Use of Traditional and Technical Knowledge in Participatory Decision-Making for Watershed Management, Santa Catarina Brazil

by

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ABSTRACT:

This study uses the Itajaí River watershed management committee in Santa Catarina, Brazil, as a case study of how different types of information, specifically lay knowledge and technical information, can be used in environmental resource management to achieve greater conservation and higher levels of collaboration and equity. Through background research, surveys and in-depth interviews of River Basin Committee members (non-governmental organizations, governmental agencies, utility companies, the public and community) it identified different kinds information use within the committee and explored the reasons that shape knowledge use to support decision-making.

This thesis argues that while decision-making in the watershed committee seems to be significantly dominated by technical knowledge, the worldviews and environmental attitudes of committee members critically shape the possibility of river basin committees to diversify and incorporate lay knowledge in decision-making in the future. It also finds that greater participation and diversity of knowledge also depends on institutional change to eliminate current obstacles to participation. The benefit of the use of combined knowledge in the River Basin Committee (RBC) is twofold. First, the use of both scientific and lay knowledge[1] is likely to provide more options for resource conservation and equity in water allocation. Second, by recognizing and valuing lay knowledge as useful to water management, RBCs may stimulate broader participation from communities and societal actors who have been traditionally alienated from meaningful participation in technically dominated decision-making bodies. In turn, if these groups are more involved and educated about the importance of the RBC, these decisions are more likely to be implemented.

[1] For this study lay knowledge combines the notion of lay, traditional and indigenous knowledge.

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LIST OF ABREVIATIONS

RBC – River Basin Committee

DNOS – National Department of Works and Sanitation

ANA – National Water Agency

ONG – Non-Governmental Organization

SPSS – Analytical computer program

DOE – Department of the Environment

IPCC – Intergovernmental Panel on Climate Change

UNESCO – United Nations Educational, Scientific and Cultural Organization

FATMA – Santa Catarina Governmental Environmental Organization

ASSEMA – Association in the Settlement Areas of the State of Maranhão

FURB – University of Blumenau

CHAPTER 1: INTRODUCTION AND OVERVIEW OF THE ITAJAÍ WATERSHED

Water is of critical consequence to human survival because of its economic, human, ecological and health impacts. The way water is managed influences the sustainability of the source and the justice of its distribution. Because of water resources social and economic importance, historically, communities, individuals and governments have actively mobilized to manage them with different outcomes. Water is also a scarce good; around the world there is a trend toward the decentralization and democratization of its management aiming at its sustainable use as an alternative to traditional management approaches that rely almost exclusively on centralized infrastructure and decision-making (Gleick 2003). Although this second path – the "soft" path – may also rely on centralized infrastructures, it often complements it with extensive investment in decentralized facilities, efficient technologies, and human capital (Gleick 2003).

In Brazil (Figure 1), since the early 1990s, water reform has tried to address the issues of sustainability and access by creating a regional watershed committee system that is participatory and democratic. This new water management system has included the enactment of specific legislation (Law 9.433) that has three underlying principles: water as an economic good, the river basin as the management unit and River Basin Committees (RBCs) as the forum where management decisions are made. These committees—constituted of water users, representatives of federal, state and municipal governments and representatives of organized civil society—are an innovative effort to encourage societal participation and decentralize water management across Brazil (Formiga et al. 2007). The new regulatory framework allows for the possibility that users and communities best manage water resources if they identify the problems and have input into how resources should be regulated.

Law 9.433 also includes the design and implementation of such management tools as a bulk water charging and user permit system. Ultimately, the reform seeks to create autonomous River Basin Committees and basin agencies that have jurisdiction over water related concerns. To accomplish these goals, one important objective of the water reform is to involve the Basin communities in the identification and demonstration of remedial measures, as well as in a dialogue process to manage common water resources.

The reform is also inspired by a package of management prescriptions commonly known as "good governance" that advocates, among other things, that stakeholders should be fully involved in both the process and benefits of decision-making regarding the management of water resources. Persuasive evidence now suggests that the greater the involvement of stakeholders in designing and carrying out environmental management plans, the greater the local commitment to them, and the higher the likelihood of successful implementation (Adnan et al 1992).

Figure 1: Map of Brazil

Petkova et al. (2002) stress that environmental issues are best handled with the participation of all concerned citizens, at the relevant level. Diverse participation in environmental decision-making also leads to better conservation and greater justice (Petkova et al 2002). Moreover, active participation of municipal governments is thought to be one of the best ways to increase downward accountability and encourage democratic decentralization, thus producing superior equity and efficiency (Brannstrom et al 2003). In this sense, reforms to Brazil's water-resources management are well suited to explore how civil-society organizations have responded to decentralization, whether they have influenced the success of reforms, and the prospects for meaningful participation (Brannstrom et al 2003).

As the World Bank has illustrated in its decentralized water management projects, one way to ensure the democratization and decentralization is to acknowledge the need for diverse sources of knowledge in the watershed management decision-making process (Brannstrom et al 2003). In order to understand such processes, it is important to assess the production and use of knowledge to support decision-making. In principle, the more access to knowledge and relevant information, the better-equipped decision-makers will be to manage scarce or at-risk resources such as water (Lemos et al. 2010). Nevertheless, empirical evidence has shown that the production and use of techno scientific knowledge in environmental policymaking has been far from straightforward (Lemos 2008, Engle and Lemos 2010, Healy and Archer 1999). Thus in order to understand the impact of knowledge on decentralized water management more research is necessary.

This thesis looks at the use of traditional and scientific knowledge within the

participatory decision-making committee of the Itajaí River Basin in the state of Santa Catarina Brazil. One main contention of this study is that a model of knowledge use that combines both scientific and lay knowledge will be more likely to lead to effective collaboration supporting the decision-making, which in turn, will stimulate both sustainable resource use and broader societal participation. The incorporation of local knowledge would also give a broader knowledge base toward finding local solutions to river basin management, just water allocation and watershed conservation. Yet, water management in Brazil (and in many other regions of the world) has been mostly dominated by technical approaches that have not only failed to incorporate lay knowledge but in many ways have framed such knowledge as useless. What factors account for the combination of techno-scientific and lay knowledge in water decision-making? How can combined knowledge be encouraged and implemented in the context of decentralized water management? In the Itajai River Basin, while it seems that professional characteristics and formal education of the current members are the main predictor of the type of knowledge mostly used, other factors such as institutional design also play a role in the type of knowledge used to support water management decision-making. And while decision-making seems to be significantly dominated by technical knowledge, the worldviews and environmental attitudes of committee members may critically affect the possibility of river basin committees to diversify and incorporate lay knowledge in decision-making. Additionally, greater participation and diversity of knowledge may also depend on institutional change to eliminate current obstacles to participation. Based on surveys of committee members this research explores how characterizations related to participation, individual watershed committee members (salient issues and worldviews) and institutional design are likely to lead to greater environmental conservation and justice. Here, the characteristics of participation may not only affect the way information and ideas are disseminated and used but also provide a platform for a diversity of information sources (such as lay, indigenous, techno-scientific information).

The benefit of the use of combined knowledge in the River Basin Committee (RBC) is twofold. First, the use of both scientific and lay knowledge[2] is likely to provide more options for resource conservation and equity in water allocation. Second, by recognizing and valuing lay knowledge as useful to water management, RBCs may stimulate broader participation from communities and societal actors who have been traditionally alienated from meaningful participation in technically dominated decision-making bodies. In turn, if these groups are more involved and educated about the importance of the RBC, these decisions are more likely to be implemented.

In the next sections I will focus on the relevant factors affecting the use and diversity of knowledge in water reform in the Itajai River Basin. Chapter Two provides a brief review of the literature that informs this analysis focusing both on decentralization of natural resources management and use of knowledge in policy-making. Chapter Three provides an account of the history of land use in the Itajaí valley and how it has affected water management in the region. Chapter Four reviews the creation of the River Basin committee focusing on stakeholder participation in the Valley. Chapter Five analyzes the connection between patterns of knowledge use, participation and environmental

[2] For this study lay knowledge combines the notion of lay, traditional and indigenous knowledge.

conservation and justice using related studies and the testimonies of committee members within the Itajaí River Basin committee. Next, I will compile a set of recommendations based both on member's interviews and in the analysis as well as a set of general conclusions that can inform water management in Brazil and around the world.

CHAPTER TWO: BACKGROUND

Water Reform in Brazil

Environmental concerns are a tactical element for public policy in Brazil (Ministry of the Environment of Brazil, 2001). Among all environmental issues, water protection, allocation, and production are of imperative importance due to their significance in economic development and human health. Growing populations, dying ecosystems, political and military disputes, and poverty are all interwoven with water or its absence. The urgency of water issues requires the combined efforts of businesses, political leaders, teachers, communities, and citizens (Gleick 2003).

Brazil is privileged in terms of water resources. According to the World Resources Institute, annually the country has 5,190 km^3 of renewable water resources, 12.7% of the 40,673-km3 available worldwide. However, the water resources available differ widely from basin to basin. While mobilization around water management in the Northeast has centered around scarcity and drought concerns, in the South, efforts have focused on poor water quality, erosion and flooding. Adequate watershed management is decisive for the conservation of biodiversity in different Brazilian biomes, as well as for the maintenance of the social and economic activities in each (National Policy for Water Resources). For this reason, governments, non-governmental organizations, and communities have become more involved in the policy making process due to heightened awareness and concern over the future of water resources. As in other parts of the world, they are looking for effective ways to implement water management policies that consider both economic development and ensure environmental sustainability.

The Brazilian water sector has undergone notable changes since the adoption of a new Constitution in 1988 with a transition in natural resource management from technocratic decision-making toward a more democratic and decentralized process that makes use of different kinds of knowledge and that seeks to manage the country's water resources in a sustainable and efficient manner. Other aspects of the Brazilian reform such as decentralization, integration, and the concept of water as an economic good, are also part of the broader pragmatic change regarding the perception and management of water all over the world.

Keck and Abers (2004) explain that this reform process did not result from either a mass movement or from lobbying by powerful interest groups. Instead, it emerged from the ideas and efforts of a handful of dedicated individuals and groups such as technical personnel in state agencies, environmental NGOs, and scientists and engineers. Few grassroots community organizations and political party activists were involved. Despite its top-down approach, if brought to culmination, this reform could yield great social benefit such as better water quality and consistent access. Of at least equal value is the potential of the new model to democratize decision-making around the administration of water (Keck and Abers 2004).

Institutionally a critical point of Brazil's effort to decentralize water happened was the transfer, in 1995, of authority over water from the Ministry of Mining and Energy to the Department of Water Resources, Legal Amazon and the newly created Ministry of Environment, ending a historical dominance of the power sector over water

management. A big part of this change involved the extinction of the National Department of Works and Sanitation (DNOS), a top down federal organization that relied mainly on civil engineering and large public works approaches. These changes culminated in the Brazilian Federal Water Resources System Law, signed by the President of Brazil on January 8, 1997. It established the National Water Resources Policy, the National Water Resources Management System and provides regulation for Paragraph XIX, Article 21, of the Federal Constitution. In addition, Law 9.984 of 2002 regulates the establishment of the National Water Agency (ANA), a federal entity to implement the National Water Resource Policy and to co-ordinate the National Water Resources Management System.

Since the Constitution distinguishes "federal waters" (i.e., inter-state rivers) from "state waters" (i.e., intra-state rivers), both the federal and state governments are responsible for managing water in their respective jurisdiction. By 2000, eight major states had also passed their own water laws. While the law precludes ownership rights to water, it does allow authorized private use rights. The National Water Resources Policy Basic Principles state that water is a public property but also a limited natural resource, which has economic value. Priority in the use of water resources is given to human consumption and the watering of animals. Moreover, water resources management should always allow for multiple uses of water. The river basin is the territorial unit for the implementation of the National Water Resources Policy and the actions of National Water Resources Management System. The law also enacts specific regulations aiming at the decentralization and democratization of water management including the creation of river basin councils formed by water users, representatives of local, state and federal governments, and representatives of organized civil society. Finally, besides defining water as an economic good, the law establishes general rules for the implementation of a bulk water permit and charging system (Lemos and Oliveira, 2004).

Even though these legal changes implemented at the national and state level have neither completely pervaded through the lower levels of water policy administration nor been accompanied by clear-cut operational policies, they did change the overall policy environment with the articulation of many progressive ideas and approaches (Porto 2001).

Yet, many issues still have to be considered. Despite the serious attempt to consolidate water issues within a single administrative apparatus, there are many water-related functions (e.g., irrigation, extension, urban water supply, and water quality) that remain still administratively dispersed making it difficult to ensure their effective integration within the broader water management concerns. The 1997 law remained largely neglectful of water pollution that is an acute and growing problem in major cities like Sao Paulo and Rio de Janeiro. Decentralization and privatization programs (in urban water supply) also need to be packaged well within the overall reform strategy. But, judging by the policy commitment and the direction of changes, Brazil is in a strong position to deepen the reform process and strengthen its water institutions. Tackling such urban water issues may call for action other than the standard technical analysis such as community-initiated solutions.

Following Brazil's socioeconomic, political, institutional and physical diversity,

each region has implemented these new laws differently according to their own need. The motivations for these reforms were economic, as the previous technocratic system did not use resources in a way that was economically, environmentally, or socially responsible (Garrido 2000). An innovative approach that has been used in the reform is to include local stakeholders in the decision-making process regarding resource policies. Although the conceptualization of this process is relatively straightforward and ideal in its incorporation of local understanding of resources such as water, the operationalization of this process is considerably more daunting. On the one hand, the incorporation of stakeholders into the decision making process brings a new dynamic of understanding into the realm of watershed management and insure better implementation of new policy since, traditionally, most decision makers have been technocrats trained in policy and the natural sciences. While the understanding of natural resource policy, economics and science of a watershed system is of great benefit, there is also a growing recognition of the value of other forms of knowledge such as of land based knowledge and knowledge gained from personal experience. Each river system is unique. The way in which the people who live near water systems relate to it is also unique. The transition toward incorporation of lay knowledge into the current technocratic system could lead to better decisions about specific water systems. Decisions that incorporate the affected community's input generally result in outcomes that are more effective than those that do not (Petkova et al 2002). One challenge is to understand how these two types of knowledge can co-exist with one another within the River Basin committee.

New watershed management in Brazil provides a good context for examining the process through which such co-existence develops. In the analytical section of this paper there are specific examples of how different types of watershed knowledge currently exists within the committee and recommendations of how diverse knowledge could be used within the committee using as an example the Itajaí committee. Findings of this study can inform water management not only in the state of Santa Catarina but also in other River Basin committees in Brazil and around the globe.

Water Reform in the Itajaí Basin

Much of the governmental environmental organization in Santa Catarina was a direct result of technical and meteorological mobilization and networking around flooding problems. The Itajai RBC was created in 1997, stimulated to some extent by the state government[3]. Figure 2 shows the state of Santa Catarina and its watershed committees.

[3] A professor at the Regional University in Blumenau coordinated the committee. She has a background in regional planning and worked on a volunteer basis.

Figure 2: Map of Santa Catarina Watershed Committees (Itajai Committee/* Comité Itajaí *to the right center)

Historically, the colonization of the Itajaí Valley brought the transformation of the river to accommodate shipment transports, the clearing of land for agriculture, and the new space to live and work. However, progress did not always bring the fruits the watershed's new citizens hoped for. With the development of nearby areas, the river increased in volume due to frequent flooding, damaging homes, industrial operations and ecosystems. The history of flooding directly corresponds to the history of settlement; land use and resource allocation in the Itajaí basin and the impact of economic development has on the basin. From 1850, sixty-seven major floods are on record (Appendix A). Since 1850 the number of small floods has greatly increased (graphic 1 in Appendix A), especially during the decade of 1920s, due in particular to the increased number of settlements on the upper valley of the Itajaí River. The reason for this great increase of flooding since the time of colonialism can be attributed to diverse factors, either incidental or due to poor planning. Recent studies propose the following actions as the main cause: indiscriminate deforestation, uncontrolled occupation of slopes near the river, and erosion cause by inadequate agricultural management. The increase of human activities in both urban and rural areas exacerbating the flooding problem and there is no

sign of slowing. The increase of major flooding was cause for reflection about the anthropocentric effect on the river basin. Flooding is a major concern to the residents and water users in the Itajaí basin.

Traditionally, in the region, policy-makers believed that engineering would fix the problem of the flooding. Three dams were built (in 1973, 1975, and 1992), under the supervision of the DNOS. It was believed that these dams would hold excess water in the reservoirs above the dam blockade. However, such actions were not enough to prevent the damages related to the great El Niño related great floods of 1983 and 1984. The flooding and its substantial socio-economic and political impacts encouraged a series of policy initiatives that culminated in the creation of the Itajaí River Basin Committee (Interview FURB, July 25, 2003).

In Santa Catarina, it was state law 9.748 established in November 1994 that encouraged the formation of decentralized committees. Regional mobilization around the Itajaí River Basin committee began in 1995 partially in hopes of finding alternatives to the flood control dams. In March of 1996 a meeting promoted by the Commercial Association and Industrialists of Blumenau resulted in the formation of work groups that were in favor of the River Basin committee. These working groups included representatives from the Itajaí Upper Valley Towns Association, Itajaí Middle Valley Towns Association, Rio Itajaí Towns Association, Itajaí Commercial Association, University of the Order of the Itajaí, and Regional University of Blumenau. These groups of stakeholders set out to accomplish the task of establishing the foundation of the Itajaí River Basin committee. Soon after the formation of the River Basin committee, it was clear that the water issues of Itajaí basin were greater than what the committee could accomplish. In August of 1996, the working groups requested support from the State Department of Hydraulic Resources, and this request was approved in June of 1997. The State decree n°2109, published August 5th, 1997 created the Committee of the Itajaí. Under State law 9.748 of 30.11.94 and Federal law 9.433 of 08.01.97 the Itajaí committee was officially installed in March of 1998.

Regional collaboration was also pushed as a result of the need to manage flooding since the committee soon discovered that one cause of the problem lay with the lack of management of smaller rivers feeding into the Itajaí River, specifically the lack of maintenance of small dams. Deforestation and other poor urban planning and farming practices also lead to problems of swift rise in the level of Itajaí River during rain. One of the important learning processes in the course of the Itajai committee's work involved interacting with specific communities affected by flooding, especially in the city of Blumenau, whose adverse environmental conditions made it particularly vulnerable. Because early on the citizens of Blumenau realized that they needed the cooperation of the small municipalities to make an effective difference in the management of water, the process of organization of the committee followed a bottom-up approach rather than the traditional top-down management more traditional in other committees in Brazil (Frank & Pinheiro 2003).

Besides flooding, water quality is another important issue for the Itajaí River Basin Committee. Industrial activities in the Itajaí watershed put a tremendous amount of stress on the health of the watershed ecosystem and the people who live within its

boundaries. Industry is a prevailing source of water pollution, contamination of sediments and aquatic organisms, and degradation of ecosystems. This is a complicated scenario since this industry represents the main economic backbone for the Itajaí region. Port dredging operations, the transportation of hazardous materials and building urban areas close to fragile ecosystems have also resulted in water pollution, contamination of sediments and aquatic organisms and dramatic reduction of important ecosystems such as mangroves (Project Marca D'agua 1998).

Poor urban planning has partially been responsible for its share of water quality degradation in the Itajaí basin. The displacement of former agricultural workers in the rural areas, forced to move to the cities, resulted building close to ecologically sensitive areas and increased housing on the hillsides. Recently urban planners' environmental concerns have been partially addressed. The City of Blumenau built an underground piping system to channel domestic sewers and began construction of treatment facilities for this waste. In addition, some of the industries surrounding the basin implemented pollution treatment facilities, in attempts to make their business more ecologically sustainable and coincidentally more attractive to international markets (Frank & Pinheiro 2003).

The region of Itajaí is heavily impacted by land-based human activities such as industries, ports, urban development, tourism, and farming. To handle these issues, effective knowledge dissemination and cooperation between community organizations, governments and industry is essential to ignite a process of ecologically sound and socially equitable watershed management. Proper management of these activities is important to a healthy watershed system within the Itajaí basin (Project Marca D'agua).

The structure of the River Basin committee in the Itajaí basin represents three sectors with varying weights. The composition of the committee is: water users 40%, organized civil society 40%, and state and federal organizations 20%. In 2002 (the time of the field campaign for this research), the committee had 60 members (Appendix B). Water users are those whose water use contributes to the economy of the region. These are organizations like industrial farmers, mining companies, meat industry, road commissions, water companies, textile factories, sanitation, and power companies. Civil Society Organizations consist of the Association of Engineers, Universities, Indigenous Communities, Residents associations, municipality associations, and town councils. Federal and State Government include State Sectors for a Better Environment, Department of Transportation, Environmental Police, and the Civil Defense.

The committee is organized in a bottom-up way with the creation of eight working groups. Each working group consists of a number of representatives from organizations and community volunteers who have an interest in a related environmental or economic water issue. The committee set out to identify alternative means of economic production or alternative economic activities. It has the advantage of benefiting from community insights and experiences, as well as minimizing environmental degradation in a manner acceptable to the communities. Some of the key issues confronting the Itajaí watershed stakeholders and decision makers are the identification and assessment of existing environmental problems, establishment of priorities, setting management objectives for prioritized problems, identification, and

creating criteria for evaluating the effectiveness of strategies and measures (Frank). Potential decisions that the committee face are: 1) the compilation and dissemination of a program of public environmental information designed to address current and potential future socio-environmental problems arising from tourism, agriculture, and urban development in critical environmental habitat areas; 2) the promotion of community-based land management, through the educational system and nongovernmental organizations (NGOs), by demonstrating good stewardship practices within the basin; 3) address the question of eco-tourism, of not only a sustainable tourist industry but also a program of transmittal of environmental information to patrons; 4) the development of sustainable management practices for commercial fisheries and the protection of native fish within the natural ecosystem. To address these issues policymakers are likely to procure and use knowledge from the same sources they have traditionally extracted them from, the science based model. But society may be better served if decision makers draw from diverse sources. However, the only way that these sources can be used is if decision makers see them as relevant. One-way to measure the use of information in watershed management is to identify how different types of information are selected in the policy making process (Project Marca D'agua).

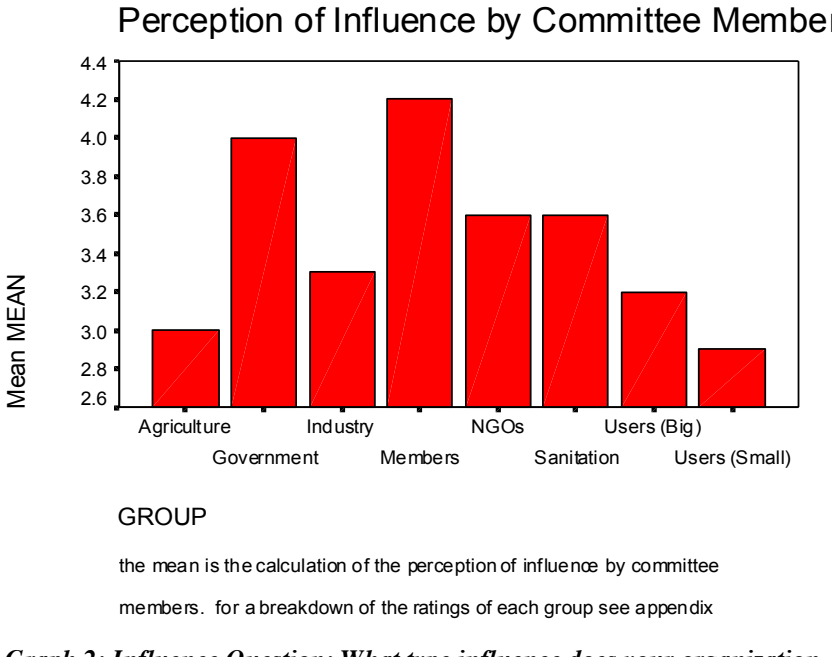
The committee meets on a monthly basis. Once per quarter all the people involved in working group activities are invited to attend the meeting. Delegates also attend the other two quarterly meetings from each working group. The primary function of the committee is to exchange information: delegates report about the projects developed by their working group. One way to measure how well these committees are working is by gauging the perception of effectiveness among committee members. The following data pertains to questions about the role of the River Basin committee. If members identified their participation as effective[4] – this may indicate in part that members have an understanding of the information presented at the committee meeting for decision-making (Frank & Pinheiro 2003).

Some committee members felt that since information is presented using technical explanations and format, certain groups would be left out of the meetings (Personal Communication). A large barrier to diverse forms of knowledge usage in the committee is that those who possess lay knowledge are not part of the decision making process. This may occur for many reasons. It may be because of the way that the committee was created or because those with land-based knowledge cannot or choose not to participate. Moreover, technical knowledge can crowd out other kinds of knowledge given the institutional mechanisms available to create and apply knowledge with watershed committees. This is the case with RBC's technical chambers that tend to dominate the production and deployment of knowledge within the broader committee's plenary section (Lemos et al. 2010, Kumler and Lemos 2008). These chambers critically shape knowledge use and participation both by insulating knowledge while legitimizing it (Lemos et al 2010) but also by addressing issue of trust within committees (Keck Abers 2002). The state of Santa Catarina is an interesting location to study combined knowledge in watershed management because of the long history of associative networks and societal contribution. In the Itajai, committee survey data suggests that though the

[4] Original question: Você considera a sua participação efetiva?

committee views itself as effective, how members perceive the relative influence of different groups is biased towards government organizations, which generate most of the technical knowledge available to support decision making (Graphs 1 and 2).

Graph 1. Effective Participation Question: Do you think that your participation is effective? 1 = not at all effective 5 = very effective 9= Don't know



Graph 2: Influence Question: What type influence does your organization have on the Committee?

1 = not at all effective 5 = very effective 9= Don't know

When broken down by group (users, government or NGOs) variation in the perception of levels of influence each group has on the watershed committee becomes clear. The River Basin committee surveyed perceives that the members have the most influence and the small users (such as subsistence farmers) have the least influence. This is significant because members determine the kind of knowledge to be used to inform decision-making at the river basin level. We can see from the pie graph of member's educational background (pie graph from the history and land use chapter) that all members come from a technical of superior educational background. Additionally, because of their training they are likely to give less credit to land based knowledge.

CHAPTER THREE: DECENTRALIZATION OF WATER MANAGEMENT RESOURCES, KNOWLEDGE AND POLICY-MAKING

Decentralization of natural resources management, knowledge and equity

Around the world centralized government management of the environment is being challenged and contested as threats to the long-term sustainability of natural resources persist.. Persistent unsuccessful attempts in averting events such as the failure of nuclear reactors in the United States and the former Soviet Union and the explosion of chemical plants in India and sewers in Mexico, has diminished public confidence in the effectiveness of environmental regulation. Environmental policy around the world is often not implemented and there is a broad crevice between the lofty promises of policy makers and actual accomplishments (Ingram et al 1995). Meaningful participation of stakeholders and incorporation of land-based knowledge can bridge that crevice by providing easy to implement solutions that work on a local level.

One of the many challenges that the democratization and decentralization of water management faces is changing formal economic and policy-making practices that will ensure access to sufficient water and to the decision-making process for the majority of the population. Traditionally, the majority of the population has been excluded from decisions made about the management of water. The challenge is to create a decision making body that includes the majority while conserving natural resources. Many of the new schemes for decentralization of water management create managing bodies that are in charge of designing policies to spur economic development, while also protecting the environment. Yet, the way that these governing bodies foster economic development can help or hurt the environment.

One way to encourage responsible economic improvement that protects valuable ecosystems may be the use of diverse knowledge systems within watershed governing bodies. Another way, related to the first, is to create the conditions for the democratic decentralization of decision-making within such bodies. Oliveira (2002), in his discussion about development in the Third World, points out that a key factor in the decentralization of managing bodies and the growth with equity development strategies within many countries is popular participation in the development process. Those who champion participatory approaches often equate decentralization with democracy and efficiency (Oliveira 2002).

Around the globe, a championed approach to attain better natural resource management and advance participatory policymaking has been the creation of decentralized decision-making bodies incorporating public and private stakeholders in their integrated policy making across natural resource policy making. Decentralization is seen as a means to moderate power from corrupt governments, encourage use of local knowledge, deepen democracy and make governments less costly (Brannstrom et al 2003).

However, to reach its goals, decentralization must do more than simply transfer authority and responsibility from one scale of government to another. It should also include meaningful participation including real power devolution, transparency and accountability (Ribot 2002). In turn, the benefits of democratic decentralization are many.

Locals can provide important information for developing the management plan, and complement institutional capacity by helping publicize and enforcing guidelines for environmental management (Oliveira 2002). Additionally, meaningful participation must also involve a platform for exchange of diverse ideas technology and knowledge patterns of local people.

Patterns of knowlege and natural resources management:

There are two main models for knowledge production and dissemination: theoretical and applied (Rogers 2003). Theoretical knowledge is a proposal for understanding the meaning of a term in relation to a set of scientifically useful hypotheses (Honderich 1995). Applied knowledge is need-based knowledge; knowledge gained from living off the land, using water and land for food production and survival. In Rogers' terms, the definition of theoretical knowledge is similar to techno-scientific knowledge and applied knowledge is similar to lay knowledge. Roger further contends that one knowledge pattern cannot exist without the other (Rogers 2003).

Incorporation of local indigenous and traditional knowledge has provided positive results for numerous governments around the world. Ribot provides examples from Bolivia, Nicaragua, India, Cameroon, and Zimbabwe all with positive decentralization outcomes due to incorporation of local knowledge in natural resource policy. In Kumaon, India, decentralized democratic authorities have sustainably managed forests for over 70 years. In Nicaragua and Bolivia, decentralized forest management has resulted in some local councils – where local councils were more open to popular influence – protecting forests against outside commercial interests (Ribot 2002). Decentralization in these areas has also lead to greater inclusion of some marginal groups in forestry decisions. In another example, indigenous groups in Nicaragua have managed to put their natural resource concerns on municipal council agendas where they have chosen to run their own candidates. Finally, the democratic process behind establishing management committees in Cameroon community forestry designs has allowed marginalized Baka villagers in Moangué-le-Bosquet to create a niche for themselves in forest management (Ribot 2002). All of these initiatives occurred because the resource committee included a format that was conducive to the incorporation of local knowledge.

Bebbington explores the increasing use of indigenous technical knowledge in and beyond the Andes and the increasing use of indigenous and technical knowledge in development as a whole. Indigenous knowledge is a dynamic response to changing contexts constructed through farmers' practices as situated agents: agents because they are actively engaged in the generation, acquisition, and classification of knowledge; and situated agents because this engagement occurs in cultural, economic, agro-ecological, and sociopolitical context that are products of local and non-local process, and that influences how and why farmers manage resources in a particular way (Bebbington 1993).

Watershed management is an example of need-based knowledge. Because there is a widespread perception in society that science based knowledge is more objective than lay knowledge, decision makers in natural resource policy have typically favored a technical approach to environmental management. The limitations of such approach are

illustrated in the science model adopted by the Intergovernmental Panel on Climate Change (IPCC). The IPCC asks for periodic assessments of regional climate change. Its model presupposes that scientific research could be targeted, in linear fashion, to fill gaps in the existing knowledge base. Once the gaps were filled, and uncertainties either reduced or eliminated, policymakers could rationally apply the products of science to formulating policy responses (Jasanoff & Wynne 1998).

Examples of failed experiments in knowledge support for decision making where attempts to impose technical knowledge over indigenous knowledge have resulted in environmental and cultural disruption are common. Lansing (1987, 1991) cited by Rogers (2003) shows that official Indonesian government attempts to introduce the Green Revolution in Bali caused social-cultural and environmental disaster. In the 1970s, by ignoring indigenous populations intricate and environmentally fragile agricultural and irrigation systems, government policies resulted in poorer rice yields, contaminated waters and negative effects on human, fish and eels populations.

In summary, one form of knowledge should not be used over another, as both seem to be necessary to accomplish management and conservation goals. The exclusion of techno-scientific knowledge would ignore technologies that could improve environmental management. The exclusion of lay and indigenous knowledge would ignore centuries of land-based observation and management.

Ideas, Knowledge and Participation

Campbell argues that ideas (theories, conceptual models, norms, world views, frames, principled beliefs, and the like) affect policy making in addition to self-interest (Campbell 2002). These ideas influence how people perceive the use of knowledge in watershed decision-making. This is of particular interest in the application of natural resource management. If this is true and the Itajaí committee members are influenced by such ideas of greater environmental conservation and justice as well as "self interest" or personal or political gain then the opportunity for diverse knowledge use within the river basin is greater. Moreover, knowledge use may contribute to manage the tension between self-interest and social good; between competition and cooperation (Wondolleck Yaffee 2000). However, ideas and knowledge are of little use if they cannot be put into practice. The ability to create meaningful change depends as much on people's confidence and skills as it does on institutional feasibility. Many participation processes involve breaking new ground, tackling difficult projects, and setting up new forms of organization (Petkova et al). 2002. In this context, institutional design also becomes an important aspect of the knowledge production and use.

One strategy for analysis is to look at the origins of lay and expert knowledge such as land culture and the patterns of colonialism. Knowledge in my argument is defined by the conceptual framework of ideas; familiarity, awareness, or understanding gained through experience or study (Peck 1994). Information, in turn, is the operational framework; the way knowledge is obtained though communication or reception of knowledge or intelligence. In this case, lay information is drawn from the cultural attitudes and locally grounded common sense (UNESCO 2002). Techno-scientific knowledge of a watershed is drawn from the traditions and works of the natural, physical

and social science. It is important to point out that the decision making process itself is shaped by the way people relate to these different types of knowledge (Lemos 2003).

Different kinds of information will affect public participation. It will either constrain participation by insulating decisions making from stakeholders, or stimulate it by enhancing the level of awareness about issues of water allocation among stakeholders (Engle et al 2011). In order to analyze the Itajaí case, I will investigate a few of the institutional arrangements shaping the current decision making process. Diverse use of knowledge sources should be revered more than a system that relies on one system that isolate a group (be it either local participation or technical expertise) as greater options provide a better chance of reaching effective, feasible and efficient environmental equity and conservation.

Access to environmental information enables citizens to make informed personal choices and encourages improved environmental protection by industry and government. For example, citizens need to know whether water is safe to drink because public knowledge of contamination creates pressure for pollution control. Informed and meaningful public participation is a mechanism to integrate citizens' concern and knowledge into public policy decisions that affect the environment. Decisions that incorporate public input generally result in outcomes that are more effective and environmentally sustainable that those that do not (Narayan & Srinivasan 1994).

With the presence of public participation and community understanding of the environmental issues at hand, implementation is much easier as citizens are more likely to follow through with a regulation that they agree with and understand. One of the biggest barriers to action is when the community feels that that environmental solution was not created with their particular community needs in mind. One way to address this problem is to involve citizens in the process so they all feel that their needs are meet. For example, Wondelleck and Yaffee (2000) explain that, in the U.S., a new style of environmental problem solving and management is under development in which government agencies, communities, and private groups, are building bridges between one another that enable them to deal with common problems, work through conflict, and develop forward-thinking strategies for regional protection and development (Wondolleck & Yaffee 2000).

In Brazil also, old patterns of confrontation between state and society have been transitioning in a more cooperative relationship (Chalmers et al 1997). The line between state and community is slowly disappearing. The emergence of associative networks for example may facilitate the sustained interaction between state and society actors that in turn may allow for the exchange of knowledge and information. This process may result in the construction of a better knowledge base to inform water management and conservation of water resources. In the context of water reform, knowledge--both science generated and lay knowledge--may play an important role in informing decision making at the watershed level.

Watershed policy provides a context for further investigation into the use of these two types of information and knowledge. The southern state of Santa Catarina is an interesting location to study combined knowledge in watershed management. It is interesting and relevant to study varied knowledge as located within this state there are a

sizable number of farmers, industry facilities (mainly textiles), University and professional presence, non-profits. This study will use a few examples of how ways of knowing inform the decision making process. Research materials are drawn from interviews with the committee members, archival and documented research, and participatory observations (see next chapter for detailed description).

This examination could serve as a model for other countries that are reforming river basin management. The use and flow of scientific and traditional local and land-based information dealing with policies in water quality, development and deforestation could lead to mobilization among the user committees to a more ecologically managed watershed system within the Itajaí basin. In other river basins in Brazil and for watershed management in other nations, the impact of a larger knowledge base and combined use of local knowledge may lead to a greater democracy in managing natural resources(Tsuji & Ho 2002).

CHAPTER FOUR: METHODOLOGY AND ANALYTICAL FRAMEWORK

During the summer of 2003, I spent two months in the city of Itajaí, Brazil interviewing stakeholder-committee members of the Itajaí watershed basin. I developed two instruments, face-to-face interviews and surveys (Appendix C) to measure how committee members use lay and scientific knowledge to inform policy on watershed usage. The combination of qualitative, the semi-structured in-depth interviews, and quantitative approaches, the surveys creates a window into the analysis of participation and combined knowledge. Both instruments include questions on selection of information sources, effectiveness of the information evaluated, flexibility of organizations involved in watershed management to new methods of information, and willingness of the organization to use folk and indigenous knowledge. Twenty-six interviews and forty surveys were completed. These interviews and surveys constitute the main source of data to the analysis of preferred kinds knowledge within the River Basin committee[5].

All of the data was organized in SPSS. The surveys were graphed by response, 0 being not relevant and 5 as complete agreement with the survey statement. The interviews were coded and marked for relevant information to the study. Comparative, or cross tabs graphs were measured for significance across committee members using the Chi-squared statistical tests in SPSS.

Definitions

For all of the interviews, I defined three terms for the interviewees: Traditional/ knowledge, scientific knowledge, and land stewardship. Traditional knowledge was defined to the committee members as that based on accumulated experiences or continuous usage of a land area based on personal knowledge or knowledge passed down (Island 1994)[6]. The Dene Cultural Institute defines traditional environmental knowledge as a body of knowledge and beliefs transmitted through oral tradition and first hand observation. It includes a system of classification, a set of empirical observations about the local environment, and a system of self-management that governs resource use. Ecological aspects are closely tied to social and spiritual aspects of the knowledge systems. The quantity and quality of traditional environmental knowledge varies among community members, depending on gender, age, social status, intellectual capacity and profession. With its roots firmly in the past, traditional environmental knowledge is both cumulative and dynamic, building upon the experience of earlier generations and adapting to the new technology and socioeconomic changes of the present (Tsuji & Ho 2002).

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[5] I am working as part of a larger research team working on this project in Brazil. The groundwork for this research has been done by Professor Maria Carmen Lemos at the School of Natural Resources and Environment. This study will complement and integrate research already in process in Brazil, within the framework of the Watermark Project, a broad comparative study coordinated by Professor Margaret Keck from Johns Hopkins University.

[6] Science of the Pacific Island People 1994.

Scientific and technical information was defined to the committee members as information in any format or medium which is derived from scientific and technical studies, work, or investigations which relate to research, development, demonstration, and other specialized areas such as environmental, health protection, and waste management (DOE 1998).

Land Stewardship was defined to the committee members as the responsible and proper management of land, water, and other natural resources to enable their passage onto future generations in a healthy condition (Folliot et al 2002).

Analytical Framework:

In accordance to the new Water Resources Law shaping water management reform in Brazil[7], the Itajaí committee formed its membership based on a combination of government, users, and community members to create a decentralized, participatory decision-making body. Given the varied input into the River Basin committee by industry and agriculture users, governmental organizations, and community within the basin of Itajaí, it was reasonable to expect a diversity of information, based both on techno-scientific and lay knowledge, would be available and used by the Itajai RBC members. This study represents an effort to analyze the creation of the novel bridges within the River Basin committee between the use of scientific and lay knowledge and its potential impact on the policymaking process and watershed usage.

In order to analyze the pattern of knowledge use and its effect on participation, three main variables are examined: Opportunities and Constraints to Participation, Patterns of Knowledge Use, Salient Issues and Societal Values. To identify opportunities and constraints to participation, a series of indicators of institutional flexibility within organizations to use new information as well as the priorities of the organizations and the individuals within the organization are examined. Patterns of Knowledge Use, in turn, consider the role of different kinds of information—Indigenous, Traditional, Technical and Scientific—within the River basin committee decision-making. Salient Issues and World Views refers to committee members' perception of their land stewardship role within the watershed, attitudes toward the greater environment, and notable issues such as flooding, water quality and water quantity.

To substantiate this analysis, I designed a survey instrument and a questionnaire used for in-depth interviews, which included these specific queries:

a) To understand opportunities and constraints to participate and use of information: how governmental agencies select sources of information and procedures they follow; traditional methods of policy making, what process do agencies go through to decide which source of information to use when two reliable sources of information conflict, and how that process may be altered by the river basin committee's use of knowledge.

b) To understand patterns of knowledge use including questions about the effect of scientific knowledge on decision-making, the ways scientific information is

[7] *Brazilian Federal Water Law 9.433 (1997) principal iv. The impact of the Brazilian water reform on the Itajaí river basin committee is discussed in detail in chapter IV: Background.*

applied to water management in Brazil; its limitations, constraints, advantages, and possibilities as described by the watershed committee members. This section also included questions about the perception by the committee members of lay and indigenous knowledge. Finally, questions were also asked about ways (if any) lay and indigenous information is applied to water management in the Itajaí watershed

c) To understand salient issues and world-views including questions about committee members' environmental attitudes and perceptions on land stewardship and questions on committee members' perception on how diverse participation affects decision-making. This section also included questions about how public attitudes influence participation and how public participation influences policy process. For the effect of salient watershed conditions such as flooding and water quality and water quantity on participation I will examine how water users' attitudes toward the local environment motivate them to participate in watershed management decision-making.

Conceptually the analytical framework for the thesis is as follows. Knowledge use in its several forms is motivated both by RBC member's levels of participation (the way they perceive the committee is flexible to incorporate different kinds of knowledge) and perception of what are the important issues for the committee to tackle (salient issues). In addition members' worldviews concerning land stewardship also may play a role of the way they use knowledge specially the amalgamation of different kinds of knowledge such as lay and technical. Knowledge use in turn influences overall participation, measured by committee members' perception of effectiveness and satisfaction, which in turn should lead to greater levels of conservation and justice. Although the last step was not actually assessed in this research it is a contention of this study that without amalgamation of different kinds of knowledge, it is unlikely to the ultimate goals of conservation and justice would be achieve. Figure 3 displays the analytical framework.

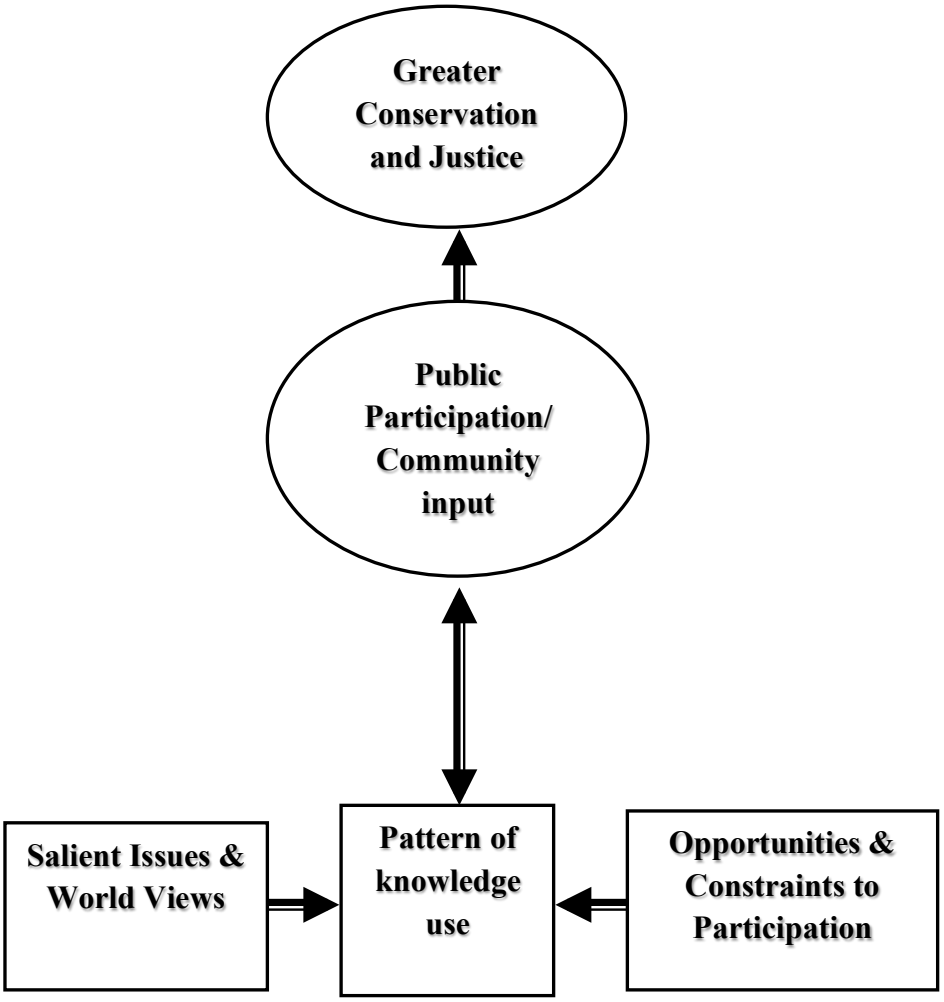


Figure 3: Model of Research Variables

Through background research and by interviewing River Basin committee members (non-governmental organizations, governmental agencies, utility companies, the public and community), I identified themes of information use within the committee that are derived from scientific and lay experience within the watershed and how these are currently incorporated into the decision-making process. Moreover, in the recommendations section I also point out opportunities within the committee where there is potential for combined use of traditional and techno-scientific knowledge.

CHAPTER 5: ANALYSIS

This analysis of knowledge use within the committee and how knowledge patterns affect levels of participation is a small part of the broader societal concern regarding fair water allocation and conservation. In this chapter I look at how participation within the committee affects and is affected by ideas and knowledge dissemination and speculate how diverse kinds of knowledge may lead to better decisions (greater environmental conservation and justice) by interviewing and surveying members of the Itajaí River Basin committee on knowledge used for decision-making and information dissemination within the committee. It has been my observation from conducting interviews and attending committee meetings that the dominant type of information used and viewed as the most relevant is scientific and technical knowledge of hydrologic systems, river basin management, and water pollution. This dominance seems to be a result both of members' professional background and education. Yet, members' worldviews and environmental attitudes seem to point in the direction of an opportunity for the incorporation of other kinds of knowledge in decision-making in the Itajaí River Basin Committee. The analysis below will examine how members' participation affects and is affected by technical knowledge as well as explore the relationship between committee members' societal values and the patterns of knowledge used in the River Basin committee decision-making.

The analysis found that professional background and education were the main determinants of the dominance of technoscientific knowledge while societal values (worldviews and environmental attitudes) were the indicators that members would be willing to incorporate other kinds of knowledge as well. Societal values in this case include dominance of techno-scientific knowledge over diverse ways of knowing in the River Basin committee and committee members' individual values regarding knowledge.

The broader question of concern for this analysis is how stakeholder participation informs patterns of knowledge used in watershed decision-making and in turn, how diverse knowledge (those that combine place-based information with science generated knowledge) and ideas could influence the effectiveness of the current model of water management in Brazil. This question leads to the greater societal concern of whether the use of information from different sources lead to a more inclusive decision-making processes leading to environmental sustainability and greater social justice. Although the later is beyond the scope of this study, I believe the Itajaí River case can offer significant contributions to understand knowledge use in water reform in Brazil. How does the Itajaí committee provide an example for this or what lessons can we take away from this study?

Each section of this chapter is divided according to the main variables studied; opportunities and constraints to use of knowledge, patterns of knowledge use, and salient environmental issues and societal values. I highlight these variables using relevant examples from the interviews and survey's of the members of the Itajaí committee[8]. The complete results with cross-tabs comparing the responses of the users, state government and society, and the chi-squared statistical significance tests of these responses can be

[8] The following graph was taken from the survey given to all of the members of the Itajaí watershed. Of all the survey's, 31 were handed back.

found in Appendix D.

Patterns of Knowledge Use

Environmental problems and solutions are often experienced at both the global and local levels. For this reason it is important that policy makers understand how different cultures of managing bodies perceive and implement the use of new technology and scientific knowledge in the management of natural resources. How does the use of science and lay-based knowledge affect decision-making within these organizations; and do they support or hinder a more democratic decision-making processes? The current institutional arrangement in the Itajaí River Basin committee may hinder the process as it values scientific knowledge above lay knowledge and most of the information presented within the committee is technical.

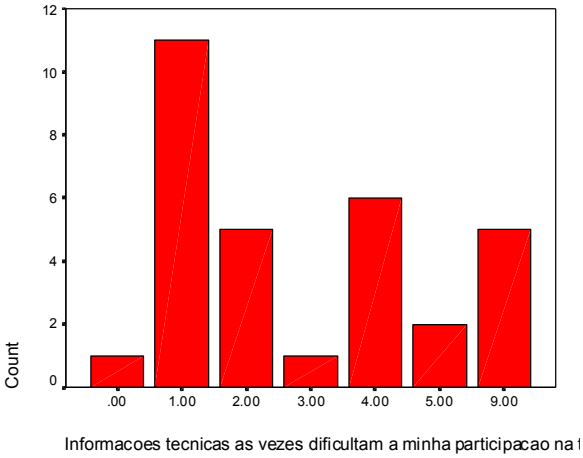
Although, there is nothing intrinsically undemocratic about the use of technical information within the River Basin committee—without it these committees would not have the infrastructure to cope with the flooding and water quality problems that face the Itajaí basin—that incorporating other kinds of knowledge can contribute to both the democratization of decision-making and increase the effectiveness of the RBC to manage water resources in a sustainable manner. The willingness of RBCs to use diverse knowledge in decision-making can also be crucially related to the levels of Committee members and other stakeholders' perception of the information's usefulness and applicability to solve river basin problems (Lemos and Morehouse 2005). Additionally, the use and dissemination of diverse knowledge patterns could also increase the enthusiasm of stakeholders to participate and their ability to agree, formulate watershed management goals and comply with RBCs' decisions. Finally, better-informed decision-making can encourage stakeholders' perception of effectiveness, which in turn, can encourage their participation. Or, in contrast, the use of extremely technical information can alienate participants from decision-making. Because techno-scientific information originates in "hard" research sciences – therefore often requiring technical expertise for its use – it can shield policymakers from stakeholders trying to influence policy implementation. In this case, technocrats' use of techno-scientific information can make decision-making less democratic (Johns 2010).

Without meaningful and diverse participation, a democratic process cannot exist. Although the committee members may all agree that techno-scientific information is useful - that by excluding diverse information, people such as small-scale farmers and indigenous groups are being excluded from this process as well.

Knowledge holds power if those that understand and use techno-scientific patterns of knowledge currently are able to contribute to the decision making process at the expense of other members who want to participate but cannot because they do not have access of understanding of technical knowledge. In this construction the knowledge, power and participation cycle is an iterative process. Techno-scientific knowledge is used within the committee; those who have attained that knowledge participate in the committee; participants make decisions. The Itajaí committee members currently value techno-scientific knowledge the greatest. Techno-scientific knowledge is of great use to the committee members because they all have specialized training in how to use this

knowledge for watershed management. Though this information is useful it can also exclude or hold power over indigenous groups or small farmers that do not have training in techno-scientific knowledge. In an alternative construction, members of the committee can legitimate the unequal distribution of knowledge if they feel themselves represented by those members who dominate technical knowledge, such as in the case of committee's technical chambers (Lemos et al. 2010; Kumler and Lemos 2008). But even is such cases, it is reasonable to expect that the incorporation of lay knowledge in decision-making is likely to improve the level of participation and its perceived quality among all members.

The graph bellow describes members' perception of the extent to which technical knowledge may facilitate or encourage participation in the RBC.[9] A rating of "1" signifies that they do not feel that technical information impedes their ability to participate in the decision-making process. A rating of "5" signifies that it does. A rating of "0" is a no answer and "9" is not applicable. We can see from the below graph that a good number of members do not feel as though technical information is a barrier to their participation.



Graph 3: Individual Participation Question: Does the Technical Information Presented During the Committee Meetings Makes it Difficult for You to Participate?

1 = not at all difficult 5 = very difficult 9= Don't know

[9] Original Question: Informacoes tecnicas as vezes dificultam a minha participacao na tomada de decisao no comite

SECTOR * Informacoes tecnicas as vezes dificultam a minha participacao na tomada de dicisao na comite Crosstabulation

Count

		Informacoes tecnicas as vezes dificultam a minha participacao na tomada de dicisao na comite							
		.00	1.00	2.00	3.00	4.00	5.00	9.00	Total
SECTOR	civil society		3	1		2		2	8
	federal state	1	5	2	1	2		2	13
	users		3	2		2	2	1	10
Total		1	11	5	1	6	2	5	31

Graph 4: Perception of Participation by other Members: I believe that technical information may keep some members from participating in the decision making of the committee? With cross-tabulation by sector

1 = not at all 5 = highly likely 9= don't know

This result is expected given most members' professional and educational background. However, the potential exclusion of other kinds of knowledge and of those members who possess it such as small farmers and indigenous groups, could damage the committee in two ways. First, the committee misses the opportunity to explore the alternative knowledge systems such groups attain. Second, if all community groups are included in the decisions making they maybe more likely to act as effective advocates of the implementation of committee designed solutions for problems affecting their localities and regions.

Another assumption explored in the survey is whether lay and indigenous knowledge would only be incorporated by the committee if members viewed these kinds of knowledge as valuable in providing sustainable management practices. If members view popular, indigenous, and lay community based natural resource based knowledge as valuable, it is expected that the committee would need to recognize that the decision making process and the resulting policy would benefit from its inclusion. Qualitative data from the interviews indicate that although many small farmers and various community members recognize the potential of their contribution to the river basin committee, the majority of the committee does not acknowledge that there is a body of knowledge that is missing. Hence, value of this knowledge and participation by those that hold it may come about with the recognition that community participants are also effective advocates of policy implementation.

During the interviews, all of the committee members said that they have a good understanding of the knowledge that is disseminated during the committee meetings. Many in the committee also felt that they are open to new methods of dissemination if it led to greater environmental conservation. This sentiment is an opportunity towards the diverse use of knowledge because it indicates willingness to use information different from what they are familiar with if that is what is best for the health and sustainability of the watershed. Many of the committee members who were interviewed said that they were familiar with lay and traditional uses of knowledge, but that these kinds of knowledge are not currently used as part of the decision making process. And while members acknowledge that technical information is valued more within the committee, they do not all agree that this is the best process. When asked if various types of information (scientific and traditional knowledge) are available with in the region, one

member responded[10], "It depends. A little. But I do not think that this is a priority within the committee." (Interview, July 8, 2003). Another member responded, "Absolutely. We have many Universities in this region. On the Internet, in libraries, in journals there are all kinds of information on scientific management, traditional, indigenous, all kinds. It is available. If people are not using this information – it is not because it is not available." (Interview July 12, 2004). The fact that techno-scientific knowledge is championed to the exclusion of lay and indigenous forms of knowledge is not surprising considering that all members come from similar training.

Some committee members felt that since information is presented using technical explanations and format, certain groups would be left out of the meetings. A large barrier to diverse forms of knowledge usage in the committee is that those who possess lay knowledge are not part of the decision making process. This may occur for many reasons. It may be because of the way that the committee was created or because those with land-based knowledge cannot or choose not to participate. For example, in her analysis of water governance of the city of Sao Paulo, Keck explains that one of the barriers to participation in watershed management in Brazil may be rooted in the distrust in the government from the way that policy funds have historically been used (Keck 2002). In a related study in Northeast Brazil, Lemos (2000) observed that farmers in Ceara preferred traditional methods of rain prediction to those of the science of climate forecasting to mitigate recurrent drought because historically Northeastern Brazil's government has failed to deal with the physical and social effects of this region's dry climate (Lemos 2003).

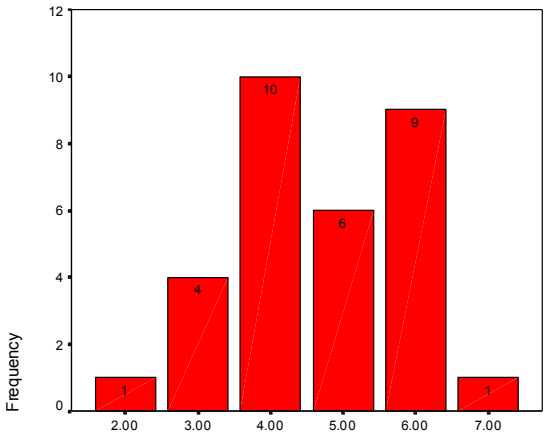
Even though the members have a preference for a certain type of information, their answers to the survey provided a picture that shows they are interested in what is best for the environment and desire to make better management decisions about the watershed. The committee members identified three possibilities that they saw for improving information dissemination towards better understanding of environmental issues: use of media (such as creation of websites that contained information about the RBC, public service announcements, and a list-serve between committee members) information sharing among regional committees, and environmental education for students and for the local community.

Sources of knowledge the Itajaí Committee

Regarding access and availability of knowledge, committee members in the Itajai RBC report different sources where they obtain information such as journals, internet, technical journals, lay knowledge, professional experience, and scientific articles[11]. In Graph 4 below, a rating of "1" indicates members use only one source while "7" indicates member have used all listed sources. The graphics show that most members gather information from at least four of the sources listed. It is also interesting to note that professional experience was noted the most often as the source of information that the watershed members reference when using information for decision making.

[10] Original question: Você sente que a informação científica e técnicas tradicionais sobre sua região é acessível? De que forma?

[11] Aonde voce encontra as informacoes relaclonadas a gescoa de agua?



SECTOR * Aonde você encontra as informações relacionadas a gestão de água? (marque com X todas que se apliquem): Crosstabulation

Count

		Aonde você encontra as informações relacionadas a gestão de água? (marque com X todas que se apliquem):						
		2.00	3.00	4.00	5.00	6.00	7.00	Total
SECTOR	civil society			4		4		8
	federal state		2	4	6	1		13
	users	1	2	2		4	1	10
Total		1	4	10	6	9	1	31

Graph 4: Survey Question – Where do you receive your information about the local watershed? Cross-tabular results by sector (below graph).

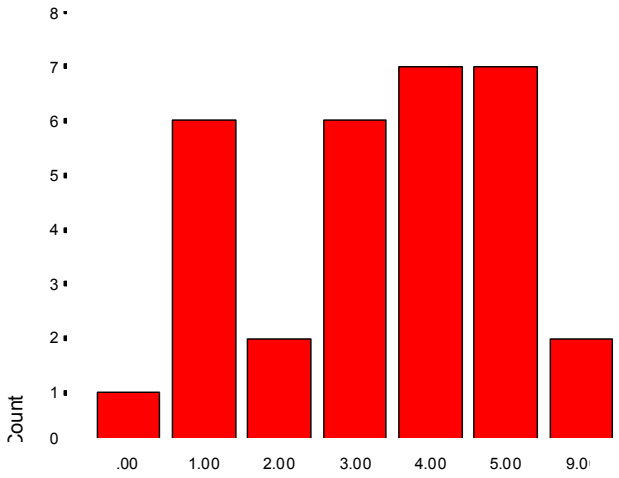
1 = from one source 7 = many sources 9= Don't know

Importance of Combined Knowledge that includes Indigenous Knowledge

As mentioned in the literature review a world-view of reciprocal relationships between humans and ecosystems underlies care-taking traditions among indigenous peoples. Elders educate youth that people need to watch over and take care of life-sustaining resources to ensure that they will always be available. Providing a practical example of care and responsibility for a particular spring for irrigation or domestic use would assume responsibility for monitoring its flow and quality. This tradition prevents abuse of community resources serves as a model for ecological monitoring (LaDuke 1994).

Regarding such worldviews in the Itajai RBC, the data below describes how members perceive their level of knowledge about the basin based on professional experience. Graph 5 below represents members rating on how good of an understanding

they feel they have of the environmental conditions of their own region. We can see that all members felt that they had a good understanding of this type of knowledge within their own region (as all rated above the neutral rating of "3").



SECTOR * Eu acho que eu tenho um bom nivel de conhecimento sobre as condicoes ambientais do minha regiao Crosstabulation

Count

		Eu acho que eu tenho um bom nivel de conhecimento sobre as condicoes ambientais do minha regiao			
		3.00	4.00	5.00	Total
SECTOR	civil society		3	5	8
	federal state	2	4	7	13
	users	7	1	2	10
Total		9	8	14	31

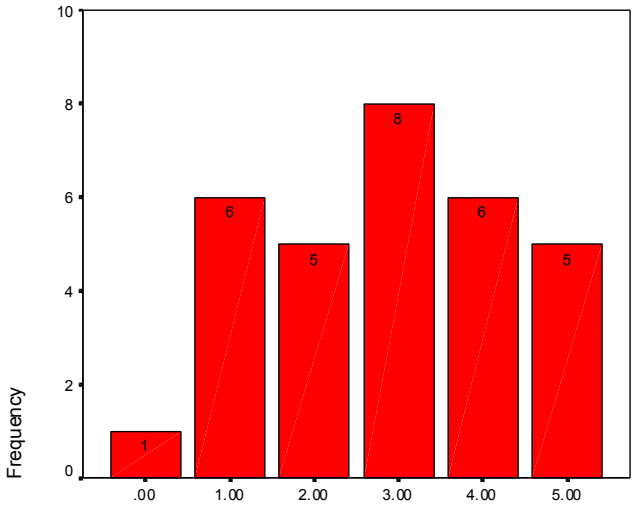
Graph 5: Environmental Understanding Question cross-tabulation by sector: Do you believe you have a good understanding of the environmental conditions of your region?

1 = no understanding 5 = high comprehension 9= Don't know

It is interesting to note that government representatives in general felt that they have an excellent understanding of the environmental conditions, 53%. Users generally (70%) felt that they had an average understanding with only 20% feeling that they had an excellent understanding.

Graph 6 below describes how different members perceive their level of familiarity with lay knowledge and local strategies applied to water management within their own

region[12]. The members were relatively split on their knowledge of its usage, so it is helpful to look at a cross tabs as to who is familiar in the committee with lay knowledge and local strategies and who is not.



SECTOR * Eu conheco tecnicas baseadas em conhecimento popular de gestao de agua na minha bacia Crosstabulation

Count

		Eu conheco tecnicas baseadas em conhecimento popular de gestao de agua na minha bacia						
		.00	1.00	2.00	3.00	4.00	5.00	Total
SECTOR	civil society		2	1		2	3	8
	federal state	1	1	2	6	2	1	13
	users		3	2	2	2	1	10
Total		1	6	5	8	6	5	31

Graph 6: Familiarity with Lay Knowledge Question: Are you familiar with Regional traditional and popular water management in your region? Cross-tabulation by sector (below graph)

1 = not familiar 5 = very familiar 9= Don't know

There are many opportunities for knowledge use that could change this dynamic within the committee structure. Many of the constraints to diverse knowledge use have been identified in the above section, especially those related with information preference, professional and educational background of the committee and the rules for membership. The next section looks at these opportunities and constraints in more detail.

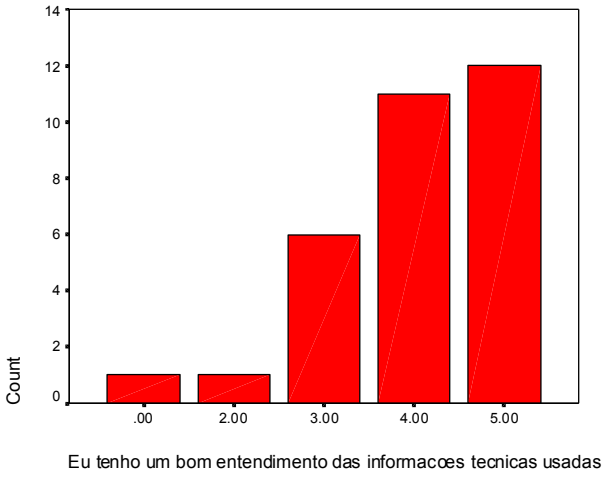
[12] Original question: Eu conheco tecnicas baseadas em conhecimento popular de gestao de agua na minha bacia.

Opportunities and Constraints for Knowledge Use

In this section I explore the effect of a set of variables including the culture within the different environmental organizations, users' sectors, state and federal organizations represented the River Basin committee, the physical problem, and the availability of knowledge within the committee on knowledge use. My interviews with committee members brought out many different themes on constraints and opportunities to the use of knowledge.

One of the factors affecting the pattern of knowledge use that many members identified was the way in which information was coordinated. In interview, members reported that the committee process itself and most information dissemination is coordinated through one person. Committee members identified this as an opportunity because of this person's commitment to the committee, her belief in the process, the respect that the other members have for her as a water scientist, engineer and professor, and her approachable style in the committee meetings. In this context, the coordinator has become a default knowledge broker through who information is streamlined and overlap in tasks is avoided. However, many members identified coordinating the information through one person as also a constraint since having one person act as a gatekeeper to the information may impede democratization of the RBC's decision making process.

The committee has a good understanding of information presented at committee meetings about the basin. The majority of respondents found information accessible both in terms of availability and understanding. The next graph illustrates the availability of technical information in the Committee. A rating of "5" signifies that it is readily accessible and a rating of "1" signifies that it is not. Most members gave this a neutral rating, expressing that members feel that technical information is accessible.



Graph 7: Accessibility of technical information question: Do you believe that you have a good understanding of how to use technical information?

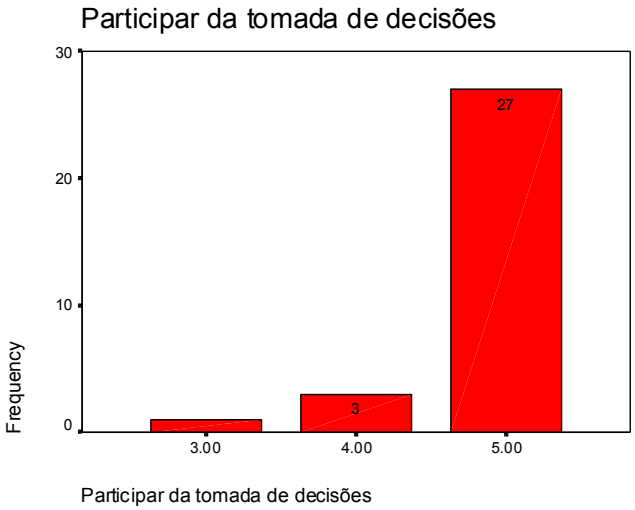
1 = no understanding, 5 = good understanding

In this case accessibility can be an opportunity because everyone has a similar understanding and comprehension of the information that is presented at the committee meetings and in reports that come out of the committee or to assist the committee in their decision-making. This is not surprising considering that the majority of members come from a similar education background, have an engineering background or hold jobs that require technical expertise. This make-up of the committee probably occurred for two reasons, one that when the committee was formed people with technical expertise watershed management were sought out. The other being that those with this type of expertise and understanding of watershed management feel comfortable participating in the watershed management committee; they feel effective. In turn, this perception of effectiveness may stimulate further participation.

Motivations to Participate

The following three graphs show how committee member's motivation to participate could be an opportunity toward combined knowledge. If the committee in general is motivated to participate for environmental reasons (finding sustainable conservation solutions) it is likely that more kinds diverse knowledge will be incorporated. On the other hand, if members of the committee are more motivated for personal, political or professional reasons they may not be as interested in incorporating diverse knowledge systems such as traditional and lay knowledge, even if this knowledge proves to support the design of more equitable and effective environmental conservation tools. Members' perception of current strategies and quality of water allocation for their own region could go either way in constraining or providing an opportunity for diverse knowledge incorporation. On the one hand, the availability of new solutions could potentially allow for better water distribution in all regions. But those currently making decision about water allocations at the time of the research, such as the industrial sector, may fear that diverse and different information may take away water and rights from their region.

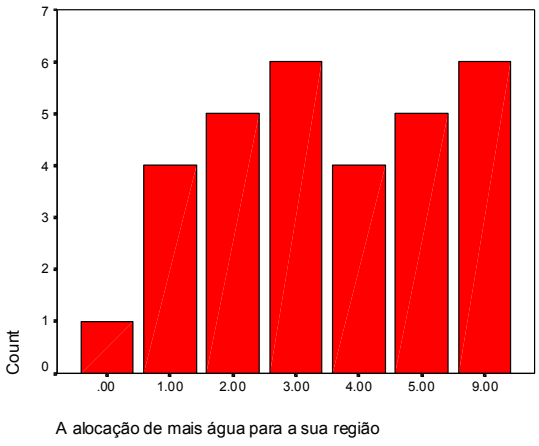
As part of the survey, three main motivations to participate were identified – personal motivation, political, and environmental. Graph 8, 9 and describe the distribution of answer for factors that motivate participation across these three factors. Graph 8 shows that members are highly motivated to participate so that they can influence the decision making of the committee in general. On the survey, a rating of "1" signifies that decision-making was not important and a rating of "5" signifies that this is very important. All but four members said that this was a very important factor for their participation.



Graph 8: Ability to affect decisions question: Do you feel motivated to participate in the committee to affect decision-making in your region?

1 = not motivated 5 = very motivated 9= Don't know

In contrast, members are less motivated to participate to influence specific water allocation in their review, reflecting a higher concern with the overall environment than with their own personal gain (Graph 9). The graph shows how strongly individual members felt motivated to participate because of allocation of water resources[13], with the majority feeling that water allocation is not a strong motivator. The graph is the closest to a normal curve of all the motivation responses. The highest responses in this graph were neutral "3" and unanswered "9".

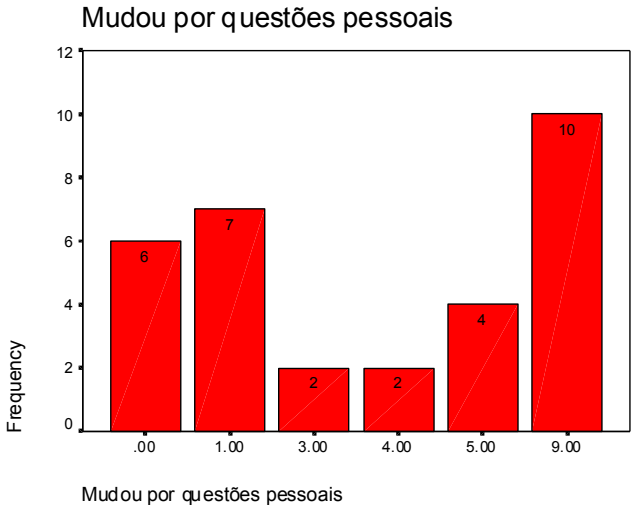


Graph 9: Regional Water Allocation Question: Do you feel motivated to participate in the committee to affect the water allocation to your region?

1 = not motivated 5 = very motivated 9= Don't know

[13] Original question: Alocação de mais água para a sua região

This next graph looks at if RBC members perceive the objective for the majority of the committee as wanting to make policy changes that will benefit the environment[14]. Many of the members did not answer this question (highest bar), which may demonstrate the lower level of importance that they attribute to having political influence as a motivator.[15].



Graph 10: Personal Gain Question: Do you feel motivated by personal reasons to participate in the committee?

1 = not motivated 5 = very motivated 9= Don't know

From the section of the questionnaire that pertained to motivation to participate, members seemed most moved by creating a better environment and helping to make better decisions about the watershed, not by improving the allocation of water resources to their in region. In this case committee members' reported motivations are consistent with theoretical assumptions that often people are motivated by other issues besides maximizing personal gain when participating in decentralized natural resources governance.

Salient environmental issues and Societal Values

It is in analyzing the societal values and power dynamics of the committee that we can begin to understand why popular community based natural resource management and indigenous knowledge is not incorporated in a collaborative manner. Interview data suggests that most members of the committee perceive that subsistence farmers and the indigenous communities are among the least influential actors in the committee. When asked about traditional knowledge use and members' familiarity with it, many members

[14] Original question (pertains to first graph): mudou por causa das mudanças políticas
[15] Original question: Mudou por questões pessoais

mentioned that they knew of traditional knowledge in their region and its use and that it was mainly within the subsistence farmers and indigenous groups of the region. Not only are subsistence farmers and indigenous groups considered non-users but they are only part of the River Basin committee through representation of a non-governmental organization. This is significant, because as mentioned earlier in this study, users were perceived as the most influential. If subsistence farmers and indigenous groups are not part of the conversations on watershed management, it is not surprising that this type of knowledge has not filtered into the committee. As mentioned before, another barrier to incorporation of indigenous knowledge is that is not viewed as science, and science is the preferred method of dissemination and several interviewees confirmed this perspective.

Indigenous knowledge will be incorporated only if the committee sees it as important. For example, when a particularly influential member of the RBC was asked if traditional land management techniques or her personal experience played a role in the decision making of the committee[16] she responded, "Yes. I have experience with the degradation of the banks. Because of globalization - it is even more important that we have experts with in the region that know how to manage the water systems. We are running out of time to do something. Germany, the US, they have their own problems - we need to take charge of the problems that are here...and we are." (Interview, July 25, 2003)

When asked if they felt that the use of traditional and lay information had increased since the creation of the committees, the same member responded[17], "In some ways yes and in some ways no. I think that we are getting more input from the people of the region. A good example of this is *Semana D'agua* (Water Week) - people can participate in this program and they themselves learn more about the regions water while teaching others. But within the committee, I would say the same type of information is still being used." Interview (July 25, 2003).

Consistently with the perception that lay knowledge only partially applies to what the committee does, it was clear that when land-based knowledge was recognized by committee members, it mostly referred to agriculture.

In contrast, technical knowledge was prominently represented in the RBC both in terms of solution as well as broader environmental education. The next graph shows the distribution of answers to the question: "Does technical information help you to make better decisions about the regulation of water"[18]. A rating of "5" signifies that members feel that technical information does help them to make better decisions and a rating of "1" signifies that it does not. We can see from the below graph that in general members feel that technical information does aid them in making better decisions.

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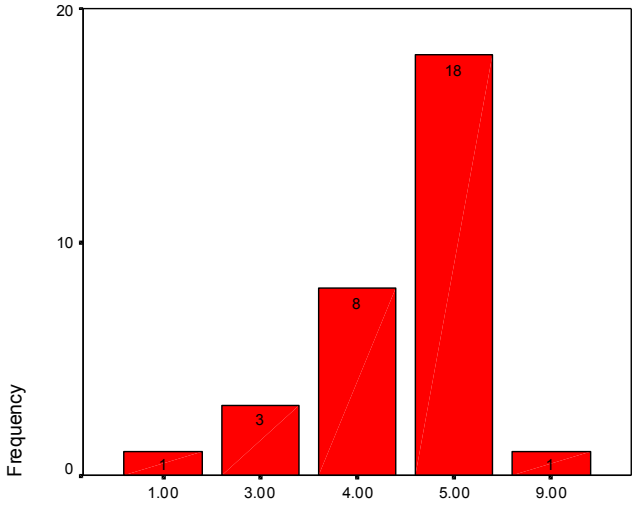
[16] *Original question: Você sente que sua experiência pessoal sobre sua região tem um papel significativo em sua tomada de decisão na bacia hidrográfica? De que forma?*

[17] *Original question: Você sente que o uso do conhecimento tradicional aumentou em sua organização desde a criação do comitê de bacia hidrográfica?*

[18] *Original question: Informacoes tecnicas me ajudam a tomar decisoes menlhores sobre a gestao das*



Graph 11: Information Flexibility Question: Do you have flexibility to bring new kinds of knowledge into the committee to inform decisions?

1 = high flexibility 5 = no flexibility 9= Don't know

When asked about the flexibility toward new information within the committee[19], one member responded, "We have little flexibility within the committee. This is a concern of mine because that with little flexibility we will not serve the environment well." (Interview July 8, 2003). In regard to the question of innovation within their own organization[20], one of the committee members answered, "This (innovation) is the most important aspect to any organization. I think environmental education solutions are the most important for the public. The environment should be for everyone. My first concern is environmental education and then politics of conservation within the region. Politics control that type of innovation - and the limit of it. I think this is where the committee comes in – if we can focus on the environment and educational solutions, may be we won't have to be so concerned about politics – but you will get a different perspective depending on who you ask." (Interview July 8, 2003)

The preference of techno-scientific knowledge restrains on the use of combined land management knowledge. However, the committee's interest in finding the best environmental solutions suggests that they would be interested in this knowledge if they saw the benefit of combined knowledge for the environment.

[19] *Original question: Como é a flexibilidade da sua organização à nova informação? Dê exemplos?*
[20] *Original question: Por favor, dê exemplos de inovação dentro de sua organização.*

CHAPTER SIX: CONCLUSION

Poor management of water, critical to human survival, has created a societal crisis. Discussions for the past several decades have focused on strategies to overcome this crisis to find more sustainable and equitable solutions for all people of the world. One solution, discussed during the 1992 Rio Summit on Sustainability, was to increase environmental management efficiency and improve equity and justice for local people. Many environmentalists have advocated participatory and community based natural resource management as one way to accomplish that. This strategy has been incorporated into resource management around the globe – but have broad enough steps been taken toward greater water resource conservation and social justice? Democratic decentralization is a promising means of institutionalization and scaling up the popular participation. However, most current "decentralization" reforms are characterized by insufficient transfer of power to local institutions that rarely represent and are not accountable to local communities. Decentralization does not in itself equate to democracy. Thus understanding the factors that shape democratization within participatory governance mechanisms is critical. This study focuses on one factor that influences participation and efficacy of decentralized governance systems, namely knowledge, especially scientific/technical and lay knowledge. Using survey and interview data, it finds that in the Itajai RBC, technical knowledge is the most dominant in supporting decision-making and the preferred kind of knowledge by committee members. Not surprisingly techno-scientific knowledge is easily accessible and familiar to most committee members due to their similar educational and professional background.

Diversity and amalgamation of different kinds of knowledge has been found to be important encourage to participation, conservation and justice. In turn, greater participation affects the way information and ideas are disseminated by providing a platform for a diversity of information sources (such as lay, indigenous, techno-scientific information). Diversity of knowledge leads to better decision-making by combining place-based information and practice with science generated knowledge. We have seen from the analysis section of this thesis that in some ways the Itajaí committee incorporates combined technical knowledge and the committee form of decision-making includes more people than it had before the reform. But, in many ways, it falls short in incorporating diverse community based natural resource management knowledge.

This study explores the argument that if the a diverse base of information were incorporated in River Basin Committees decision-making, participation would be likely to be more diverse, a greater audience would be reached and effectiveness would be greater. As mentioned before, two arguments for community based natural resource management are the opportunity for realizing new solutions toward conservation and more effectiveness in implementation. First, greater conservation options would be realized because combined techno-scientific knowledge and traditional land and place based knowledge collaboration would involve the exchange of research, technology transfer, technical assistance, shared skills, and cooperative planning, land and resource programs and project activities that could benefit all parties interested in a sustainably

managed river basin. Second, implementation would be more effective because when people feel that they have had the opportunity to participate in planning future change, they are likely to buy into the changes that may be required of them. By increasing participation of subsistence farmer, indigenous groups and other local stakeholders, opportunities would increase for improving the responsiveness and implementation of new river basin management projects and would also create awareness of the science and technological need of the end user.

Lessons from the Itajaí Committee

Three main conclusions can be drawn from this study. First, in regards to opportunities and constraints toward the use of diverse knowledge, because RBC members are highly motivated to participate to find solutions and for greater environmental conservation rather than personal or political gain, there seems to be an opportunity for the incorporation of other kinds of knowledge.

Second, as demonstrated from the surveys and interviews, technical knowledge is currently the most used and preferred by the committee members. This is the case because it is easily accessible and familiar to the committee due to their similar educational and professional background.

Third, committee members have a preference and knowledge of scientific knowledge over lay and traditional knowledge – this social value is a definite restraint on the use of combined land management knowledge. This correlates strongly with the members being from similar professional and educational technical backgrounds. This is significant in two ways – one is that members are unaware of alternative solutions that may be effective and there is not diverse and meaningful participation within the committee.

Recommendations for and by the Committee:

When interviewed, the committee members had many suggestions on how traditional knowledge could be incorporated as well as how scientific and technical knowledge could be incorporated more effectively. This chapter is an accumulation of those recommendations as well as a summary of how other groups have incorporated traditional knowledge and used existing sources of knowledge more effectively.

What steps can be taken toward incorporation on diverse knowledge use? During the interviews, committee members had a few ideas. Below is a summary of some of the steps that could be taken toward more effective and inclusive knowledge use in watershed management as it is presented in this study and as suggested by the Itajaí River Basin committee:

- Institutional Change in the definition of the Users sector
- Incorporation of different types of information and knowledge
- Meeting location rotation

- Information sharing among committees
- University/ community-based initiatives on incorporation on knowledge.

Institutional Change of the Users sector:

When asked about traditional knowledge use and members familiarity with it, many members mentioned that they knew of traditional knowledge in their region and its use and that it was mainly within the subsistence farmers and indigenous groups of the region. Many of the members did see a value or express an interest in incorporating it into the RBC process. Not only are subsistence farmers and indigenous groups considered non-users but they are only part of the River Basin committee through representation of a non-governmental organization. This is significant, because as mentioned in the analysis section of this study, users were perceived as the most influential. If subsistence farmers and indigenous groups are not part of the conversations on watershed management, this type of knowledge has no way of filtering into the committees.

Currently, the status of "user" within the committee is determined using an economic model. The water users with the greatest return on water usage receive water "user" status. The president of the committee at the time of the research is the CEO of the largest textile factory in the region and textiles are the largest industry in Itajaí. This is demonstrative of the power the industrial sector has over the reformed river basin management process.

A few of the people interviewed expressed a fear that use of local knowledge may create a less efficient system where services decline in quality due to a lack of local institutional and technical capacity to perform new tasks will create a stagnant system. Little is done to promote democracy and efficiency when a decentralized reform simply transfers authority and responsibility from one institution to another. There is a lack of faith in moving toward a truly new system committed to the use of innovation and knowledge of local stakeholders. The river basin reform process that transfers power to community stakeholders should include technology transfer and technology compatibility between western science technology and indigenous technology. The location of the managing body has changed from the federal to local level, but the basic structure within has not changed. The power has not moved to the people. To see the results that decentralization touts a meaningful transfer of power has to occur also to those local people with innovative knowledge systems.

Active participation of stakeholders with the municipal governments is thought to be one of the best ways to increase downward accountability and encouraged democratic decentralization, thus producing superior equity and efficiency. By contrast, administrative decentralization (which seems to be the case in the Itajaí basin) makes committees or councils upwardly accountable to higher levels of government (Brannstrom et al 2003). In this model decentralized groups may remain disconnected from the local population at large.

Incorporation of different types of information and knowledge

By using only one model of knowledge in the decision making process only those individuals who possess that knowledge will be able and entitled to take part in the process. If varied knowledge types are incorporated into the process more people will participate and their participation will be more meaningful.

As suggested in this study greater benefit could be achieved in watershed management if varying types of information were used to support each other. In this way people with different knowledge patterns understand and begin to incorporate new knowledge systems that will lead to greater justice and greater conservation. The struggle for indigenous rights is inextricably linked to the environmental sustainability movement. In the words of Ryser and Karn (1985), the earth's biodiversity is mirrored by the diversity of cultures humans created over great lengths of time.

Meeting location rotation

Members from the indigenous groups, or organizations that were to represent their interests, were not present at the committee meetings. When I enquired why it was so, the answer was that because committee meetings were usually held too far away from where they were located, they were not able to and could not afford to come to the meetings. This is a very common problem in around the globe when it comes to collaboration with community groups – especially indigenous tribes. It may be beneficial to have a meeting location rotation so even if everyone can not come all the time, then at least all parties can come for part of the meetings.

Unlike the participants from government, industry, and some community organizations, participation from indigenous groups, small subsistence farmers and other local stakeholders that would be able to provide land and place based knowledge would not have a paid positions that allow them to partake in the river basin committee. For example, to remedy inequity of travel and time away from a job the United States Department of Agriculture and Forest Service have recommended that meeting that involve American Indians and Alaska Native stakeholders to hold all meetings or every other meeting on tribal land and to hold meetings after work hours. A similar strategy could be use in the Itajaí region.

Information sharing among committees

I was asked by some of the committee members about the River Basin committee in Ceará and what I had observed there during my short stay. Members said that they heard that this committee was "very innovative", but they did not know in what way. This is a good example of how information sharing among committees could be beneficial in creating greater diversity of knowledge within the committees.

When working groups were first created in Itajaí around the formation of the river basin committee there were delegates from each of the groups that attended other working two quarterly meetings. The primary function of this delegate transfer was for

the purposes of information exchange on project development and ideas. Though logistically difficult, a similar delegation exchange would be beneficial for this exchange of ideas between committees. Though this will be logistically difficult for many committees varying on location, some of the University committee members suggested use of the media, the Internet and University resources for exchange of ideas and to inform and educate on innovative management projects.

University/ Community-based initiatives

Some members say the use of the media, the Internet and University resources as helpful in generating awareness among the public as to what some of the environmental concerns are in the area. This use of media, committee members argue, would be a great way to educate the public and stir their awareness in becoming active in the River Basin committee. If there were more transparency to the general public of the issues and the committee's agenda, they would be able to share their knowledge of watershed management solutions.

Roberts & Thanos (2003) argue that ultimately more attention needs to be given toward the development of creative community-based economic initiatives that incorporate traditional indigenous beliefs with sustainable ecosystem management. A catalyst for this change should come from the University. To achieve and recruit greater participation of local community members and to reach greater dissemination, education on the importance of natural resource management decisions new methods may be required. As mentioned in earlier sections of this study, mobilization of the greater public for water conservation and equity poses a tremendous challenge. The University of Blumenau has graduate students who are looking at the equity in which committee members are chosen. The University of Blumenau also has, as mentioned in the interview, public and environmental education program such as *Semana da Aagua* (Water Week) to educate and get the community involved in water conservation. This type of environmental education could be incorporated into more sectors of the RBC.

Challenges exist in incorporating indigenous and popular community based natural resource knowledge with the scientific knowledge in watershed management decision-making. Both are beneficial and successful management techniques. Used in combination they will be more effective. The barrier of incorporation is understanding and value of traditional knowledge. These barriers may be broken down in the RBC by including members that hold reliable information on traditional knowledge and by applying this traditional knowledge within the river basin committee.

Appendix A:
History of Flooding in the Itajaí Watershed

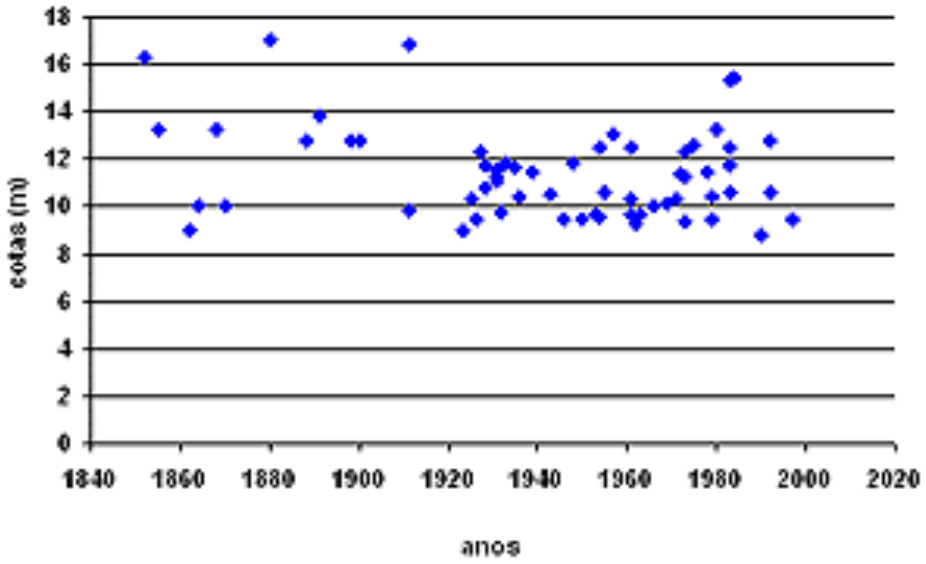
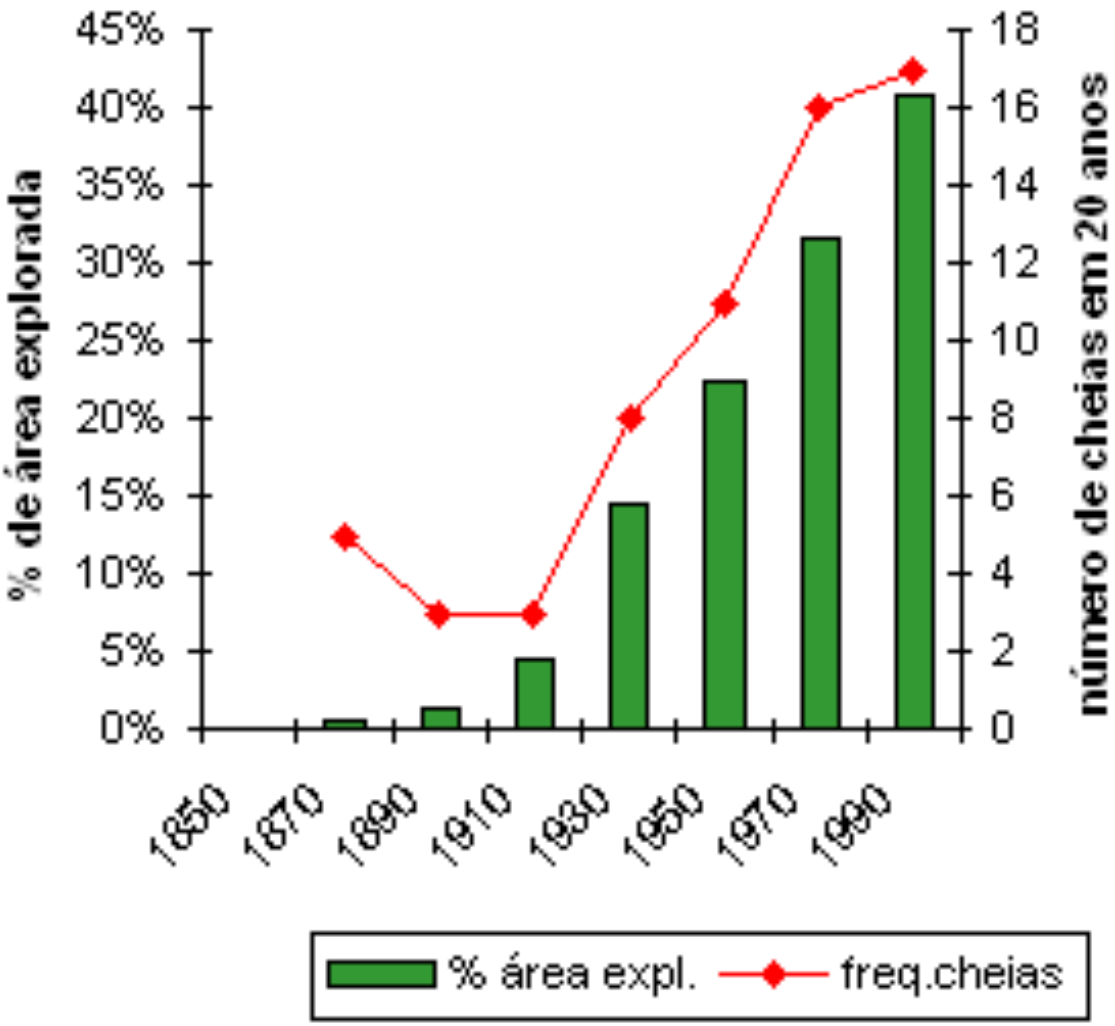


Gráfico 1 - Distribuição das enchentes ocorridas em Blumenau entre 1850 e 1992 (Fonte: IPA/FURB)

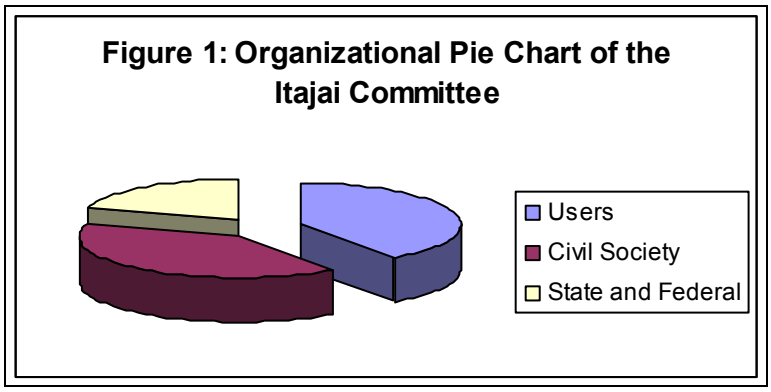
Ano	Cota(m)	Ano	Cota(m)
1851	16,30	1953	9,65
1855	13,30	1954	9,56
1862	9,00	1954	12,53
1864	10,00	1955	10,61
1868	13,30	1957	13,07
1870	10,00	1961	10,35
1880	17,10	1961	9,63
1888	12,80	1961	12,49
1891	13,80	1962	9,29
1898	12,80	1963	9,67
1900	12,80	1966	10,07
1911	9,86	1969	10,14
1911	16,90	1971	10,35
1923	9,00	1972	11,35
1925	10,30	1973	11,30
1926	9,50	1973	9,35
1927	12,30	1973	12,35
1928	11,76	1975	12,63
1928	10,82	1978	11,50
1931	11,05	1979	9,45
1931	11,25	1979	10,45
1931	11,53	1980	13,27
1932	9,75	1983	10,60
1933	11,85	1983	15,52
1935	11,65	1983	15,34
1936	10,40	1983	11,75
1939	11,45	1984	15,46

1943	10,50	1990	8,82
1946	9,45	1992	12,80
1948	11,85	1992	10,62
1950	9,45	1997	9,50

Tabela 1:
Picos de enchentes registradas em Blumenau. As cotas são todas referenciadas à régua linimétrica da Ponte Adolfo Konder (Fonte: IPA/FURB)



Appendix B:
Members of the Itajaí Watershed Committee



Membros - Usuários da Água

Organização	Assento		Data Ind.	Representante
CASAN	1	T	14/03/01	Luis Roberto Coceiro
		S	12/09/02	Leandro Gerônimo Lyra
	2	T	16/07/01	Nei Dionisio Locatelli
		S	16/07/01	Antônio Carlos Finck

SAMAE	3	T	01/01/00	
		S	01/01/00	Rosita Hoffmann
	4	T	01/01/00	Roberto Bolognini
		S	01/01/00	Valmor Zuchi
CELESC	5	T	24/11/00	Oscar José Graf
		S	24/11/00	Nicanor Alegri
PEQUENOS PRODUTORES DE ENERGIA HIDRELÉTRICA	6	T	04/07/01	Macos Persuhn
		S	04/07/01	Osnir Osmar Bona
SINDICATO DOS TRABALHADORES RURAIS	7	T	24/07/01	Carlos Venzon
		S	24/07/01	João Anselmo Cerpa

	8	T	01/01/00	Laurindo Neckel
		S	01/01/00	João Brandes
ASSOCIAÇÕES DE PISCICULTORES	9	T	13/07/01	Ildo Klaumann
		S	13/07/01	Sérgio Tadeu Jurovisky Tamassia
ASSOCIAÇÕES DE AGRICULTURA ECOLÓGICA	10	T	09/07/01	Antônio de Águida
		S	09/07/01	Adolar Reckelberg
ASSOCIAÇÕES DE IRRIGANTES	11	T	01/01/00	Luiz Peron
		S	01/01/00	Arno Concentius
	12	T	13/07/01	Gerson Theiss
		S	28/02/01	Dionísio Scharf

AFUBRA	13	T	08/05/01	Adoniram Carlos Livramento
		S	08/05/01	Danilo Fernando Becker
DEOH	14	T	15/05/02	Milton Sant'Ana
		S	15/05/02	Sebastião Silveira
Superintendência do Porto de Itajaí	15	T	30/11/00	Amilton Machado Alcântara
		S	30/11/00	Jackeline Daros Abreu de Oliveira
SINDICATO DOS MINERADORES	16	T	09/11/00	José Carlos Beckauser
		S	09/11/00	Marcos Eichstaedt
SINDICATO DAS INDUSTRIAS DE SERRARIAS	17	T	28/11/00	Adroaldo Brocardo
		S	28/11/00	Fábio Marchetti
SINDICATO DAS INDUSTRIAS DE FIAÇÃO E TECELAGEM	18	T	20/08/01	Alvin Rauh Neto
		S	20/08/01	João Bechtold
	19	T	25/09/02	Verner Willrich

		S	25/09/02	Vivian Rudolf Kormann
SINDICATO DAS INDÚSTRIAS DE PESCA	20	T	26/02/02	Eduardo José de Borba Duarte
		S	26/02/02	Bruno Hofmann
SINDICATO DAS INDÚSTRIAS DE ALIMENTOS - FRIGORIFICOS	21	T	07/02/02	Jacir Pamplona
		S	07/02/02	Leopoldo Alberto Zimermann
TURISMO ESPORTE E LAZER AQUÁTICO	22	T	13/07/01	Otto Friedrich Hassler
		S	13/07/01	José Augusto Coelho Neves Júnior
DEPARTAMENTO DE ESTRADAS DE RODAGEM - DER	23	T	09/07/01	Simone Hering de Oliveira
		S	09/07/01	Jair José da Silva
SECRETARIAS MUNICIPAIS DE PLANEJAMENTO E OBRAS	24	T	01/01/00	Roberto Ferrari
		S	01/01/00	Leliani Valéria de Souza
	25	T	01/01/00	Sérgio Feuser
		S	01/01/00	Gerson Ricardo Müller
	26	T	01/01/00	Fazer nova indicação

		S	01/01/00	Fazer nova indicação

Membros - Entidade da Sociedade Civil

Organização	Assento		Data Ind.	Representante
ASSOCIAÇÕES INDUSTRIAIS E COMERCIAIS	27	T	15/03/02	Maria Izabel Pinheiro Sandri
		S	15/03/02	Antônio Cezar de Souza
	28	T	01/01/00	Hans Prayon
		S	01/01/00	Mário Favero
	29	T	06/11/02	Jair Francisco
		S	06/11/02	Germano Emílio Purnhagen
FURB	30	T	20/04/01	Beate Frank
		S	20/04/01	Noemia Bohn
UNIVALI	31	T	11/06/02	Leonardo Rubi Rörig
		S	11/06/02	Fernando Luiz Diehl
UNIDAVI	32	T	28/03/01	Jaime João Pasqualini
		S	28/03/01	Dalmir da Silva
FEBE	33	T	01/01/00	Ronaldo Uller
		S	01/01/00	Sérgio Sebold
FEDERAÇÃO DAS ENTIDADES ECOLOGISTAS CATARINENSES	34	T	10/09/02	Leandro da Rosa Casanova
		S	10/09/02	Odair Luiz Andreani
	35	T	30/03/00	Elias João de Melo
		S	30/03/00	Lauro Eduardo Bacca

COMUNIDADES INDÍGENAS	36	T	01/01/00	Fazer nova indicação
		S	01/01/00	Fazer nova indicação
CÂMARAS DE VEREADORES	37	T	11/02/03	Celso Marcelino
		S	11/02/03	Caluto Juarez Zandonai
	38	T	22/11/00	Celso Cristofolini
		S	22/11/00	Luiz Schuster
	39	T	08/05/01	Maria Juçara Pamplona
		S	01/01/97	Fazer indicação
ASSEBLÉIA LEGISLATIVA	40	T	01/01/00	Ana Paula Lima
		S	01/01/00	Nelson Goetten
AMAVI	41	T	01/01/00	Jaci José Bortolon
		S	01/01/00	Valcir Leopoldo Nardelli
AMMVI	42	T	17/08/01	Roberto Schulz
		S	17/08/01	Celso Pedro Zucchi
AMFRI	43	T	01/01/00	Jandir Bellini
		S	01/01/00	Carlos Luiz Pissetti
MUNICÍPIOS	44	T	15/03/02	Julcemar Alcir Coelho
		S	15/03/02	João Luiz Coelho
	45	T	01/01/00	Carlos Hoegen
		S	01/01/00	Fazer nova indicação
	46	T	23/04/01	Ciro Marcial Rosa
		S	31/07/01	Jorge Luíz Bonamente

ASSEMA	47	T	23/04/02	José Constantino Sommer
		S	12/07/01	Júlio Adelaido Serpa
MUNICÍPIOS SEDE DE BARRAGENS	48	T	01/01/00	Horst Gerhard Purnhagen
		S	01/01/00	Augustinho Fusinato
ORGANIZAÇÕES E MOVIMENTOS E CONSELHO SOCIAIS E CONSELHO INTERDENOMINICIAL DE ENSINO RELIGIOSO	49	T	01/01/00	Fábio Floriani
		S	01/01/00	Valdir Iatzac
	50	T	10/10/02	Robson Luiz Polmann
		S	10/10/02	Ana Maria Vedrami
OAB	51	T	01/01/00	Fazer nova indicação
		S	01/01/00	Fazer nova indicação
ASSOCIAÇÕES DE ENGENHEIROS	52	T	01/12/00	Sebastião Fernardo Abrão
		S	01/12/00	José Jacques Zeitoune

Appendix C:
Interview of Members of the Itajaí Watershed Committee

The purpose of this study is to analyze the information use and selection of the policy maker in the watershed committees. Please answer the following interview questions honestly and with as much detail as possible. If there are any questions that you do not feel comfortable answering, please feel free to pass the question. Participation is voluntary.

The following topics will be covered in this interview:

Questions pertaining to institutional flexibility
Questions pertaining to organizational and individual priorities
Questions pertaining to use of information
Questions pertaining to Land Stewardship
Questions pertaining to World View and Environmental Attitudes
Questions pertaining to Source Selection

A. FLEXIBILITY:

1. What does your organization do?

2. How flexible is your organization to new information?

3. In what ways do you think information can help you manage the watershed?

4. Please give examples of flexibility within your organization.

5. Please give examples of innovation within your organization.

B. PRIORITIES:

1. What do you think should be the watershed committee's priorities to ensure the environmental recovery of the basin?

2. Is the current information you have of your region sufficient to help you manage according to the priorities of your region as you have stated?

3. In what ways could the current source or availability of information within your organization be improved?

C. USE OF INFORMATION:
Scientific and technical information is defined as information in any format or medium which is derived from scientific and technical studies, work, or investigations which relate to research, development, demonstration, and other specialized areas such as environmental, health protection, and waste management[21]. The following questions are in regard to scientific knowledge.

1. Do you use climate information? If so, what type of information do you use and how do you apply it?

2. Do you feel that you have a good understanding of the science and technology use in your organization regarding watershed decision-making?

3. Do you feel that technical information use in watershed management is adequately explained or could be better explain? In what ways?

4. Do you feel that scientific information has kept you from participating in the watershed committee decision-making? In what ways?

5. Do you feel that scientific information has helped you to make better decisions? In what ways?

6. Do you feel that scientific information about your region is accessible? In what ways?

Traditional Knowledge is defined as that based on accumulated experience or continuous usage[22]. The following questions are in regards to Traditional Knowledge.

7. Do you feel that your personal experience about your region's watershed contributes a significant role in your decision-making? In what ways?

8. Do you feel that the use of traditional or community knowledge has increased since the creation of the watershed committees in your organization?

9. Are you aware of traditional knowledge and community management techniques within your region?

10. Are traditional management techniques about your regions water management available?

11. Please give some examples of traditional management techniques.

[21] DOE Nevada Operations Office Scientific and Technical Review Process October 1998
[22] Science of the Pacific Island People 1994

12. In what ways, if any, does your organization incorporate traditional management techniques?

The following questions are in regards to the way in which your organization uses general knowledge.

13. How could current ways of receiving information about your regions watershed be better accessed?

14. How do you gauge politics affecting management information?

15. In hypothetical terms, what type of information would be useful to have when making watershed management decisions?

D. LAND STEWARDSHIP:
Land stewardship is defined as the responsible and proper management of land, water, and other natural resources to enable their passage onto future generations in a healthy condition[23]. The following questions are in regards to Land stewardship.

1. What do you feel are the most important environmental problems facing your region?

2. How do you feel the watershed committee addresses these problems?

3. What information do you feel the committee needs to better address those problems?

4. How could information lead to better land stewardship?

WORLDVIEW/ ENVIRONMENTAL ATTITUDES:

1. Does your concern for the environment lead you to participate in the watershed committee?

2. Do you believe the decisions you make in the watershed committee effects environmental quality locally?

3. Do you believe the decisions you make in the watershed committee effects environmental quality globally?

4. Do you worry about the pollution of the rivers, ponds and seas?

[23] Land Stewardship through Watershed Management 2002

5. Do you think the water in your region is safe?

6. Do you feel that you personally need to change your consumption habits? In what ways?

7. Do you feel that most people need to change their water consumption habits so future generations can continue to enjoy a good quality of life and environment?

SOURCE SELECTION:

1. Do you feel that members of the committee typically have individual interest in mind when they make water shed decisions or the interests of the community?

2. Where do you typically find information to help you make decisions about watershed management?

3. How do you gauge the effectiveness of the information you use about your region?

4. What type of scientific information do you use in your watershed management decision-making process?

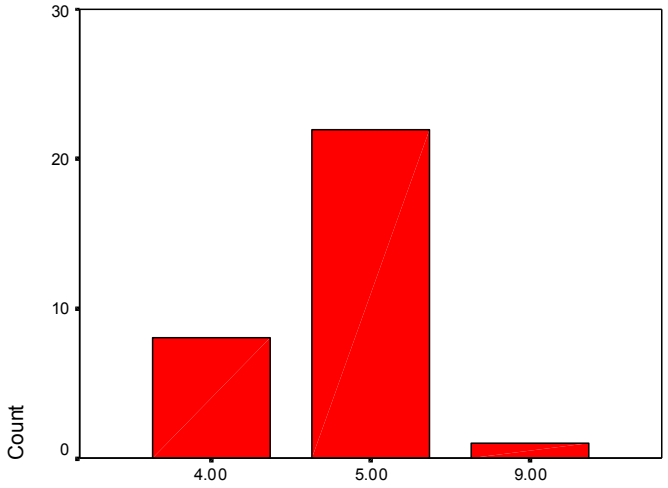
5. What type of community/regionally based information do you use in your watershed management decision-making process?

Appendix D:
Complete Results from Surveys

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	3.235[a]	4	.519
Likelihood Ratio	3.595	4	.464
N of Valid Cases	31		

a. 6 cells (66.7%) have expected count less than 5. The minimum expected count is .26.



Assegurar que os interesses da comunidade sejam representados

SECTOR * Assegurar que os interesses da comunidade sejam representados Crosstabulation

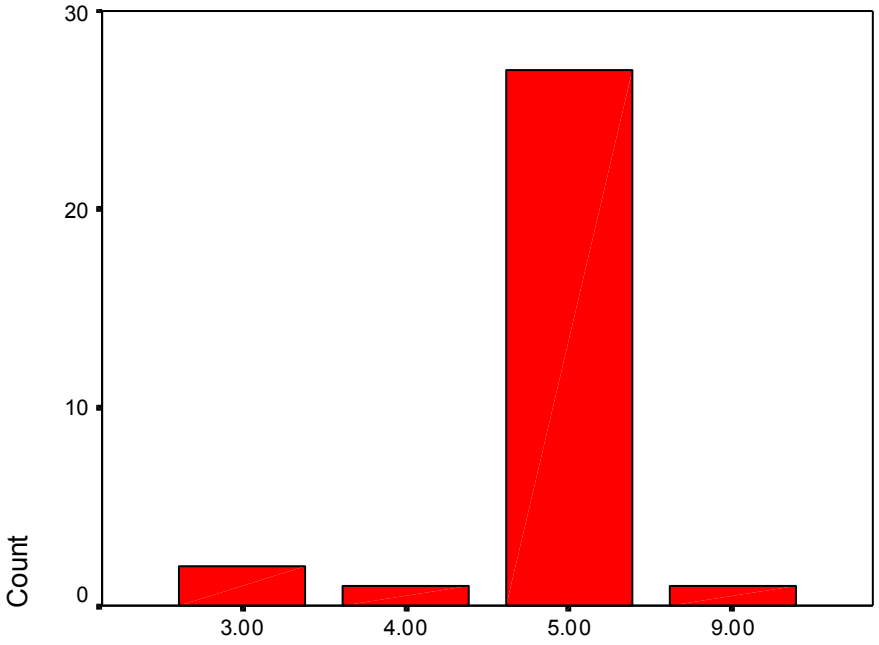
Count

		Assegurar que os interesses da comunidade sejam representados			
		4.00	5.00	9.00	Total
SECTOR	civil society	1	7		8
	federal state	3	9	1	13
	users	4	6		10
Total		8	22	1	31

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2.915[a]	4	.572
Likelihood Ratio	3.974	4	.409
N of Valid Cases	31		

a. 6 cells (66.7%) have expected count less than 5. The minimum expected count is .26.

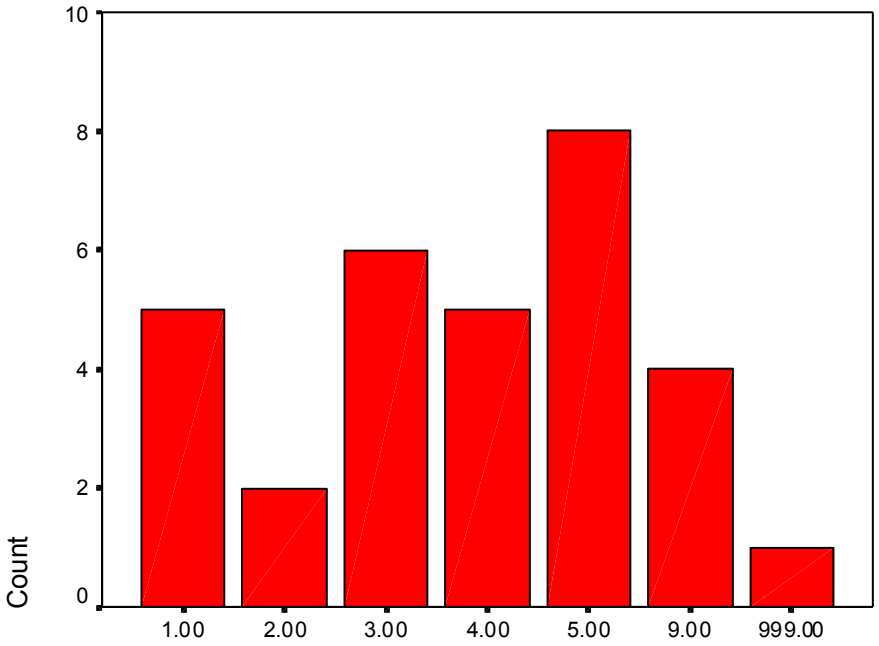


Assegurar que os interesses da sua instituição sejam representad

SECTOR * Participar da tomada de decisões Crosstabulation

Count

		Participar da tomada de decisões			
		3.00	4.00	5.00	Total
SECTOR	civil society			8	8
	federal state	1	2	10	13
	users		1	9	10
Total		1	3	27	31



SECTOR * Obter benefícios para você e para sua organização Crosstabulation

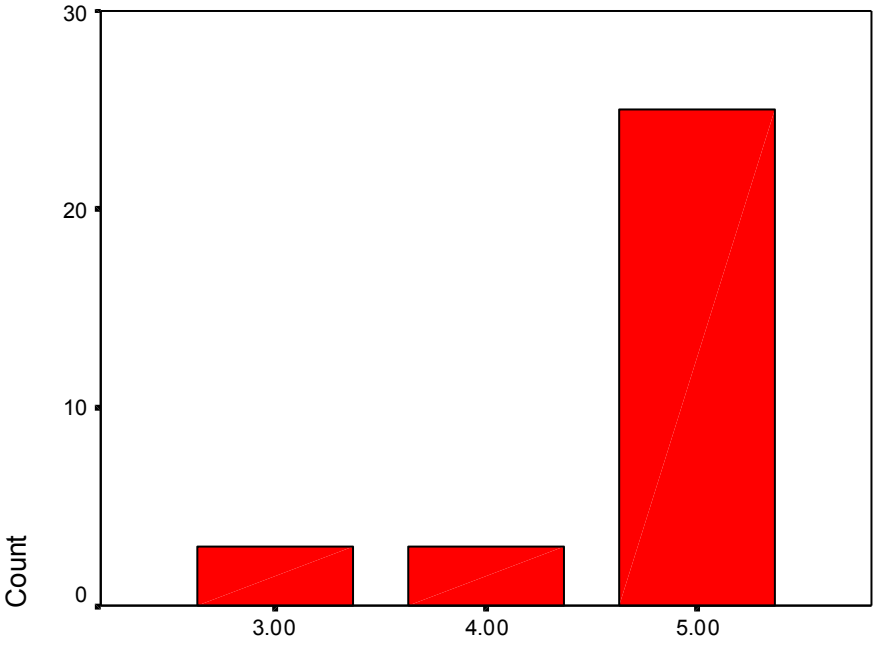
Count

		Obter benefícios para você e para sua organização							
		1.00	2.00	3.00	4.00	5.00	9.00	999.00	Total
SECTOR	civil society	1		1	2	4			8
	federal state	3	1	2	2	3	2		13
	users	1	1	3	1	1	2	1	10
Total		5	2	6	5	8	4	1	31

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	9.348[a]	12	.673
Likelihood Ratio	10.800	12	.546
N of Valid Cases	31		

a. 21 cells (100.0%) have expected count less than 5. The minimum expected count is .26.



Interesse e preocupação com o meio ambiente

SECTOR * Interesse e preocupação com o meio ambiente Crosstabulation

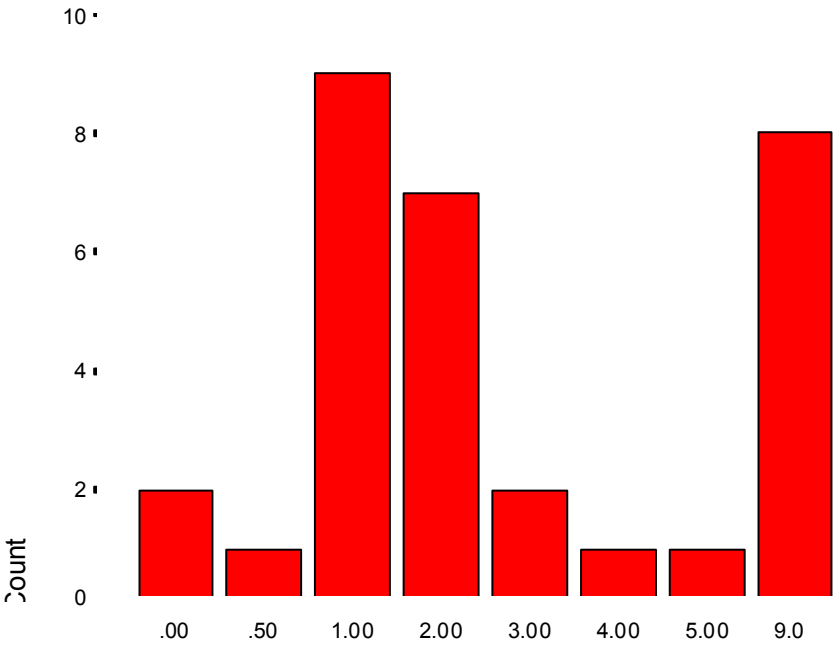
Count

		Interesse e preocupação com o meio ambiente			
		3.00	4.00	5.00	Total
SECTOR	civil society		1	7	8
	federal state		2	11	13
	users	3		7	10
Total		3	3	25	31

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	7.984[a]	4	.092
Likelihood Ratio	9.372	4	.052
N of Valid Cases	31		

a. 6 cells (66.7%) have expected count less than 5. The minimum expected count is .77.



SECTOR * Fatores ligados a carreira e a política Crosstabulation

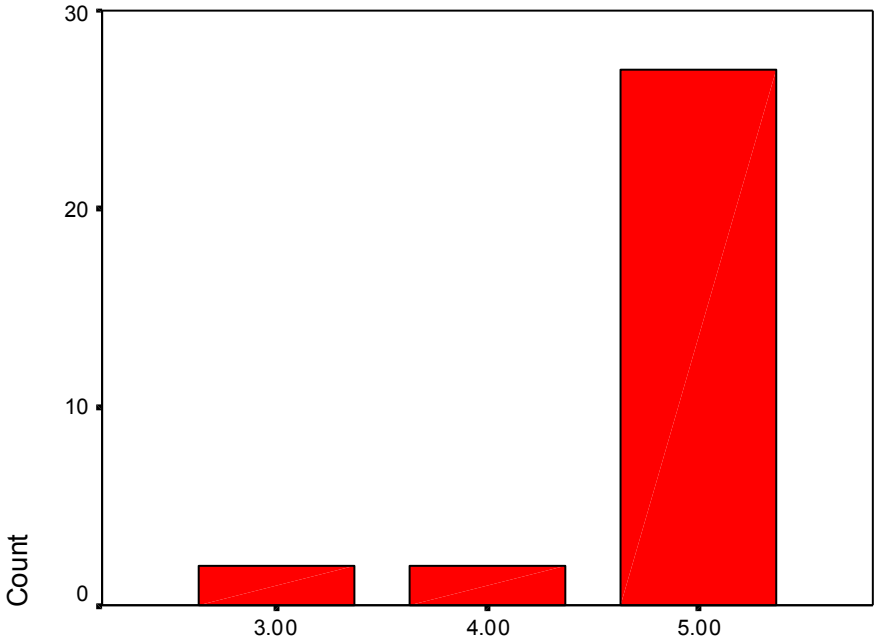
Count

		Fatores ligados a carreira e a política								
		.00	.50	1.00	2.00	3.00	4.00	5.00	9.00	Total
SECTOR	civil society			6	1			1		8
	federal state	2		2	2	2			5	13
	users		1	1	4		1		3	10
Total		2	1	9	7	2	1	1	8	31

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	25.459[a]	14	.030
Likelihood Ratio	27.655	14	.016
N of Valid Cases	31		

a. 24 cells (100.0%) have expected count less than 5. The minimum expected count is .26.



Interesse e preocupação com questões ligadas a água

SECTOR * Interesse e preocupação com questões ligadas a água Crosstabulation

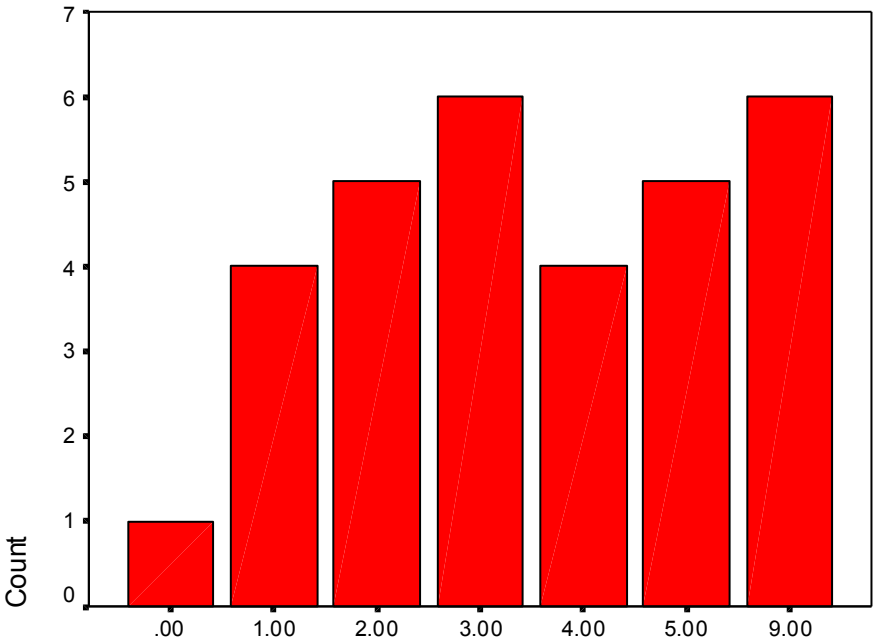
Count

		Interesse e preocupação com questões ligadas a água			
		3.00	4.00	5.00	Total
SECTOR	civil society		1	7	8
	federal state		1	12	13
	users	2		8	10
Total		2	2	27	31

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	5.428[a]	4	.246
Likelihood Ratio	6.300	4	.178
N of Valid Cases	31		

a. 6 cells (66.7%) have expected count less than 5. The minimum expected count is .52.



A alocação de mais água para a sua região

SECTOR * A alocação de mais água para a sua região Crosstabulation

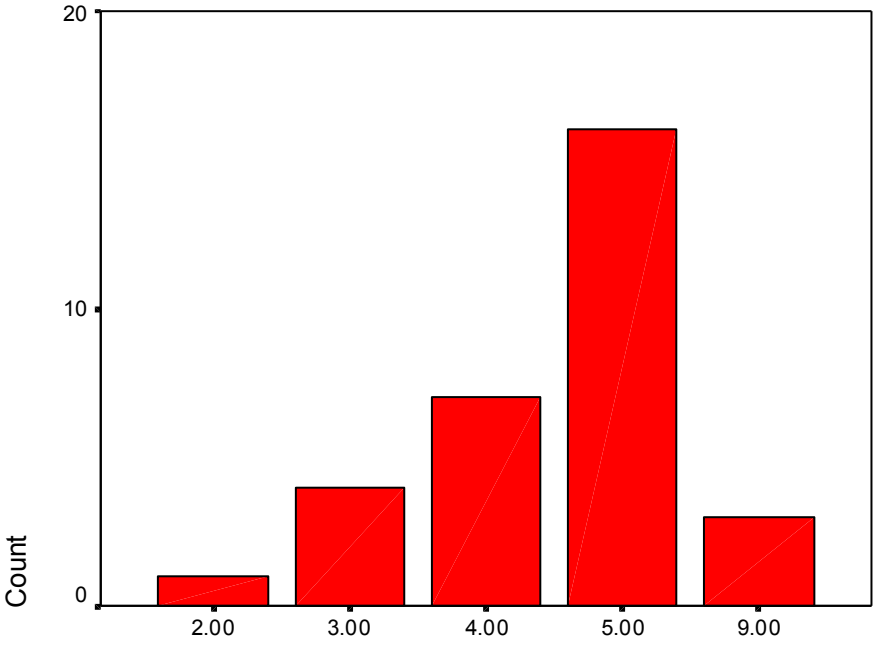
Count

		A alocação de mais água para a sua região							
		.00	1.00	2.00	3.00	4.00	5.00	9.00	Total
SECTOR	civil society		2		2	1	1	2	8
	federal state	1	2	2	2	1	3	2	13
	users			3	2	2	1	2	10
Total		1	4	5	6	4	5	6	31

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	7.964[a]	12	.788
Likelihood Ratio	10.433	12	.578
N of Valid Cases	31		

a. 21 cells (100.0%) have expected count less than 5. The minimum expected count is .26.



SECTOR * Para cumprir com o seu dever de cidadão Crosstabulation

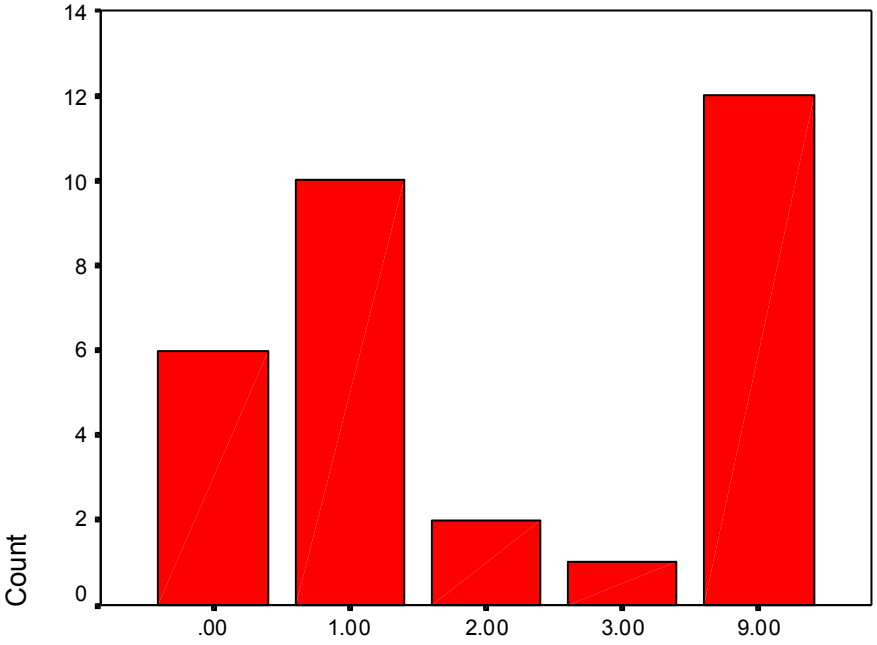
Count

		Para cumprir com o seu dever de cidadão					Total
		2.00	3.00	4.00	5.00	9.00	
SECTOR	civil society	1		2	5		8
	federal state		1	4	6	2	13
	users		3	1	5	1	10
Total		1	4	7	16	3	31

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	9.030[a]	8	.340
Likelihood Ratio	10.165	8	.254
N of Valid Cases	31		

a. 13 cells (86.7%) have expected count less than 5. The minimum expected count is .26.



SECTOR * Mudou por causa das mudanças políticas Crosstabulation

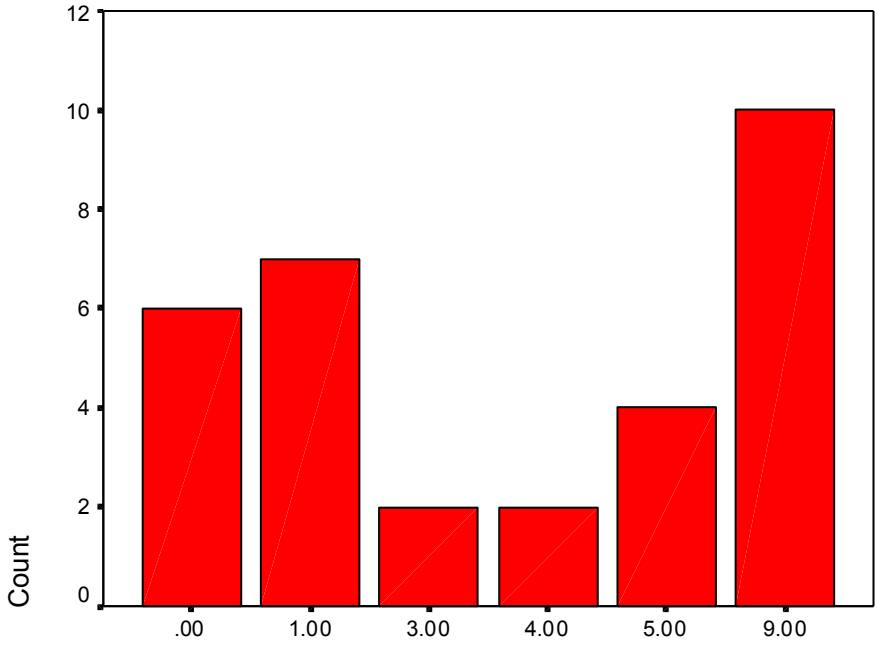
Count

		Mudou por causa das mudanças políticas					
		.00	1.00	2.00	3.00	9.00	Total
SECTOR	civil society	2	3	1		2	8
	federal state	2	6			5	13
	users	2	1	1	1	5	10
Total		6	10	2	1	12	31

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	6.927[a]	8	.544
Likelihood Ratio	8.304	8	.404
N of Valid Cases	31		

a. 14 cells (93.3%) have expected count less than 5. The minimum expected count is .26.



SECTOR * Mudou por questões pessoais Crosstabulation

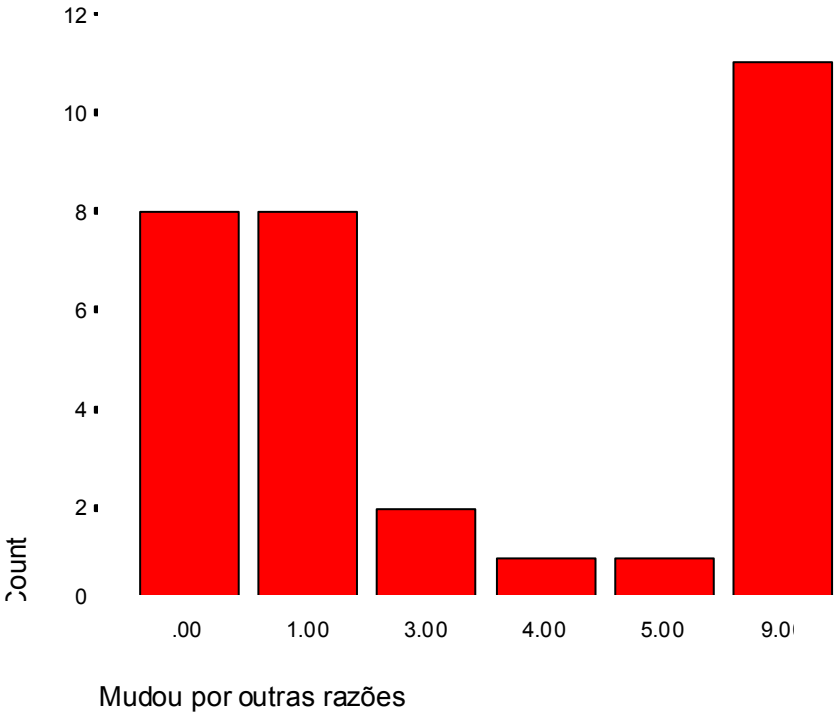
Count

		Mudou por questões pessoais						
		.00	1.00	3.00	4.00	5.00	9.00	Total
SECTOR	civil society	2	2	1	1		2	8
	federal state	2	3	1	1	3	3	13
	users	2	2			1	5	10
Total		6	7	2	2	4	10	31

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	6.138[a]	10	.804
Likelihood Ratio	7.970	10	.632
N of Valid Cases	31		

a. 18 cells (100.0%) have expected count less than 5. The minimum expected count is .52.



SECTOR * Mudou por outras razões Crosstabulation

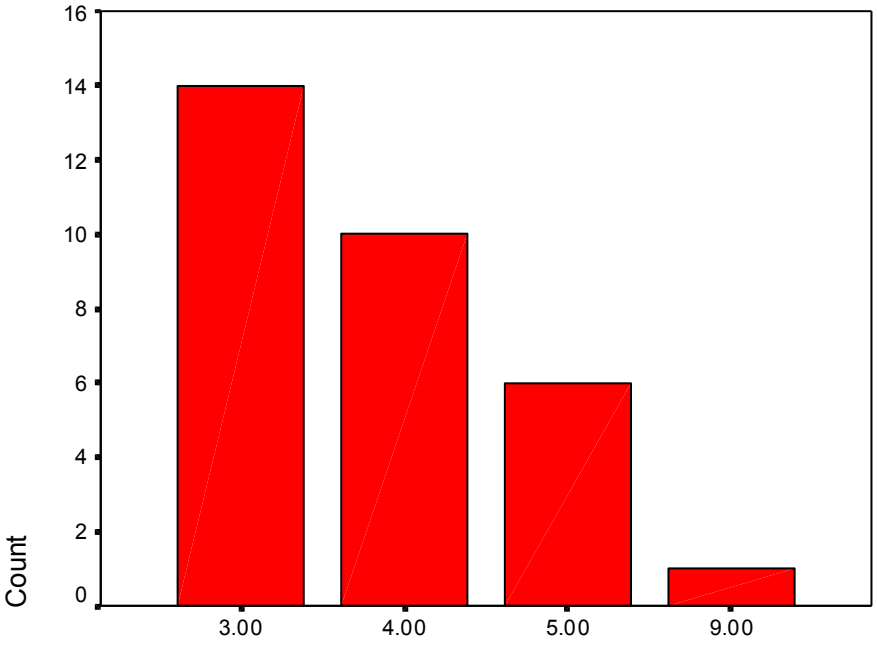
Count

		Mudou por outras razões						Total
		.00	1.00	3.00	4.00	5.00	9.00	
SECTOR	civil society	2	3	1			2	8
	federal state	2	3	1	1	1	5	13
	users	4	2				4	10
Total		8	8	2	1	1	11	31

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	6.159[a]	10	.802
Likelihood Ratio	7.376	10	.690
N of Valid Cases	31		

a. 18 cells (100.0%) have expected count less than 5. The minimum expected count is .26.



SECTOR * Seus objetivos estão sendo alcançados Crosstabulation

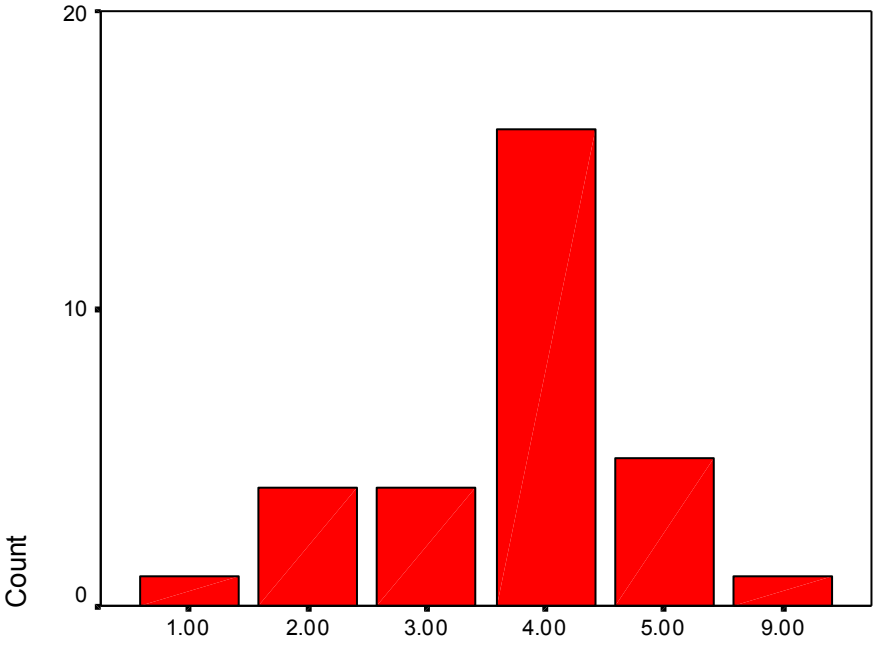
Count

		Seus objetivos estão sendo alcançados				
		3.00	4.00	5.00	9.00	Total
SECTOR	civil society	3	2	2	1	8
	federal state	5	4	4		13
	users	6	4			10
Total		14	10	6	1	31

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	6.863[a]	6	.334
Likelihood Ratio	8.453	6	.207
N of Valid Cases	31		

a. 11 cells (91.7%) have expected count less than 5. The minimum expected count is .26.



SECTOR * você considera a sua participação efetiva Crosstabulation

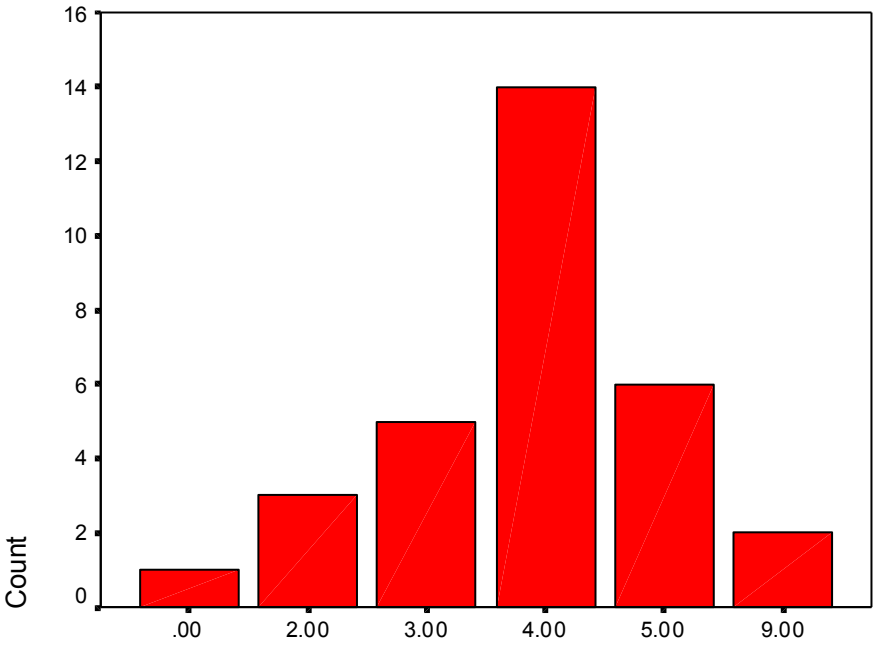
Count

		você considera a sua participação efetiva						Total
		1.00	2.00	3.00	4.00	5.00	9.00	
SECTOR	civil society				5	2	1	8
	federal state		3	3	4	3		13
	users	1	1	1	7			10
Total		1	4	4	16	5	1	31

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	13.581[a]	10	.193
Likelihood Ratio	16.873	10	.077
N of Valid Cases	31		

a. 16 cells (88.9%) have expected count less than 5. The minimum expected count is .26.



Os interesses e demandas que você representa são considerados

SECTOR * Os interesses e demandas que você representa são considerados na tomada de decisões da comitê de bacia hidrográfica Crosstabulation

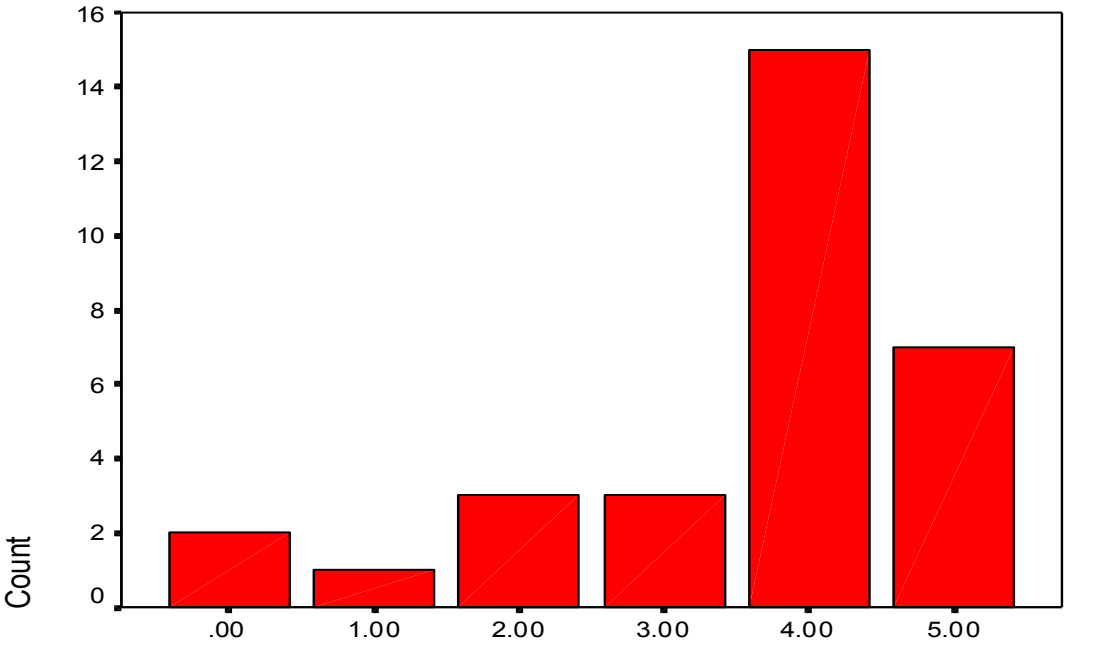
Count

		Os interesses e demandas que você representa são considerados na tomada de decisões da comitê de bacia hidrográfica						
		.00	2.00	3.00	4.00	5.00	9.00	Total
SECTOR	civil society	1	1	1	1	2	2	8
	federal state		1	2	6	4		13
	users		1	2	7			10
Total		1	3	5	14	6	2	31

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	15.109[a]	10	.128
Likelihood Ratio	16.967	10	.075
N of Valid Cases	31		

a. 17 cells (94.4%) have expected count less than 5. The minimum expected count is .26.



SECTOR * Eu tenho confiança que as decisões da comitê de bacia hidrográfica são implementadas Crosstabulation

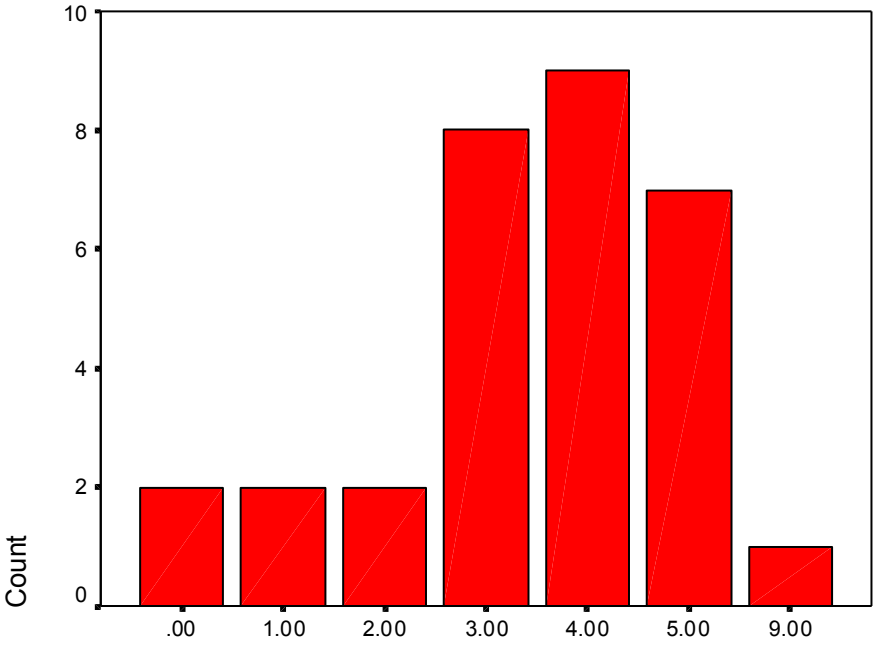
Count

		Eu tenho confiança que as decisões da comitê de bacia hidrográfica são implementadas						
		.00	1.00	2.00	3.00	4.00	5.00	Total
SECTOR	civil society	1	1		1	5		8
	federal state			1	1	8	3	13
	users	1		2	1	2	4	10
Total		2	1	3	3	15	7	31

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	12.022[a]	10	.284
Likelihood Ratio	15.048	10	.130
N of Valid Cases	31		

a. 17 cells (94.4%) have expected count less than 5. The minimum expected count is .26.



SECTOR * Outras instituições envolvidas na gestão das águas entendem e respeitam as decisões tomadas pela comitê Crosstabulation

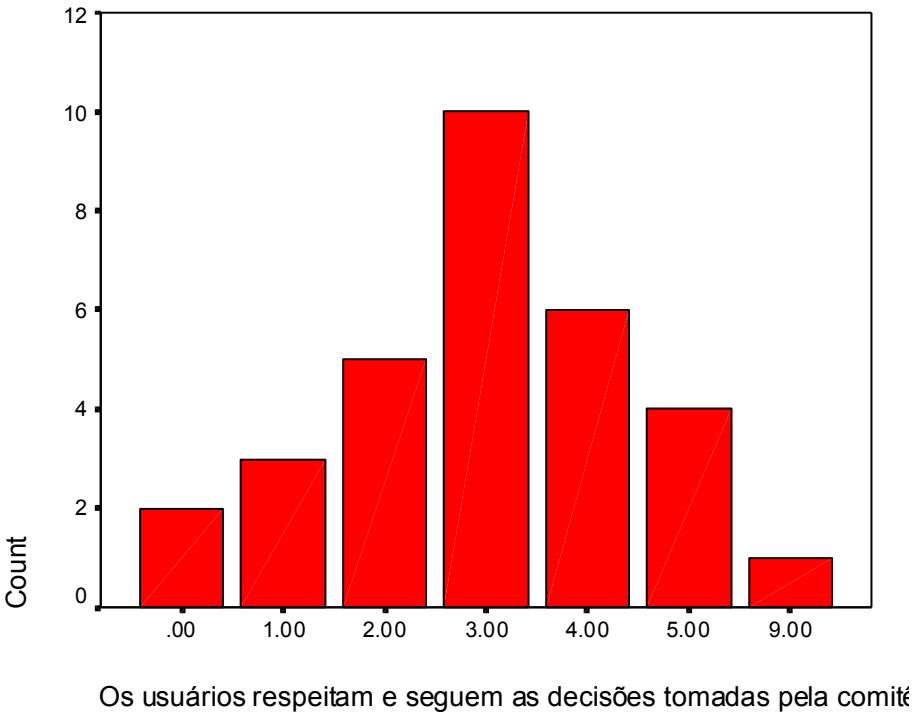
Count

		Outras instituições envolvidas na gestão das águas entendem e respeitam as decisões tomadas pela comitê							
		.00	1.00	2.00	3.00	4.00	5.00	9.00	Total
SECTOR	civil society	1	2			4	1		8
	federal state	1		1	5	3	3		13
	users			1	3	2	3	1	10
Total		2	2	2	8	9	7	1	31

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	14.918[a]	12	.246
Likelihood Ratio	17.611	12	.128
N of Valid Cases	31		

a. 21 cells (100.0%) have expected count less than 5. The minimum expected count is .26.



SECTOR * Os usuários respeitam e seguem as decisões tomadas pela comitê Crosstabulation

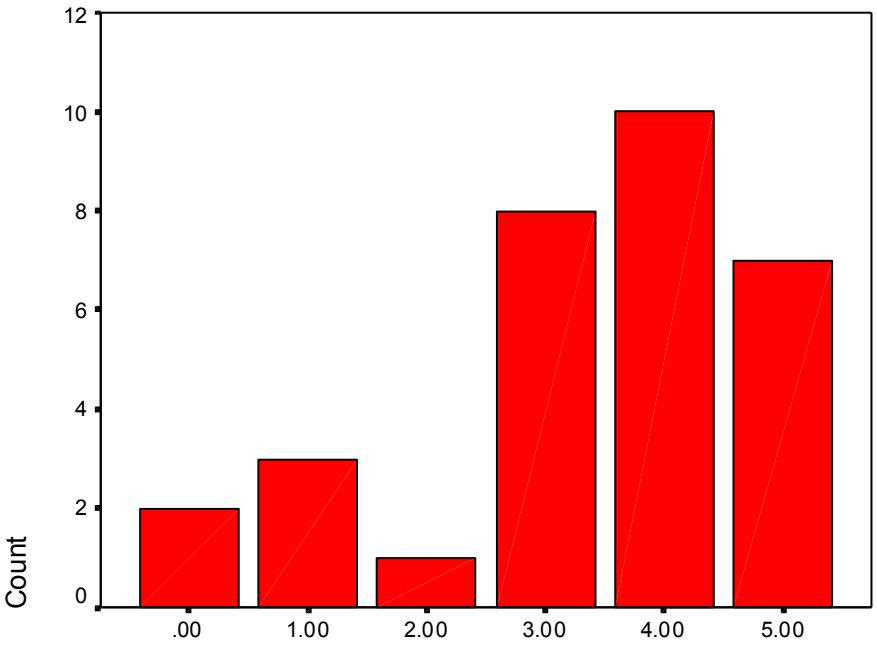
Count

		Os usuários respeitam e seguem as decisões tomadas pela comitê							Total
		.00	1.00	2.00	3.00	4.00	5.00	9.00	
SECTOR	civil society	1	3	2		1		1	8
	federal state	1		1	5	4	2		13
	users			2	5	1	2		10
Total		2	3	5	10	6	4	1	31

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	20.404[a]	12	.060
Likelihood Ratio	23.755	12	.022
N of Valid Cases	31		

a. 21 cells (100.0%) have expected count less than 5. The minimum expected count is .26.



Outros órgãos do governo reconhecem a autoridade da comitê

SECTOR * Outros órgãos do governo reconhecem a autoridade da comitê Crosstabulation

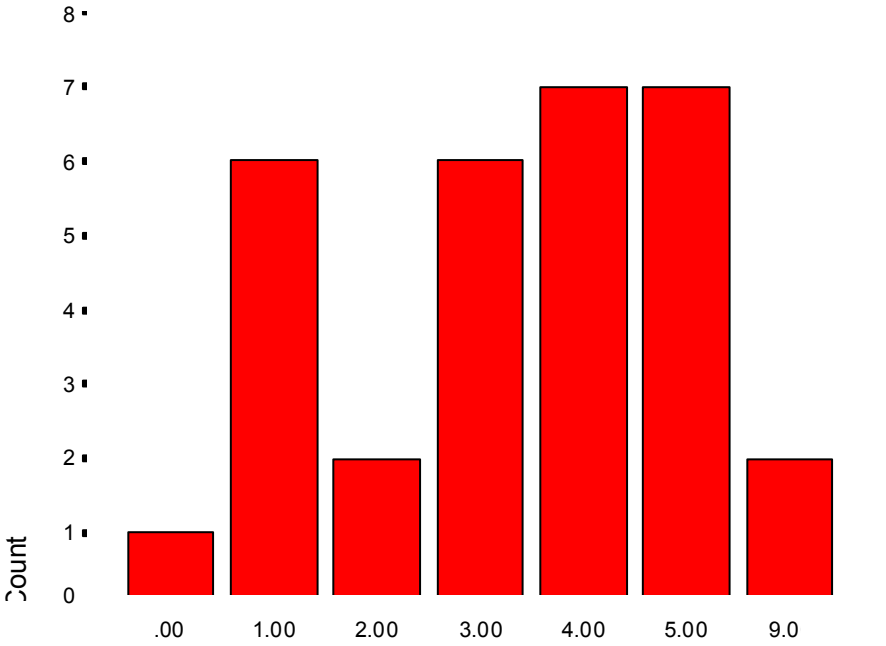
Count

		Outros órgãos do governo reconhecem a autoridade da comitê						
		.00	1.00	2.00	3.00	4.00	5.00	Total
SECTOR	civil society	1	1		1	3	2	8
	federal state	1		1	4	4	3	13
	users		2		3	3	2	10
Total		2	3	1	8	10	7	31

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	5.825[a]	10	.830
Likelihood Ratio	7.831	10	.645
N of Valid Cases	31		

a. 18 cells (100.0%) have expected count less than 5. The minimum expected count is .26.



SECTOR * Eu tenho autoridade para tomar decisões sem consultar a quem represento Crosstabulation

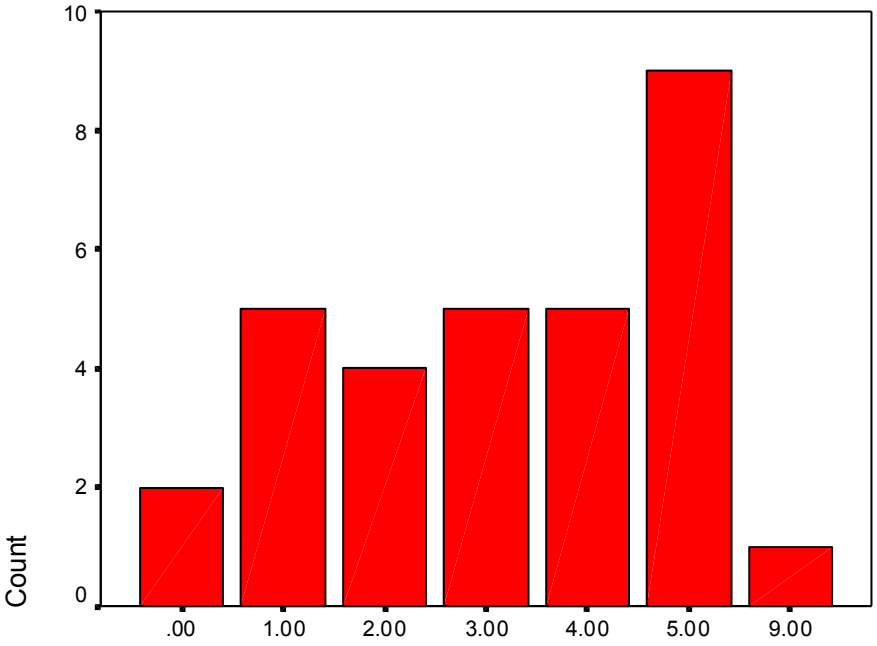
Count

		Eu tenho autoridade para tomar decisões sem consultar a quem represento							
		.00	1.00	2.00	3.00	4.00	5.00	9.00	Total
SECTOR	civil society	1	1		1	3	1	1	8
	federal state		4	1		3	4	1	13
	users		1	1	5	1	2		10
Total		1	6	2	6	7	7	2	31

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	16.098[a]	12	.187
Likelihood Ratio	18.094	12	.113
N of Valid Cases	31		

a. 21 cells (100.0%) have expected count less than 5. The minimum expected count is .26.



SECTOR * Eu tenho que consultar quem represento antes de tomar decisões no comitê Crosstabulation

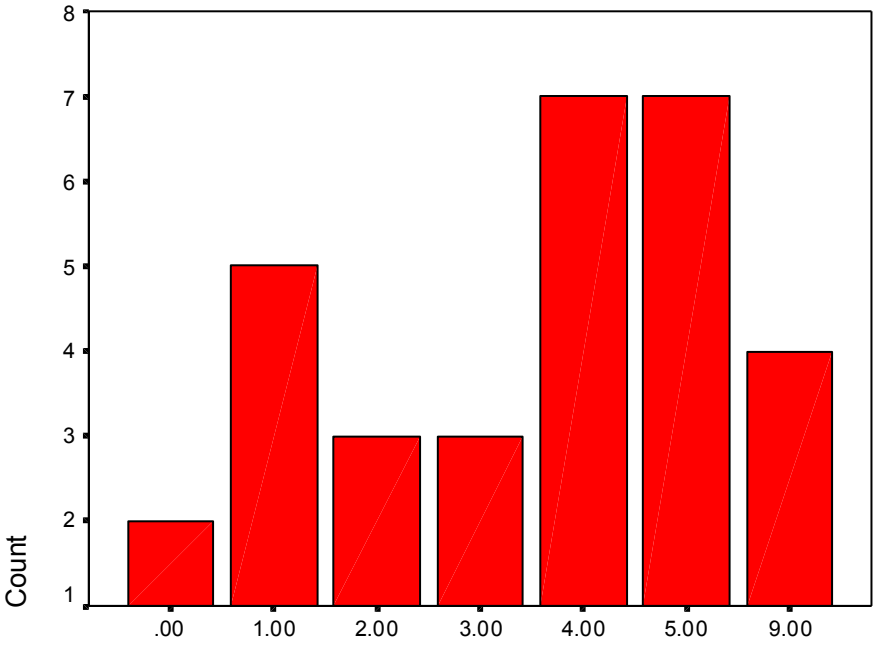
Count

		Eu tenho que consultar quem represento antes de tomar decisões no comitê							Total
		.00	1.00	2.00	3.00	4.00	5.00	9.00	
SECTOR	civil society	1	1		1		4	1	8
	federal state	1	3	1		4	4		13
	users		1	3	4	1	1		10
Total		2	5	4	5	5	9	1	31

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	19.682[a]	12	.073
Likelihood Ratio	22.744	12	.030
N of Valid Cases	31		

a. 21 cells (100.0%) have expected count less than 5. The minimum expected count is .26.



SECTOR * Eu posso votar sem consultar em alguns casos, mas não em todos Crosstabulation

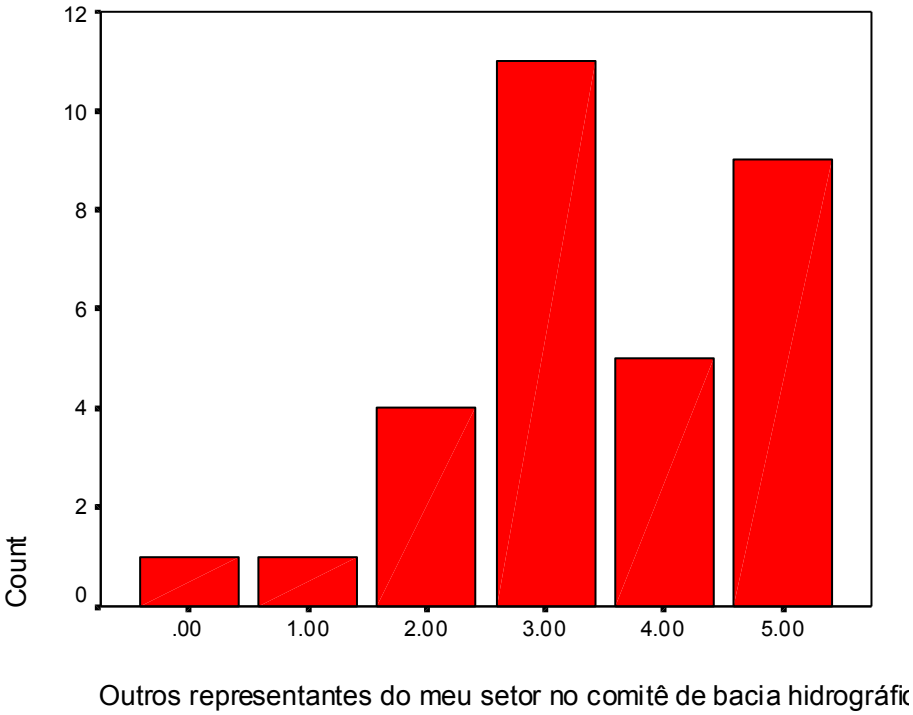
Count

		Eu posso votar sem consultar em alguns casos, mas não em todos							
		.00	1.00	2.00	3.00	4.00	5.00	9.00	Total
SECTOR	civil society	1	1	1			3	2	8
	federal state	1	3	2	1	4	1	1	13
	users		1		2	3	3	1	10
Total		2	5	3	3	7	7	4	31

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	11.207[a]	12	.511
Likelihood Ratio	15.044	12	.239
N of Valid Cases	31		

a. 21 cells (100.0%) have expected count less than 5. The minimum expected count is .52.



SECTOR * Outros representantes do meu setor no comitê de bacia hidrográfica Crosstabulation

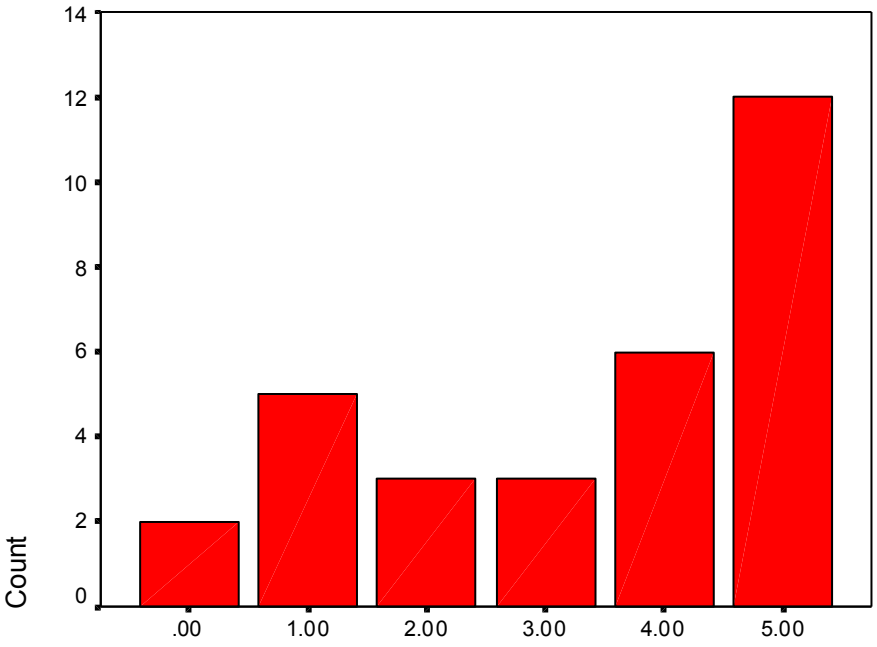
Count

		Outros representantes do meu setor no comitê de bacia hidrográfica						
		.00	1.00	2.00	3.00	4.00	5.00	Total
SECTOR	civil society	1		1		2	4	8
	federal state		1		5	3	4	13
	users			3	6		1	10
Total		1	1	4	11	5	9	31

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	17.633[a]	10	.061
Likelihood Ratio	23.139	10	.010
N of Valid Cases	31		

a. 18 cells (100.0%) have expected count less than 5. The minimum expected count is .26.



Representantes do governo a nível federal, estadual ou municipal.

SECTOR * Representantes do governo a nível federal, estadual ou municipal. Crosstabulation

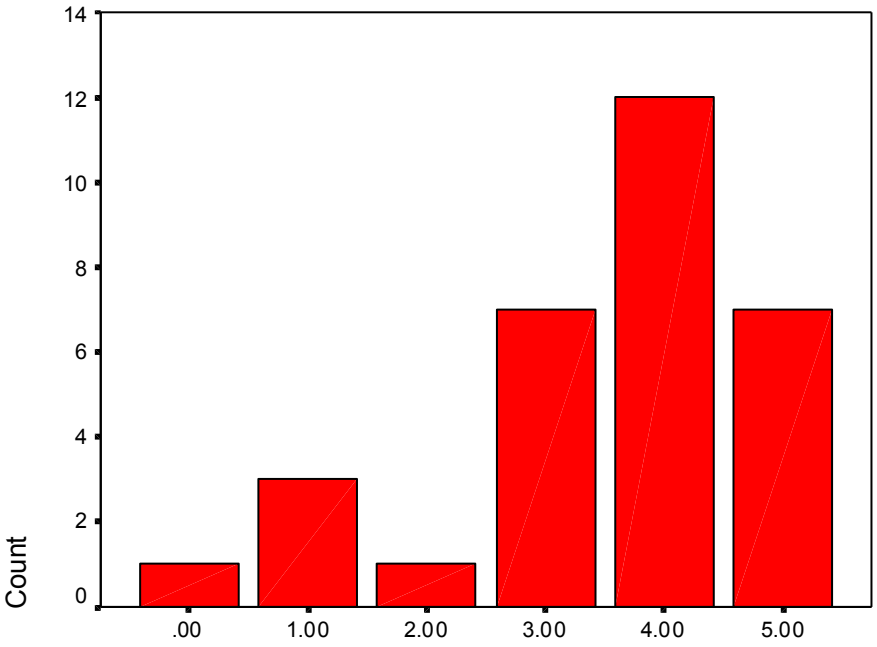
Count

		Representantes do governo a nível federal, estadual ou municipal.						Total
		.00	1.00	2.00	3.00	4.00	5.00	
SECTOR	civil society	1				2	5	8
	federal state	1		2	1	4	5	13
	users		5	1	2		2	10
Total		2	5	3	3	6	12	31

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	19.787[a]	10	.031
Likelihood Ratio	24.170	10	.007
N of Valid Cases	31		

a. 17 cells (94.4%) have expected count less than 5. The minimum expected count is .52.



Sociedade civil organizada.

SECTOR * Sociedade civil organizada. Crosstabulation

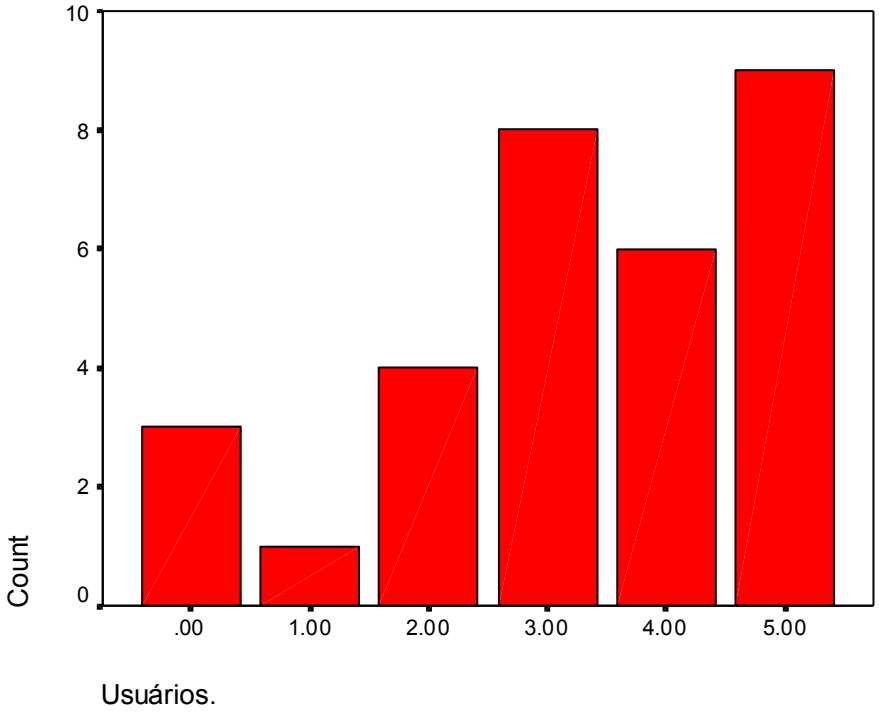
Count

		Sociedade civil organizada.						Total
		.00	1.00	2.00	3.00	4.00	5.00	
SECTOR	civil society	1			1	1	5	8
	federal state				3	8	2	13
	users		3	1	3	3		10
Total		1	3	1	7	12	7	31

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	23.448[a]	10	.009
Likelihood Ratio	24.686	10	.006
N of Valid Cases	31		

a. 17 cells (94.4%) have expected count less than 5. The minimum expected count is .26.



SECTOR * Usuários. Crosstabulation

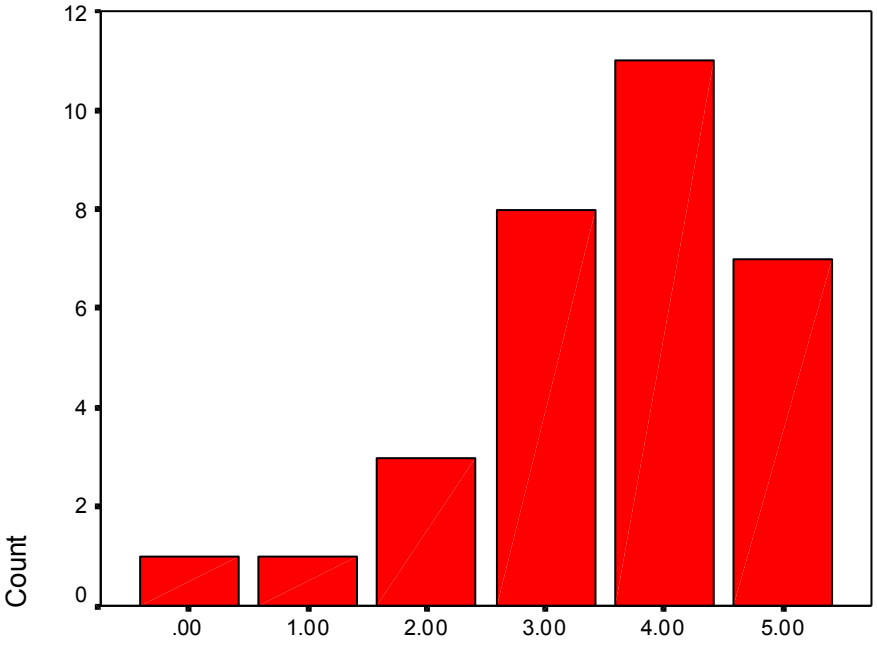
Count

		Usuários.						
		.00	1.00	2.00	3.00	4.00	5.00	Total
SECTOR	civil society	1		1	1	1	4	8
	federal state	2		3	1	5	2	13
	users		1		6		3	10
Total		3	1	4	8	6	9	31

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	19.268[a]	10	.037
Likelihood Ratio	22.306	10	.014
N of Valid Cases	31		

a. 18 cells (100.0%) have expected count less than 5. The minimum expected count is .26.



Membros da comunidade.

SECTOR * Membros da comunidade. Crosstabulation

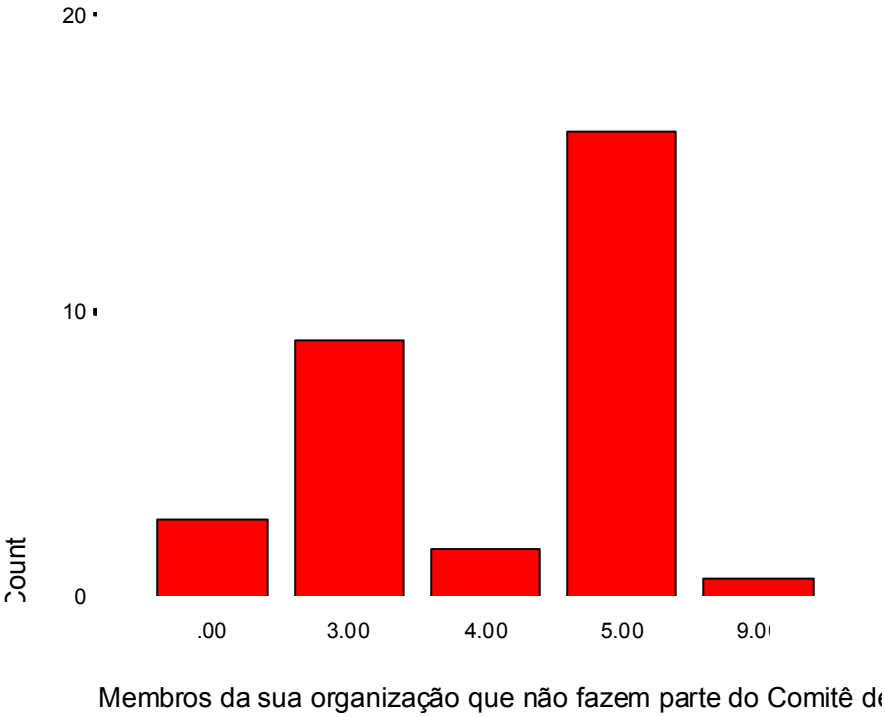
Count

		Membros da comunidade.						Total
		.00	1.00	2.00	3.00	4.00	5.00	
SECTOR	civil society	1		1	1	2	3	8
	federal state			1	3	6	3	13
	users		1	1	4	3	1	10
Total		1	1	3	8	11	7	31

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	8.703[a]	10	.561
Likelihood Ratio	8.767	10	.554
N of Valid Cases	31		

a. 18 cells (100.0%) have expected count less than 5. The minimum expected count is .26.



SECTOR * Membros da sua organização que não fazem parte do Comitê de Itajai. Crosstabulation

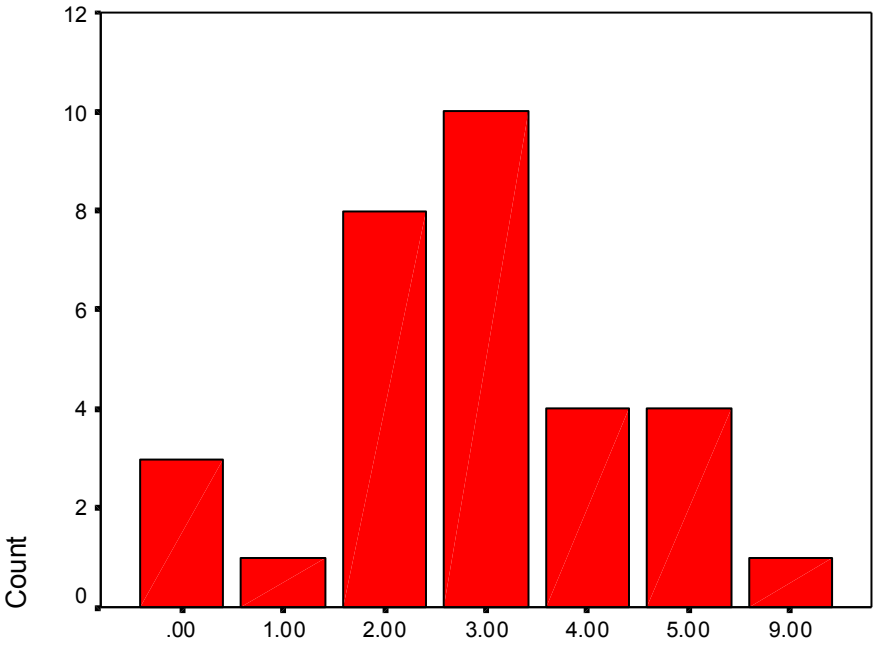
Count

		Membros da sua organização que não fazem parte do Comitê de Itajai.					
		.00	3.00	4.00	5.00	9.00	Total
SECTOR	civil society	1	1		6		8
	federal state		6		7		13
	users	2	2	2	3	1	10
Total		3	9	2	16	1	31

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	12.837[a]	8	.118
Likelihood Ratio	14.413	8	.072
N of Valid Cases	31		

a. 13 cells (86.7%) have expected count less than 5. The minimum expected count is .26.



SECTOR * Empresas agrícolas Crosstabulation

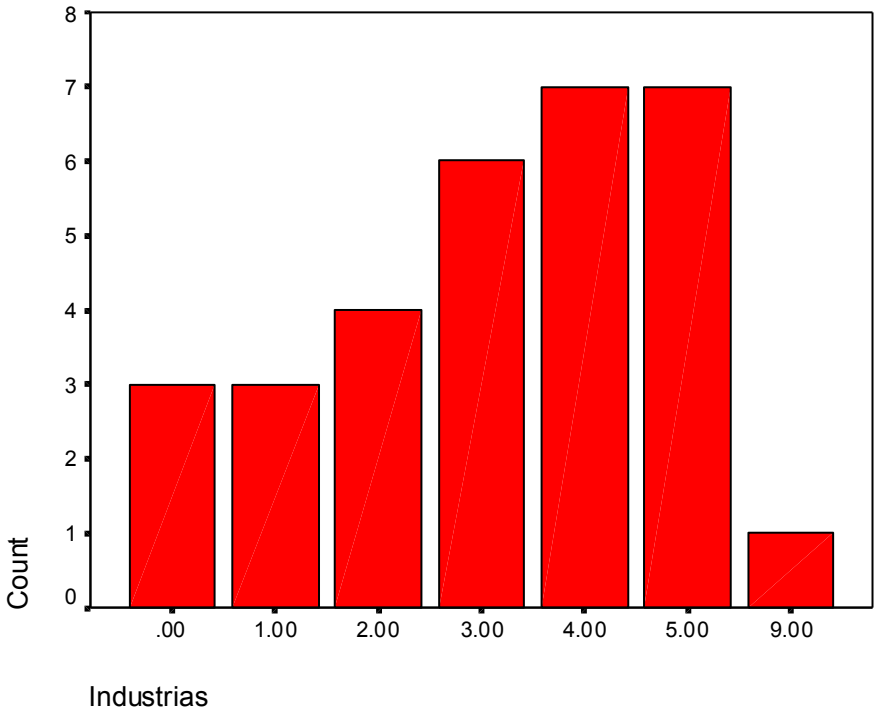
Count

		Empresas agrícolas							Total
		.00	1.00	2.00	3.00	4.00	5.00	9.00	
SECTOR	civil society	2		3	2			1	8
	federal state	1	1	2	5	3	1		13
	users			3	3	1	3		10
Total		3	1	8	10	4	4	1	31

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	14.273[a]	12	.284
Likelihood Ratio	16.171	12	.184
N of Valid Cases	31		

a. 21 cells (100.0%) have expected count less than 5. The minimum expected count is .26.



SECTOR * Industrias Crosstabulation

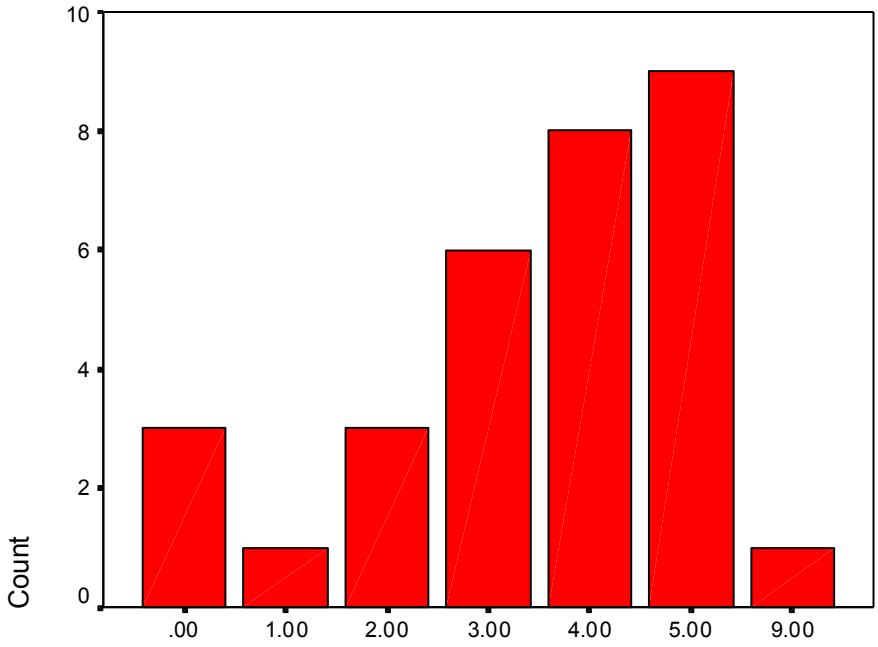
Count

		Industrias							Total
		.00	1.00	2.00	3.00	4.00	5.00	9.00	
SECTOR	civil society	2	2	1		2		1	8
	federal state	1			4	5	3		13
	users		1	3	2		4		10
Total		3	3	4	6	7	7	1	31

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	22.288[a]	12	.034
Likelihood Ratio	29.184	12	.004
N of Valid Cases	31		

a. 21 cells (100.0%) have expected count less than 5. The minimum expected count is .26.



SECTOR * Serviços de Abastecimento e Saneamento (CASAN, SAMAE) Crosstabulation

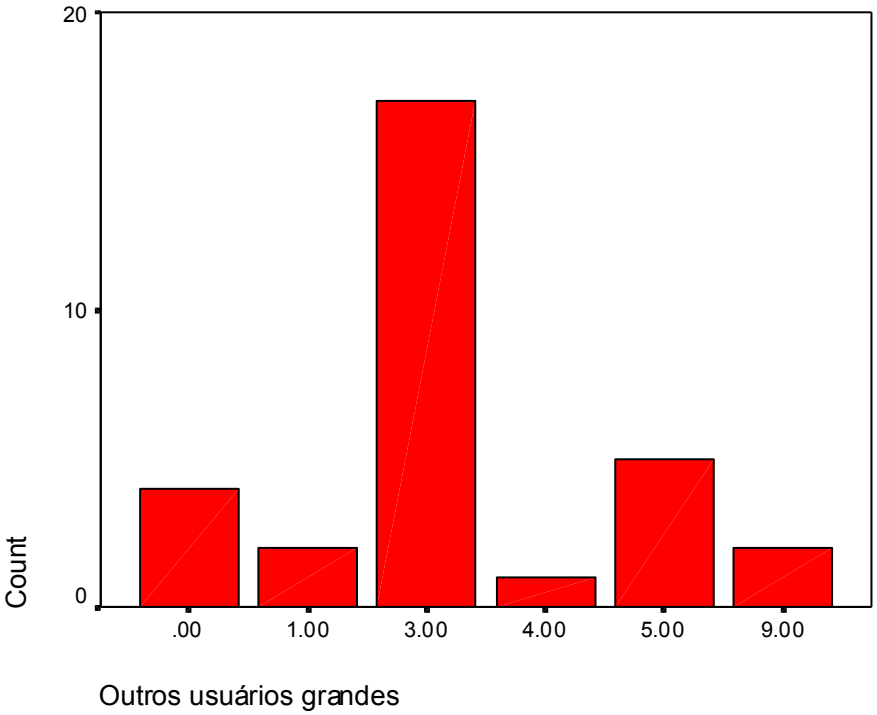
Count

		Serviços de Abastecimento e Saneamento (CASAN, SAMAE)							
		.00	1.00	2.00	3.00	4.00	5.00	9.00	Total
SECTOR	civil society	2	1	2		2		1	8
	federal state	1		1	2	5	4		13
	users				4	1	5		10
Total		3	1	3	6	8	9	1	31

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	21.157[a]	12	.048
Likelihood Ratio	24.850	12	.016
N of Valid Cases	31		

a. 21 cells (100.0%) have expected count less than 5. The minimum expected count is .26.



SECTOR * Outros usuários grandes Crosstabulation

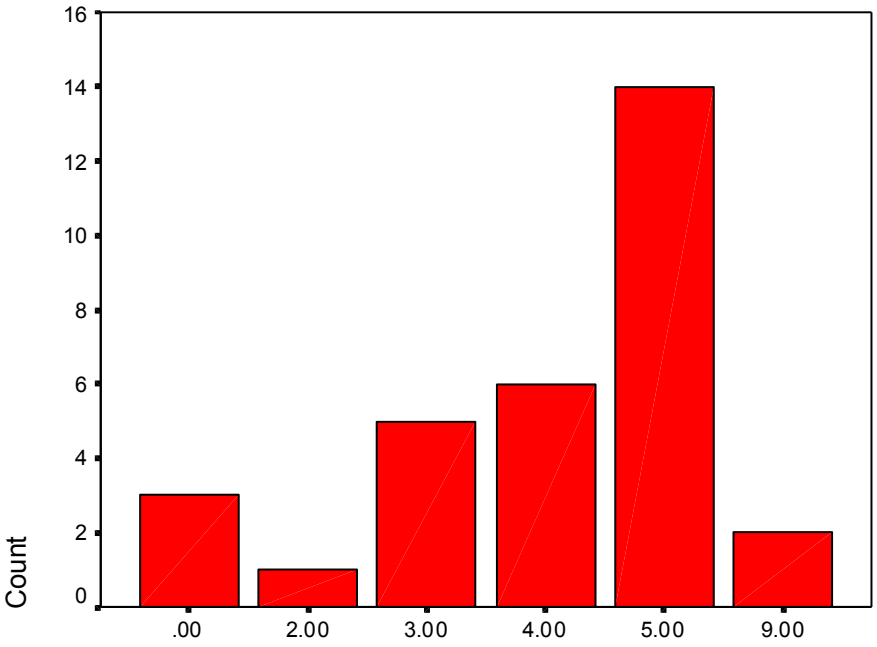
Count

		Outros usuários grandes						Total
		.00	1.00	3.00	4.00	5.00	9.00	
SECTOR	civil society	3	2	1		1	1	8
	federal state	1		9	1	2		13
	users			7		2	1	10
Total		4	2	17	1	5	2	31

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	17.625[a]	10	.062
Likelihood Ratio	19.539	10	.034
N of Valid Cases	31		

a. 16 cells (88.9%) have expected count less than 5. The minimum expected count is .26.



SECTOR * Membros do comitê de bacia hidrográfica Crosstabulation

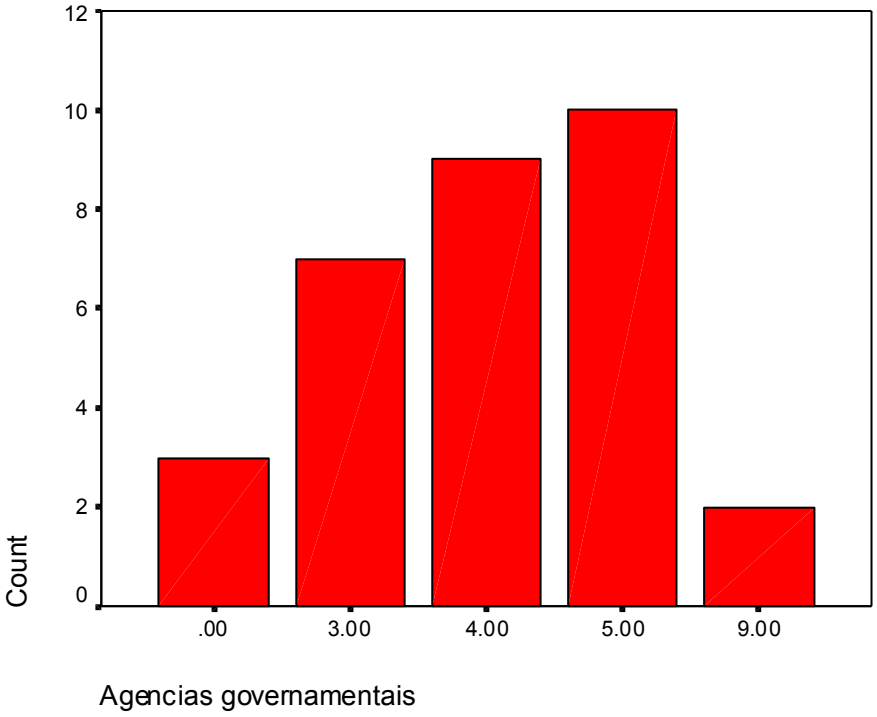
Count

		Membros do comitê de bacia hidrográfica						Total
		.00	2.00	3.00	4.00	5.00	9.00	
SECTOR	civil society	2	1	1	2	1	1	8
	federal state	1		3	2	7		13
	users			1	2	6	1	10
Total		3	1	5	6	14	2	31

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	10.845[a]	10	.370
Likelihood Ratio	12.468	10	.255
N of Valid Cases	31		

a. 17 cells (94.4%) have expected count less than 5. The minimum expected count is .26.



SECTOR * Agencias governamentais Crosstabulation

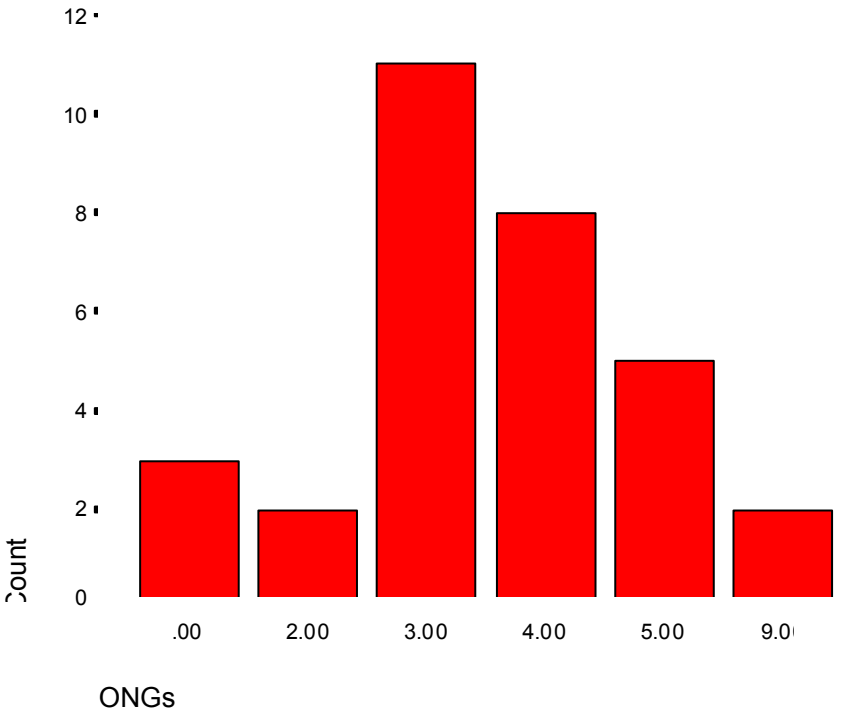
Count

		Agencias governamentais					Total
		.00	3.00	4.00	5.00	9.00	
SECTOR	civil society	2		3	2	1	8
	federal state	1	4	3	5		13
	users		3	3	3	1	10
Total		3	7	9	10	2	31

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	7.546[a]	8	.479
Likelihood Ratio	10.375	8	.240
N of Valid Cases	31		

a. 15 cells (100.0%) have expected count less than 5. The minimum expected count is .52.



SECTOR * ONGs Crosstabulation

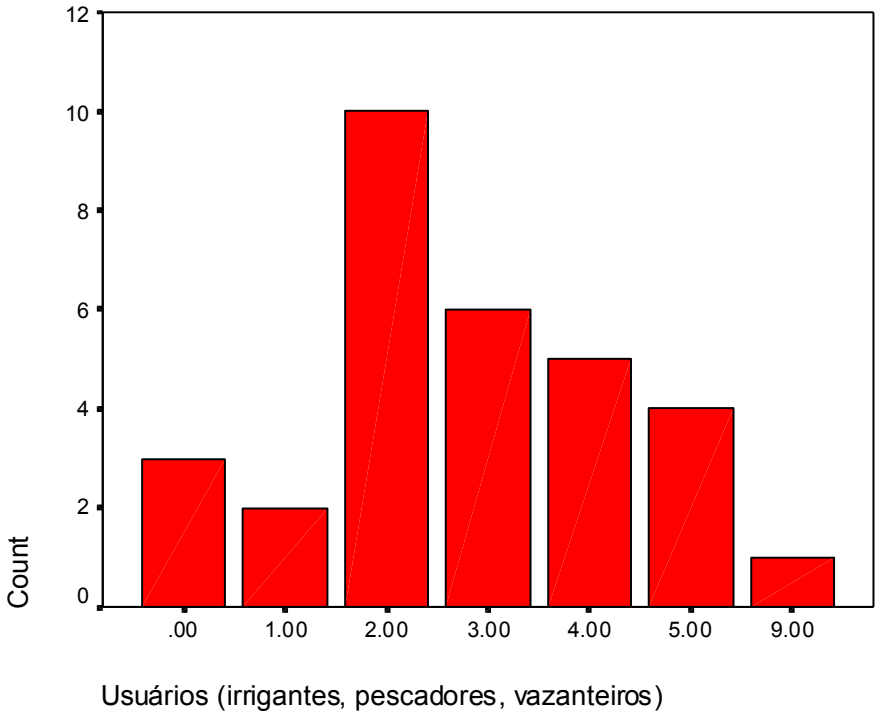
Count

		ONGs						Total
		.00	2.00	3.00	4.00	5.00	9.00	
SECTOR	civil society	2		1	3	1	1	8
	federal state	1	2	6	3	1		13
	users			4	2	3	1	10
Total		3	2	11	8	5	2	31

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	11.308[a]	10	.334
Likelihood Ratio	13.324	10	.206
N of Valid Cases	31		

a. 18 cells (100.0%) have expected count less than 5. The minimum expected count is .52.



SECTOR * Usuários (irrigantes, pescadores, vazanteiros) Crosstabulation

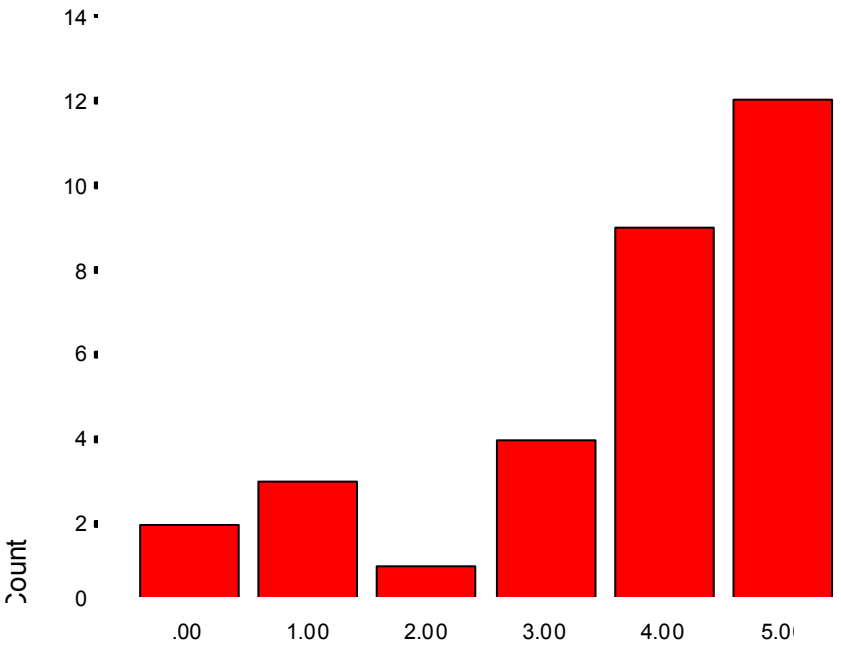
Count

		Usuários (irrigantes, pescadores, vazanteiros)							
		.00	1.00	2.00	3.00	4.00	5.00	9.00	Total
SECTOR	civil society	2	1			2	2	1	8
	federal state	1		5	4	2	1		13
	users		1	5	2	1	1		10
Total		3	2	10	6	5	4	1	31

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	15.335[a]	12	.224
Likelihood Ratio	19.936	12	.068
N of Valid Cases	31		

a. 21 cells (100.0%) have expected count less than 5. The minimum expected count is .26.



A minha organização estimula o uso da informação técnica para

SECTOR * A minha organização estimula o uso da informação técnica para ajudar nas decisões sobre a gestão Crosstabulation

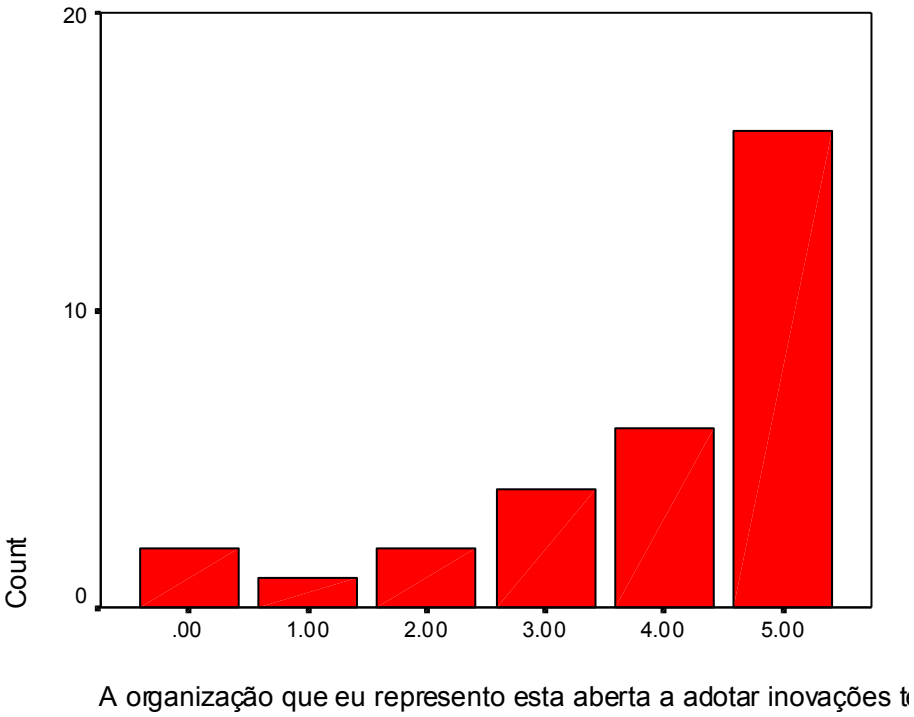
Count

		A minha organização estimula o uso da informação técnica para ajudar nas decisões sobre a gestão						
		.00	1.00	2.00	3.00	4.00	5.00	Total
SECTOR	civil society	2	1		1	2	2	8
	federal state			1		5	7	13
	users		2		3	2	3	10
Total		2	3	1	4	9	12	31

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	15.581[a]	10	.112
Likelihood Ratio	17.637	10	.061
N of Valid Cases	31		

a. 17 cells (94.4%) have expected count less than 5. The minimum expected count is .26.



SECTOR * A organização que eu represento esta aberta a adotar inovações tecnológicas Crosstabulation

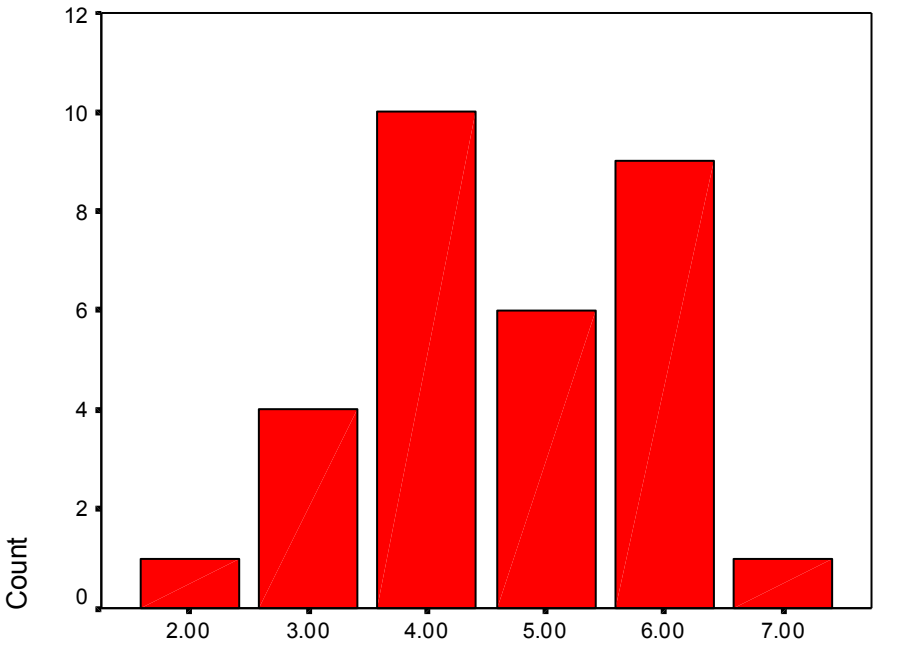
Count

		A organização que eu represento esta aberta a adotar inovações tecnológicas						
		.00	1.00	2.00	3.00	4.00	5.00	Total
SECTOR	civil society	2			1	1	4	8
	federal state			2		3	8	13
	users		1		3	2	4	10
Total		2	1	2	4	6	16	31

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	15.366[a]	10	.119
Likelihood Ratio	16.989	10	.075
N of Valid Cases	31		

a. 16 cells (88.9%) have expected count less than 5. The minimum expected count is .26.



SECTOR * Aonde você encontra as informações relacionadas a gestão de água? (marque com X todas que se apliquem): Crosstabulation

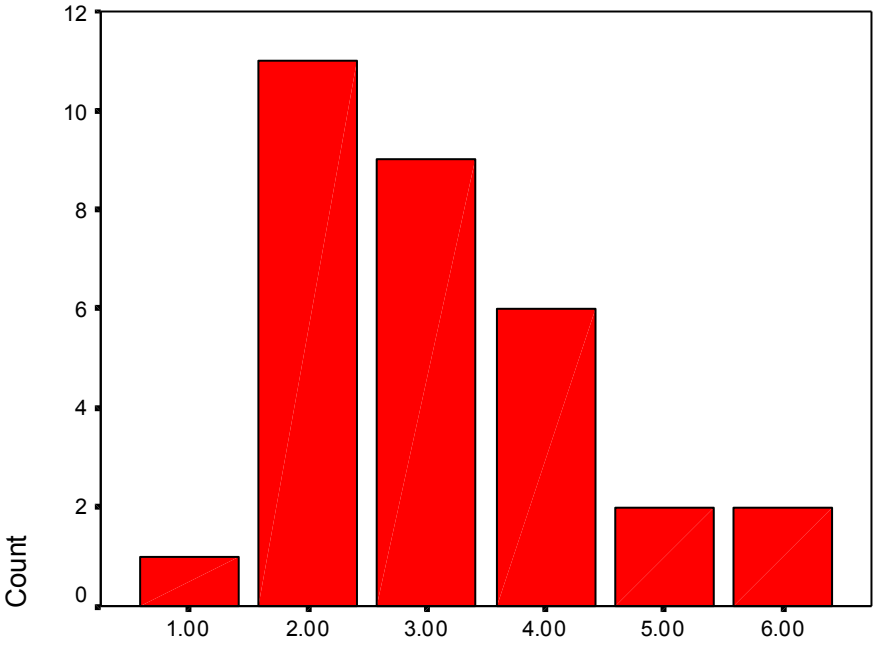
Count

		Aonde você encontra as informações relacionadas a gestão de água? (marque com X todas que se apliquem):						
		2.00	3.00	4.00	5.00	6.00	7.00	Total
SECTOR	civil society			4		4		8
	federal state		2	4	6	1		13
	users	1	2	2		4	1	10
Total		1	4	10	6	9	1	31

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	18.913[a]	10	.041
Likelihood Ratio	22.883	10	.011
N of Valid Cases	31		

a. 18 cells (100.0%) have expected count less than 5. The minimum expected count is .26.



SECTOR * Qual ou quais são os principais tipos de informações que você usa para participar na gestão de águas?(Marque todas as relevantes) Crosstabulation

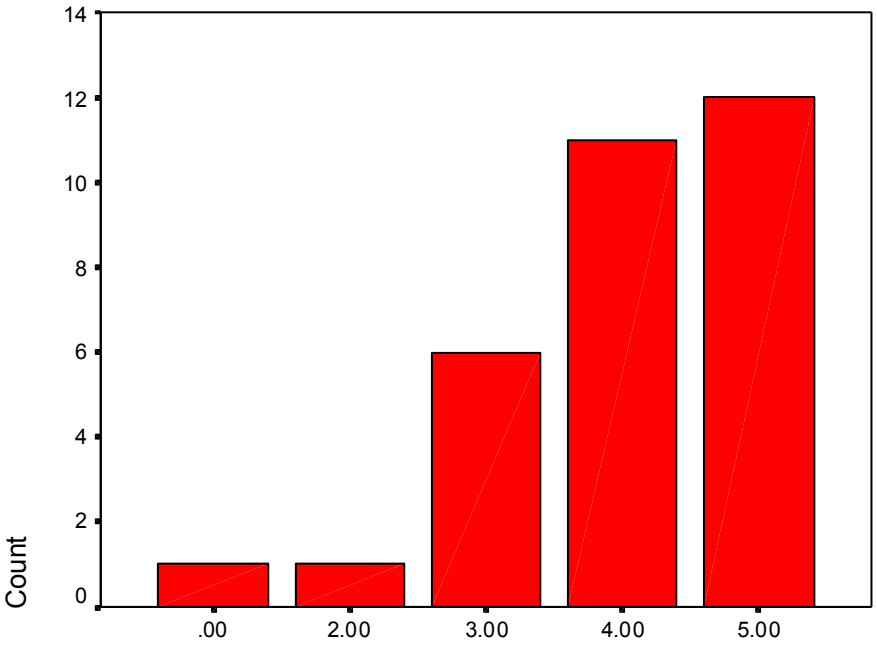
Count

		Qual ou quais são os principais tipos de informações que você usa para participar na gestão de águas?(Marque todas as relevantes)						
		1.00	2.00	3.00	4.00	5.00	6.00	Total
SECTOR	civil society		3	1	2	2		8
	federal state		5	5	2		1	13
	users	1	3	3	2		1	10
Total		1	11	9	6	2	2	31

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	10.113[a]	10	.431
Likelihood Ratio	10.600	10	.390
N of Valid Cases	31		

a. 18 cells (100.0%) have expected count less than 5. The minimum expected count is .26.



Eu tenho um bom entendimento das informacoes tecnicas usadas

SECTOR * Eu tenho um bom entendimento das informacoes tecnicas usadas nas decisoes do comite Crosstabulation

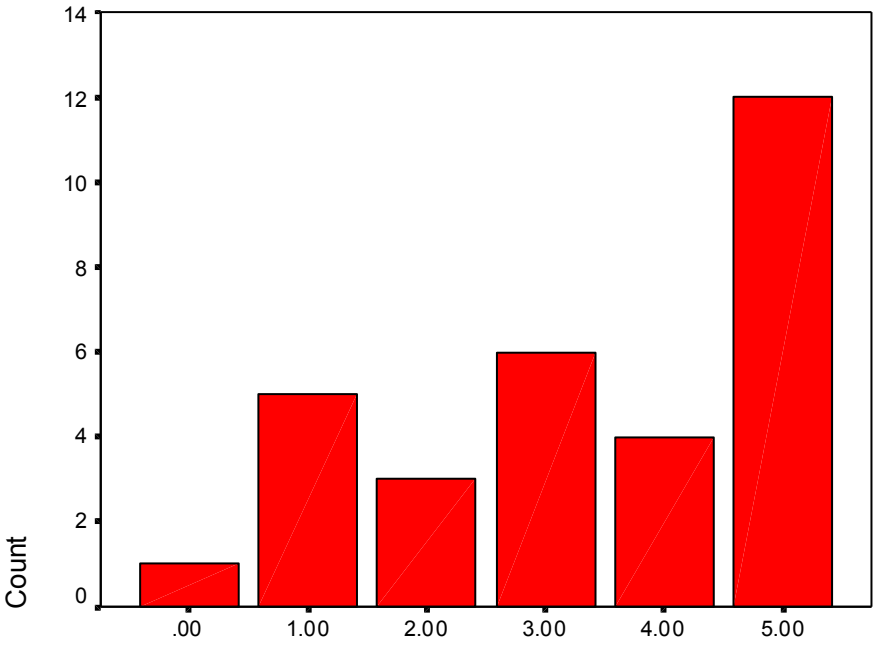
Count

		Eu tenho um bom entendimento das informacoes tecnicas usadas nas decisoes do comite					
		.00	2.00	3.00	4.00	5.00	Total
SECTOR	civil society			2	2	4	8
	federal state	1		1	5	6	13
	users		1	3	4	2	10
Total		1	1	6	11	12	31

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	6.807[a]	8	.558
Likelihood Ratio	7.689	8	.464
N of Valid Cases	31		

a. 14 cells (93.3%) have expected count less than 5. The minimum expected count is .26.



SECTOR * Eu acho que as informacoes tecnicas usadas nas decisoes da comite devem ser melhor explicadas Crosstabulation

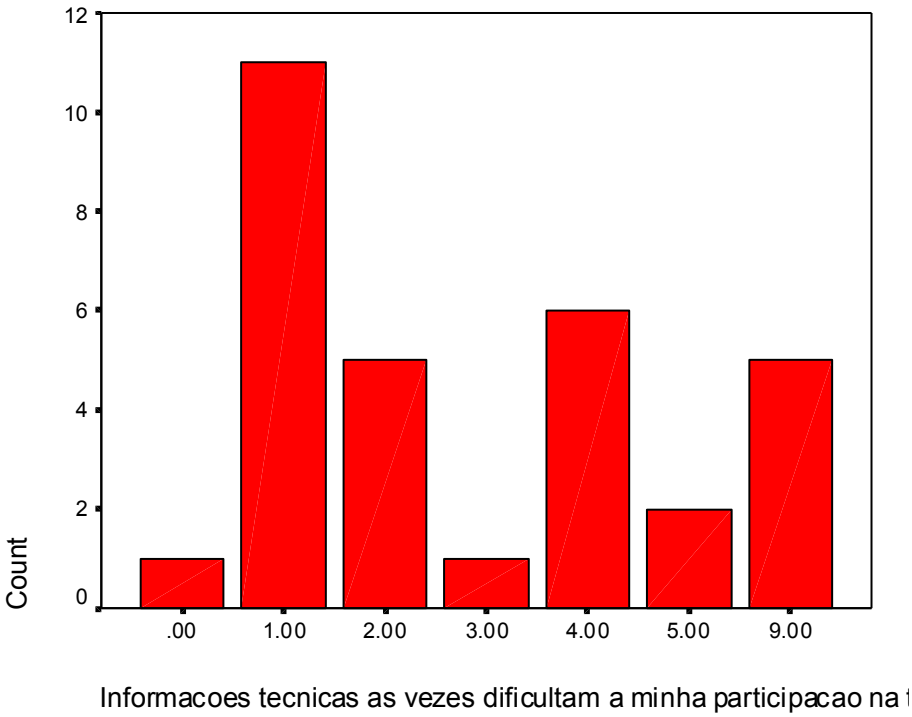
Count

		Eu acho que as informacoes tecnicas usadas nas decisoes da comite devem ser melhor explicadas						
		.00	1.00	2.00	3.00	4.00	5.00	Total
SECTOR	civil society		1	1		3	3	8
	federal state	1	2	1	6	1	2	13
	users		2	1			7	10
Total		1	5	3	6	4	12	31

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	19.649[a]	10	.033
Likelihood Ratio	22.225	10	.014
N of Valid Cases	31		

a. 17 cells (94.4%) have expected count less than 5. The minimum expected count is .26.



SECTOR * Informacoes tecnicas as vezes dificultam a minha participacao na tomada de dicisao na comite Crosstabulation

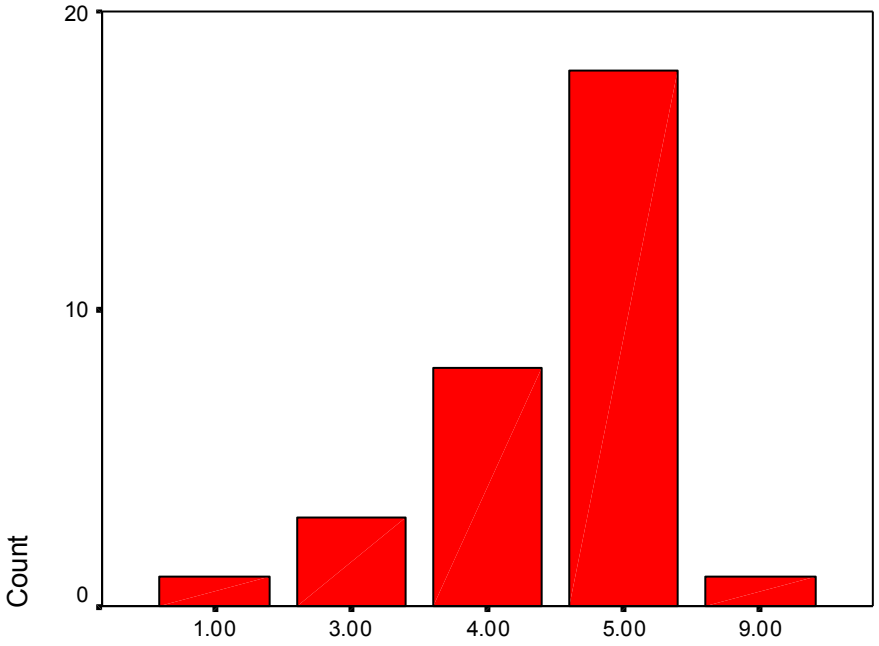
Count

		Informacoes tecnicas as vezes dificultam a minha participacao na tomada de dicisao na comite							
		.00	1.00	2.00	3.00	4.00	5.00	9.00	Total
SECTOR	civil society		3	1		2		2	8
	federal state	1	5	2	1	2		2	13
	users		3	2		2	2	1	10
Total		1	11	5	1	6	2	5	31

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	8.126[a]	12	.775
Likelihood Ratio	9.138	12	.691
N of Valid Cases	31		

a. 21 cells (100.0%) have expected count less than 5. The minimum expected count is .26.



SECTOR * Informacoes tecnicas me ajudam a tomar decisoes menlhores sobre a gestao das aguas Crosstabulation

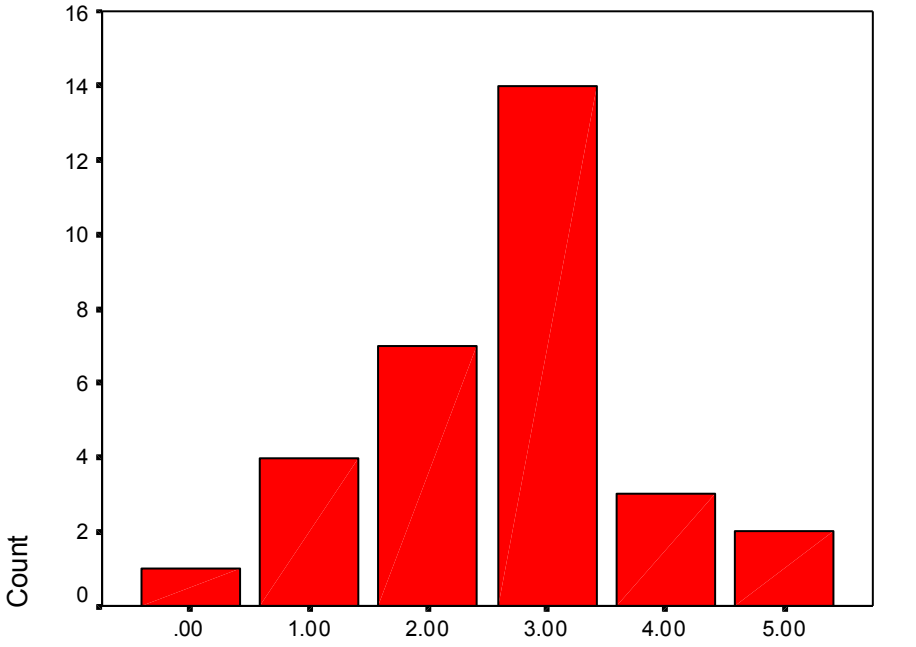
Count

		Informacoes tecnicas me ajudam a tomar decisoes menlhores sobre a gestao das aguas					
		1.00	3.00	4.00	5.00	9.00	Total
SECTOR	civil society		1		6	1	8
	federal state		1	4	8		13
	users	1	1	4	4		10
Total		1	3	8	18	1	31

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	9.048[a]	8	.338
Likelihood Ratio	11.023	8	.200
N of Valid Cases	31		

a. 13 cells (86.7%) have expected count less than 5. The minimum expected count is .26.



SECTOR * Informacoes tecnicas na minha regiao estao facilmente disponiveis Crosstabulation

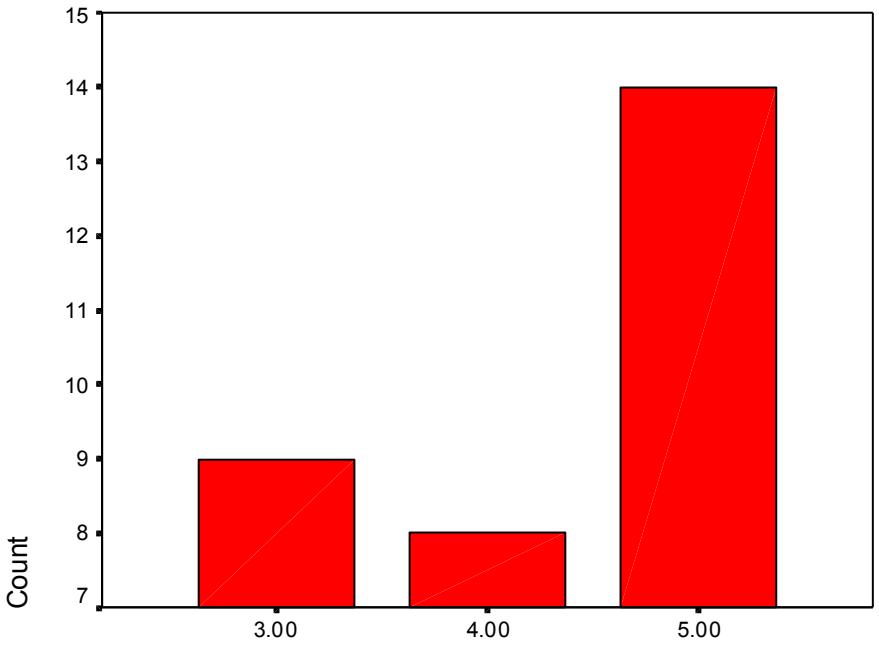
Count

		Informacoes tecnicas na minha regiao estao facilmente disponiveis						
		.00	1.00	2.00	3.00	4.00	5.00	Total
SECTOR	civil society		1	1	4	1	1	8
	federal state	1		4	6	2		13
	users		3	2	4		1	10
Total		1	4	7	14	3	2	31

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	9.166[a]	10	.516
Likelihood Ratio	12.214	10	.271
N of Valid Cases	31		

a. 17 cells (94.4%) have expected count less than 5. The minimum expected count is .26.



Eu acho que eu tenho um bom nivel de conhecimento sobre as co

SECTOR * Eu acho que eu tenho um bom nivel de conhecimento sobre as condicoes ambientais do minha regiao Crosstabulation

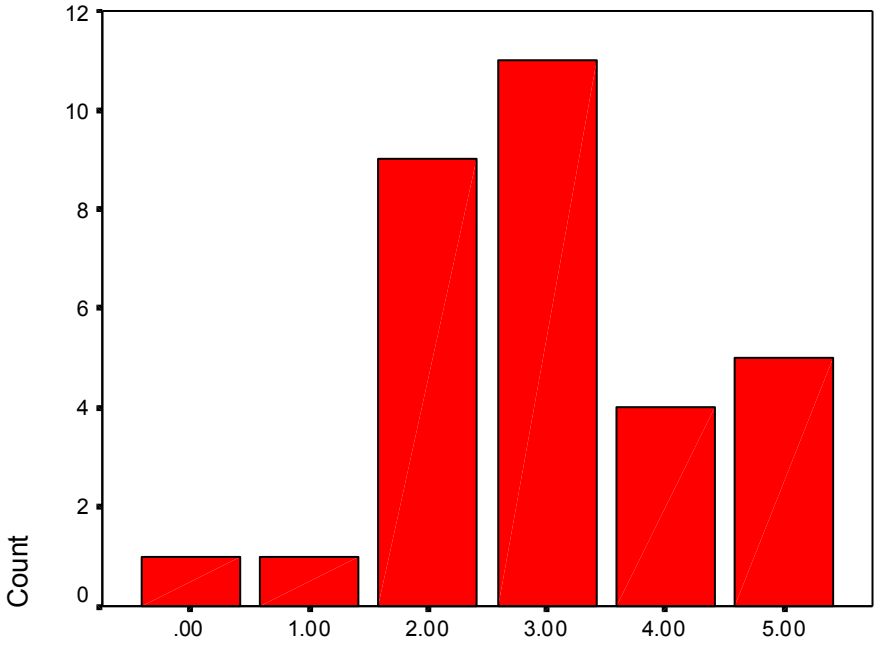
Count

		Eu acho que eu tenho um bom nivel de conhecimento sobre as condicoes ambientais do minha regiao			
		3.00	4.00	5.00	Total
SECTOR	civil society		3	5	8
	federal state	2	4	7	13
	users	7	1	2	10
Total		9	8	14	31

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	12.605[a]	4	.013
Likelihood Ratio	13.988	4	.007
N of Valid Cases	31		

a. 8 cells (88.9%) have expected count less than 5. The minimum expected count is 2.06.



sabedoria popular sobre a minha bacia tem um papel importante n

SECTOR * sabedoria popular sobre a minha bacia tem um papel importante no meu processo de tomada de decisoes Crosstabulation

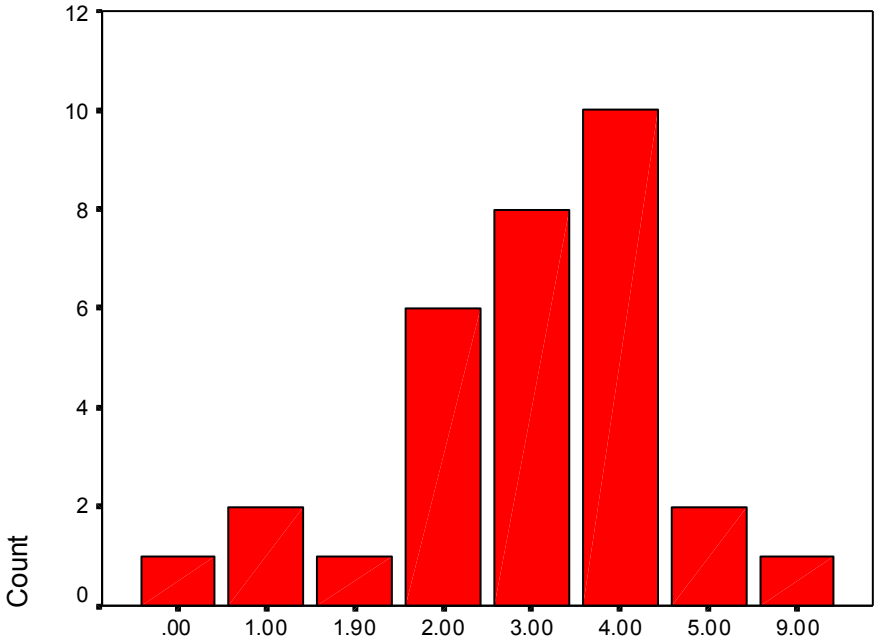
Count

		sabedoria popular sobre a minha bacia tem um papel importante no meu processo de tomada de decisoes						Total
		.00	1.00	2.00	3.00	4.00	5.00	
SECTOR	civil society		1	2	1	2	2	8
	federal state	1		4	6		2	13
	users			3	4	2	1	10
Total		1	1	9	11	4	5	31

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	9.589[a]	10	.477
Likelihood Ratio	11.544	10	.317
N of Valid Cases	31		

a. 18 cells (100.0%) have expected count less than 5. The minimum expected count is .26.



SECTOR * Desde a criacao de comite, o uso de conhecimento popular aumentou na minha organizacao Crosstabulation

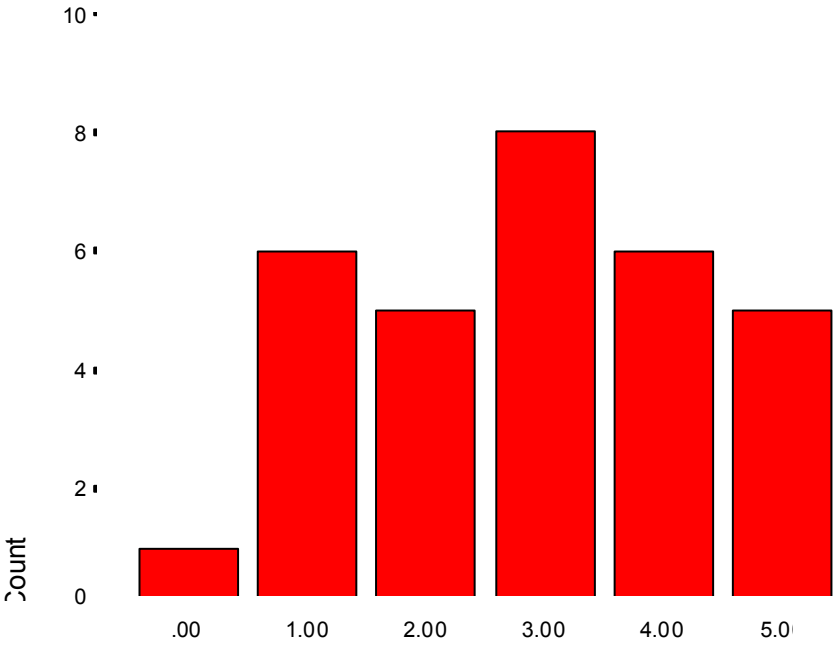
Count

		Desde a criacao de comite, o uso de conhecimento popular aumentou na minha organizacao								
		.00	1.00	1.90	2.00	3.00	4.00	5.00	9.00	Total
SECTOR	civil society		1			2	3	1	1	8
	federal state	1		1	5	4	2			13
	users		1		1	2	5	1		10
Total		1	2	1	6	8	10	2	1	31

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	15.520[a]	14	.344
Likelihood Ratio	18.715	14	.176
N of Valid Cases	31		

a. 24 cells (100.0%) have expected count less than 5. The minimum expected count is .26.



SECTOR * Eu conheco tecnicas baseadas em conhecimento popular de gestao de agua na minha bacia Crosstabulation

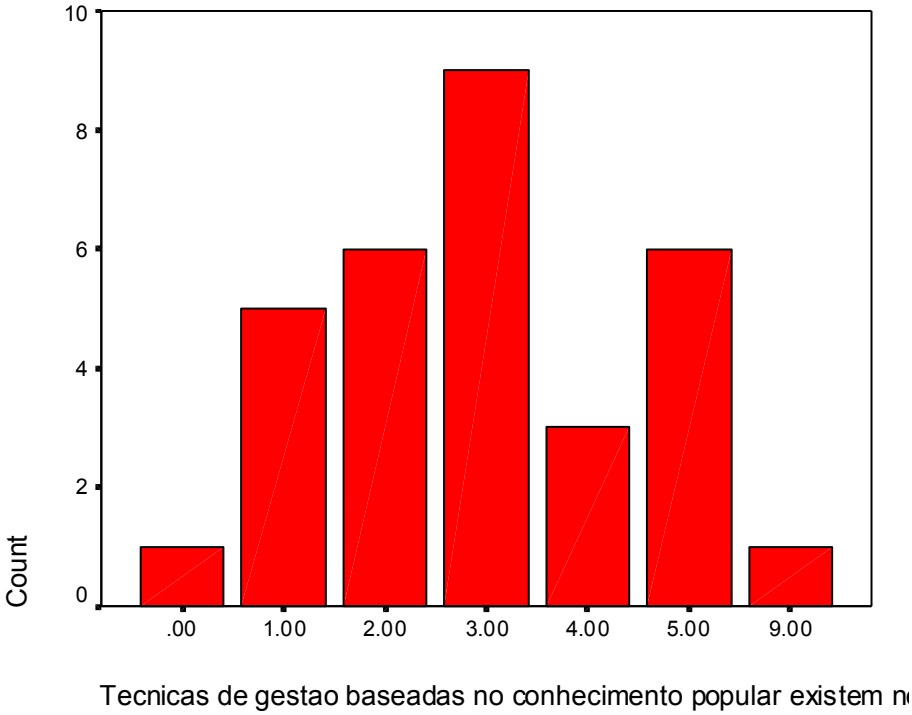
Count

		Eu conheco tecnicas baseadas em conhecimento popular de gestao de agua na minha bacia						
		.00	1.00	2.00	3.00	4.00	5.00	Total
SECTOR	civil society		2	1		2	3	8
	federal state	1	1	2	6	2	1	13
	users		3	2	2	2	1	10
Total		1	6	5	8	6	5	31

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	10.771[a]	10	.376
Likelihood Ratio	12.526	10	.251
N of Valid Cases	31		

a. 18 cells (100.0%) have expected count less than 5. The minimum expected count is .26.



SECTOR * Tecnicas de gestao baseadas no conhecimento popular existem ne minha regiao Crosstabulation

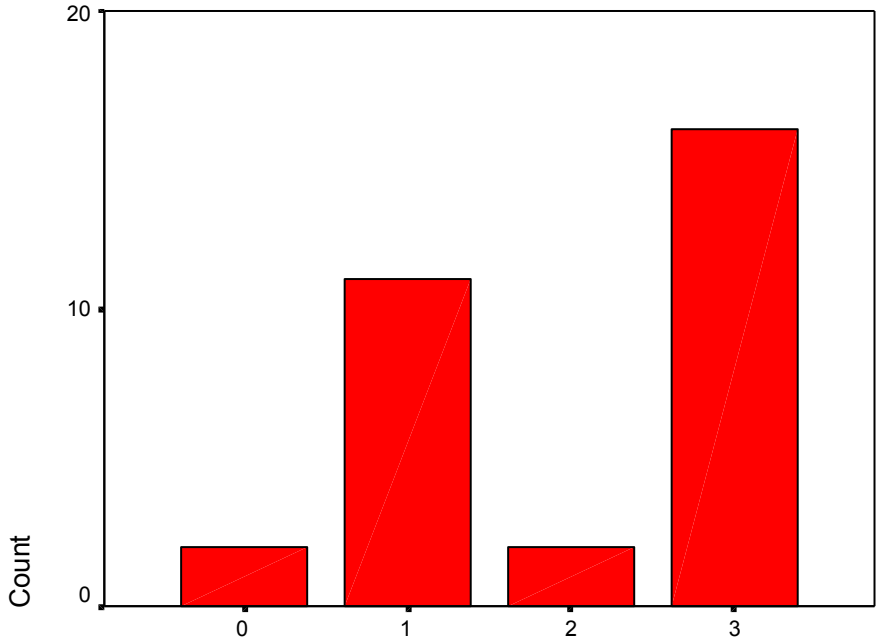
Count

		Tecnicas de gestao baseadas no conhecimento popular existem ne minha regiao							
		.00	1.00	2.00	3.00	4.00	5.00	9.00	Total
SECTOR	civil society		2	1		1	4		8
	federal state	1		4	5	2	1		13
	users		3	1	4		1	1	10
Total		1	5	6	9	3	6	1	31

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	18.540[a]	12	.100
Likelihood Ratio	23.160	12	.026
N of Valid Cases	31		

a. 21 cells (100.0%) have expected count less than 5. The minimum expected count is .26.



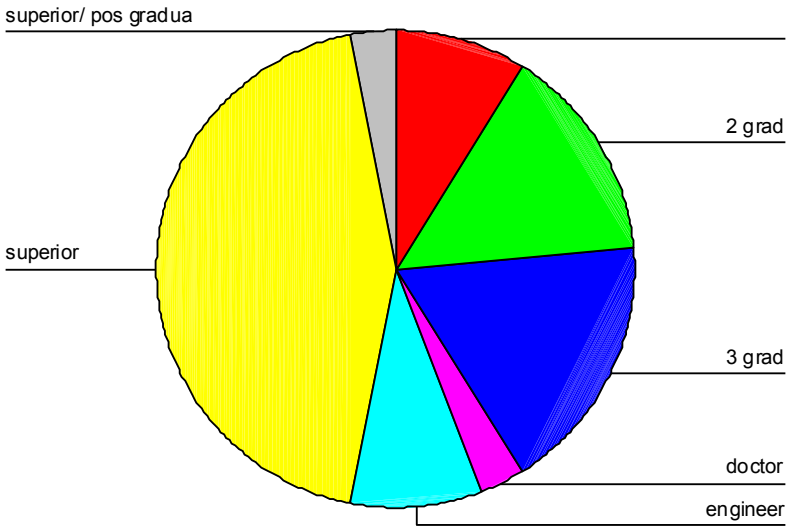
Eu acho que a minha região no futuro será:

SECTOR * Eu acho que a minha região no futuro será: Crosstabulation

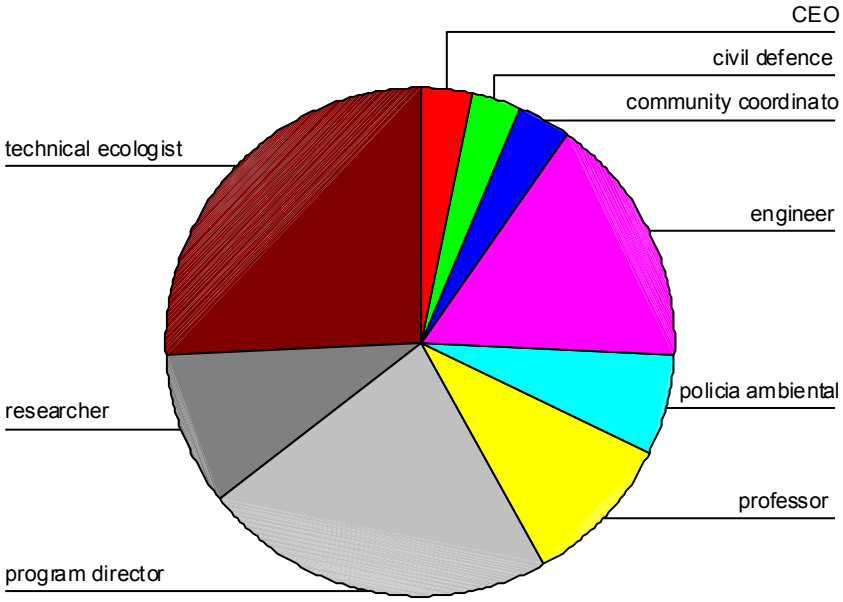
Count

		Eu acho que a minha região no futuro será:				
		0	1	2	3	Total
SECTOR	civil society	1	4	1	2	8
	federal state	1	4	1	7	13
	users		3		7	10
Total		2	11	2	16	31

Appendix E: Pie Charts of Educational and Professional Background



Pie Chart of Educational Background



Pie Chart of Professional Background

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