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**The role of public participation, spatial
information and GIS in natural resource
management of the dry tropical coast,
northern Australia**

Volume 1

Thesis submitted by
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in January 2010

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Thesis Abstract

Public participation is undergoing worldwide recognition as an indispensable component of natural resource planning and management. Nevertheless, effective engagement and communication between resource users and managers is considered the main challenge towards achieving participatory decision-making processes. Spatial information and geographic information systems have been increasingly used as means of engaging and communicating natural resource issues with grassroots groups. The public participation geographical information system has emerged as a promising approach to facilitate visualisation, availability and dissemination of information. It also provides a complementary alternative to traditional participation techniques. However, a meaningful public participation depends on the relevance of the issues involved, the perspectives and interests of participants, the existing cultural, political and organisational contexts, and the level of public participation aimed at being achieved.

The overall purpose of this research was to investigate and document the extent to which public participation processes and geospatial tools have been developed in practice. Three case studies located at the Queensland tropical coast (North Queensland, Australia) were used to illustrate issues, problems and opportunities of integrating public participation, spatial information and related technologies in natural resource management. The tropical coast of the Great Barrier Reef was selected because of the diversity of stakeholder groups that is users of information, resource-use exploiters and information providers. The region also displays a complexity of natural resources decision making processes, an increasing number of public participation initiatives, and current and emergent needs for spatial information and GIS. Three research objectives were addressed to achieve this purpose: (1) analysis of public participation strategies and tools used to communicate with and engage key stakeholder groups in natural resource management; (2) assessment of the extent to which spatial information and GIS technology have been used to furnish access to information and to support participation in decision making processes; (3) development of a conceptual model identifying the key drivers, needs and barriers in terms of participation and use of spatial information and GIS in the management context of the tropical coast.

Data collection involved a combination of qualitative and quantitative techniques including semi-structured interviews, self-completion questionnaires, participant observations, and document analyses. Case studies were selected from both catchment and coastal water systems in the tropical coast of the Great Barrier Reef. The selected case studies provide realistic

decision making situations at distinct management scales to investigate the socio-institutional and technical dimensions of the spatial management changes by comprehending how different users understand and make use of spatial information and geographic information tools. Qualitative and quantitative techniques were used to analyse the datasets of the three case studies. Qualitative data composed of document summaries, interviews transcriptions and observation notes were expanded, reviewed and coded. Quantitative data from the surveys were analysed using exploratory and descriptive statistical techniques. Geographic information technology and advanced spatial analysis tools were employed to analyse mapped data.

Regardless of the differences inherent to each case study, findings indicated that many stakeholders are highly motivated and committed to influence decisions on natural resource management. There is also an increasing demand for geographic information technology in land and water management, including real time environmental data to assist with the land and water management process. However, the existing mechanisms, that is the main sources of spatial information and communication tools, the ways geospatial data are developed and acquired, and strategies that people use are not fully supportive of PPGIS initiatives. The public participation processes and the provision of spatial data and use of geographic tools are not fully tailored to the immediate needs of the stakeholders. The current strategies for spatial data acquisition, access and dissemination are mainly driven by government and research institutions. Consequently, most of the immediate public interests do not overlap with the GIS technology and the spatial data provided. The most common factors found in the three case studies investigated were uncertainty about data sources, inappropriateness of the information provided, lack of technical skills and spatial expertise, and inadequate infrastructure.

The research found that despite the limitations found in the three case studies, results of this study provided important and valuable data to support the development of more appropriate ways of interacting, communicating and learning with spatially-referenced data. The conceptual model linked and synthesized the social and technological frames across the case studies providing a coherent framework that integrates the findings of three real natural resource management situations that is catchment, coast and marine systems catchment, coast and marine systems. To enhance support for PPGIS initiatives, users' interests need to be intersected by GIS technology and the spatial data provided. To achieve that, this research recommends that four major strategies need to be addressed: (1) trust between government and resource management agencies with resource users needs to be urgently strengthened; (2) parameters to be measure by geospatial technologies, such as the sensor networks, have to be better linked to a specific management problem, so a more purposive collection and use of data can be designed; (3) investment in collaborative joint initiatives in the use of existing structures and established

community-based networks may possibly strengthen efforts, within and across interested stakeholder partners, facilitating the management, storage, access and acquisition of spatial data and geographic information technology, and (4) effective participation and the meaningful use of GIS and spatial information needs to be adopted as a continuous process, instead of as an end, and as tool to fulfill legal requirements.

The conceptual framework developed and the results achieved in this thesis contribute to general development in the field of geographical research, particularly PPGIS theory and GIScience. Findings of this research provided relevant information on the social, technological and institutional elements that shape and influence public participation and the context-dependent use of spatial information and GIS tools in natural resource management. This thesis touched different management contexts (from water quality of coastal resources to rezoning of marine protected areas and innovative spatial sensor technology), several stakeholder groups (recreational fishers, coastal managers, government agencies, industry, landholders, science providers, and community-based organisations), and a myriad of issues involving public participation and the use of spatial information and GIS. Future research should be directed at investigating the multiple contexts (cultural, social, political and technological) of coupled public participation and geographic information; differential access to geographic information and technology, and public perceptions of space and understanding of the spatial aspects of decision problems.

TABLE of CONTENTS

Volume 1

Chapter 1	General Introduction	1
Chapter 2	Literature Review and Theoretical Foundations	12
Chapter 3	Research Methodology	50
Chapter 4	Case Study 1: Maps, spatial information and community engagement in natural resource management - <i>The Role of Spatial Information and Geospatial Tools in Community Engagement and Management Processes of Water Quality in the Dry Tropics Coast Natural Resource Management Region</i>	66
Chapter 5	Case Study 2: Effects of the Rezoning of the Great Barrier Reef for Recreational Fishers - <i>A spatial and social assessment of management changes of the Great Barrier Reef rezoning for recreational fishers in Queensland</i>	122
Chapter 6	Case Study 3: Adoption of Spatial Sensor Technology by Coastal Managers - <i>Linking Science and Management in the Adoption of Sensor Network Technology in the Great Barrier Reef Coast</i>	179
Chapter 7	General Discussion and Synthesis - <i>Development of a Conceptual Framework for Linking Public Participation, Spatial Information and GIS in the Management Process of the Great Barrier Reef Dry Tropical Coast</i>	216
References		247

Volume 2

Appendix A	Copy of the Ethics Approval and consent forms.	1
Appendix B	Chapter 4 supporting information: list of documents analysed, meetings observed, interviews and survey protocols.	7
Appendix C	Chapter 5 supporting information: semi-structured interview and questionnaire protocols, descriptive statistical tables of distance values.	29
Appendix D	Chapter 6 supporting information: key informant interview protocol and list of detailed management issues identified by the participants of the workshop.	53

Volume 1 List of Tables

Chapter 2

Table 2.1	Summary list of key concepts, definitions and sources used in the thesis.	16
Table 2.2	Brief summary of PPGIS and P-GIS approaches.	24

Chapter 3

Table 3.1	Example of the meanings of reliability and validity in quantitative and qualitative research paradigms.	59
Table 3.2	Summary of the main procedures adopted during the research process.	60

Chapter 4

Table 4.1	Example of best management key issues, practices and principles for grazing and sugar cane farming for the Burdekin WQIP region.	75
Table 4.2	List of the data collection methods.	79
Table 4.3	Level of importance with statements about elements of an effective engagement program in natural resource management	91
Table 4.4	Summary of information, communication and engagement tools and techniques within the scope of CCI-WQIP and related activities.	95
Table 4.5	Best communication and engagement practices in land and water management in the Burdekin WQIP region identified by participants.	98
Table 4.6	Major needs, priority, main sources of information, benefits and constraints for spatial information in land and water management in the Burdekin Dry Tropics NRM region.	105
Table 4.7	Level of agreement with statements about the use of mapping and geospatial technologies to facilitate participation in natural resource planning and management processes.	106

Chapter 5

Table 5.1	Weight values for the input rasters.	134
Table 5.2	Level of importance with statements about attributes/outcomes of public consultation programs rated as highly and lowest important by Participants and non-participants (NP).	159

Chapter 6

Table 6.1	Overview of presentations of the first and second workshops.	191
Table 6.2	Pre-workshop online questions provided to the participants of the second workshop.	192
Table 6.3	Initial set of topics addressed in the first workshop.	196
Table 6.4	Example of compelling research questions relevant to the GBR Ocean Observation System (GBROOS).	197
Table 6.5	Clusters of compelling questions and issues that require wireless technologies for inshore/nearshore water quality.	199
Table 6.6	Respondents' level of agreement with statements about public participation in coastal and water quality management processes.	205

Volume 1 List of Figures

Chapter 1		
Figure 1.1	Outline thesis structure.	9
Chapter 2		
Figure 2.1	Levels of involvement, direction of interactions, and mechanisms involved in the relationship between government institutions and citizen groups' participation in policy-making.	17
Figure 2.2	GIS, public participation, Internet and its interactions and ramifications.	26
Figure 2.3	The e-participation ladder.	29
Figure 2.4	Collaborative GIS cube.	36
Figure 2.5	Theoretical framework underling the mutual influence of social and technological contexts.	43
Chapter 3		
Figure 3.1	Outline of the main research design steps.	51
Figure 3.2	Components of the data collection design.	54
Figure 3.3	Map of studied region in the Queensland state. Case studies were located inside the marked area.	61
Figure 3.4	Conceptual diagram of the selected case studies and contexts.	62
Chapter 4		
Figure 4.1	Schematic representation of government agencies involved with water source management and institutional jurisdictions in the GBR region.	68
Figure 4.2	Basins of the Burdekin Water Quality Improvement Plan (WQIP) region and inset of the study area.	71
Figure 4.3	Schematic diagram of development and implementation processes of a Water Quality Improvement Plan for the Burdekin Dry Tropics NRM region.	75
Figure 4.4	Data Collection Framework.	79
Figure 4.5	A group of participants identifying needs, sources, benefits and constraints of spatial information.	82
Figure 4.6	Schematic representation of major themes, institutional scales and contexts of participation in water quality management.	86
Figure 4.7	Identification of an effective communication and engagement process in natural resources and land-based management issues.	88
Figure 4.8	Interactive group discussion activity. a) A group of participants in an interactive activity about sharing understand of the different levels and techniques used in public participation.	89
Figure 4.9	Alliance triad between the public, the management agency, and the operational facility.	92
Figure 4.10	Perceptions about the usefulness of various techniques for consulting the public about natural resource management.	96
Figure 4.11	Use of mapping and satellite imagery information within the scope of	100

	water quality and land-based management projects coordinated by the NQ Dry Tropics Land and Water Solutions.	
Figure 4.12	Stage of use of spatial data technologies (e.g. satellite imagery, geographic information systems) in natural resources-land management activities.	102
Figure 4.13	Use of spatial data and related technologies in natural land-based management activities.	102
Figure 4.14	Schematic representation of organisational and individual spheres and interaction with spatial information and GIS.	115
Chapter 5		
Figure 5.1	Map of study area showing the extent of the study area, as well as old and new fishing exclusion zones (green zones).	128
Figure 5.2	Schematic outline of the main components of data collection, processing, and analysis.	129
Figure 5.3	Polygons indicating location of previous (P) and current (C) fishing spots and number of spatial clusters.	137
Figure 5.4	Spatial overlay of previous (lost) fishing spots in Townsville (a) and Rockhampton (b). MNP refers to Marine National Park (green zones or no-take areas).	138
Figure 5.5	Schematic representation of spatial displacement from lost previous locations to fished more locations in the Townsville (a) and Rockhampton (b) regions.	140
Figure 5.6	Schematic representation of spatial displacement from lost previous locations to new fishing locations in the Townsville (a) and Rockhampton (b) regions.	142
Figure 5.7	Fishing intensity map of the most important saltwater recreational fishing locations within the GBR for the a) Townsville and b) Rockhampton sites.	145 - 146
Figure 5.8	Average fishing intensity and distance (km) from the boat ramp departure points to spatial fishing clusters in Townsville (a) and Rockhampton (b).	149
Figure 5.9	Fishing intensity and average distance (logarithmic scale) from submerged structures in general and for the different high intensity fishing spots.	150
Figure 5.10	Fishing frequency (number of fishing boat trips in the last 12 months) for pre- and post- rezoning process.	153
Figure 5.11	Level of use of maps and spatial related tools by recreational fishers.	162
Figure 5.12	Substitution and compensation scenarios for recreational fishing at the GBR.	168
Chapter 6		
Figure 6.1	Schematic diagram of data collection, process and deliver of a sensor network.	186
Figure 6.2	Sensor network pilot sites.	187
Figure 6.3	Summary matrix used at the workshops to identify requirements and limitations for the adoption of sensor network and effective use of real-time data.	190
Figure 6.4	Conceptual scheme of spatio-temporal scale of requirements (a) and limitations (b) for the adoption of sensor network data and technology.	200

Figure 6.5	Variables measurable by the wireless environmental sensor network.	202
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Chapter 7

Figure 7.1	A generic PPGIS framework integrating levels of public participation and use of spatial information and GIS in public participation.	221
Figure 7.2	Detailed conceptual framework of contextual factors that shape participation and the role of spatial information and GIS in community engagement and management processes in water quality in the Dry Tropics NRM region (case study 1).	230
Figure 7.3	Detailed conceptual framework of contextual factors that shape recreational fishers' participation and the role of spatial information and GIS in the rezoning process of the Great Barrier Reef (case study 2).	233
Figure 7.4	Detailed conceptual framework of contextual factors that shape participation and the role of spatial information and GIS in linking science and management in the adoption of sensor network technology along the Great Barrier Reef coast (case study 3).	236

Abbreviations and Acronyms

ACTFR	Australian Centre for Tropical Freshwater Research
AIMS	Australian Institute of Marine Science
BDT(NRM)	Burdekin Dry Tropics (Natural Resource Management)
BBIFMAC	Burdekin Bowen Integrated Floodplain Management Advisory Committee
BSES	Bureau of Sugar Experiment Station
BPS	Burdekin Productivity Services
BWQIP	Burdekin Water Quality Improvement Plan
CCI	Coastal Catchments Initiative
CSR	CSR Sugar Australia
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CVA	Conservation Volunteers Australia
DEH	Department of Environment and Heritage
DPI & F	Department of Primary Industries and Fisheries
EPA	Environmental Protection Agency
EVs	Environmental Values
CESNNQ	Coastal Environmental Sensor Networks in Northeast Queensland
GA	Geoscience Australia
GBR	Great Barrier Reef
GBRMP	Great Barrier Reef Marine Park
GBRMPA	Great Barrier Reef Marine Park Authority
GBRWHA	Great Barrier Reef World Heritage Area
GIS	Geographic Information System(s)
HRIC	Herbert Resource Information Centre
JCU	James Cook University
NCGIA	National Center for Geographic Information and Analysis
NHT	Natural Heritage Trust
MNP	Marine National Park
MPA	Marine Protected Area
NRM	Natural Resource Management
P-GIS	Participatory GIS
PPGIS	Public Participation GIS
RWQIP	Reef Water Quality Protection Plan
WCED	World Commission on Environment and Development
WQBMP	Water Quality Burdekin Management Plan
WQIP(s)	Water Quality Protection Plan(s)
WQO	Water Quality Objectives
WWW	World Wide Web

Publications Associated with this Thesis

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Publications

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Reports

De Freitas, D.M. (2007). Report on the Adoption of Sensor Network by Coastal Managers: An Inshore Water Quality Approach – Workshop 2. School of Earth and Environmental Sciences, James Cook University. Townsville, Australia. 26 July 2007. 31pp.

De Freitas, D.M. (2007). Let's get together to talk about Public Participation and the use of Mapping Information in the Burdekin Dry Tropics Coast. Workshop Report, 2pp.

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Conference Presentations

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De Freitas, D.M., Sutton, S., Moloney, J., Lédée, E., Tobin, R. (2009). Spatial Assessment of the Implications of the 2004 Rezoning of the Great Barrier Reef for Recreational Fishers. Marine and Tropical Sciences Research Facility (MTSRF) 2009 Annual Conference, 28-30 April, Townsville (Australia).

De Freitas, D.M., Sutton, S. (2008). Spatial Implications of Rezoning of Australia's Great Barrier Reef for Recreation Fishers. 5th World Recreational Fishing Conference November 10-13, Florida (USA).

De Freitas, D.M. (2008). Spatial Implications of Rezoning of the Great Barrier Reef for Recreational Fishers. Spatial Technologies Supporting Regional Queensland Conference. 24-26 October, Townsville (Australia).

De Freitas, D.M. (2008). The use of Spatial Information and GIS in Community Engagement and Management Processes of Natural Resources in the Burdekin Dry Tropics Coast. Coast to Coast 2008, 18-22 August, Darwin (Australia).

De Freitas, D.M., Sutton, S., Moloney, J. (2007). Spatial and Non-Spatial Dimensions of Geographic Information-Based Tools in Supporting Participation in the Great Barrier Reef Coast (Northern Australia). 8th International Symposium on GIS and Computer Mapping for Coastal Zone Management. 8-10 October, Santander (Spain).