Specialist Advisory Group (SAG) on Applications of Artificial Intelligence to Environment Natural Resources & Agriculture Policy, Scottish Government

Workshop Report, 9th May 2024

Authors: Professor Mark J Brewer (Biomathematics and Statistics Scotland) and Professor Georgios Leontidis (University of Aberdeen)

Overview

A new SEFARI Gateway Specialist Advisory Group on AI (AI-SAG) has been created to advise the Scottish Government on the use, future opportunities, risks and regulatory aspects of Artificial Intelligence both as being used or might be applied to support Environment, Natural Resources and Agriculture (ENRA) policy in Scotland. AI-SAG is co-chaired by Professors Georgios Leontidis (University of Aberdeen) and Mark Brewer (Biomathematics and Statistics Scotland).

The SAG's first event was a workshop held in Edinburgh on the 9th May 2024, which brought together a small grouping of AI experts from across the UK, policy advisors from Scottish Government, SAFERI Gateway and colleagues from SEFARI engaged in AI and data science.

The workshop considered key questions, such as what is meant and understood by AI in an ENRA context, issues with data availability and completeness, and the specific ethical issues of data and AI in the fields of environmental science and agriculture. The SAG will ultimately produce a report (or series of reports on specific subjects) to advise Scottish Government on future policy development and evaluation.

The initial findings of this first workshop are described briefly in this report.

Panel Members

The AI-SAG expert panel members were chosen for their specialisms in Artificial Intelligence and its application in relevant contexts. The six panel members are:

- Dr Jessica Enright – Senior Lecturer in Computing Science, University of Glasgow
- Dr Christos Tachtatzis – Reader, Department of Electronic and Electrical Engineering, University of Strathclyde
- Professor Shannon Vallor – Baillie Gifford Chair in the Ethics of Data and Artificial Intelligence at the Edinburgh Futures Institute (EFI), University of Edinburgh
- Professor Elizabeth Sklar – Chair in Agri-Robotics, University of Lincoln
- Professor Kate Jones – Chair in Ecology and Biodiversity, Division of Biosciences, University College London
- **(Not in attendance)** Professor Simon Pearson – Founding Director of Lincoln Institute for Agri-Food Technology (LIAR), University of Lincoln

What is AI?

The four main components of AI are: monitoring; modelling; adapting; and problem solving:

- **Monitoring** involves perception, including the collection of data and knowledge, or "sensing";
- **Modelling** includes knowledge representation, and can require either estimation (describing the current situation) or prediction (describing a future situation);
- **Adapting** is the process of learning or improving over time, most commonly thought of as machine learning (or ML), something often confused with AI in itself; and
- **Problem solving** involves reasoning and decision-making; this can manifest itself in robotic installations or via natural language processing and generative AI.

The skillsets required for each component of AI can vary. For example, modelling and knowledge representation can require data engineering, and machine learning will need programming and statistical expertise.

AI can make statistical predictions based on unimodal, bi-modal or multi-modal training data and support decision-making for people, robots or agents by modelling situations, behaviours and relationships between them. Furthermore, AI can directly improve models over time.

AI is not "common sense", nor is application of AI a guarantee of perfection; human intervention is always necessary at some stage. The effectiveness of any AI intervention will depend on its use and understanding of existing knowledge, the quality of data provided and the methodology used for training. Crucially, not all AI is data-driven.

AI and Policy

AI can be used both for policy development and for the evaluation and monitoring of policy impacts. This addresses a key concern for governments, namely who are the winners and losers of any policy intervention; a sound evidence-base for assessment of policy impacts – both before and after implementation – is where AI can help. AI can be seen as a broad toolbox and group of methodologies or approaches, rather than an endpoint in itself.

The use of AI in policy contexts needs to be handled with care. The use of AI is not without its controversy, and trust in AI is low in some sectors of the population. There has been a wider public move in opinion against the use of AI and "big data", being seen as invasive and detrimental to privacy, in particular in light of the widespread use of generative AI systems, such as ChatGPT, Claude, Meta Llama, Microsoft co-pilot, and others.

For these reasons, application of AI in policy formulation and assessment would need careful handling, with appropriate communication and demonstration of its benefits. Overall, the questions should be:

- Can AI help in a given situation and in what way?
- Should we use AI, given associated costs and potential privacy or ethical concerns?
- How can the use of AI and perceived benefits of AI be demonstrated and sold to relevant audiences, be they ministers, stakeholders or the general public?

Common misconceptions view AI as a "monolith", whether as another term for machine learning, for robotics, or – as is currently in vogue – as a particular example of a large language model (e.g. ChatGPT). These misconceptions present barriers to the acceptance of using AI in government, as do disagreements on definitions of AI. Unrealistic expectations are a further problem, as leaders can ask for an "AI solution", without establishing what this means or even whether applying AI is the best path for finding a solution.

AI and Data Ethics

Ethical concerns over the use of AI and the management and collection of associated data sets have received a lot of attention in all forms of media, and the hype around tools such as ChatGPT has created concern over what some see as "plagiarism".

While there has been a considerable amount of research into the ethics of AI to date, this has been based almost entirely on an "individual-based" model of risks; there has been correspondingly little research or discussion on the risks associated with AI in ENRA-related contexts, whether environmental, agricultural, or on animal and plant health.

An assessment as to the worth of AI for ENRA must ask questions such as:

- What is the problem at hand?
- What will the AI intervention be doing?
- What are the costs and benefits, both financial and environmental, of AI compared to alternatives?

The fact that AI is not a single method but a general concept – with very many different tools and techniques at each stage – means that this assessment is a complex process. Sadly, there are vendors of "AI tools" who ignore the questions above to promote certain products – the pressure comes from imparting a feeling of being "left behind" if AI is not employed.

Academic research has a long-standing approach to ethics; however, most ethical concerns regarding data have tended to relate to personally identifiable data. Existing concerns centre on bias in training data (especially in terms of gender and ethnicity), and the corresponding bias which is transferred to outputs produced from those data. Of course, data in an ENRA context – including agricultural or environmental – may pose new and different ethical questions, and solutions cannot simply rely on GDPR, for example.

Furthermore, new research is needed to ask questions as to the ethical implications of using AI in research, if that use consumes large amounts of resource (such as is necessary for storing huge quantities of data or for processing data and running very large computer models). It would be ironic indeed if research into the effects of climate change actually contributed to the problem due to excessive energy use. In summary, there needs to be a complete reshaping of the ethics of collection and use of data in an ENRA context.

Next Steps

The AI-SAG recommends that ENRA and RESAS move to consider specific sectors and application areas to provide clear focus for discussions, as well as highlighting technical matters of concern. Representatives of governmental and agency bodies can be consulted and included in relevant future activities of AI-SAG; these could include NatureScot, SEPA and the Marine Directorate, as well as others.

Particular topics for further examination identified at the workshop included:

- o Providing an introduction to a suite of tools associated with AI and establishing an accepted, collective definition;
- o Research into ENRA-specific ethical issues, especially on sources of bias;
- o A study into the environmental impact of the entire lifecycle of AI adoption in a specific setting or use case; and
- o Providing a worked example of the overall application of AI with the ENRA portfolio.

At the workshop, the topic of AI and data in biodiversity assessment received attention, from both government representatives and expert panel members. A common theme was around data gaps, and the possibility of using AI to support the collection and processing of data to plug those gaps. This is just one possible application focus area, although if a wider, systems approach were taken, the impact could be wider than "just" biodiversity assessment.

In terms of skillsets, the SEFARI and the Scottish University sector have considerable resource, experience and expertise in the application of AI methods to problems within ENRA – even if the term "AI" has not always been applied to such work. This includes AI researchers, application-area experts and applied quantitative specialists in statistics and modelling as applied to finding solutions to ENRA's questions.

Scotland is thus well equipped to make a start in supporting ENRA in applying AI, and to identify skills gaps and further training needs to make the best use of opportunities for collection, analysis and interpretation of data.