LASER PULSE
Delivering Practical, Research-Driven Solutions to Global Development Challenges

LASER PULSE

Long-term Assistance and SErvices for Research (LASER) Partners for University-Led Solutions Engine (PULSE)

EAST AFRICA WATER SECURITY PROJECT
TRAINING MANUAL

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ABOUT LASER PULSE

LASER (Long-term Assistance and SErvices for Research) PULSE (Partners for University-Led Solutions Engine) is a five-year, $70M program funded through USAID's Innovation, Technology, and Research Hub, that delivers research-driven solutions to field-sourced development challenges in USAID partner countries.

A consortium led by Purdue University, with core partners Catholic Relief Services, Indiana University, Makerere University, and the University of Notre Dame, implements the LASER PULSE program through a growing network of 2,700+ researchers and development practitioners in 61 countries.

LASER PULSE collaborates with USAID missions, bureaus, and independent offices, and other local stakeholders to identify research needs for critical development challenges, and funds and strengthens the capacity of researcher-practitioner teams to co-design solutions that translate into policy and practice.

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1 ABOUT THE MANUAL

This Manual has been developed as part of the LASER PULSE East Africa Water Security project. The project focuses on providing water information and data access for water resources decision making and management for the East African countries of Kenya, Tanzania, and Uganda to ultimately improve water security across the region. It is a collaboration between an academically oriented Research Team[1] and Translation Partners[2] who are development practitioners, aiming to ensure that "*research ultimately results in on-the-ground solutions to development challenges*."[3]

WHAT IS LASER PULSE?
LASER PULSE stands for Long-term Assistance and Services for Research, Partners for University-Led Solutions Engine. It is a USAID-funded consortium that convenes and catalyzes a global network of universities, government agencies, nongovernmental organizations and the private sector. The Consortium members are Purdue University, CRS, Indiana University, Makerere University, and the University of Notre Dame. Through collaboration between researchers and practitioners, LASER PULSE delivers research-driven, practical solutions to critical development challenges in low- and middle-income countries.

This Manual is intended for use in training water managers, policymakers, and other water resources personnel on the use of data for decision making to improve water security. It is for an introductory training (1 – 2 days) on the basics of watershed modelling, research/results translation, and data – policy relations. The Manual has limitations in time which affect the depth of the content; it focusses on the process whilst suggesting potential tools and techniques that interested Trainees may use for an in-depth look on the topic.

The Manual is organised in two parts:
Part A (Training Material) is based on three modules that build on each other yet individually complete and stand-alone, such that a trainee who takes a module obtains its complete process-wise picture. *Module One* introduces the 'hard' science and application of watershed modelling, using three watersheds in East Africa (Sasumua; Kenya, Simiyu; Tanzania, and Murchison Bay; Uganda) as the starting point, infused with insights and lessons from other parts of the world. *Module Two* introduces research/results translation including examples of translation products and their dissemination mechanisms based on stakeholder preferences, technology compatibilities, among others. *Module Three* explores the interdependence between data and policy. Each Module highlights the limitations and key considerations for success.

Part B (Facilitators' Guide) provides the Facilitator with an adaptable tricks and approach for delivering the training. This is, by no means, prescriptive. It is only a foundation for the Facilitator to contextualise the training based on his/her understanding of the prevailing circumstances such as Trainees' background and prior experiences, time availability for the training, available logistics, among other factors.

[1] Purdue University, Makerere University, US Department of Agriculture, University of Dar Es Salaam
[2] AidEnvironment, GWP Tanzania, Resource Plan
[3] LASER PULSE (2020). LASER PULSE Research Awards Manual, available at https://laserpulse.org/publication/laser-pulse-core-research-awards-manual/

2 MODULE ONE: MODELLING

This Module aims at explaining the science and application of hydrological modelling. It covers the rationale and potential applications for modelling, explores challenges surrounding data needs for modelling and their resolution, and explains additional issues that may be encountered in applications.

2.1 Introduction

A model is a representation of something. In the context of water resources, the something is typically a watershed or watershed system. It could also be specific entities within the system, e.g. a reservoir, an urban area, etc. that are modelled as part of or apart from the watershed system. In modelling, we use existing concepts, equations, and numbers to describe the past, present, and/or anticipated future states of our water resource systems.

So why are we modelling? Oftentimes, we use modelling to understand underlying processes and patterns; for example, how pollutants move in the environment; watershed conditions that can result in flooding, etc. We can also use models to conduct assessments, such as to determine if there are specific areas in a watershed that are of particular concern. In areas where landscape or land use changes are planned or being contemplated, modelling helps provide insights into how the watershed will respond, should such changes be implemented; for example, would these cause more or less flooding downstream; would implementation lead to an increase or decrease in a particular pollutant of concern, etc.

Changes, occurrences, and systems that can be represented using modelling include (and are not limited to): land use responses and land use changes; climate changes and climate interactions; floods and flooding; management (pollutant control) practice effects (BMPs); ponds and reservoirs; etc.

2.2 Tools and input

2.2.1 Modelling tools/software

Because a lot can be accomplished through modelling, there are a large number and great variety of modelling tools and software. These models work at different spatial scales—ranging from plot to river basin—and may produce outputs at a variety of timesteps (average annual through daily or hourly) even while the model itself operates on a specific timestep (e.g. daily). The types of processes or components simulated vary across models and, therefore, so do the outputs produced. Thus, before selecting a model, it is important to ask yourself some key questions (Box at right).

CHOOSING A MODEL

1. Why are you modelling? What are you modelling?
2. What components are of interest? What level of output is desired?
3. What data do you have available? In what quantities? What is its quality?
4. How much computational power do you have? Do you have the base software?
5. Do you have time/capacity to work on modifications if needed?

2.2.2 Data

Data[4] are the basis for all modelling calculations and analyses. In this sense, they provide the foundation for decision-making and management. It is, therefore, critical that data be accessible and of good quality, such that resulting information is objective.

Baseline data used in modelling includes land use, climate, topography, soil map units, watershed boundaries, hydrography, and gaging station locations. Other inputs include management, crop parameters, soil properties, and features that are important for representing the watershed. Having detailed in-stream data including stream discharges, and sediment and nutrient loads or concentrations is important for in-depth model calibration and validation[5], which helps improve accuracy of modelling results. If other constituents are of concern, having measured values of the constituents is also important. Baseline spatial data can be obtained from open data repositories[6] such as the USGS Earth Explorer and ISRIC SOTER databases. Climate, and river gaging station locations and associated data are best obtained from country-specific entities that collect and curate the data.

In case of limited or no data, information can be obtained from secondary sources. This includes data already published in any form and have not necessarily been collected by the researchers, for example: literature-based values of soil hydraulic conductivity summarized by broad soil classes and textures. Management operations data, such as planting and harvesting dates and fertilizer application dates and rates, can be obtained from standard recommendations with the underlying assumptions that landowners follow recommendations. It is good practice to verify the information at a local level by, for example, speaking with landowners, watershed managers, and other agents working in the area of interest. Parameter Regionalization[7] can be used in instances where in-stream data are either insufficient or unavailable for use with model calibrations. A soft-data approach can also be used, allowing simulated values to be compared with published data from the same or similar regions. Climate data can be generated using weather/climate generators. If using these, it is important to check that the generators are effective in simulating essential characteristics[8] in addition to basic statistical properties of the local climate.

2.3 Key considerations for modelling

2.3.1 The problem model divergence

Ideally, Performance—especially performance statistics-Nash-Sutcliffe Efficiency, NSE and Coefficient of Determination, R^2—obtained should not differ substantially between calibration and validation phases. Furthermore, values of these statistics should not differ

[4] Singular or plural? Both are acceptable; the plural construction is more common in published material.

[5] Moriasi et al (2015). Hydrologic and water quality models: Performance measures and evaluation criteria. doi: 10.13031/trans.58.10715

[6] https://earthexplorer.usgs.gov/; https://www.isric.org/projects/soil-and-terrain-soter-database-programme

[7] Gitau and Chaubey (2010). Regionalization of SWAT model parameters for use in ungauged watersheds. https://doi.org/10.3390/w2040849; Merz and Bloschl (1995). Regionalisation of catchment model parameters. https://doi.org/10.1016/j.jhydrol.2003.09.028

[8] Mehan et al. (2017). Comparative study of different stochastic weather generators for long-term climate data simulation. https://doi.org/10.3390/cli5020026

substantially, i.e. values obtained for NSE should not differ substantially from those obtained for R^2. When this happens, the phenomenon is known as model divergence[9] and is an indicator of inadequate or improper parameterization. This means that the model would need to be re-calibrated and re-validated.

2.3.2 The problem of equifinality

Similar to the problem of model divergence, is the problem of equifinality[10]. In this case, different parameter sets can give the same performance. This brings up the question as to which set provided suitable or the most suitable representation of watershed responses. Resolving this problem requires an in-depth knowledge of the system being studied.

2.3.3 Getting around data limitations

All in all, data unavailability, insufficiency, and quality present the biggest challenges for modelling. To get around data limitations, it is important to:

- Know your data (and its/their limitations): What data do you have? In what quantities? At what scales? What is its quality? What are the key characteristics?
- Know your watershed/the system that you are modelling: What goes on in the watershed/area? Have you visited the watershed? Spoken with residents or those working in the area?
- Use multiple methods of evaluating model performance[11]: graphical, statistical, soft-data, other.
- Document everything carefully.

2.3.4 Documentation and reporting

As with any other scientific endeavour, the reproducibility of modelling results is of utmost importance. This entails careful documentation and reporting of the modelling effort(s), and more so when working in data-scarce areas or contexts. Include a description of the methodology used in sufficient detail to allow someone else to reproduce the work. Include tables of default and calibrated parameter values along with acceptable parameter ranges. Include complete details on model performance including calibration, validation, and diagnosis along with supporting information. With the transition towards open information and open data, consider sharing your data files, model code, and supplemental materials. A major concern in this regard is ensure that you get credit for your work/products. Today, a variety of open data repositories exist that will provide a Digital Object Identifier for products deposited at their sites, such that these products can be cited appropriately.

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[9] Sorooshian, S.; Gupta, V.K. Model Calibration. In Computer Models of Watershed Hydrology; Singh, V.P., Ed.; Water Resources Publications: Highlands Ranch, CO, USA, 1995.

[10] Beven, K. 1996. Equifinality and Uncertainty in Geomorphological Modelling. The Scientific Nature of Geomorphology: Proceedings of the 27th Binghamton Symposium

[11] Moriasi et al (2015). Hydrologic and water quality models: Performance measures and evaluation criteria. doi: 10.13031/trans.58.10715

2.4 Watershed Model Applications & Results

2.4.1 The 3 example watersheds in East Africa

2.4.1.1 General Attributes

The three watersheds of focus in in East Africa are Sasumua (Kenya), Simiyu (Tanzania), and Murchison Bay (Uganda). These watersheds represent a variety of landscapes from mountainous to coastal; and threats to water security including urbanization, climate change, and land degradation. The similarities and differences across watersheds make them ideal examples.

Table 1: Characteristics of the three watersheds

Watershed	Characteristics	Current threats
Murchison Bay Watershed, Uganda (Kiggundu et al., 2018)	▪ Area: 40.9 km2 ▪ Average annual rainfall: 1,290 mm ▪ Supports a variety of human activities ▪ Core changes: urban expansion (29%); decreases in agricultural areas (18%), forests (6%), and wetlands (7%)	▪ Anthropogenic perturbations particularly land use/land cover change ▪ Associated water quantity and quality impacts
Simiyu River Watershed, Tanzania (Mulungu and Munishi, 2007; Rwetabula et al., 2007)	▪ Area: 13,972 km2 ▪ Average annual rainfall: 700 mm–1,000 mm ▪ Simiyu River is ephemeral ▪ Waters discharged into Lake Victoria ▪ Primary land uses: Grassland, woodland, cultivated land ▪ Water uses: agriculture, fishing and livestock production.	▪ Water fluxes due to land use/land cover change ▪ Pollutants in water courses ▪ High rates of erosion
Sasumua River Watershed, Kenya (Mwangi et al., 2015)	▪ Area: 107 km2 ▪ Average annual rainfall: 1,000–1,600 mm. ▪ Land use: primarily agricultural and forested ▪ Provides 20% of the water supply for the City of Nairobi. ▪ Western and central parts characterized by poorly drained soils	▪ Erosion and flooding in the western and central parts ▪ Land degradation ▪ Associated water quality impacts

2.4.1.2 Modelling Approach

Why SWAT model: The Soil and Water Assessment Tool (SWAT)[12] is a continuous-simulation, daily time step, physically-based, watershed-scale model that can be used to predict land use, land management, and climate impacts on water, sediment, nutrients, and other chemical yields in complex watersheds over long periods of time. Some of the strengths of SWAT include that it is well supported with detailed web-based documentation, active user support groups, and regional and international conference offerings. The model package offers accessible databases, GIS interface tools, pre- and post-processing tools, and open-source code. In addition, SWAT has been extensively used worldwide including in the study areas in the three East African countries by the project Co-PIs[13]

[12] Arnold, J.G., Srinivasan, R., Muttiah, R.S., and Williams, J.R. (1998). Large area hydrologic modeling and assessment part I: Model Development. https://doi.org/10.1111/j.1752-1688.1998.tb05961.x

[13] Anaba, L.A., Banadda, N., Kiggundu, N., Wanyama, J., Engel, B., and Moriasi, D. (2017). Application of SWAT to assess the effects of land use change in the Murchison Bay catchment in Uganda. 10.4236/cweee.2017.61003; Mulungu, D.M.M. and

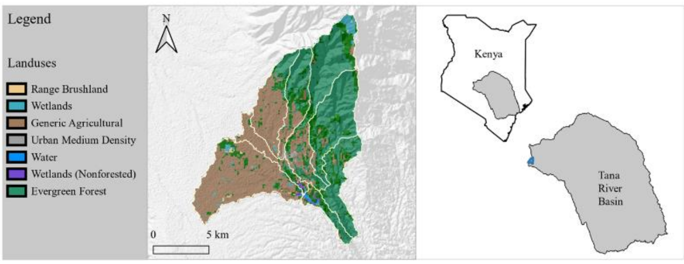
Building the model: As described earlier, the SWAT model requires a variety of datasets to simulate water quantity and water quality. The model simulates the watershed by delineating into sub-watersheds or subbasins, which are further sub-divided into homogeneous hydrologic response units (HRUs), which are a product of a unique combination of average slope, soil type, and land use. For the applications presented, the required data were obtained from available sources, processed, and used to build the SWAT model for each of the watersheds. Appropriate SWAT GIS-based user interfaces were used to build the SWAT model. Care was taken to ensure that the study areas were accurately represented in the model, including making sure that major physical features such as the presence of reservoirs/dams; river/stream channel network, management practices etc. were represented, so as to minimize chances of obtaining inaccurate final model outputs.

Model parameter adjustments: Due to limited or lack of information about important parameters, parameter values that are considered suitable for the use of a model in each study area were determined by adjusting parameters that are sensitive to the process of interest, that is, through calibration. The adjusted parameters for the important processes were determined through a process called sensitivity analysis that determined parameters that impacted the outputs of interest the most. Adjustment was stopped when model outputs compared reasonably well with available measured data and using pre-set performance criteria thresholds or compared with literature values for model outputs in which measured data was not available. We called this process model validation.

Defining and performing modelling scenarios: Once model outputs were validated, they were deemed ready to be used as tools for various applications, which we call modelling scenarios. In general, the scenarios consisted of quantifying the impacts of current concerns in each watershed and explore possible solutions to the identified issues. This information is useful for decision and policy making. watershed-specific concerns, study objectives, model validation results, and the scenarios and the corresponding results are provided next.

2.4.1.3 Sasumua watershed

Location:



Size: ~136km^2

Watershed is located within the Tana River Basin

Aqueduct connects Chania River to Sasumua River 5km upstream of dam, and water is diverted from Kiburu River to reservoir

Primary landcover transitions from agriculture to forest as elevation increases

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Munishi, S.E. (2007). Simiyu River catchment parameterization using SWAT model. https://doi.org/10.1016/j.pce.2007.07.053; Mwangi, J.K., Shisanya, C.A., Gathenya, J.M., Namirembe S., and Moriasi, D.N. (2015). A modeling approach to evaluate the impact of conservation practices on runoff and sediments in Sasumua watershed, Kenya. DOI: https://doi.org/10.2489/jswc.70.2.75.

Problem statement: The primary concern for Sasumua watershed is maintaining high water quality for this important source of fresh water for the city of Nairobi while also accommodating existing agricultural activity. Another issue is limited information on the impacts of a changing climate on the watershed. There are also signs that agricultural land is beginning to encroach on forested areas of the watershed, increasing runoff.

Study objectives: The overall goal was to show the use of data for water resources management decision-making. This was accomplished by using the SWAT model to quantify the impacts of various management practices on water quality and climate change on water resources.

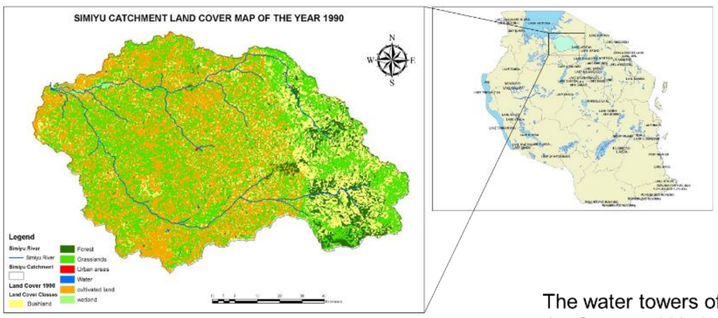
Validation of model outputs: There were no measured data available to validate the model outputs for Sasumua watershed. However, the model surface runoff and sediment outputs were within the reported values.

Scenarios & implications for policy & decision-making: The two main scenarios applied in Sasumua watershed were quantifying the impacts of various management practices on water resources and the impact of future climate scenarios on water resources. The studied management practices were riparian buffers, filter strips, terracing, field diversions, agricultural water harvesting ponds, and the combination of several. Four future climate scenarios were used to determine their impact on water flows.

The results indicated that overall, for three of four future scenarios the water flows be more than twice the values for the baseline period of 2011-2020. With respect to the impacts of management practices on water quality, results indicated that the filter strips reduced the watershed sediments losses the most. However, combining all the management practices is the most successful approach to reducing the watershed losses. From the policy and decision-making, it is recommended that data policies be updated to improve curation and access among relevant agencies to ensure that data is accessible for informing water resources management decisions.

2.4.1.4 Simiyu watershed

Location:



Problem statement: The main concerns for the Simiyu watershed are the increased human activities that have led to major land use changes resulting in high amounts sediment and nutrient losses into water bodies. In addition, climate change has led to reduced agricultural productivity with respect to both crop yields and livestock production. Another major issue is limited data to help determine and understand the impacts of these land use changes and climate change on the hydrology of the watershed.

Study objectives: The objectives of this study were to analyse current and future projected climate data to identify trends that have significant impacts on water resources and agricultural production, quantify the land use changes, and then use a SWAT model to assess the impacts of land use and land cover changes on water budget components and sediments of the Simiyu Watershed.

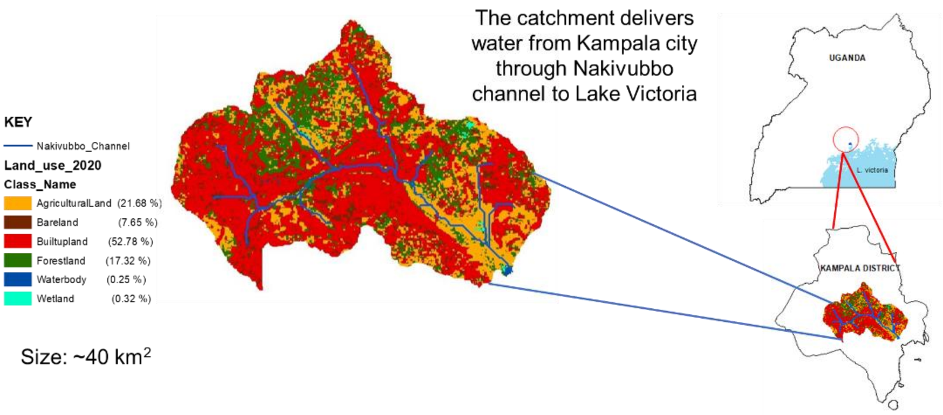
Validation of model outputs: Overall model outputs were within 13% of measured flow and within 22% of measured sediment and nutrients, which are within acceptable modelling performance criteria.

Scenarios & implications for policy & decision-making: The main scenarios in the Simiyu watershed were associated with quantifying the impacts of land use and climate change on water resources. The main land use changes are an increase in urban and cultivated areas. Analysis of precipitation data indicates that, currently, precipitation has increased by 62% compared to the historical baseline period. Future projections indicate increasing trend of more than 100%. An apparent increase in temperature was investigated, but trends lacked statistical significance.

Modelling results indicated that overland flow and total water yield will increase rapidly in all the climate scenarios, which can lead to increased incidences of flooding in the basin. Results of impacts of land use changes indicated that sediments increased by more than 7%. The likelihood of increased sediments and nutrients will lead to poor water quality in the basin.

2.4.1.5 Murchison Bay watershed

Location:



Problem statement: The major concerns for Murchison Bay watershed are human induced natural resources degradation and unregulated land use land cover changes over the last decade. Yet, the impacts of these changes on water resources are poorly understood.

Study objectives: The overall goal of this study is to assess the effects of land use/land cover change on water quantity and quality. This will be accomplished by assessing the spatial and temporal changes in land use and land cover in the watershed and then using the validated SWAT model to predict the impacts of these changes on water resources.

Validation of model outputs: The model stream flow outputs were within 3% of the values, which is a satisfactory model performance. There were no measured surface runoff and sediments data with which to compare the model outputs. However, the model surface runoff and sediment outputs were within the reported values.

Scenarios & implications for policy & decision-making: The main scenarios were associated with quantifying the impacts of land use changes from the past to present and to the projected future land use changes. Another scenario applied several management practices and quantified their impact on water resources. The best management practices applied studied were vegetative filter strips, grassed waterways, and surface runoff detention ponds.

Overall, the results indicated that streamflow, surface runoff, and some nutrients increased with current and projected changes in land use. The increased streamflow may explain the increasing incidences of flooding. The increasing population is the leading driver of wetland loss and increased sediment yield over the years and the deterioration of water quality in the catchment. Results of the impacts of best management practices showed that vegetation filter strips at filter width of 2 m reduced sediment yield by 42% and 5 m by 70%. The retention ponds of 20 m3 reduced surface run of by 60% in the catchment. However, the grassed waterways presented minimal impact. These interventions would lead to increased groundwater recharge, hence people in low areas will have to be resettled.

2.4.1.6 General conclusions

1) Generally, major challenges are associated with land use changes, climate change, and a growing population.
2) There is need for resilient and sustainable production systems for a growing population under a changing climate, while keeping the environment clean.
3) SWAT shows potential as a tool to quantify the impacts of land use changes and climate changing and identify best management systems to mitigate against the negative impacts while ensuring increased and sustainable food production systems for a growing population.
4) A major observation is the issue of limited data. It is recommended that data policies be updated to improve curation and access among relevant agencies to ensure that data is accessible for informing water resources management decisions.

2.5 Useful Resources and Tools

- PPT
- LASER PULSE East Africa Water Security Quick Start Guide

DISCUSSION QUESTIONS

1. What can be done to ensure data are available in ample quantities for use with modeling applications?
2. How many of are familiar with use of model for work like this one? What specific topics would you be interested more about with respect to modeling?
3. What pollutants are causing the impairments/threats in your catchment? Where are the pollutants coming from?
4. What management/conservation practices are you familiar with?
   - Specifically – how is the riparian buffer defined for policy and decision-making in each country?
5. In general, have you noticed incidences of drought and flooding within your catchment? What have been/are the negative impacts of drought and flooding within your catchment?
   - From your observations, have you noticed a trend in the number of incidences related to drought and flooding within your catchment from the past to present? In general, would you say they remain same, decreasing, or increasing? What do you think would be possible solutions and why?

3 MODULE TWO: RESEARCH/RESULTS TRANSLATION

This Module aims at bridging the gap between knowledge generation (through research and modelling) and practice. It covers possible ways of packaging and disseminating the knowledge considering stakeholder preferences and capacity (including technological compatibilities).

3.1 Raw and processed data and results

Data and results can be packaged in three different formats based on anticipated users and uses:

1. Processed data and results should be packaged to provide actionable information and enable their use by water quality managers and other water professionals in water resources decision-making and management. This can be done by packaging data for easy download and interoperability with different applications (e.g., as csv or txt files); providing online visualizations of detailed results using graphs, charts, or maps; and, providing downloadable pdf and printed versions of the visualizations to account for different levels of technology.
2. Snapshot visualizations of aggregated results in a variety of forms—including graphs, charts, maps, and colour bars—with accompanying text narratives. These can be presented online as web-based visualizations with explanatory text and downloadable pdfs, and in print as easy-distribution pamphlets or factsheets. This format is targeted at the individual, including youth, and contains information on how to access the products in the other two formats depending on interest and need
3. Raw data (where possible), processed data, and base model parameters should be packaged to enable their use in research. These data should also be packaged for easy download and interoperability with different models and tools (e.g., as *.csv, *.txt). The datasets are targeted at personnel in higher education and/or research institutions and consultants for use in conducting water resources research.

3.2 Research Results, Translation products & dissemination

In addition to raw and processed data, the research/modelling process generates various products including default model parameter sets, reports, among others. These products should be packaged into targeted translation knowledge products for different stakeholders. The knowledge products could include: 1) briefing documents, 2) press releases, 3) videos, 4) others.

3.2.1 Briefing documents

These include policy briefs, research briefs, evidence briefs, technical briefs, white papers, among others. LASER PULSE identifies the following considerations for a brief.

- Map the policy environment to understand who will use your brief
- Research key groups to understand what is most important to them and how to best influence them
- Engage stakeholders early on to build confidence, trust, and ownership in your work

- Tailor your brief's content, language, and framing toward a specific audience
- Target the right people at the right time with the right message through the right channel
- Consider a variety of complementary dissemination activities

Additional guidance on the preparation and utilisation of briefs, as well as templates, can be found here.[14]

DISCUSSION QUESTIONS

1. Which products are most produced through research and modelling?
2. What do you see as strengths and barriers in utilizing research and modeling products?
3. In which forms could the products be packaged and disseminated to enhance effectiveness?
4. What other products/types of products would be helpful in your work? In which other products would you be interested?

3.2.2 Press releases

A press release is an official statement delivered to the media to briefly communicate something significant and specific, e.g., an event, report, etc. The intention is to notify the media in the hope that it will trigger a news item about the topic. A press release should have a "catchy' heading, and the first paragraph should have information on the "who," "what," "why," and "where." When preparing a press release, keep your target audience in mind and send it to a journalist who has shown interest in the topic of the release.

3.2.3 Videos

The human brain remembers visual content a lot more than written content. An average person retains about 10% of the message when they read it and 95% when they watch it. (https://sheffieldav.com/production/5-reasons-we-love-video-marketing-and-you-should-too)

Make the knowledge products available in multiple formats to account for differences in stakeholder preferences and capacity (including technological compatibilities). The formats include electronic and print; text, maps, graphs, charts, color bars; downloadable data; etc. Publicize the products widely through socio-professional media such as LinkedIn, and through other media for example in newsletters, and personal and project websites.

3.3 Key considerations for success

Integrate translation in the research process instead of as a final phase: Instead of a two-phase process in which research findings are translated into practical applications after the research has been concluded, research translation is most effective if it is an integrated component of the entire research cycle. From the very beginning of the process, researchers (scientists) aiming to find solutions to a development challenge should collaborate with practitioners working to solve it, ensuring that the solutions are custom-generated, and easily adapted and applied by the practitioners.

Identify and involve key stakeholders early in the research process: Involving key stakeholders at critical -if not all – moments in the research process in-builds stakeholders' awareness about (and input into) the translated products, enhances stakeholder ownership of

[14] https://laserpulse.org/wp-content/uploads/2022/01/How-to-Plan-for-and-Utilize-a-Brief.pdf

the process, and increases the likelihood of the stakeholders adopting and applying the products. Stakeholder mapping, analysis and engagement planning should be an integral part of the research process.

Custom-make the knowledge products: The content and language of the translation knowledge products should depend on the stakeholder needs and be as context specific as possible. While not all members of your audience can relate well to scientific information, they most likely will like a good story about how research can solve their everyday problems. Instead of describing your research process, focus on why the problem needs solving (how it affects the audience), what solutions your research offers, and what it would take to implement the solutions.

3.4 Useful Resources and Tools

- PPT
- Embedded Research Translation Overview: https://laserpulse.org/wp-content/uploads/2021/06/Embedded_Research_Translation_Overview.pdf
- Effective Storytelling in Research Translation: https://laserpulse.org/wp-content/uploads/2021/10/Effective-Storytelling-in-Research-Translation-Summary.pdf
- Embedded Research Translation Stakeholder Analysis
- https://laserpulse.org/wp-content/uploads/2021/10/ERT_Stakeholder_Analysis_2020.pdf
- How to Plan for and Utilize a Brief: https://laserpulse.org/wp-content/uploads/2022/01/How-to-Plan-for-and-Utilize-a-Brief.pdf

4 MODULE THREE: DATA POLICY

This Module explains the important link between policy and data. It also addresses potential ways to improve documentation that will help increase the availability of data in the future.

4.1 Interdependence between data and policy

It is important to acknowledge that data has value. It is a tool for research, and that research has the power to help decision-makers determine how to effectively distribute funding and what programs and concepts are worthy of their attention. If available, water and climate data can play a pivotal role in important projects like flood risk assessment and early warning systems, planning hydropower infrastructure, or understanding the best way to protect water resources. When data of future interest is not collected or when data is collected but remains inaccessible can be considered as a loss of potential. It follows then that funding towards climate and water data programs is a wise investment in informing decisions for success.

4.2 Crucial Elements for Increasing Access to Climate and Water Data

The use of comprehensive and direct language in policies and documentation indicating how data will be collected, stored, and made available to the public creates an excellent foundation upon which effective data infrastructure can be arranged. Based on a survey of existing documentation from various countries within and beyond the East African region, the presence of a formal commitment to making data available to the public was strongly correlated with data accessibility. Some additional key elements included clear definitions of the party responsible for collecting and disseminating a data type, the destination database where these records would be accumulated, and the format in which data would be stored (e.g. variables, units, file type).

4.3 Key considerations for success

Although no individual element would be expected to carry a national climate and water data program, there is evidence that thoroughness of documentation on these subjects is more likely to culminate in a functional, accessible portal for data access.

4.4 Useful Resources and Tools

- PPT
- Comparative Evaluation of Water Resource Data Policy Inventories Towards the Improvement of East African Climate and Water Data Infrastructure: https://link.springer.com/article/10.1007/s11269-022-03231-z

PART B: FACILITATORS' GUIDE

5 FACILITATORS' GUIDE

5.1 Introduction

The training approach includes introductory PowerPoint presentations; open discussions and break-out sessions for Trainees to share their experiences; on on-the-fly question and answer sessions to gauge Trainee learning and perceptions; and, where possible, a field visit to expose the Trainees to the on-the-ground application of the training. Each Module should end with a rapid evaluation to obtain participant perspectives and suggestions for future engagement.

General tips for power point presentations

Avoid wordy slides. The slide is as a reminder to you on what to say, not for your audience to read. Put short statements as reminders to yourself about what to say and in what order. Include illustrations, quotes, tables, and similar.

Avoid font types and colours that are difficult to read. Check the presentation from where the participants will be seated and see if the slides are legible.

Importantly, the number of slides should depend on the time available/allocated for your presentation. You will need an average of 3 minutes per slide. Do not prepare more than 10 slides for a 30-minute presentation.

5.2 Module 1

- Decide upfront if you are okay with participants asking questions on–the-fly or you would prefer that participants hold their questions to the end of the presentation (s). For lengthy presentations, the presenter(s) could choose to pause briefly at intervals to allow participants to ask questions (*Facilitator in consultation with Presenters*).
- Decide upfront if you will introduce all presenters at the beginning of the module or at each presentation. For longer and/or more complex presentations, it is best to introduce all speakers upfront. Obtain brief bios of the presenters beforehand. (*Facilitator*)
- Start with general perspectives on modelling, framed considering regional contexts and needs (*1 Presenter*).
- Provide examples of modelling applications within the region, starting with an overview of goals and methodologies used. Next, address watershed specific challenges including an overview of the problem addressed, goals, model calibration and validation, scenario evaluations, and a summary of key findings. Finally, tie things together by returning to and framing the findings in the broader context. (*1 Primary Presenter/Coordinator; other Presenters based on watersheds represented*).

- Provide information on tools and resources available to participants (*1 Presenter*)
- Facilitate a discussion session on key issues related to the module (*1-2 Facilitators, 1-2 Notetakers; use breakout sessions/rooms if necessary*). For hybrid sessions, online participants will form a separate breakout group. Assign one of the online participants to take notes of the discussion. (*Facilitator*)
- Provide a summary of key items coming out of discussions and any post-workshop action/activities to be undertaken (*Facilitator, Notetaker(s)*).

5.3 Module 2

- What you need for the session: presentation material, discussion points (use questions in the manual as the starting point), guide for group work,
- Check the participants' knowledge and adjust the length and speed of the module. Your audience may only need a refresher if they are already familiar with the topic. Ask the following questions at the start of the session: What does research translation mean? Why is research translation important?
- Engage the participants: break the presentation every few minutes to get participants' feedback. The feedback may be in form of questions, additional information or comments. When participants ask challenging questions, do not feel pressured to answer all by yourself; remember, your participants are experts, ask them to answer some of the questions.

5.4 Module 3

- Presentation material will be used as an informative discussion starter. The presentation should address the questions: (1) Why is accessible data important to water management policy decisions? (2) How can policies and guidelines be updated to foster data availability and access?
- If presented in the suggested order, participants have already seen examples of what types of questions and issues can be addressed with data, so more focus can be placed on critical data policy elements.
- The presentation portion should last 10-20 minutes, the main purpose of this session is to engage in discussion and encourage participants to evaluate whether the data policies they follow on a regular basis have any or many of the crucial elements. Also, encourage participants to discuss any additional elements they have found useful (or detrimental) in forming clear procedures for data collection and dissemination.

6 ANNEXES

The pages that follow contain handouts of the PowerPoint presentations used in this training workshop. The presentations will be made available online after the workshop.