

Training and Utilization of Geographic Information Systems at Rahmatullah Lempake Samarinda Islamic Boarding School


Andrew Stefano

Samarinda State Agricultural Polytechnic, Samarinda,
75242, Indonesia
andrew.itb2001@gmail.com

Sri Endayani *

Department of Forest, Faculty of Agriculture, University
of 17 August 1945, Samarinda, 75123, Indonesia
nd4.70des@gmail.com

*Corresponding author

 Submitted: 2024-09-27; Accepted: 2024-10-18; Published: 2024-12-06

Abstract— The application of Geographic Information System (GIS) technology in education is becoming increasingly vital for enhancing digital literacy and spatial analysis skills. Rahmatullah Lempake Islamic Boarding School in Samarinda is one of the educational institutions with significant potential to utilize this technology in supporting the management of its environment and local resources. The initiative aims to provide students with training in GIS, enhancing their knowledge and skills in spatial data management and geographic analysis. The training employed a combination of lectures, discussions, and practical sessions using GIS software. It was attended by students aged 12 to 15 and covered foundational topics, such as an introduction to GIS, mapping applications, and data analysis techniques. The results of this training demonstrated a notable improvement in the students' understanding and basic GIS skills, as well as increased awareness of the technology's potential applications in their local environment. The integration of GIS into the educational process offers significant benefits, particularly in enhancing students' technological literacy and spatial analysis capabilities, which can be applied to environmental management activities within the Islamic boarding school. In conclusion, the GIS training at Rahmatullah Lempake Islamic Boarding School has effectively developed the students' foundational skills in technology and geographic analysis, offering practical benefits for future resource management and environmental planning endeavors.

Keywords— Observation, Information Technology, Interview, Insights

I. INTRODUCTION

Geographic Information Systems (GIS) have emerged as a pivotal technology for spatial data management and analysis, serving both scientific and practical purposes across various fields, including education. GIS facilitates the collection, management, and analysis of geographically referenced information, enabling more informed decision-making in contexts that require spatial considerations (Ahmed et al., 2021; Al-Bahrani et al.,

2022; Aljenaïd et al., 2022). In today's digital era, the ability to understand and use GIS technology is becoming increasingly important, especially in the context of education, to prepare the young generation who are able to compete globally in natural resource management and sustainable environmental development (Alqahatany, 2023; Bedair et al., 2022; Çetinkaya et al., 2022).

Rahmatullah Lempake Islamic Boarding School in Samarinda is one of the educational institutions that has great potential to utilize GIS technology, considering its location in an area with various environmental challenges, such as land use, water resource availability, and environmental sustainability monitoring. The empowerment of GIS in this pesantren environment will provide added value to learning, especially in improving technological literacy and the ability of students to understand geographical aspects that are directly related to their daily lives (Chowdhury & Hafsa, 2022; Chukwuma et al., 2021; Desalegn & Mulu, 2021). The use of GIS in educational institutions is not only beneficial for teaching, but also to support the management of the environment around the boarding school more effectively (Dhinsa et al., 2022; Elbeih, 2021; Elboshy et al., 2022). The training on the use of GIS at the Rahmatullah Islamic Boarding School aims to equip students with basic knowledge about this technology, as well as to train practical skills in operating GIS software. This is in line with efforts to improve the digital skills of the younger generation in rural areas and areas that have not been optimally touched by technology (El-Hadidy & Morsy, 2022; Erdem et al., 2021; Ghoneim et al., 2022). With this training, students are expected to understand how to collect, analyze, and visualize spatial data, which in turn will help them in understanding and solving environmental problems around them. In addition, this training is also expected to increase awareness of the importance of sustainable environmental management.

The training methods applied in this activity include a lecture approach to provide a theoretical understanding of GIS concepts, followed by discussion sessions and hands-on practice using software *open source* like *Autodesk Map*. Participants not only understand the basic concepts of GIS, but also have the opportunity to directly apply their knowledge through simple case exercises that are relevant

to the environmental conditions of the Islamic boarding school (Gupta et al., 2022; Gürtekin & Gökçe, 2021; Isihak et al., 2022). The students were invited to map the land around the pesantren, map the distribution of existing resources, and make a simple analysis of the potential and challenges of the surrounding environment.

The results of the training showed a significant improvement in students' understanding and skills related to the use of GIS technology. Before participating in the training, most students did not have an adequate understanding of spatial concepts and the importance of GIS technology in environmental management. However, after participating in a series of training activities, the students began to be able to do basic mapping and understand how spatial data can be used to analyze problems in their environment, such as monitoring land use and potential flood risks in the area around the pesantren (Khalil et al., 2021; Kumar et al., 2022; Larkin et al., 2021). The use of GIS technology at the Rahmatullah Lempake Islamic Boarding School provides various benefits, both in terms of internal management of the boarding school and improving the competence of students. In terms of cottage management, the data obtained through GIS can be used to manage the layout of facilities, monitor land use, and optimize existing resources. Meanwhile, for students, this skill can be a valuable asset for their future, both in continuing education to a higher level and in contributing to society (S. Li et al., 2022; W. Li et al., 2021; H. Liu et al., 2021). GIS also opens opportunities for students to be involved in community service activities, such as mapping disaster-prone areas or better land use planning.

Further discussion of the results of this training emphasized the importance of curriculum adaptation in Islamic boarding schools to accommodate technology-based learning, especially GIS. Considering that this technology has high relevance to various real-life problems, the integration of GIS materials into the formal learning curriculum in Islamic boarding schools will have a positive impact on improving the quality of education and the competitiveness of students. This will also strengthen the role of Islamic boarding schools as educational institutions that not only focus on the spiritual aspect, but are also able to produce graduates who have practical skills according to the needs of the times (Q. Liu et al., 2021; Lumbreras et al., 2022; Massano et al., 2022).

In conclusion, the training and utilization of Geographic Information Systems at the Rahmatullah Lempake Samarinda Islamic Boarding School has a significant positive impact on improving technological literacy and spatial analysis skills of students. Through lectures, discussions, and hands-on practice approaches, the students can understand the basics of GIS technology and apply it in the context of the surrounding environment. The use of GIS in the pesantren environment not only improves the competence of individual students, but also provides practical benefits in managing pondok pesantren resources more effectively. Therefore, it is hoped that this activity can be a model for other educational institutions, especially in rural areas, in adopting GIS technology as

part of the learning process and community empowerment (Yousef et al., 2022; Yudhana et al., 2021; Zhang et al., 2021).

II. METHODS

The training method used in this activity includes several strategic stages, namely introduction to theory, interactive discussions, and hands-on practice. Introduction to theory is carried out with lectures and presentations using visual media such as slides and videos. The goal is to provide a basic understanding of the concept of Geographic Information Systems (GIS), their functions, and benefits in various fields, including environmental management. At this stage, students are given an explanation of GIS components, such as hardware, software, and spatial data, as well as basic principles in spatial data processing (Murugesan et al., 2022; Pepe et al., 2021; Quan & Bansal, 2021). By understanding these basic concepts, participants can build the necessary foundation of knowledge before moving on to the next stages.

An interactive discussion stage was implemented after the presentation of theoretical material, where students were encouraged to ask questions and discuss related to the application of GIS in the context of their daily lives. This discussion aims to identify the initial understanding of students and explore creative ideas on how GIS can be applied in overcoming environmental problems around Islamic boarding schools. This discussion approach is adapted from an active learning method that aims to increase participants' involvement in the learning process, so that they can relate the theory to the real context they are facing (Taloor et al., 2021; Tamiru & Wagari, 2021; Turek & Stepniak, 2021). Students can more easily understand the relevance of GIS in their lives, as well as be motivated to actively participate in training.

The next stage is hands-on practice, where students are given the opportunity to operate GIS software, especially software *open source* like *Autodesk Map*. Students learn how to download spatial data, process the data, and make map visualizations that describe the Islamic boarding school environment. This practice is carried out using case studies that are relevant to the conditions around the pesantren, such as land use mapping and identification of areas that are vulnerable to flooding (Villacreses et al., 2022; Wu et al., 2022; Xiao et al., 2022). This hands-on approach aims to provide students with real experience regarding the spatial data processing process, which is expected to improve their skills in using GIS technology independently.

In addition to practicing the use of software, the training also involves field activities to collect spatial data directly. Students were invited to make measurements and observations in the area around the pesantren using a simple GPS device, then the data collected was integrated into the GIS software for further analysis. This method aims to combine theoretical and practical learning with real experience in the field, which can improve participants' ability to identify spatial problems and process them into useful information (Murugesan et al., 2022; Pepe et al., 2021; Quan & Bansal, 2021). Students

can better understand the relationship between data obtained in the field and information generated through GIS.

The training evaluation was carried out to measure the understanding and skills of students before and after participating in the training. The evaluation is carried out using a written test and a skill test (practice). The written test is used to assess the students' conceptual understanding of the GIS, while the skill test is carried out by giving simple tasks in the operation of the use of the Garmin 60 CSX GPS and *software Autodesk Map* (Q. Liu et al., 2021; Lumbreras et al., 2022; Massano et al., 2022).

III. RESULTS AND DISCUSSION

The results showed a significant improvement in students' understanding and skills regarding the basic concepts and applications of GIS technology. Before the training, the majority of students did not have enough knowledge about GIS, both theoretically and practically. After participating in the training, the evaluation results showed that students could understand the basic concepts of GIS, such as the functions of GIS hardware and software, as well as the basic principles of mapping. In addition, students can also operate software *Autodesk Map* (Gupta et al., 2022; Gürtekin & Gökçe, 2021; Isihak et al., 2022).

The community service activities conducted at Pondok Pesantren Rahmatullah Lempake were designed to

enhance students' technical competencies in GPS usage and geospatial data processing. The service comprised three distinct phases:

1. **Classroom Instruction:** This initial phase focused on theoretical instruction, providing students with a comprehensive understanding of GPS technology and its practical applications. Additionally, the session covered data correction techniques and the use of Autodesk Map software for geospatial data processing.
2. **Field Practice:** In the second phase, students engaged in hands-on field practice using Garmin 60CSX GPS devices. This activity allowed students to gain practical experience in data collection, including capturing geographical coordinates and applying coordinate correction methods.
3. **Laboratory Data Processing:** The final phase involved data processing using Autodesk Map software in the computer laboratory at the Rahmatullah Lempake Islamic Boarding School. This stage focused on translating the collected GPS data into actionable insights using geospatial software tools.

These activities aimed to foster practical geospatial skills among students, equipping them with the knowledge and tools necessary for real-world applications in geographic information systems (GIS). (Figures 1, 2, and 3).



(a) Activities in the classroom



(b) Activities in the field



(c) Activities in the computer room

Figure 1. Community service activities

Table 1. Garmin 60 CSX GPS Usage Training Test Results

No.	Name	Class	Written Test		Oral Test	Practice Test
			Pre-Test	Post-Test Scores		
1	R1	X	55	65	80	85
2	R2	X	40	60	70	80
3	R3	XI	50	60	75	75
4	R4	XI	50	60	70	70
5	R5	XII	50	60	75	75
6	R6	XII	50	55	75	70
7	R7	XII	50	55	80	80

Participants experienced an increase in scores on the post-test compared to the pre-test in various categories, which showed that this training successfully improved participants' understanding

and skills in using the Garmin 60 CSX GPS. This indicates that the training carried out is quite effective in improving the competence of participants in utilizing technology.

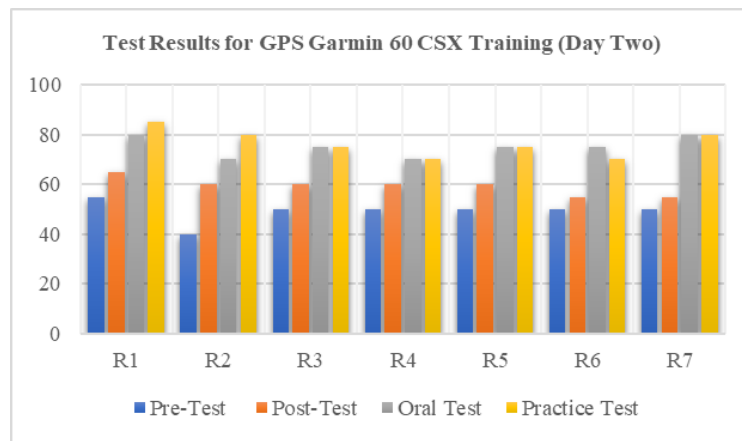


Figure 2. Results of using the Garmin 60 CSX GPS tool

Table 2. Results of the data processing test with Microsoft Excel and *Auotodesk Map software*

No.	Name	Class	Written Test		Oral Test	Practice Test
			Nilai Pre-Test	Post-Test Scores		
1	R1	X	50	70	85	85
2	R2	X	45	65	80	80
3	R3	XI	40	70	75	75
4	R4	XI	45	60	75	75
5	R5	XII	45	65	70	75
6	R6	XII	40	65	80	80
7	R7	XII	55	70	85	85

The data showed a significant increase in post-test scores in almost all participants, indicating that the training successfully improved participants' ability to use both software. The training has a positive impact on improving the ability of participants, especially in the use of software for data processing. This indicates that the training is effective in improving the technical competence of the participants (Figure 3).

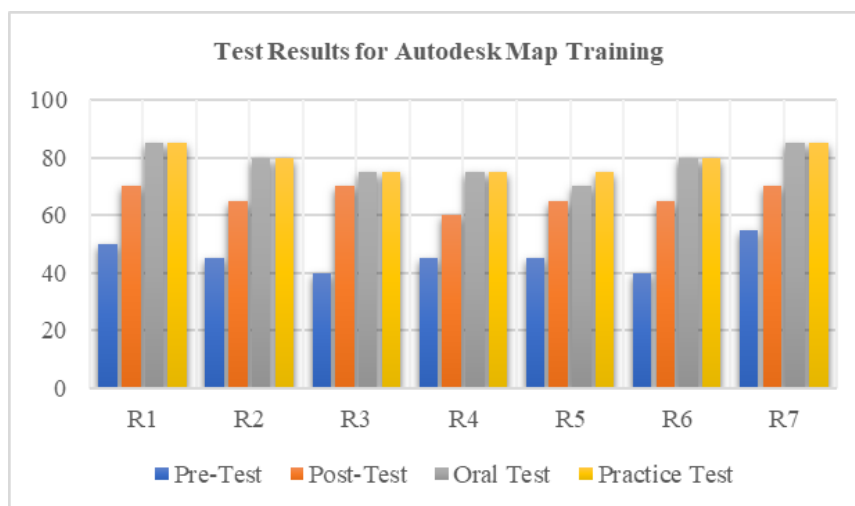


Figure 3. Use of Autodesk Map Software

This improvement shows that training methods consisting of lectures, discussions, and hands-on practice can have a positive impact on students' ability to master complex technologies such as GIS. The ability of students to map the environment around the Islamic boarding school. This process involves the use of GPS devices for the capture of coordinate points, which are then integrated into the GIS software for analysis and visualization (Dhinsa et al., 2022; Elbeih, 2021; Elboshy et al., 2022). This experience provides students with a deeper understanding of how GIS technology can be used to solve real problems they face.

Further discussion shows that the use of GIS in the pesantren environment is not only beneficial for the development of students' technical skills, but also provides benefits in the management of the pesantren environment as a whole. This technology can play an important role in improving the quality of life and environmental sustainability of Islamic boarding schools (Alqahtany, 2023; Bedair et al., 2022; Çetinkaya et al., 2022). This GIS training also has an impact on improving students' critical and analytical thinking skills. In the process of data collection, analysis, and visualization, students learn to identify problems and find solutions based on existing data. GIS is not only a tool for creating maps, but also an analytical tool that can help in data-driven decision-making (El-Hadidy & Morsy, 2022; Erdem et al., 2021; Ghoneim et al., 2022). This shows that GIS training can increase the capacity of students to become agents of change who are more critical and solutive in dealing with environmental problems. It is very relevant to the goal of pesantren to educate students to become individuals who are not only spiritually superior but also have practical skills that are useful to society (Gupta et al., 2022; Gürtekin & Gökçe, 2021; Isihak et al., 2022).

However, there are several challenges faced during the training process. One of the main challenges is the limitation of adequate hardware to support training. In some practice sessions, students have to share computer devices, which sometimes hinders the learning process due to limited time for independent exploration. In addition, limited internet access is also an obstacle in downloading

spatial data needed for analysis activities. Therefore, additional support, both in the form of hardware and infrastructure, is needed to ensure that GIS training can be carried out more optimally in the future (Khalil et al., 2021; Kumar et al., 2022; Larkin et al., 2021).

Overall, the results and discussions of the GIS training at the Rahmatullah Lempake Islamic Boarding School in Samarinda show that this training has succeeded in improving the knowledge and skills of students in using GIS technology. This positive impact can be seen from the ability of students to map and analyze spatial data relevant to their surrounding environmental conditions, as well as the improvement of critical thinking skills and initiative in the use of GIS. With better infrastructure support, this training has the potential to have a greater impact on student empowerment and sustainable management of the pesantren environment (S. Li et al., 2022; W. Li et al., 2021; H. Liu et al., 2021).

IV. CONCLUSION

The Geographic Information System (GIS) training at the Rahmatullah Lempake Islamic Boarding School in Samarinda succeeded in improving the knowledge and skills of students in understanding and applying GIS technology for environmental management. Through a lecture, discussion, and hands-on practice approach, students are able to conduct basic mapping and spatial analysis that is relevant to local needs. This training has a positive impact on technological literacy, critical thinking skills, and environmental concern of students, so it is hoped that it can continue to be developed to support sustainable resource management. The training program on Geographic Information Systems (GIS) at Rahmatullah Lempake Islamic Boarding School in Samarinda has successfully enhanced students' knowledge and skills in utilizing GIS technology for environmental management. The combination of lectures,

discussions, and hands-on practice has enabled students to conduct basic mapping and spatial analysis relevant to local needs. The training has significantly contributed to improving technological literacy, critical thinking, and environmental awareness among the students. To further optimize the outcomes of this training, several recommendations can be considered for future development. First, expanding the training materials to include more advanced spatial data analysis and applications of GIS in various sectors, such as disaster management, urban planning, or agriculture, would provide students with a broader understanding of GIS technology. Second, increasing the duration and intensity of the training, including more extensive fieldwork and laboratory sessions, would help students gain a deeper understanding of GIS applications. Third, fostering collaboration with external GIS institutions or practitioners, such as universities or government agencies, could provide access to the latest technological advancements and a wider variety of real-world case studies. Finally, establishing a continuous mentoring program post-training would allow students to further refine their skills and apply GIS knowledge to real-world projects that support sustainable resource management in their local communities.

REFERENCES

- Ahmed, H. G. I., Mohamed, M. H., & Saleh, S. S. (2021). A GIS model for exploring the water pumped storage locations using remote sensing data. *Egyptian Journal of Remote Sensing and Space Science*, 24(3), 515–523. <https://doi.org/10.1016/j.ejrs.2021.09.006>
- Al-Bahrani, H. S., Al-Rammahi, A. H., Al-Mamoori, S. K., Al-Maliki, L. A., & AL-Ansari, N. (2022). Groundwater detection and classification using remote sensing and GIS in Najaf, Iraq. *Groundwater for Sustainable Development*, 19, 100838. <https://doi.org/10.1016/j.gsd.2022.100838>
- Aljenaid, S., Abido, M., Redha, G. K., AlKhuzaei, M., Marsan, Y., Khamis, A. Q., Naser, H., AlRumaidh, M., & Alsabbagh, M. (2022). Assessing the spatiotemporal changes, associated carbon stock, and potential emissions of mangroves in Bahrain using GIS and remote sensing data. *Regional Studies in Marine Science*, 52. <https://doi.org/10.1016/j.rsma.2022.102282>
- Alqahtany, A. (2023). GIS-based assessment of land use for predicting increase in settlements in Al Ahsa Metropolitan Area, Saudi Arabia for the year 2032. *Alexandria Engineering Journal*, 62, 269–277. <https://doi.org/10.1016/j.aej.2022.07.020>
- Bedair, S., Sayed, S. A., & AlMetwaly, W. M. (2022). Enhancing Hybrid Learning using Open Source GIS-Based Maps Archiving System. *Egyptian Journal of Remote Sensing and Space Science*, 25(3), 779–793. <https://doi.org/10.1016/j.ejrs.2022.07.003>
- Çetinkaya, C., Erbaş, M., Kabak, M., & Özceylan, E. (2022). A mass vaccination site selection problem: An application of GIS and entropy-based MAUT approach. *Socio-Economic Planning Sciences*. <https://doi.org/10.1016/j.seps.2022.101376>
- Chowdhury, M. S., & Hafsa, B. (2022). Multi-decadal land cover change analysis over Sundarbans Mangrove Forest of Bangladesh: A GIS and remote sensing based approach. *Global Ecology and Conservation*, 37. <https://doi.org/10.1016/j.gecco.2022.e02151>
- Chukwuma, E. C., Okonkwo, C. C., Ojediran, J. O., Anizoba, D. C., Ubah, J. I., & Nwachukwu, C. P. (2021). A Gis Based Flood Vulnerability Modelling Of Anambra State Using An Integrated Ivfrn-Dematel-Anp Model. *Heliyon*, 7(9). <https://doi.org/10.1016/j.heliyon.2021.e08048>
- Desalegn, H., & Mulu, A. (2021). Mapping flood inundation areas using GIS and HEC-RAS model at Fetam River, Upper Abbay Basin, Ethiopia. *Scientific African*, 12. <https://doi.org/10.1016/j.sciaf.2021.e00834>
- Dhinsa, D., Tamiru, F., & Tadesa, B. (2022). Groundwater potential zonation using VES and GIS techniques: A case study of Weserbi Guto catchment in Sululta, Oromia, Ethiopia. *Heliyon*, 8(8). <https://doi.org/10.1016/j.heliyon.2022.e10245>
- El-Hadidy, S. M., & Morsy, S. M. (2022). Expected spatio-temporal variation of groundwater deficit by integrating groundwater modeling, remote sensing, and GIS techniques. *Egyptian Journal of Remote Sensing and Space Science*, 25(1), 97–111. <https://doi.org/10.1016/j.ejrs.2022.01.001>
- Elbeih, S. F. (2021). Evaluation of agricultural expansion areas in the Egyptian deserts: A review using remote sensing and GIS. In *Egyptian Journal of Remote Sensing and Space Science* (Vol. 24, Issue 3P2, pp. 889–906). Elsevier B.V. <https://doi.org/10.1016/j.ejrs.2021.10.004>
- Elboshy, B., Alwetaishi, M., M. H. Aly, R., & Zalhaf, A. S. (2022). A suitability mapping for the PV solar farms in Egypt based on GIS-AHP to optimize multi-criteria feasibility. *Ain Shams Engineering Journal*, 13(3). <https://doi.org/10.1016/j.asej.2021.10.013>
- Erdem, F., Atun, R., Yigit Avdan, Z., Atila, I., & Avdan, U. (2021). Drought analysis of Van Lake Basin with remote sensing and GIS technologies. *Egyptian Journal of Remote Sensing and Space Science*, 24(3), 1093–1102. <https://doi.org/10.1016/j.ejrs.2021.10.006>

- Ghoneim, S. M., Yehia, M. A., Salem, S. M., & Ali, H. F. (2022). Integrating remote sensing data, GIS analysis and field studies for mapping alteration zones at Wadi Saqia area, central Eastern Desert, Egypt. *Egyptian Journal of Remote Sensing and Space Science*, 25(1), 323–336. <https://doi.org/10.1016/j.ejrs.2022.02.001>
- Gupta, L., Agrawal, N., Dixit, J., & Dutta, S. (2022). A GIS-based assessment of active tectonics from morphometric parameters and geomorphic indices of Assam Region, India. *Journal of Asian Earth Sciences*: X, 8. <https://doi.org/10.1016/j.jaesx.2022.100115>
- Gürtekin, E., & Gökçe, O. (2021). Estimation of erosion risk of Harebakayış sub-watershed, Elazığ, Turkey, using GIS based RUSLE model. *Environmental Challenges*, 5. <https://doi.org/10.1016/j.envc.2021.100315>
- Isihak, S., Akpan, U., & Bhattacharyya, S. (2022). Evolution of GIS-based rural electrification planning models and an application of OnSSET in Nigeria. *Renewable and Sustainable Energy Transition*, 2, 100019. <https://doi.org/10.1016/j.rset.2022.100019>
- Khalil, N., Mhanna, M., & Assaf, E. H. (2021). Horizontal corridor optimization of highway using GIS & CFSC method in mountainous areas. *Egyptian Journal of Remote Sensing and Space Science*, 24(3), 509–514. <https://doi.org/10.1016/j.ejrs.2021.08.008>
- Kumar, M., Singh, P., & Singh, P. (2022). Integrating GIS and remote sensing for delineation of groundwater potential zones in Bundelkhand Region, India. *Egyptian Journal of Remote Sensing and Space Science*, 25(2), 387–404. <https://doi.org/10.1016/j.ejrs.2022.03.003>
- Larkin, A., Gu, X., Chen, L., & Hystad, P. (2021). Predicting perceptions of the built environment using GIS, satellite and street view image approaches. *Landscape and Urban Planning*, 216. <https://doi.org/10.1016/j.landurbplan.2021.104257>
- Li, S., Zhang, M., Yuan, F., Li, X., Wang, C., Long, J., & Jiao, J. (2022). Isotope spatiotemporal analysis and prospecting indication based on GIS in Tibet. *Ore Geology Reviews*, 147. <https://doi.org/10.1016/j.oregeorev.2022.104997>
- Li, W., Winter, P. L., Milburn, L. A., & Padgett, P. E. (2021). A dual-method approach toward measuring the built environment - sampling optimization, validity, and efficiency of using GIS and virtual auditing. *Health and Place*, 67. <https://doi.org/10.1016/j.healthplace.2020.102482>
- Liu, H., Zhang, Z., Chen, T., Yang, J., Li, Q., & He, D. (2021). Simplified Modelling of Transient Ground Potential Rise of GIS in Ultra-high-voltage Substations with Hybrid Reactive Power Compensation. *Electric Power Systems Research*, 199. <https://doi.org/10.1016/j.ejrs.2021.107441>
- Liu, Q., Zhai, G., & Lu, X. (2021). Integrated land-sea surveying and mapping of intertidal zone based on high-definition remote sensing images and GIS technology. *Microprocessors and Microsystems*, 82. <https://doi.org/10.1016/j.micpro.2021.103937>
- Lumbreras, M., Diarce, G., Martin-Escudero, K., Campos-Celador, A., & Larrinaga, P. (2022). Design of district heating networks in built environments using GIS: A case study in Vitoria-Gasteiz, Spain. *Journal of Cleaner Production*, 349. <https://doi.org/10.1016/j.jclepro.2022.131491>
- Massano, M., Macii, E., Lanzini, A., Patti, E., & Bottaccioli, L. (2022). A GIS Open-Data Co-Simulation Platform for Photovoltaic Integration in Residential Urban Areas. *Engineering*. <https://doi.org/10.1016/j.eng.2022.06.020>
- Murugesan, M., Venkatesan, P., Kumar, S., Thangavelu, P., Rose, W., John, J., Castro, M., Manivannan, T., Mohan, V. R., & Rupali, P. (2022). Epidemiological investigation of the COVID-19 outbreak in Vellore district in South India using Geographic Information Surveillance (GIS). *International Journal of Infectious Diseases*, 122, 669–675. <https://doi.org/10.1016/j.ijid.2022.07.010>
- Pepe, M., Costantino, D., Alfio, V. S., Restuccia, A. G., & Papalino, N. M. (2021). Scan to BIM for the digital management and representation in 3D GIS environment of cultural heritage site. *Journal of Cultural Heritage*, 50, 115–125. <https://doi.org/10.1016/j.culher.2021.05.006>
- Quan, S. J., & Bansal, P. (2021). A systematic review of GIS-based local climate zone mapping studies. In *Building and Environment* (Vol. 196). Elsevier Ltd. <https://doi.org/10.1016/j.buildenv.2021.107791>
- Taloor, A. K., Adimalla, N., & Goswami, A. (2021). Remote Sensing and GIS applications in Geoscience. *Applied Computing and Geosciences*, 11. <https://doi.org/10.1016/j.acags.2021.100065>
- Tamiru, H., & Wagari, M. (2021). Evaluation of data-driven model and GIS technique performance for identification of Groundwater Potential Zones: A case of Fincha Catchment, Abay Basin, Ethiopia. *Journal of Hydrology: Regional Studies*, 37. <https://doi.org/10.1016/j.ejrh.2021.100902>
- Turek, T., & Stepniak, C. (2021). Areas of integration of GIS technology and smart city tools. Research findings. *Procedia Computer Science*, 192, 4681–4690. <https://doi.org/10.1016/j.procs.2021.09.246>
- Villacreses, G., Martínez-Gómez, J., Jijón, D., & Cordovez, M. (2022). Geolocation of photovoltaic farms using Geographic Information Systems (GIS) with Multiple-criteria decision-making (MCDM) methods: Case of the Ecuadorian energy regulation.

In *Energy Reports* (Vol. 8, pp. 3526–3548). Elsevier Ltd. <https://doi.org/10.1016/j.egy.2022.02.152>

Wu, X., Xu, C., Xu, X., Chen, G., Zhu, A., Zhang, L., Yu, G., & Du, K. (2022). A Web-GIS hazards information system of the 2008 Wenchuan Earthquake in China. *Natural Hazards Research*. <https://doi.org/10.1016/j.nhres.2022.03.003>

Xiao, Y., Yan, Y., Yu, Y. S., Wang, B., & Liang, Y. H. (2022). Research on pose adaptive correction method of indoor rail mounted inspection robot in GIS Substation. *Energy Reports*, 8, 696–705. <https://doi.org/10.1016/j.egy.2022.03.155>

Yousef, G. A., Elazony, M. A., Abdelsattar, A., Sewailam, M. M., & Elsaid, O. H. (2022). Applying an integrated Remote Sensing-GIS approach in the documentation of handicraft centers at New Valley

Governorate, Egypt. *Egyptian Journal of Remote Sensing and Space Science*, 25(3), 731–739. <https://doi.org/10.1016/j.ejrs.2022.04.004>

Yudhana, A., Sulisty, D., & Mufandi, I. (2021). GIS-based and Naïve Bayes for nitrogen soil mapping in Lendah, Indonesia. *Sensing and Bio-Sensing Research*, 33. <https://doi.org/10.1016/j.sbsr.2021.100435>

Zhang, S., Liu, X., Li, R., Wang, X., Cheng, J., Yang, Q., & Kong, H. (2021). AHP-GIS and MaxEnt for delineation of potential distribution of Arabica coffee plantation under future climate in Yunnan, China. *Ecological Indicators*, 132. <https://doi.org/10.1016/j.ecolind.2021.108339>