



Remote Sensing

Remote sensing refers to the process of detecting and monitoring the physical characteristics of an area by measuring its reflected and emitted radiation at a distance, usually from satellite or an aircraft. **Researchers at the Rights Lab are using remote sensing to support national governments and anti-slavery practitioners to identify sites of modern slavery and prioritise locations for on-the-ground interventions.ⁱ**

Anti-slavery practitioners can use satellite remote sensing to:

- Provide reliable and timely, spatially explicit and scalable data on modern slavery activity
- Enable the rapid mapping of large geographical areas to provide credible estimates of the number of potential sites of modern slavery and, by proxy, modern slavery prevalence
- Allow for the temporal monitoring of land use to assess fluctuations in the number of potential sites of modern slavery
- Gather information about areas that are physically difficult to access, such as conflict-affected regions
- Reduce the need for time-consuming and resource-intensive field operations by minimising the search area to be covered, and therefore provide operational decision-making support to prioritise resources for ground-based interventions.

Rights Lab researchers have, to date, used satellite remote sensing data to:

1. Provide a rigorous and credible estimate of the number of brick kilns, known to be sites of modern slavery, across the 'Brick Belt' that runs across south Asia.
2. Assess the relationship between tree loss and modern slavery across four countries: Brazil, Ghana, Indonesia and Mozambique.
3. Monitor fluctuations in the location and number of informal settlements in Nea Manolada in southern Greece, in which migrant labourers were found to be working in conditions of labour exploitation.
4. Map and track artisanal cobalt mining activities (tunnelling and open-surface mines), known to use child labour, in the Democratic Republic of Congo over a ten-year period.

Examples of forced labour in other known industries that could benefit from remote sensing analyses include quarrying and illegal deforestation.

Remote sensing to identify labour exploitation in Greek strawberry production: A case study

This research method combines the use of satellite imagery with field observation data, and decision-making methods - namely, Multi-Criteria Decision Analysis (MCDA)ⁱⁱ – to identify and risk assess informal housing settlements; enabling local partners to prioritise locations for site visits to identify and support at-risk workers, and more effectively allocate their resources.



For example, the team successfully employed this method in Nea Manolada, a small provincial town in southern Greece noted for its strawberry production fields, which was thrown into the international spotlight in May 2013 when three local field guards shot and injured 30 Bangladeshi workersⁱⁱⁱ. The team supported partners in Greece to monitor changes in the number of informal settlements housing migrant workers, where poor living conditions and exploitative labour practices had been reported.

An overview of the research method and its application in Greece is set out below.

Methodology	Application in Nea Manolada, Greece
STEP 1: Desk-based identification of informal settlements using satellite remote sensing data.	Using high-resolution (up to 50cm) AIRBUS satellite imagery, the entire study area of Nea Manolada was examined for informal settlements and housing units, where migrant workers were potentially being housed. 52 informal settlements were identified.
STEP 2: Verification of informal settlements identified in Step 1 through field visits undertaken by local partners.	To verify that the informal settlements observable in the satellite images were hosting migrant workers, field visits were undertaken. These field visits confirmed 48 settlements, housing approximately 6,000 workers.
STEP 3: Application of the Normalized Difference Vegetation Index (NDVI) algorithm on satellite imagery of the study area, to distinguish between vegetated and non-vegetated areas, in order to monitor changes in the number of settlements over time.	The algorithm was tested on 8 example settlements and found to work well. It was applied at the end of the 2019 strawberry-picking season across the study area and new informal settlements were identified.
STEP 4: On-the-ground investigation of potential new settlements identified in Step 3.	A field visit confirmed the existence of two more informal settlements housing migrant workers.
STEP 5: Development and application of the Multi-Criteria Decision Analysis (MCDA) for estimating the risk for workers under forced labour conditions in the settlements identified.	In order to develop the criteria for the MCDA, to assess the risk of forced labour conditions in the identified settlements, semi-structured interviews with workers were carried out and combined with field officers' personal observations about site conditions. The 8 MCDA criteria included hours of work/day, hygiene (access to clean water/proximity to stagnant water/access to cleaning products), safety measures, visibility of the settlement from nearby roads, and suitability of work clothing.
STEP 6: Prioritisation of identified settlements for intervention based on MCDA ratings	Using the MCDA, 6 informal settlements were ranked from highest to lowest risk for labour exploitation. Those settlements deemed to have the highest risk of forced labour were prioritised for inspection and interventions. Settlements located in close proximity to, and visible from, villages and main roads tended to have better conditions for workers.



The satellite images below show the changes in land use in one search area in Nea Manolada between 2015 and 2019. Closer inspection of the two example pixels in the images highlights the development of an informal settlement in the intervening period, in which workers may be housed. Identification of these sites via satellite imagery minimizes the search area for local anti-slavery practitioners, thereby saving valuable time and resources, and making it easier to locate and support workers.



Using remote sensing to support the European Court of Human Rights (ECtHR) in the case of *Chowdury and Others v. Greece, 2017*^{iv}

As noted above, the town of Nea Manolada gained international attention in 2013 when three local field guards shot and injured 30 Bangladeshi migrants working in its strawberry fields. In March 2017, the European Court of Human Rights (ECtHR) ruled that the migrant workers had been subjected to forced labour and that Greece had violated Article 4 of the European Convention on Human Rights by not preventing human trafficking. After the 2017 ECtHR decision, the workers started to receive their salary regularly; however, reports from NGOs and field visits undertaken by members of the Rights Lab team in November 2019 confirmed the living and working conditions for workers had not improved.

By providing tailored monthly reports of potential locations of new informal settlements, and providing a tool to risk assess the informal settlements, the Rights Lab supported practitioners in Greece to improve the labour conditions for these workers, and assisted the Greek government in its efforts to comply with the ECtHR's judgment. This research methodology, and its use of satellite imagery, is referred to in Greece's 2019- 2023 Action Plan^v as an outstanding development to support anti-trafficking efforts.

Remote sensing can be used in a multitude of ways and contexts to support anti-slavery activities. If you think this technology may be able to assist you in your work, or you would like further information about the Rights Lab, please contact the team at rightslab@nottingham.ac.uk

ⁱ For further information on the Rights Lab's 'Slavery from space' programme, see <https://www.aljazeera.com/programmes/101east/2019/08/fighting-slavery-space-190815130559574.html> and <https://www.sciencemag.org/news/2019/02/researchers-spy-signs-slavery-space>.

ⁱⁱ MCDA has been recognised as an important method in decision-making for formalising and addressing the problem of competing decision objectives. For further information on selecting the correct MCDA method, see <http://mcda.it/>.

ⁱⁱⁱ Gialis, S., A. Herod. 2014. Of steel and strawberries: Greek workers struggle against informal and flexible working arrangements during the crisis. *Geoforum*, 57: 138-149.

^{iv} https://ec.europa.eu/anti-trafficking/case-law/chowdury-and-others-v-greece-0_en

^v Action Report, Council of Europe DH-DD (2020)275, 19/03/2020