhabitat.org/report-on-sustainable-competitiveness-of-cities-worldwide2020-2021

Asiaweek Magazine. Asia's Best Cities: The Top 40 Places to Live. December 1998

Tanoto, Thiodorus Kenny. Studi Efektivitas Teknologi Artificial Intelligence dalam Pengembangan Smart Mobility untuk Mewujudkan Kota Jakarta sebagai Smart City 4.0. Unpublished Thesis. Jakarta: Universitas Tarumanagara. 2024

Soesilo, M. (1986). *Perjalanan hidup H. Moh. Soesilo: architect & town planner*. Retrieved from https://books.google.co.id/books?id=YUTBuAAACAAJ

Fahmi, E. (2021). The Planning Approach for Kebayoran Baru in Jakarta: Background and Lessons Learned. *Journal of Regional and City Planning*, *32*(1), 56-70.

Hernina, R., Putera, R., Rosyidy, M. K., Ramadhan, M. I., & Putra, T. A. (2019). Analisis Tinggi Terbang Drone dan Resolusi Untuk Pemetaan Penggunaan Lahan Menggunakan DJI Phantom 4 Pro (Studi Kasus Kampus UI). In *PROSIDING SEMINAR NASIONAL PENGINDERAAN JAUH 2019*. Pusat Pemanfaatan Penginderaan Jauh, Lembaga Penerbangan dan Antariksa Nasional.

Junida, A. I. (2023, October 25). Potensi pasar drone RI capai 93 juta dolar AS di 2028. *Antara News*. https://www.antaranews.com/berita/3790947/potensi-pasar-drone-ri-capai-93-juta-dolar-as-di-2028

Rahardjo, P., Santoso, F., Herlambang, S., Ju Tjung, L., Kesuma, M., Lestari, N. A. R., Mawaddah, N., Astuti, W. K., Suryadjaja, R., & Syona, I. (2019). *Studi Penyediaan Kawasan Hunian Di Pulau Panggang, Kepulauan Seribu DKI Jakarta*. Universitas Tarumanagara.

Kesuma, M., Leman, S., Tjung, L. J., & Nurmawaddah, N. (2019). Studi Perencanaan Infrastruktur Dan Utilitas Di Pulau Panggang, Kepulauan Seribu, Dki Jakarta. *Jurnal Bakti Masyarakat Indonesia*, *2*(1).

Suryadjaja, R., & Astuti, W. K. (2021). Small island settlement planning in Panggang island, DKI Jakarta. *IOP Conference Series Earth and Environmental Science*, *916*(1), 012019.

Wibowo, A., Shidiq, I. P. A., Supriatna, Pin, T. G., Indratmoko, S., Putera S, R., Aridhianto, R., Nugroho, B. P., Misnadi, F., Muhammad, H. A., Apriyani, I. I., & Setiawan, O. (2017). *Management Hutan Kota Dengan Menggunakan Drone-Lidar dan Drone-Foto Udara Urban Forest Management using LIDAR-Drone and Aerial-Drone Photography*. Paper presented at Prosiding Seminar Nasional Penginderaan Jauh 2017, Depok, Indonesia.

Lee, Seong Yeob. (2000). A Study on Building Extraction Method from High Resolution imagery. Unpublished Thesis. Sogang University

Im, Su Bong. (2016). Creation of Spatial Information and Accuracy Evaluation Using Unmanned Aerial Photogrammetry. Unpublished Dissertation. Chungnam National University

Kim, Gwang Ho. (2015). Construction of High-Resolution Photo-realistic Model using UAV Photogrammetry. Unpublished Thesis. Chungbuk National University.

Valdez-Delgado, K. M., Garcia-Salazar, O., Moo-Llanes, D. A., Izcapa-Treviño, C., Cruz-Pliego, M. A., Domínguez-Posadas, G. Y., Armendáriz-Valdez, M. O., Correa-Morales, F., Cisneros-Vázquez, L. A., Ordóñez-González, J. G., Fernández-Salas, I., & Danis-Lozano, R. (2023). Mapping the Urban Environments of Aedes aegypti Using Drone Technology. *Drones*, *7*(9), 581. https://doi.org/10.3390/drones7090581

Pan, H., Page, J., Zhang, L., Cong, C., Ferreira, C., Jonsson, E., Näsström, H., Destouni, G., Deal, B., & Kalantari, Z. (2019). Understanding interactions between urban development policies and GHG emissions: A case study in Stockholm Region. *AMBIO*, *49*(7), 1313–1327.

Page, J., Jonsson, E., Kalantari, Z., & Destouni, G. (2020, May). Carbon Emissions and Sequestrations in Urban Landscapes and their Various and Changing Land and Water Covers. *EGU General Assembly Conference Abstracts*, 4755. doi:10.5194/egusphere-egu2020-4755

Heinonen, J., Säynäjoki, A., & Junnila, S. (2011). A longitudinal study on the carbon emissions of a new residential development. *Sustainability*, *3*(8), 1170–1189.

Noor, N. M., & Hashim, M. (2023). Environmental gaseous sensing using Sniffer drone for urban development control. In *Lecture notes in civil engineering* (pp. 145–156).

Rakte, S. (2021). Unmanned Aerial Vehicle (UAV)/ Drone Surveying & Its applications in Urban Planning. *International Journal for Research in Applied Science and Engineering Technology*, *9*(8), 2129–2138. https://doi.org/10.22214/ijraset.2021.37711

Ayamga, M., Akaba, S., & Nyaaba, A. A. (2021). Multifaceted applicability of drones: A review. *Technological Forecasting and Social Change*, *167*, 120677.

Muricho, M. W., & Mogaka, C. O. (2022). Drone technology and performance of retail logistics. *Journal of Sustainable Development of Transport and Logistics*, *7*(1), 73–81.

Moreno-Armendáriz, M., Calvo, H., Duchanoy, C., López-Juárez, A., Vargas-Monroy, I., & Suarez-Castañon, M. (2019). Deep Green Diagnostics: urban green space analysis using deep learning and drone images. *Sensors*, *19*(23), 5287. https://doi.org/10.3390/s19235287