



Journal of Geography Education in Africa (JoGEA)

Journal of the Southern African Geography Teachers' Association sagta.org.za

Commentary

Using ArcGIS Portal to inform decision making for Integrated Coastal Management, KwaZulu-Natal

Bronwyn Goble^{a,b} and Trevor Hill^{b*}

^a Oceanographic Research Institute, Durban, South Africa – bgoble@ori.org.za

^b Discipline of Geography, School of Agricultural, Earth and Environmental Sciences, University of KwaZulu-Natal, Pietermaritzburg, South Africa

*Corresponding author – hilt@ukzn.ac.za, <https://orcid.org/0000-0001-7015-6906>

How to cite this article: Goble, B. & Hill, T. (2020). Using ArcGIS Portal to inform decision making for Integrated Coastal Management, the case of KwaZulu-Natal. *Journal of Geography Education in Africa* (JoGEA), 3: 81 – 87. https://doi.org/10.46622/JoGEA_v3i.2449 .

Abstract

The coastal environment is one of the most utilised for human activities; providing a diverse range of goods and services such as fisheries, water purification and coastal erosion protection. This results in the need for effective, ongoing management and informed decision making, to ensure long-term sustainability of the coastal environment. However, Goble et al. (2017) highlight that institutional knowledge and capacity are currently limited to achieve the objectives of effective coastal management. This research considers the use of ArcGIS Portal as a component of a Decision Support System (or Info-portal) for coastal management in KwaZulu-Natal, through the development of an online, interactive mapping platform. This platform offers a portal to decision makers to access and interrogate data and information, thus informing decision making. The development of this tool followed a participatory approach, and engagement with end-users throughout the process to ensure that the tool meets users' requirements. To date, the info-portal has been well utilised by both decision makers and members of the public that are interested in the coast. It offers an excellent example of the power of a spatial tool in improving decision making.

Introduction

The coastal environment is used for a myriad of environmental, socio-economic and cultural activities. It is estimated that the

coast supports approximately 44% of the world's population (UN Atlas of the Oceans, 2016), resulting in high pressure on this ecosystem, often leading to reduced coastal functionality and amplified risk of natural

hazards (O'Connor et al., 2009). These pressures result in the need for sound, proactive management. South Africa aims to enhance coastal management through the Integrated Coastal Management Act (ICM Act) (RSA, 2008), which offers a holistic approach, and aims to tackle the interlinked problems of coastal development and conservation; however, implementation have been frustratingly slow. Goble et al., (2017) identified that implementation of coastal regulations is challenging in light of human and financial capacity constraints; in addition, knowledge of those tasked with these portfolios is often limited to a focused area of expertise. For coastal management to be effective in South Africa managers require a broad range of scientific and social information, modelled data and environmental indicators (Living with Environmental Change, 2014; Phillips, 2018), meaning that the scope and complexity of coastal management is highly dependent upon individuals capacity and knowledge of the coast and ICM.

This research considers the knowledge and capacity gaps for coastal management focusing on the KwaZulu-Natal (KZN) Province, one of four coastal provinces in South Africa. KZN-specific barriers to ICM implementation were identified, from which requirements for an information support tool were determined. The tool offers two main platforms to assist those tasked with ICM and the implementation of the ICM Act with information to support their decision making:

A standard website interface which aims to enable continued knowledge acquisition and retention, thereby acting as an 'institutional knowledge bank' for decision makers.

A spatial, GIS based interactive mapping support tool, to inform current management decision making.

Development of the tool followed a participatory approach, through which the application of a series of surveys with users was carried out. The strong focus on the participatory development ensured that all coastal decision makers and stakeholders had input. Thus, ensuring they utilise the tool and its functions voluntarily. The key focus of the developed tool is to ensure appropriate, up to date data and information and supporting scientific data are available to assist coastal decision makers in fulfilling their ICM obligations.

However, while such tools can improve understanding and lead to improved decision-making, their effectiveness depends on continued use by managers (Phillips-Wren et al., 2009). This highlights the value of ongoing training and evaluation.

Background

Capacity (both human and financial) constraints have been identified multiple times in the context of effective coastal management within South Africa (Goble et al., 2017; Sowman and Malan, 2018; Rosendo et al., 2018). This has resulted in several guidelines and support documents for assisting in ICM. However, these documents are only as useful as the understanding and interpretation by managers, thus alternative information sharing approaches could prove to be more effective in improving decision making. Interactive, innovative tools are considered as an appropriate approach to addressing identified information gaps and facilitating a better understanding of the coastal environment, resulting in better management decisions. For KZN, a storm event in 2007, which caused extensive coastal erosion and severe damage (Smith et al., 2007; 2010; Mather, 2008) and left managers reacting to the resultant crisis highlighted the need for alternative, innovative support approaches, as guideline

documents and reports added little value to response and emergency management at the time. This triggered the development of a rapid coastal vulnerability assessment by the government to ensure information was readily available on risk to facilitate proactive responses going forward. The vulnerability assessment culminated in a coastal vulnerability index (CVI) and viewer or decision support tool to simplify the presentation of complex scientific data for managers and decision makers. It offered a simple, user-friendly interface and focused on identifying properties and infrastructure potentially at risk to future storm surge and erosion events (Palmer et al., 2011). The CVI tool was well utilised, supporting government in decisions pertaining to development applications along the coast. However, as pressure in coastal areas increased, managers are faced with greater management challenges. Hence the need for a more encompassing approach that could better assist in facilitating all aspects of ICM, and the development of an interactive Decision Support System (DSS) or info-portal.

Methods

For KZN a coastal info-portal has been developed, taking the form of an online decision support system, (www.coastkzn.co.za). The info-portal is an innovative decision support platform aimed at assisting coastal managers in the absence of human capacity. It aims to provide a ‘one stop shop’ platform, housing all data and information relevant to ICM in the province. A key component is that of the interactive map, developed using the ArcGIS Portal platform. The aim of which is to store all

relevant spatial data that can be used by managers to inform coastal decision making (Figure 1). The use of an ArcGIS Portal platform allows for the integration of spatial data and access to a range of tools for users, such as adding their own layers, drawing and producing a map for inclusion in reports. Key layers available in the spatial platform include, data related to risk and vulnerability, recreational layers (swimming beaches, fishing zones and launch sites), coastal access, estuaries, conservation areas and land cover (Figure 1). The first step to ensuring ‘success’ was to provide training to decision makers, particularly to guide the use of the interactive map. The interactive map offers a powerful mapping platform that requires some guidance for non-GIS users. That said, the format is intuitive and interactive and can be used without having used a traditional GIS. Four training sessions were offered, the focus of which were to ensure that decision makers are exposed to the decision support tool and how best to apply it. Training highlighted the value of the interactive map and the spatial data provided, ensuring that users were able to find locations, turn layers on and off, make a map and export them for use in reports. To-date, training has been attended by 89 people. While the focus was on decision makers, attendees included government (75%), consultants (13%) and conservation agencies/NGOs (12%). Follow-up surveys were sent to users that had attended training sessions to determine if they were using the info-portal for daily ICM. The surveys determined future needs for such a platform. As this work forms part of an ongoing project, all survey questions were considered and approved by an ethics committee, while anonymity of survey respondents was guaranteed.

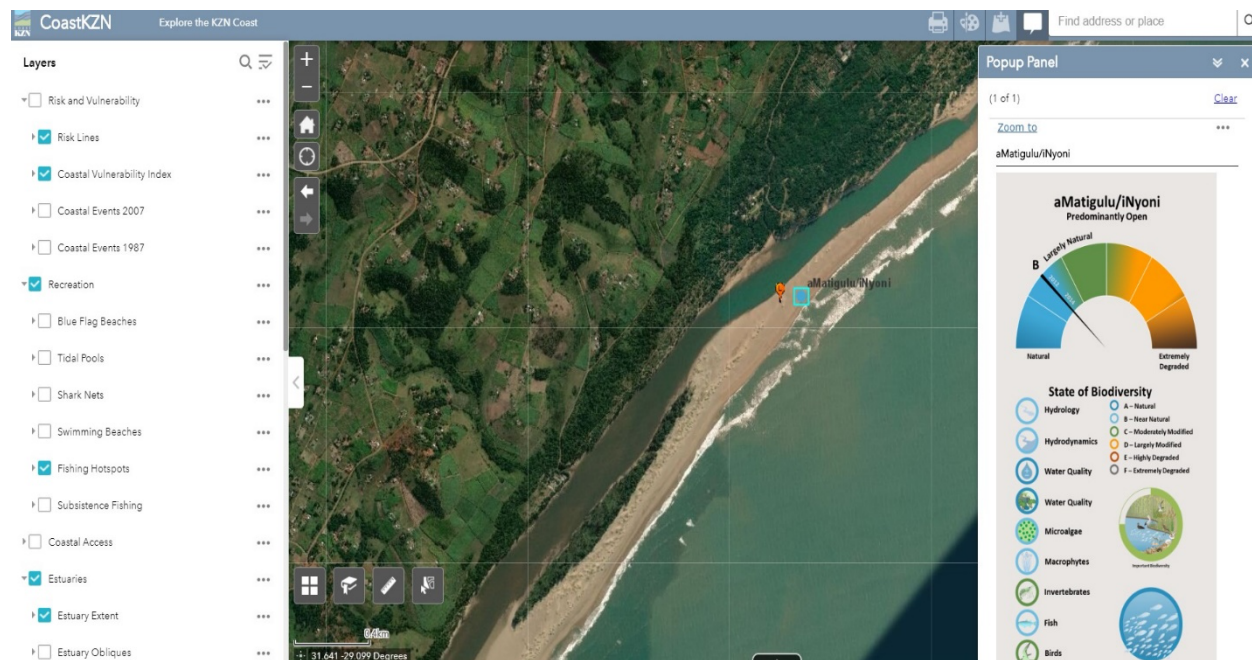


Figure 1: additional information offered on the interactive map (Source: Author).

Results

A total of 82 (92%) feedback responses were received from training attendees. Significantly, 61% of respondents stated that the training session was their first interaction or exposure to the info-portal, having not looked at it prior to the session, highlighting the value of such sessions. Ninety-six percent of respondents are of the opinion that the training session had enhanced their skills and knowledge relating to the info-portal and its use.

Ninety percent of respondents are of the opinion that the tool will be useful in their work and decision making. One respondent stated that the info-portal is “...like a library where you can find all the information you require for this field” (Respondent, 2018). Respondents found value in the info-portal,

for a range of reasons, from the documents presented (Acts and policies) to the interactive map and ability to make maps for reports they require particularly for non-GIS users (Figure 2). Users stated that this should further aid in the environmental authorisation process¹ whereby environmental practitioners could draw relevant coastal information prior to the submission of reports (Respondents, 2018). Uptake of the info-portal reflects successful use, with 13 000 sessions on the info-portal and almost 30 000 pages within it viewed, between October 2017 and October 2019 (Figure 2).

Importantly this tool contains data and information generated through short- to long-term research or monitoring projects, some in partnership with government,

¹ Environmental authorisation process: the legislative process for determining environmental impacts of proposed developments



ensuring that each component presented has a scientific, data-validated foundation and has undergone authentication prior to inclusion. The info-portal has simplified access to relevant legislation and supporting information, thereby simplifying the ICM planning process. (O. Parak, 2018, pers. comm., in Goble et al., 2017).

In addition, the tool has been used by coastal managers to identify encroachments into coastal public property from private property, through the identification of cadastral boundaries and infrastructure. These are then addressed through the legal process of ‘repair and removal notices’ outlined in the ICM Act.

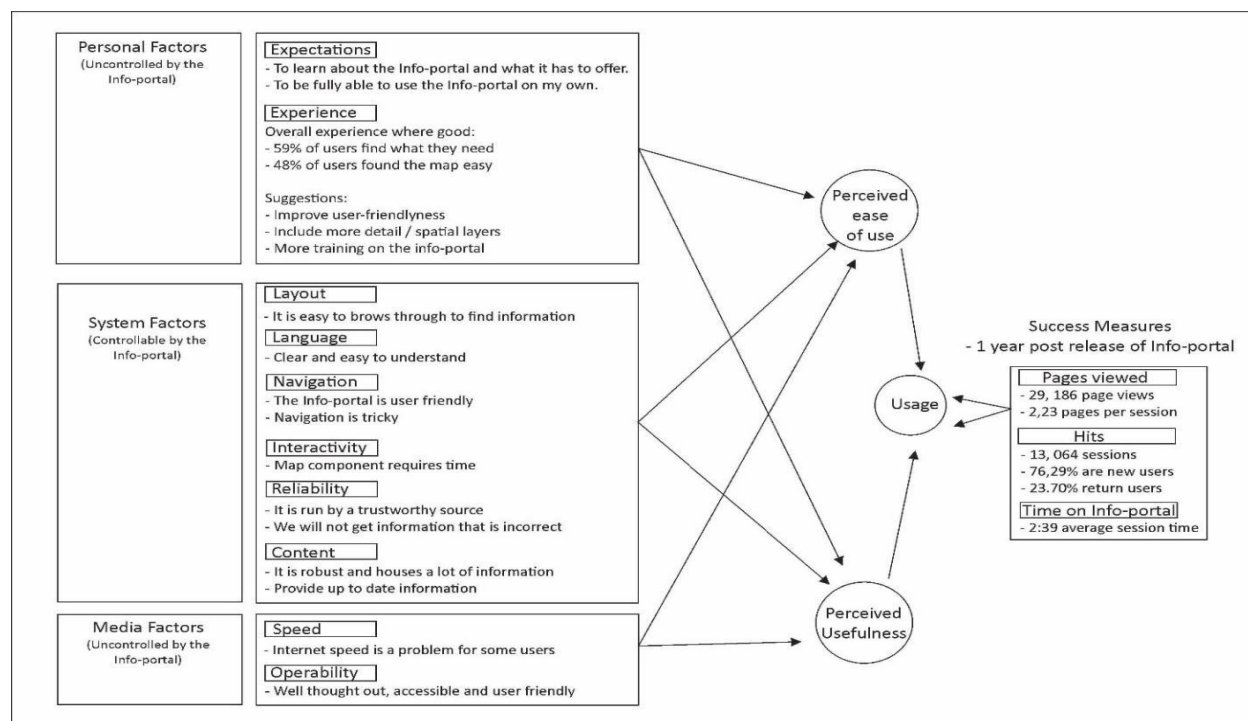


Figure 2: Info-portal user experience - Input factors and success measures

Conclusion

Importantly, this tool is a first of its kind for South African coastal management and uptake is expected to be slow, as managers balance daily demands with learning and using a new approach. Overall feedback has been positive, and the tool is increasingly being used in decision making and by the public to develop an understanding of the spatial extent and challenges of the coast. This is a powerful tool that comprises all the

basics of a GIS system that can and should be used for a range of learning applications, bearing in mind it is a freely available and accessible tool, containing scientifically credible data and information. The tool is constantly being updated with new data and information becomes available, thus ensuring it remains relevant to coastal managers and members of the public that wish to access and utilise it.

References

- Goble, B.J., Hill, T.R. and Phillips, M.R. (2017). An Assessment of Integrated Coastal Management Governance and Implementation Using the DPSIR Framework: KwaZulu-Natal, South Africa. *Coastal Management*, 45:107-124.
- Living with Environmental Change. (2014). *New tools to improve the management of the coastal environment: How can new approaches help national decision makers improve management of coastlines for people and wildlife?* Living with Environmental Change, Note No. 10. Swindon, United Kingdom.
- Mather, A.A. (2008). *Coastal Erosion and Sea-Level Rise: Are Municipalities Ready for This?* eThekwini Municipality, Durban. 16pp.
- O'Connor, M.C., Lybery, G., Cooper, J.A.G., Gault, J. and Mckenna, J., (2009). Practice versus policy coastal defence management. *Marine Policy*, 33, 923-929.
- Palmer, B.J., van der Elst, R., Mackay, F., Mather, A.A., Smith, A.M., Bundy, S.C., Thackeray, Z., Leuci, R. and Parak, O. (2011). Preliminary coastal vulnerability assessment for KwaZulu-Natal, South Africa. *Journal of Coastal Research*, Special Issue 64:1390-1395.
- Phillips, M.R. (2018). Integrated Coastal Zone Management: Policy Evolution and Effective Implementation? In: Jones, A.L. and Phillips, M.R. (eds) *Global Climate Change and Coastal Tourism: Recognizing Problems, Managing Solutions and Future Expectations*. CAB International, UK, 23-34.
- Phillips-Wren, G., Mora, M., Forgionne, G.A. and Gupta, J.N.D. (2009). An integrative evaluation framework for intelligent decision support systems. *European Journal of Operational Research*, 195(3): 642-652.
- Republic of South Africa (RSA). (2008). National Environmental Management: Integrated Coastal Management Act 24 of 2008. Retrieved from <https://www.gov.za/documents/nationalenvironmental-management-integrated-coastal-management-act>
- Rosendo, S., Celliers, L. and Mechisso, M. (2018). Doing more with the same: A reality-check on the ability of local government to implement Integrated Coastal Management for climate change adaptation. *Marine Policy*, 87:29–39.
- Sale, P.F., Butler IV, M.J., Hooten, A.J., Kritzer, J.P., Lindeman, K.C., Sadovy de Mitcheson, Y.J., Steneck, R.S. and van Lavieren, H. (2008). *Stemming Decline of the Coastal Ocean: Rethinking Environmental Management*. United Nations, New York. 50pp.
- Smith, A.M., Guastella, L.A., Bundy, S.C. and Mather, A.A. (2007). Combined marine storm and Saros spring high tide erosion events along the KwaZulu-Natal coast in March 2007. *South African Journal of Science*, 103: 274-276.
- Smith, A.M., Mather, A.A., Bundy, S.C., Cooper, J.A.G., Guastella, L.A., Ramsay, P.J. and Theron, A. (2010). Contrasting styles of swell-driven coastal erosion: examples from KwaZulu-Natal, South Africa. *Geological Magazine*, 147:940-953.

Sowman, M. and Malan, N. (2018). Review of progress with integrated coastal management in South Africa since the advent of democracy. *African Journal of Marine Science*, 40:121-136.

UN Atlas of the Oceans. (2016). *UN Atlas of the Oceans: Human Settlements on the Coast* www.oceansatlas.org/subtopic/en/c/114/ [20 January 2016]