IDEMS International Annual Report 2020

1 February 2020 – 31 December 2020

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Directors' Forward

2020 was an incredibly difficult and challenging year for everybody. The impacts of the Covid-19 pandemic on lives and livelihoods across the world was huge. We consider ourselves to be extremely fortunate and our thoughts are with the many who have suffered through these difficult times. We have had to become more inward looking to adapt but we are proud that we have also managed to contribute in small ways to help others affected by the pandemic.

We did feel the impact of this year, both personally and as an organisation. Most notably, we very sadly lost our friend and colleague Zobinou "Zed" Mawusi in May 2020. Zed had been supporting agriculture research projects to achieve better outcomes in the West Africa region for over 10 years and was a close personal friend to some of us.

When the pandemic hit in March 2020 much of our usual work, which relied on face-to-face interactions in Africa, disappeared overnight as international travel was halted. We had to rapidly reinvent ourselves to survive. We were fortunate to be able to extend aspects of our work which could be carried out remotely, most notably development of digital solutions. We took the initiative to support our partners technology needs during the lockdowns, and there were instances where additional funding followed. These relationships of shared responsibility enabled much needed flexibility during these uncertain times.

At the beginning of 2020 we employed our first full-time team members, which came with a notable increase in responsibility for us as directors. This coincided with additional responsibilities in projects with bigger partners aiming to work at large scales with big impact, which further increased pressure to deliver. The timing of this increased responsibility made it a baptism by fire due to the impact of the pandemic. Although there have been growing pains along the way, we are pleased to have made this institutional leap.

The shift to remote working affected the support offered to our partners in Africa. Capacity building efforts that we would usually do in person were no longer possible. We continued to engage them by finding components of the work they could take responsibility for and supported them to mitigate the effects of the pandemic, backstopping their cash flow. However, we recognise that the shift to remote work was much more challenging in their environments.

In 2020 we prioritised responding to emerging needs brought on by the Covid pandemic which affected our previous social impact focus on capacity building of African partners. The urgent needs emerging during lockdowns were varied and we responded whenever we could. This included offering our expertise in developing remote learning tools and open education resources to partners in the UK and beyond. Highlights included support for a remote learning GCSE to A level bridging course for mathematics in UK schools and the creation of a phygital ecosystem to support virtual maths camps in Africa.

We were set for a year of breakthroughs and growth in 2020, with our largest contracts to date secured and a busy schedule in place. We came out of the year having maintained growth, taken on a manageable debt from an essential cash flow loan and survived the transformation of our work with a positive outlook for the future. We enter 2021 under pressure to deliver on our big projects and maintaining growth will be essential to meet our expanding commitments. We are seeing our growth translate into increased impact potential, and this is what drives and motivates us in our work.

Overview

About IDEMS

IDEMS International (IDEMS) is a not-for-profit company devoted to Innovations in Development, Education, and the Mathematical Sciences. Our mission is to work collaboratively with diverse partners to enable the evolution of innovations which can impact lives all over the world.

IDEMS International was founded in 2018, by mathematical scientists with long term experience working in education and development, looking to achieve wider impact beyond academia. We are passionate about projects related to development, education, and the mathematical sciences, and particularly work that can impact more than one of these areas. As a company we are motivated by our social mission, transparency in our accounting and guided by our principles.

IDEMS International is legally registered in the UK as a Community Interest Company. This structure enables us to be defined by the communities we serve while doing business commercially. Serving a community gives us a sense of purpose beyond our own self-interest as individuals, or even as a company.

IDEMS International supports and collaborates with INNODEMS, which was established by our partners in Kenya in 2019. INNODEMS follows a similar business model to IDEMS International as a route to creating sustainable opportunities for our Kenyan colleagues.

Our Team

This was a transformative growth year for our team. At the end of 2019 we welcomed our first additional full-time employee in the UK. By the end of this year, we had a further two full time employees in the UK, making a total of five, plus a UK-based subcontractor and new collaborators in Italy, the Netherlands, and the USA. The Kenyan teams we support also expanded, and we gained an additional collaborator in Uganda. We also continued working with team members in West Africa, with Francis in Ghana, and with Zed, in Niger, who sadly passed away in May 2020.

In 2020 we launched our Post-Doctoral Impact Activation Fellowships, which saw us recruit two recent PhD graduates to work with IDEMS. These fellowships provide opportunities for PhD graduates to convert their academic expertise into skills which are of value to socially impactful initiatives, while also having opportunities to engage in research activities.

We ended the year by launching a new recruitment process to expand our software development team, both for a specific upcoming project, and for our growing general software development needs.

In May 2020 we were saddened by the sudden loss of Zobinou "Zed" Mawusi. Zed was our Research Methods Assistant for the Collaborative Crops Research Program in West Africa. Zed provided vital local support to the projects in Niger and the West Africa region, to complement the international based support. He was dedicated in his work and valued the importance of his role in improving agriculture research in the region. Zed was an extremely friendly and supportive person, who was always fun to be around and well respected and appreciated by all those who interacted with him. He is greatly missed.

Major activities

In 2020 there was an increase in activities related to open source software development. This became our largest area of work, overtaking our consultancy work. Parenting for Lifelong Health (PLH) Digital, consisting of the design and development of a parenting app with the University of Oxford and other partners, became our largest single project. It was continuously stimulating and challenging work which adapted to the challenges of Covid. The project helped drive organisational growth, enabling us to build our technical team. This has opened a whole new area of meaningful work and collaborations which we value highly.

Consultancy contracts remained as a core component of our work as we continued ongoing relationships with our collaborators. A highlight was establishing a three-year agreement based with the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT) to support training on climatic analysis, including with R-Instat. This work has enabled us to develop training materials that could serve a wide user base going forward.

There was a big demand for our community work this year, particularly due to Covid disruptions. However, it was difficult to adapt to the changing needs, so not all interventions were impactful. The most successful intervention was actually for a UK school where we supported remote learning of mathematics. Our biggest effort was to work with the charity Supporting African Maths Initiatives (SAMI) to create a virtual maths camp to replace the cancelled camps across Africa. We also put a lot of effort into 'Soma Nyumbani', an imaginative initiative to support Kenyan teachers who were required by the government to provide home study learning to mitigate the Covid disruption of schools. Just as this started getting used by teachers but before the impact could be felt, the Kenyan government changed the policy and schools reopened, highlighting the challenges of emergency responses.

Finances

IDEMS International ended year three with a small surplus for the third consecutive year. We had an increased turnover of £310,000 and a surplus of £9,400 after impact investments and donations. Our full accounts are provided for transparency.

The Covid-19 pandemic changed many of our activities and ways of operating this year, most notably with a large reduction in travel and subsistence costs compared to last year. To support cash flow during the pandemic, we obtained a £50,000 coronavirus Bounce Back Loan Scheme.

We expanded our team in response to new work with staff and subcontractor costs increasing from last year.

Creditors amounts and cash in hand are high as we are currently holding multi-year grant funds in a dedicated account, which includes unspent funds due to Covid disruptions.

We donated £2,900 to the charity Supporting African Maths Initiatives (SAMI). £2,000 of this was unrestricted, and £900 was to support maths camp activities.

We provided a zero-interest loan of £13,700 to INNODEMS, our partners in Kenya, to help them establish and build up their team and activities. We also invested in education activities in the UK and Africa as emergency responses to Covid.

Reflection points

Our diverse project ecosystem makes us resilient

We have deliberately built up a diverse portfolio of projects. This came largely from our experience working in Africa where the operating environment can change suddenly and unpredictably. This diversity served us well when the pandemic hit as we were able to rebalance our efforts. A lot of work was simply put on hold, which enabled us to increase our investment support where the Covid-19 situation was placing high demand on our partners. Our response to the impacts of Covid led to further diversification of our portfolio which we hope will, in turn, increase our ability to adapt in the future.

Our recruitment strategy can be refined

Our growth and recruitment carried out this year helped us more clearly understand the types of team members we can enable to thrive within our structures at this stage of the organisation's life cycle. Our projects require solving novel and challenging problems, which are often hard to constrain or clearly and require an appreciation and experience of dealing with complexity. We found these characteristics in academics, familiar with innovative work, and in industry veterans, with a history of working on complex projects, and these two groups generate synergies when working together. This insight informs us as we enter our next recruitment cycle.

Debt is a useful growth supporting tool

At the start of 2020, we had low debt levels and our perception of debt was largely negative. As we end the year having grown and looking to maintain growth over the next few years, we have begun to recognise the value of debt as a useful tool to support cash flow while enabling growth. The effects of Covid triggered cash flow issues in mid-2020, which were solved through a Coronavirus Bounce Back Loan. Despite the fact that we remained profitable over the year, the additional debt was essential in supporting operations during unpredicted invoicing delays. We appreciate the usefulness of sensible, well managed debt, and we are now open to considering further debt options as part of our growth plans in 2021 and beyond. For example, we could consider a loan to fund additional Post-Doctoral Impact Activation Fellowships, this would enable recruitment of talent, and time to get fellows ready for new projects, supporting further growth.

Looking ahead

We expected the first 6 months of 2021 to be intense. We need to meet the deadlines of our new and existing contracts, most notably with the University of Oxford and UNICEF, while continuing to build our reputation for quality and reliability. Achieving this would solidify our growing partnerships and prepare us to take on further challenges. We are continuing to expand our team to support this and other work and have started an open recruitment process for this.

We hope that the second 6 months of 2021 will be a period with fewer urgent deadlines, enabling us to consolidate, focus on longer-term projects and investment activities. This should also give team members the time and space to develop skills and pursue projects of personal interest. We expect to end 2021 larger and more mature, with improved structures and processes that are appropriate for the increased size and complexity of our organisation. 2021 should be a year of consolidation, following this year's transformation.

Activities

Open source products

Parenting for Lifelong Health Digital

September 2019 – present

Funded by: University of Oxford

Parenting for Lifelong Health (PLH) is a suite of open access, non-commercial parenting workshop programmes, developed by the University of Oxford and other collaborators, including WHO, Clowns Without Borders South Africa (CWBSA), UNICEF and the University of Cape Town, South Africa. Workshops for parents and their children using the PLH resources have been run by various non-governmental organisations around the world to support families in their communities. Studies have shown that the workshops have many positive effects on the families that attend them, improving mental health and wellbeing and reducing violence in the home. Programmes are now being scaled in several countries but the demand for these programmes far outweighs the capacity to reach everyone through face-to-face workshops.

PLH Digital will extend the reach and impact of these efforts by creating a free mobile PLH app, based on existing PLH resources, with the potential to reach millions of families. IDEMS is leading the development of the app in this long-term project, spanning four years, and including multiple co-development and testing cycles across countries with a formal randomised controlled trial to support rigorous evidence and research outputs. The app will be a low-data offline-first application that will work on the most basic smartphones to ensure it can reach as many families as possible and those most in need. We are also including a significant amount of capacity building within the project to enable our partners in Kenya to contribute to the software development of the app and take a key role in the project.

Following the co-development workshop in January 2020 to conceptualise the app, software development workshops were planned for early 2020 to begin creating the app. However, these plans were disrupted by the pandemic and the UK and Kenya software developments teams were forced to collaborate remotely instead. Plans were adapted and remote development workshops were held followed by development cycles. Considerable work was done to develop the app in 2020. A first alpha version of the app was created in September/October 2020. Feedback from this, led to a re-development process and updated version of the app at the end of 2020 with a modified user experience and improved look and feel.

This is a long-term project and the app development work will continue in 2021 as we move to piloting the app in preparation for research trials.

This project is challenging work for our team as we are involved in a broad range of activities including the conceptualisation, design and development stages. We have included elements of human centred design in the processes which we believe will lead to better final outcomes, however this approach is also challenging as it often leads to changing specifications and re-designs. This is a large project and we are extremely excited by the potential to scale out and support families all over the world. This project is also enabling IDEMS to grow its

technical team, in the UK and through partners in Kenya, which will support the development of this project and allow IDEMS to take on new app and software development projects in the future.

Development of the Internet of Good Things (IoGT)

August 2020 – present

Funded by: University of Oxford and UNICEF

The Internet of Good Things (IoGT) is a UNICEF initiative and set of websites which make life-saving and life-improving information (maternal health, hygiene, emergency information on diseases, HIV and sexual health advice for adolescents, internet safety, positive parenting techniques and more) available for free even on low-end devices in over eighty countries. IoGT includes multimedia elements and two-way communication features, used to capture feedback and local best practices from communities.

We were introduced to IoGT through our collaboration with the University of Oxford on PLH Digital. The overlap between PLH and IoGT in terms of its user group and technologies was immediately obvious to us and we started to investigate the potential for collaboration. As technical advisors for the PLH Digital ecosystem we also started to interact with IoGT in country meetings related to integrations with the PLH RapidPro chatbot.

In August 2020, we were contracted to update the existing version of IoGT to fix data and security issues in the existing version due to outdated dependencies. This involved investigating issues related to a Python upgrade and implementing a small set of enhancements to the IoGT codebase.

Through this contract we learned more about IoGTs vision, user requirements and deployment. We also gained an understanding of IoGT's architecture, technologies and design constraints. We are looking forward to continuing work on IoGT in 2021 where we have been contracted by UNICEF to develop IoGT version 2. This version will upgrade the codebase to the latest technologies, and implement new features, particularly for interaction with users such as quizzes and chatbot integration. It will also have a new design which is adaptive to device type, including support for feature phone users.

Development of R-Instat

January 2018 – present

Funded by: IDEMS community work

IDEMS is committed to supporting the open source development of R-Instat, a front end to the popular statistics language R, conceived for and developed primarily in Africa. It was instigated by the African Maths Initiative (AMI) as part of their collaborative African Data Initiative (ADI) project to support data having a transformative role in African development and education.

IDEMS continues to support the development of R-Instat, through contributions to the source code, often linked to other projects which use custom functionalities in R-Instat. We also continue to provide support and mentorship for the developers within AMI and now INNODEMS. We actively look for contracts which can raise funds to support the development team in Kenya, and IDEMS has taken on a responsibility to source this continued funding stream.

Over the last year, R-Instat has continued to be recognised by various international groups, the World Meteorological Organisation (WMO) and EUMETSAT, for the analysis of historical climatic data, including satellite and reanalysis data. During 2020, we also produced a vision document outlining our long-term ambitions for R-Instat for the analysis of climatic data. The vision includes ideas for making R-Instat accessible on more devices, including Linux, as well as providing remote access options. The vision also includes aspects, such as an improved user interface, which will help to position R-Instat as a tool suitable for wider international audiences. The vision has helped us to align our long-term strategies and could help us to obtain support from other organisations who want to support us in achieving this vision.

R-Instat continues to be used for a variety of other applications, including in statistics courses for university students, in the analysis of agricultural research data and for the analysis of public procurement data.

In the long term, we are committed to supporting R-Instat and the ADI project in its aims to transform statistics education across Africa to be more relevant and data focused, and more broadly to see data being used to support better decision making for development in Africa and elsewhere.

Development of Climsoft

January 2018 – present

Funded by: UK Met Office and IDEMS investment

IDEMS continues to support the development of Climsoft, an open source Climate Data Management System (CDMS). Like R-Instat, Climsoft was developed primarily in Africa, for an African audience, and was developed for the African national meteorological services.

The UK Met Office has been a long-term supporter of the Climsoft project, and they continue to fund IDEMS to contribute to its development. With the support of the UK Met Office, we mentor developers in Kenya to enable them to contribute to the development of Climsoft. This is driven by our belief in developing talent in Africa and our commitment to ensuring that Climsoft remains primarily an African product.

In 2020, work towards Climsoft v5 continued, however this was partly disrupted due to the pandemic. Discussion on the new OpenCDMS project and its progress in 2020 also led to a decision to delay larger changes to the Climsoft codebase in favour of solidifying the existing version and enhancing its existing features. Countries continued to use the current Climsoft version for new installations and for upgrading outdated installations.

We are excited by the Climsoft work because we know how important it is for African meteorological services to have access to products that match their data management needs. We are also pleased that we have helped position the Climsoft project as an important partner on the OpenCDMS project. Both projects share an aligned vision to provide a sustainable long-term solution that will enable meteorological services around the world to make better use of their historical data.

Development of OpenCDMS

June 2020 – present

Funded by: UK Met Office and World Meteorological Organization (WMO)

In 2019, through our work on Climsoft, IDEMS was involved in discussions on OpenCDMS. The OpenCDMS Project is a community of collaborators who are working together to address Earth system data management needs of developing and developed countries by setting and implementing global data management standards and good practices. The project is focused on the development and application of recommendations, best practices and standards intended for all climate data management systems and also the support and creation of free and open source software solutions to assist with implementation. It is a long-term project with the aim that the full OpenCDMS software will be available by 2025, with a development roadmap provided to achieve that aim. The Climsoft and R-Instat teams agreed to be part of the OpenCDMS project and work to make these tools compatible and in some cases integrate into OpenCDMS.

This year, IDEMS was involved in a number of activities to support OpenCDMS. These included contributing to the OpenCDMS DataAPI specification and prototype, and supporting the design of the OpenCDMS process library. In particular, the IDEMS team delivered a proposed grammar to serve as a framework for the Process library and all its processes; a fully documented list of processes from R-Instat and Climsoft to be implemented in the OpenCDMS Process library with prioritisation for implementation; implemented initial R-Instat processes in the Process Library Python codebase, contributions to discussions on the general structure for processes (in line with the proposed grammar) to ensure a consistent, modularised approach is taken; and a documented proof of concept for the PICSA app (https://picsa.app/) as a use case of the OpenCDMS Process library.

We are excited to be involved in a large, international effort, which aligns with the aims of our existing work on Climsoft and R-Instat, and has the potential to have global impact. We look forward to continuing to support the OpenCDMS project however we can in the years to come.

Support for CAST (Computer Assisted Statistics Textbooks)

July 2019 – present

Funded by: IDEMS community work

CAST (Computer Assisted Statistics Textbooks) is a collection of free electronic textbooks. CAST is highly interactive, with dynamic graphics, animations and randomised exercises that give automated feedback. CAST's approach is highly data focused with many example datasets used to demonstrate concepts in a practical way.

The IDEMS and Stats4SD teams have been involved in the use and development of CAST for over 10 years. Using CAST for teaching statistics in Kenya has shown evidence of improved student performance and motivation for statistics.[1] In the past, we have contributed to the development of CAST textbooks with African examples and climatic statistics textbooks. In 2019 we funded continued development of CAST with the aim of CAST becoming an open source project which can attract developers to sustain the project in the long term.

The pandemic disrupted plans to support further development in 2020, however, we are still eager to continue to support the maintenance and development of CAST and to see it reach the potential we believe it has. Huge effort has been put into developing the content, animations, interactive graphics, randomised exercises, and

[1] http://icots.info/9/proceedings/pdfs/ICOTS9_8J2_ZACHARIAH.pdf

feedback over more than 10 years. Now that CAST is officially open source with its codebase hosted on GitHub, there is potential to enhance its feature and make it more accessible to a wider audience e.g. by being mobile friendly, so that it can continue to support improvements to the teaching and learning of statistics.

Consultancy contracts

Research methods support for projects in the McKnight Foundation's Collaborative Crop Research Program (CCRP), West Africa

January 2018 – present

Funded by: McKnight Foundation's Collaborative Crop Research Program

With our partner, Statistics for Sustainable Development (Stats4SD), IDEMS offers support for research methods (statistics and data) to agriculture research projects funded by the McKnight Foundation's Collaborative Crop Research Program (CCRP). IDEMS leads on the support for the West African projects, a collection of agriculture research projects across Niger, Burkina Faso, and Mali. The projects we support in West Africa aim to improve access to local, sustainable, and nutritious food through collaborative research and knowledge sharing with smallholder farmers, research institutions and development organisations.

It is challenging and diverse work for our team. Our work involves supporting projects in the whole research process—from design and collection through to analysis and communication. This is often achieved through in-country and regional workshops, data clinics, tailored training courses to stakeholders, inception and community of practice meetings, and online remote support.

This year was heavily affected by Covid. Pre-pandemic, a highly successful Community of Practice (CoP) event was held in France, which brought together all West African research projects and support and leadership teams as a sharing and collaborative event. After March, much of the planned activities within the West African region were disrupted. All face-to-face events were cancelled and this was particularly disruptive for the research projects on the ground. Most noticeably, project inception meeting, which would be facilitated by the research methods and support teams, largely did not take place. One notable exception was an extended, remote process that took place with one project to define their theory of change. Although, we could not meet projects face to face, our support continued remotely and we maintained connections with all the projects. The monitoring tour, which usually involves a tour of project sites visiting their fields and farmers, still took place but remotely and in quite a different form as everyone adapted to the current situation.

Despite the challenges this year, this work continues to be stimulating for us because of the efforts CCRP is making to put Farmer Research Networks (FRNs) at the centre of the research programme. From a research methodology perspective this is exciting as it is leading to science that tackles more complex multi-faceted problems. This requires a reinvention of research approaches which embrace large scale farmer experimentation with highly variable social and physical contexts. In many cases we are challenged to adapt and reinvent research methodologies that can be implemented at scale while staying true to core scientific principles. This often involves letting go of many of the traditional notions of 'rigor' and embracing the power of bigger data.

During the year, we sadly lost our colleague Zobinou "Zed" Mawusi. Zed was our Research Methods Assistant based in Niger. He had been involved with supporting CCRP projects in the region for over 10 years and was a close friend to some of us over many years.

Looking ahead to 2021, we expect that the current challenges are likely to remain, and we will continue to interact with projects remotely. In order to better support the projects on the ground, we are also investigating how we

can build capacity within the region e.g. through recruitment/internships, to provide complementary local research methods support and our current remote-based support.

Support for user training on R-Instat for climate data analysis

March 2020 – present

Funded by: EUMETSAT

With our partner, Stats4SD, IDEMS supports training events organised by the EUMETSAT on climate data analysis, particularly using the R-Instat statistics software.

The Satellite Application Facilities of EUMETSAT provide free access to vast amounts of historical and current satellite climate data. These data have the potential to greatly improve our understanding of the climate and improve climate services offered by meteorological services and other organisations by complementing existing networks of ground stations. The data provided include estimates of radiation, sunshine hours, land surface temperature, vegetation cover and many other parameters.

In previous years, training events have been in the form of face-to-face workshops attended by staff from national meteorological services, researchers and university lecturers. Stats4SD and IDEMS supported EUMETSAT in these workshops by introducing R-Instat to participants as a way of easily working with satellite data (NetCDF files) and ground station data (various formats) to allow comparisons of satellite and ground truth data, as well as other facilities. IDEMS also supports participants in the use of R, particularly the CM SAF R Toolbox, which is tailored to CM SAF satellite data.

We are excited about this collaboration with Stats4SD and EUMETSAT because of the potential huge role of satellite data in Africa where ground measurements are sparse and often of poor quality (many missing values). Satellite data has the potential to give estimates of the climate in places far away from a ground station, or to fill gaps in ground station data to make them more usable. Understanding the potential of satellite data and its usability by comparison with ground measurements opens the use of satellite data to a wide range of applications, from agriculture and health to renewable energy. We are also pleased to be developing training materials on R-Instat with EUMETSAT, which can have wider distribution for R-Instat users, and to be developing Linux-based and cloud-based R-Instat solutions, which could also open up the R-Instat user base.

Parenting for Lifelong Health Covid Response

June 2020 – Present

Funded by: University of Oxford

Through our work on Parenting for Lifelong Health (PLH) Digital in developing a mobile app, we were approached by the University of Oxford team to provide support for the Parenting Covid response. During Covid, there was a huge demand for parenting resources, particularly in places where lockdowns were enforced as this increased family stress and the risk of domestic violence.

Our role in their Covid response was to redevelop the Covid-19 Parenting website, making resources available through and to support the development of ParentText, a chatbot based messaging intervention.

ParentText was developed using the RapidPro software. PLH content was packaged into a format accessible through a question-and-answer messaging system so that parents could access the resources they needed easily by messaging with the chatbot. Our role was to set up the structures and system for hosting this content in the chatbot and to then implement the chatbot features using the content provided.

The second component of this work was supporting the Covid-19 Parenting website, which had seen high demand during the pandemic. The website hosted "tips sheets" which provide evidence-based playful parenting tips on a range of parenting topics including talking about Covid-19 with your children, dealing with remote learning, managing stress, staying positive and structuring one-on-one time with your children. As well as redesigning the website which hosted these, we also managed the translation of the tips sheets into over 100 languages.

We were very happy to be able to contribute to a meaningful Covid response project. This was a very demanding and at times stressful project, as the turnarounds and deadlines were very short because this was an emergency response that needed to reach people quickly. We are proud to be part of an initiative which has now reached almost 200 million people around the world.

Supporting PICSA in Mozambique

August 2019 – present

Funded by: University of Reading

The Participatory Integrated Climate Services for Agriculture (PICSA) project is a highly successful participatory extension approach, developed by researchers at the University of Reading. PICSA makes use of historical climate data, forecasts, and farmers' knowledge of what works in their own context, with participatory planning methods to help farmers make informed decisions about their agricultural practices. IDEMS supports PICSA, particularly on the climatic data component, by working with local partners, often the national meteorological services, to analyse historical daily climatic data to provide the local climate information.

In 2019, we supported the implementation of PICSA in Mozambique by helping to run the "training of trainers" workshops. In 2020, our work focused on activities to support the national meteorological services of Mozambique. Due to the limitations of ground station data, satellite data could become an important component of providing climate services to farmers in Mozambique. To support the use and understanding of satellite data, we implemented new features in the R-Instat software for working with satellite data. These features allowed easy production of graphs and metrics that compare station and satellite/reanalysis data. We also added features to allow satellite and reanalysis data to be directly accessed and downloaded from within the software. These features will support the staff at the national meteorological services of Mozambique, and other users of R-Instat, to access, work with and understand the potential for satellite data more easily.

In 2021, we are looking forward to continued work related to PICSA in Mozambique. We will be providing support in understanding new methods for developing a seasonal forecast in Mozambique and exploring how this can be communicate and understood for agricultural uses. We will also continue to work with the national meteorological services of Mozambique in evaluating satellite and reanalysis rainfall estimates in comparison with ground station data.

Supporting recruitment for surveys on attitudes towards corruption in four African countries

August 2020

Funded by: Nottingham Trent University

Through our previous work with the University of Sussex on data-based approaches to understanding corruption risks, we were approached by colleagues at the Nottingham Trent University to support the recruitment of participants in Africa for surveys on attitudes towards corruption risks.

The pandemic disrupted their original plans of having the surveys carried out face to face within communities across Africa. The surveys were then redesigned to be conducted online. We were approached to support the recruitment of participating students in four African countries because of the strong connections we have across Africa. We also had trusted local partners within each of the countries who could administer the small payments to participants through mobile money for completing the survey.

We were happy to provide support to a research project that was attempting to advance knowledge of understanding of corruption risks, which also had ethical clearance to be carried out and supported the survey participants within the countries by providing a small payment for their time and internet costs.

IDEMS community work

A Level Mathematics bridging course for UK Schools

Covid disruptions in the UK this year led to school students learning from home for long periods of time, and end of year exams being cancelled. Teachers we were in touch with were particularly concerned about students how students who were completing these GCSEs and moving onto A Level Mathematics in the following year would cope with this transition, which can be challenging even in a normal year.

To address this, we worked with maths teachers to develop a free, online A Level Mathematics bridging course designed to prepare students making the transition to A Level Mathematics. The course was created in Moodle and included a variety of resources including interactive questions in STACK, GeoGebra activities, useful links and other materials.

The course was shared freely with a number of schools during the year. Feedback from the teachers and students highlighted in particular the appreciation for the interactive questions which allowed students to practice and test their understanding. This is mentioned as being a particularly engaging and unique component of the course. This feedback aligns with feedback we have received in implementing interactive STACK questions for university courses across Africa, and we are delighted to be able to provide support to UK-based students this year.

Support for African Maths Initiative (AMI)

January 2018 – present

IDEMS has a strong connection with African Maths Initiative (AMI), a Kenyan NGO formed by mathematicians and mathematics educators working to create a stronger mathematical community and culture of mathematics across Africa at all academic levels. IDEMS has collaborated with AMI on consultancy contracts and open source software development projects. IDEMS also plays a role in mentoring junior staff in AMI. These activities are important aspects of our commitment to build capacity in Africa.

This year, we supported the transition of some of the interns from AMI into the newly created social enterprise, INNODEMS. INNODEMS will also play a supporting role to AMI, and IDEMS continues to support the activities and interns within AMI.

We began the year spending substantial time within Kenya supporting a variety of activities described below. The pandemic prevented us spending more time in Kenya throughout the year, which limited the effectiveness of our capacity building efforts, however, we were able to continue engaging and supporting remotely.

At the beginning of 2020, in collaboration with AMI, we launched a new, innovative 21st Century Skills course for Kenyan high school leavers. AMI recognised that the gap between the skills people learn, and the skills people need is becoming more obvious. To thrive in today's world, one must be able to think logically, be data literate, be able to communicate and solve problems. These and other skills could equip different groups of people to succeed in the ever-evolving economies. Hence, in collaboration with AMI, we developed a four-week long residential 21st Century Skills course to equip students with the foundation of skills which are essential for future jobs and opportunities. The course was designed to have an emphasis on the foundations of

coding/programming, data literacy, critical and logical thinking, communication, presentation and media making skills.

The first run of the course took place in January/February 2020 at Manor House Agricultural Centre, for a cohort of 13 students (8 female). Sessions led by AMI, IDEMS and Manor House staff. Participants developed a wide range of skills during the course and there was a mix of dedicated sessions, project time, physical activity and team building exercises. Over the four weeks, participants developed a portfolio of work as evidence of the skills gained during the course. Following completion of the course, a selection of top performing participants were given an internship opportunity with AMI to use their new-found skills to contribute to AMI's software development projects. The course was also run again for a second cohort in March 2020, run largely by the AMI and Manor House team with remote support from IDEMS. Covid prevented further runs of the course this year, and also prevented plans for follow-on courses in professional programming and data skills.

Following the completion of the first running of the 21st Century Skills course, a selection of the participants were given an opportunity to use their skills in an internship to contribute to the Parenting for Lifelong Health (PLH) Digital project. This demonstrates a key aim of the course to equip young people with skills they can use directly in employment opportunities.

We also worked with AMI to develop, Soma Nyumbani (Learn at home in Kiswahili), a community-based learning program for Kenyan students who were not attending school during the pandemic. Soma Nyumbani was a response to the Kenyan government's decision to embrace the idea of a community based learning approach to engage learners within their communities during the COVID-19 schools' closure. In particular, the government recognised that community-based learning would be different in nature to school-based learning, and emphasised the opportunity for programmes which engage learners in practical skills relevant for today's world. With our recent experience of delivering a 21st Century Skills course, we quickly developed a programme of open educational resources to share with students and teachers which emphasised logical thinking, data literacy, communication and problem-solving skills. Activities were designed to be fun, engaged, largely self-paced, and accessible with no more than pen and paper, but with electronic progress features available. Just as we began to share initial materials with interested students and teachers, government policy changed and schools were reopened, hence the programme didn't get to achieve the impact intended. Despite this, we are still proud of our efforts and ability to quickly respond to an emerging challenge, and we were aware from the beginning that with rapidly changing needs, not all interventions survive.

Support for Supporting African Maths Initiatives (SAMI)

January 2018 – present

Supporting African Maths Initiatives (SAMI) is a UK charity established by mathematics educators in the UK to support initiatives in mathematics education across Africa, initially supporting the work of AMI. SAMI coordinates the international volunteer programme that supports maths camps run across Africa. SAMI also fundraises to support AMI in offering internships in Kenya.

IDEMS has a legal relationship with SAMI. SAMI is mentioned in IDEMS Articles of Association as a specified organisation. IDEMS can transfer assets (including money) within its requirements as a community interest company to SAMI. IDEMS made donations to SAMI this year totally £2,900.

This year the SAMI supported maths camps across Africa were postponed due to the pandemic. In response to this, we worked with SAMI and other partners to develop Virtual Maths Camps. Virtual Maths Camps is an idea to turn the challenges presented by the COVID-19 pandemic into opportunities, and continue to provide a maths camp experience for students, teachers, and facilitators from across the globe - in a new, dynamic, partially virtual and fully international environment. IDEMS was involved in all aspects of designing Virtual Maths Camps content including supporting the design of a card deck where every card features a unique game, puzzle or fun mathematical fact, and developing a chatbot system for students to interact with mathematical content, solve puzzles and learn new facts. The resources began to be used successfully for virtual events in Kenya and Ghana in 2020 with more events planned in Togo, Benin, Ethiopia and other countries in 2021.

This year, IDEMS also supported SAMI by running a series of sessions to develop SAMI's Theory of Change in February 2020 and attended the Annual General Meeting in September 2020.

An agroecology hub in Kenya to bridge science, practice, and movement

December 2018 – present

Funded by: McKnight Foundation's Collaborative Crop Research Program

The McKnight Foundation's Collaborative Crop Research Program (CCRP) funds collaborative research projects that aim to explore solutions for sustainable local food systems. IDEMS's staff have been involved in providing research methods support for CCRP's East and West African projects for several years. In December 2018, IDEMS received a separate planning grant to establish an agroecology hub (AE Hub) based in western Kenya.

Agroecology is an ecological approach to agriculture which centres on food production that makes the best use of nature's goods and services without damaging these resources. Across the world, scientists, researchers, NGOs, CBOs, activists, farmers, consumers, universities, and others are working in the agroecology space. However, there is often a disconnect between what is happening in the *science* and research into agroecology, the *movement* of those promoting agroecology and the *practice* of what agroecological practices farmers are actually using. Therefore, the AE Hub, formed with partners such as Manor House Agricultural Centre (MHAC), AMI and Participatory Ecological Land Use Management (PELUM) Association, Kenya, has an overarching aim of bridging the gap between science, practice and movement in agroecology.

This year's activities were highly disrupted by Covid. Most of the planned activities had to be re-thought and adapted and many were postponed. However, a number of activities and progress was made throughout the year. A number of improvements to Manor House infrastructure, as the anchor of the AE Hub, were implemented in order to transform Manor House into a more ecological, sustainable and environmentally conscious centre. Improvements included installation of biogas systems and energy efficient cooking equipment for kitchens and an improved water filtration and storage system. In general, many activities with existing partners were able to continue. In particular, supporting social learning for members of farmer research networks through activities using distributed smart phones and the development of fact sheets through training for AE Hub partners on written and video communication. However, the lack of face-to-face events meant it was not possible to engage new partners as intended. The Covid-19 pandemic led to high levels of uncertainty for the AE Hub community, but we are thankful that our partners were not as seriously affected as others were in the region.

We are committed to this project and to supporting local partners to develop the necessary structures that can enable them to support the wider farming community across East Africa with effective agroecological approaches. We expect the challenges of the current situation to continue into next year but we have confidence in the ability of our partners to continue to adapt to the changing situations on the ground and continue these important activities. We believe in the importance of bridging the gap between science, practice, and movement, and feel this aligns with IDEMS's desire to work within and across broad areas. We also believe in the importance of research for impact development and want to support research for development in this area.

Support for Maseno University, Kenya

August 2018 – present

IDEMS team members have had a close relationship with the School of Mathematics, Statistics and Actuarial Sciences at Maseno University, Kenya, for more than 10 years. Electronic assessment continues to be used in the School and we continue to support lecturers wishing to implement this for mathematics and statistics courses. This year we also discussed and offered support for conducting examinations remotely as an emergency Covid response. However, this didn't materialise with the university choosing another direction due to the short timescales.

We look forward to continuing this important collaboration and further efforts to formalise this relationship.

Development of electronic assessment tools for teaching and learning mathematics

November 2018 – present

In 2019 we began working with lecturers at Maseno University, Kenya, and then others across Africa to develop automated electronic assessment that would provide high quality feedback to students. Questions were created using the open source STACK system and integrated into Moodle, a course management system. The power of STACK is that it is specially designed for mathematics and allows complex input and checking of mathematical expressions, which is more useful than multiple choice questions alone. At Maseno University, STACK was used to develop weekly quizzes for students to practice and test their understanding. It was well received by lecturers and students as it enabled students to receive feedback during a course, which is otherwise limited or not possible at all due to the large class sizes and high workload of lecturers.

This year, we are pleased that STACK continues to be used at Maseno University, and other universities who have adapted the content for their own courses. During the year we provided some support to these universities to help them continue to use our developed resources, which we make available freely and openly.

We also collaborated with AMI and INNODEMS to begin producing STACK questions for the Kenyan high school curriculum. Covering the curriculum across year groups is a large undertaking and is an ongoing effort. Initial discussions with teachers about the system was positive and we are investigating ways of supporting schools to be able to use these resources.

In 2020, our biggest use of STACK was to support UK schools to use this as part of remote learning for their students, and this is described in the A Level Mathematics bridging course for UK Schools.

Looking ahead, we hope to continue to support our partners to use these resources for their own teaching and we will continue to build our bank of openly available questions and courses to support others. We have gained initial experience in the use of STACK for schools both in the UK and in Kenya, and we plan to continue to investigate this opportunity as a way of improving teaching and learning of mathematics in schools.

Teaching statistical climatology & statistical problem solving on AIMS Cameroon's Master's Programme and Project Supervision

March 2020 & November 2020

Also funded by: Royal Statistical Society

Since 2018 IDEMS and Stats4SD have co-taught a statistical problem solving course to MSc mathematical science students at the African Institute for Mathematical Sciences (AIMS) Cameroon. The course, taught over a three-week period with five two-hour lectures per week, exposes students to problems in statistics, ranging from design, collection, manipulation and organisation of data, to analysis and reporting through games and simulated data and real data. Students also work in groups to explore and report on a specific problem, including climate for agriculture, procurement for corruption, a poverty survey, and other topics. The course forms part of a series of statistics courses at AIMS Cameroon supported by the Royal Statistical Society as an effort to strengthen the statistical component of AIMS training.

This year, we continued to teach the statistical problem solving course to the new group of students, but also taught a second course to the 2019 intake on statistical climatology. The statistical climatology course is a more focused and specialised course, which builds on previous statistics courses and introduces a range of analyses related to climatic data. In the course this year, topics included circular data, time series analysis, extremes, satellite data, Markov chain models of rainfall data and crop simulation modelling. As in the statistics problem solving course, the final week of the course is dedicated to a group project where students get the opportunity to spend more time and deepen their understanding of a topic from the course.

This year the courses were particularly challenging to teach as they were conducted largely remotely due to travel restrictions. For the statistical climatology course in March our team was completely remote, whereas for the statistics problem solving course in November, Francis Torgbor from Ghana was able to attend in person with the rest of the team supporting remotely. Building on our experience in 2019 using Moodle to host course material, we developed Moodle courses again and also continued to use STACK questions to support student learning and self and continuous assessment. Lectures were presented online and recorded for students to rewatch, which was mentioned by students as being particularly useful. Our remote teaching was supported by tutors at AIMS Cameroon who provided a vital link between us and the students and we feel lucky that this resource was available to support the course.

Despite the challenges, the statistics problem solving course continued to be an "eye opener" for many students and provided a very different experience from their past statistics courses. The statistical climatology course supported those students who chose the climatic stream at AIMS and three of the students from that course went on to do their final project under our supervision.

We are pleased that this year we also achieved our aim of capacity building and handing over aspects of the courses to our African colleagues. This year Francis Torgbor from Ghana and James Musyoka from Kenya led the statistical problem solving course, with Francis Torgbor coordinating the sessions and activities at the centre, and other IDEMS and Stats4SD staff providing support. Francis and James also led components of the statistical climatology course. We continue to believe in the importance of supporting our African partners to teach at AIMS so that they can teach such courses at AIMS and other universities in Africa in the future.

IDEMS maintains strong links with AIMS and is proud to support AIMS in delivering high quality mathematical science training in Africa. We are particularly keen in continuing to support the AIMS Cameroon centre through a strong statistics stream of courses supported by the Royal Statistical Society and now also a climatic stream.

Support for AIMS climate internship programme

March 2020 – Present

Also funded by: AIMS

This year AIMS launched a climate internship programme to provide its graduates with industry opportunities to work on projects related to climate and climate change in Africa. We were pleased to partner with AMI to offer six internships to AIMS graduates for a period of 6 months. The selection process was highly competitive and we had a team of six talented interns from Kenya, Ghana, Tanzania and Niger. Unfortunately, Covid prevented some of the interns travelling to Kenya but the internships continued remotely and we were impressed by the dedication shown by the team despite the challenges of working from home. The interns worked on a number of areas, particularly improving R-Instat's climatic data analysis functionality. Some of the interns were retained after the internship period, while others got opportunities for work based on their experience during the internship. We were pleased to provide these opportunities and also enjoyed working with talented individuals who contributed meaningfully to our projects.

Conferences and workshops

This year, many planned conferences and workshops were cancelled. Some events were transformed into online events and our team attended a limited number of these throughout the year.

2020 African Mathematics Conference

19-20 November 2020

IDEMS team members attended the 2020 African Mathematics Conference. The conference aimed to show case open source state of the art online technological tools ready to be deployed by most universities to aid functional learning and online assessment of mathematics. Of particular interest to us were the presentations on STACK, and also PreTeXt, which we consider as important tools with huge potential in improving mathematics education and access to resources across Africa. The conference was also an opportunity to learn about other open source software tools to aid mathematics learning and interact with lecturers and researchers interested in these ideas.

1st International JSXGraph Conference

October 2020

Santiago Borio from IDEMS presented a talk: "JSXGraph and STACK: Draw a function and get feedback on your sketch" with Tobias Mai, Alexander Meyer, and Chris Sangwin. The conference was an opportunity to bring together developers and teachers, instructors and designers who are interested or already experienced in using JSXGraph to enhance digital learning of STEM topics. JSXGraph is a JavaScript library for interactive geometry, function plotting, charting, and data visualization in the web browser. Santiago's talk presented how we have used JSXGraph with the STACK assessment system to create questions with interactive graphing components that allow high levels of automated feedback to be given. This is an important area of work for our development of mathematics and statistics online courses for schools and universities. The conference was an opportunity to share this work and interact with others in the community.

QE Data Challenge

April – May 2020

IDEMS was part of the team that took part in the 2020 Quantitative Ethnography (QE) Data Challenge over one week in April and May. The project was on the evolution of guidance to individuals on risk factors and mitigation factors from early January to late March 2020. IDEMS members supported the project team in data analysis and research methods and it was an interesting experience of multi-disciplinary teamwork.

IDEMS investment

Post-Doctoral Impact Activation Fellowships

May 2020 – present

The Post-Doctoral Impact Activation Fellowship programme was born out of our personal experience. It was supported by our experience working with doctoral students who felt trapped in a narrow range of career paths. We knew they could easily acquire the skills that could add substantial value to development projects. Specifically, we knew many highly skilled PhD graduates in the mathematical sciences, who were primarily socially motivated, but lacked the opportunities or awareness of how their skills could contribute to socially impactful work.

Hence, IDEMS is developing a programme for such people to take on fellowship positions within IDEMS where they can both use their existing technical skills, and develop further skills, including soft skills, to contribute to our impact-oriented work. These fellowships are designed to provide opportunities for PhD graduates to convert their academic expertise into skills which are of value to socially impactful initiatives, while also having opportunities to engage in transdisciplinary research activities.

The programme was launched this year and we recruited two PhD graduates as the first fellows who are already contributing to some of our most important activities. Recruitment of fellows has initially been informal and opportunist through our existing networks. If the programme continues to be successful, we envisage extending the recruitment to an open call for applications in the future.

Supporting INNODEMS, Kenya

November 2018 – present

In 2019 colleagues in Kenya registered INNODEMS as a company in Kenya with a similar legal structure to IDEMS, a company limited by guarantee.

At the beginning of this year, we supported the transition of people from interns within AMI to employees of INNODEMS. IDEMS covered contributions to staff costs in the period before they were formally employed by INNODEMS to avoid the team losing any months of income. IDEMS has also provided INNODEMS with a zero-interest cash flow loan in order to start up its activities. Over the year, we have been involving INNODEMS in many of our projects, including Parenting for Lifelong Health (PLH) Digital, and continue to commit to capacity building its staff, and supporting INNODEMS to obtain similar work locally. We also supported INNODEMS to establish a relationship with Manor House Agricultural Centre, which provided an initial base for the INNODEMS team during Covid which was vital in enabling the team to carry out its activities.

We hope that INNODEMS will be a model for how we can provide sustainable opportunities for talented people who can contribute both to international projects and support development initiatives locally. We look forward to further developing the relationship with INNODEMS and exploring this model in other places, initially with colleagues in Ghana.

Francis Torgbor in Ghana

December 2018 – present

Francis has been part of the IDEMS team since 2018. He is based in Ghana and IDEMS is supporting Francis while he completes his PhD. His PhD has been extended by 1 year and he now expects to complete his PhD by the end of 2021.

Alongside his PhD, Francis continues to be involved in a number of IDEMS projects, including R-Instat development, recruitment in Ghana for surveys on attitudes towards corruption, teaching and supervision of MSc students at AIMS Cameroon, and Virtual Maths Camp activities in Ghana. Francis also continues to have a strong relationship with the PICSA team where there is ongoing collaboration.

Francis is also investigating establishing an organisation in Ghana, in a similar way to INNODEMS in Kenya, in order to build up a team and activities once he completes his PhD.

We are excited to have Francis on board because of his exceptional talent and commitment to development in Ghana, and we have confidence that he will be able to lead a successful local team once his PhD is complete. IDEMS has a vision to impact African development by making skills that are in demand available locally. Establishing a team in Ghana is part of that vision, with a long-term plan for IDEMS International to collaborate and support locally led African groups with a similar vision and philosophies.

Maxwell Fundi support during MSc

September 2019 – present

Maxwell has been part of the AMI team in Kenya since 2015 when he first volunteered for the Maseno maths camp. He is the only member of the R-Instat development team in Kenya who was there from the beginning of the project in 2015, and he is now a leading staff member at INNODEMS where he continues his passion for both software development and education.

In September 2019, Maxwell began a part time Masters in Computing at Maseno University, Kenya alongside his other commitments. IDEMS has supported Maxwell during this process and continues to cover his tuition fees. This allowed him to continue his important work with IDEMS part time alongside his MSc studies. This year, Covid disrupted his studies and delayed them due to universities closures. He continues to make progress in his studies and expects to complete them next year.

Maxwell has been an important part of IDEMS and now INNDOEMS' projects in Kenya, and we are pleased that this support enables him to continue this work.

Danny Parsons support during PhD

November 2019 – present

In 2020, Danny began his PhD in climate change sciences at the University of Rwanda and the African Institute for Mathematical Sciences (AIMS), Rwanda, as part of a cohort of PhD students in climate change sciences based at AIMS centres across Africa.

Danny continues to be involved with IDEMS during this time, and his PhD work overlaps with many IDEMS climate related projects. As well as giving Danny the flexibility to pursue his PhD studies, IDEMS may also provide small amounts of support when appropriate. This year, Danny's plans were disrupted by Covid as he intended to spend a larger proportion of his time in Rwanda. However, he has been able to continue his research work and interact with others remotely. He looks forward to travel opening up to enable him to spend more time based in Rwanda.

At IDEMS we believe strongly in education, and we are supportive of members of our team that choose to further their education. We hope that Danny's and Maxwell's cases provide a template for how others in IDEMS could pursue educational opportunities.