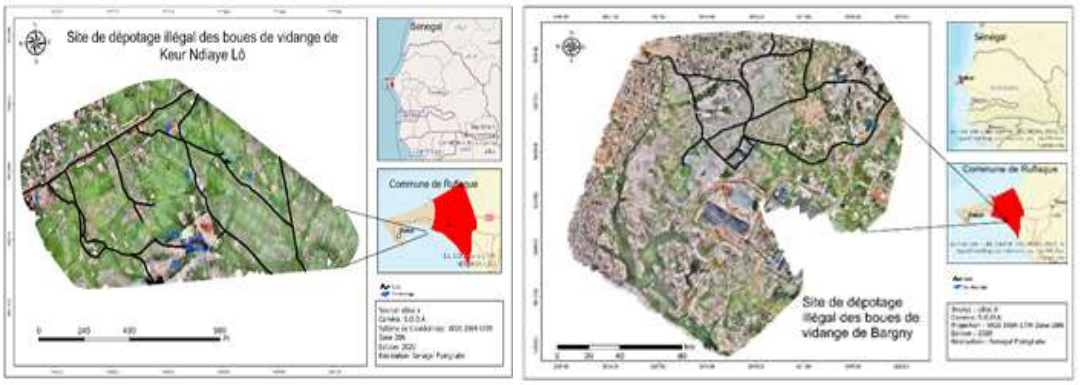
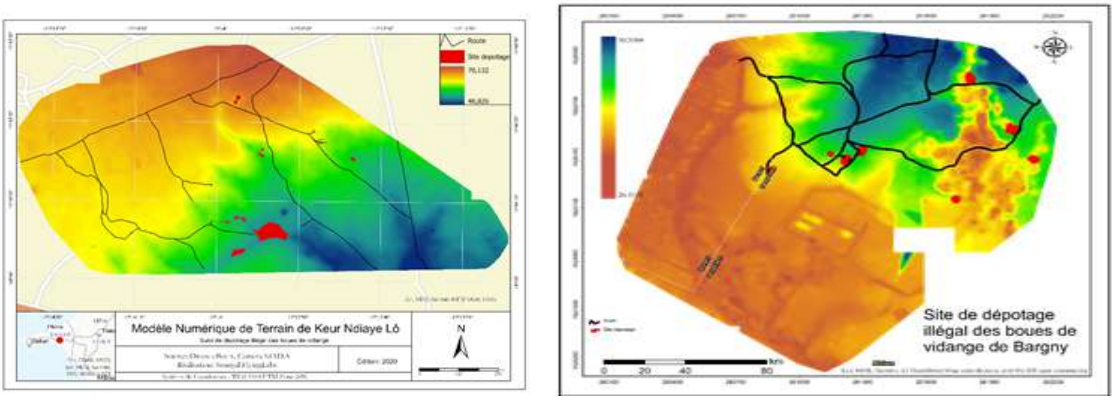
Monitoring of illegal dumping of sewage sludge by drone



Location maps of Keur Ndiaye Lo (left) and Bargny (right)



Digital Terrain Models of the locations with the illegal deposits marked in red

OVERVIEW	
Flying Labs	Senegal Flying Labs
Geographic area	Bargny and Keur Ndiaye Lo, Dakar, Senegal
Date range	July - September 2020
Sector program	DevRobotics
Main SDGs	Goal 6: Ensure access to water and sanitation for all

SCOPE	
Project stakeholders	*Participants*: IPAR et Delvic Sanitation Initiatives during data collection missions and at the time of data interpretation. *Clients*: IPAR - The West African Sanitation Policy & Activators Project (WASPA) *Project partners*: IPAR, Ministry of Water and Sanitation (MEA) through the Direction de l'Assainissement (DA), the Office National de l'Assainissement du Sénégal (ONAS), Speak Up Africa (SUA), Niyel, Delvic S. I.

People impacted	Population of Commune of Bargny and Keur Ndiaye Lô first and, in the broader sense, the whole city of Dakar. Ministry of Water and Sanitation (MEA) through the Direction de l'Assainissement (DA), the Office National de l'Assainissement du Sénégal (ONAS).
Number of people impacted	Population of Bargny: 70 000 (2019) Population of Keur Ndiaye Lô: 3 808 (2003)
Challenge	In Senegal, improvement of the living conditions of the population through efficient and adapted sanitation systems is a priority of the government and its development partners. However, the political and strategic orientations of the public authorities have for a long time fought in favour of "all to the sewer" to the detriment of individual sanitation, even though about 75% of the population throughout the country has access to an individual sanitation system. With regard to faecal sludge disposal, the emptiers dump it in the natural environment, disregarding all precautions to protect the local population and the receiving environment. It is worth noting that foul odours are emitted at these sites and have a direct impact on the local population. In addition, these practices can have negative effects on the development of the market in the sewage sector as they can interrupt the flow of materials and financial flows.
Scope	The objective was to use drones to show the negative effect of the proliferation of these dumping sites on the environment. Namely mapping of dumping sites and acquiring photos and videos of dumping trucks at clandestine sites to determine the frequency of illegal dumping. The extent of the project included the Commune of Bargny (700 ha) and the village of Keur Ndiaye Lô (about 100 ha). The collected data showed the extent of the problem and created room for policy makers, local people, dumpers and dumping companies to undertake participatory efforts to stop these devastating operations. The first step was to raise awareness and then to put in place strategies to protect the environment. All the while allowing the emptiers to continue their work but in an optimal way by integrating the concept of sustainable development into their concept.

Outcome	The project resulted in detailed maps of the illegal dumping sites in the two sites, drone videos and photos of the trucks dumping illegally, and quantification of the frequency of dumping over a well-defined time interval. Our actions have enabled organisations such as Delvic and IPAR to become aware of the contribution of drones in their sector. Previously, the information was collected manually in the field making it difficult to gather all the necessary information. The worry of doing so in full view of the emptiers was a major problem. The drones made it possible safely and in a timely manner.
Impact	Thanks to our study, the local population was able to see the extent of the disaster in their direct surroundings and thus participate in the efforts to protect their living environment. The study showed that the sludge was also used by market gardeners in their operations and therefore in the market basket of the people of Dakar (fertile soil in Bargny and Keur Ndiaye Lô and market garden areas). The emptiers have become aware of the harmful effect of their activities on the environment, health and market gardening. The emptiers asked for the construction of other large-capacity emptying stations to avoid long queues that impact their earnings. Significant efforts continue to be made by the Office National d'Assainissement du Sénégal (ONAS) and have led to improvements in the management of faecal sludge.
Next steps	1) A new decree in relation to sanitation in Senegal 2) Expansion of the project in the sub-regions

COMMUNITY ENGAGEMENT AND STAKEHOLDER SUPPORT	
Consent for data acquisition	For the sludge project, only IPAR, Delvic and some local people (focal points) were informed about this work. This was because we wanted to maximise the information to be collected, as previous studies on the same subject had failed.
Activities to engage with the community	Meeting with stakeholders and community leaders, recorded interview of communities and their leaders, exchange with youth and some local farmers
Community groups engaged with	● The inhabitants (because they are the first to be affected). ● The market gardeners.

	• The women whose crops overlap with the illegal sites (because they are active in picking and marketing market garden produce). • The emptiers (because they are anxious not to be the cause of all this disarray in the medium and long term).
Community attendance	Two focal points helped us a lot during the data collection as well as in the identification of all the illegal dumping sites in the two sites. This study was not meant to be revealed to the whole population, because sometimes it is the focal points themselves who inform the drivers of the emptying trucks of the presence of the agents. In addition, during the collection phase, the Senegal Flying Labs team was hidden in carefully selected and well-defined locations, to avoid arousing the curiosity of the population, market gardeners and emptiers. This would hamper the data collection.
Community feedback	Both focal points welcomed the contribution of drone technology to solving the problem. The main actors in illegal dumping were all aware of the harmful effect of this practice and praised the work done by the drones.
Stakeholder support	We helped the actors make the right decisions from the processed and analyzed drone images regarding this illegal activity.

DATA ACQUISITION	
Size of area	Bargny : 277.4718 ha (2.775 km²) Keur Ndiaye Lo: 126.04ha (1.260km²)
Drone	DJI Phantom 4 Pro V2 (for the collection of photos and videos) eBee X (for autonomous flight missions)
Sensor(s)	RGB
Flight plan software	eMotion
Flight height	For autonomous flights: 120 m above the ground For photos and videos: 15 - 80 m above the ground
GSD (Accuracy)	2.70 cm/pix
Number of images acquired	Bargny: 1038 Keur Ndiaye Lo: 380
Number of flights	3 autonomous flights Many more flights to collect videos and photos
Time invested in data acquisition	6 days (3 for Bargny and 3 for Keur Ndiaye Lo)
Georeferencing	Onboard GPS

DATA PROCESSING & ANALYSIS	
Processing software	PIX4Dmapper
Processing time	4 days
Data products	Orthomosaic, DTM and DSM
Analysis tools	ArcGIS Pro
Analysis outputs	Maps
Final outputs shared with stakeholders	Videos, photos and maps identifying illegal dumping sites
Data sharing	Google Drive, external hard drive