**Critically analyse some of the key issues associated with water management at the international level.**

**Introduction**

This paper critically evaluates four key present day water management issues at the international level. Firstly, this paper argues that the Integrated Water Resource Management (IWRM) approach has been an environmental governance approach, using interdisciplinary knowledge and skills to create equitable and sustainable solutions to improve water development and management. IWRM has been used by planners in both the developing and developed world, and advocates for the basin approach. However, this paper asserts that the translation of IWRM principles to implementation and action has not been smooth in all cases. Most poignantly, IWRM integration requires it to be sensitive to developing country realities, such as lack of human and financial resources to implement systems in the region in question. Secondly, this paper asserts that another key issue associated with water management at the international level is the lack of clean drinking water and proper sanitation in the developing world, and investing in Agricultural Water Management (AWM) methods can help to reduce poverty in some cases. This paper advocates a knowledge sharing is an important method in learning about differing water policies and a comparison between the India and Australia case is examined. In addition, this paper argues that in order to assist with easing the clean drinking water and sanitation crisis in developing nations, it is crucial that government place more emphasis on implementing and developing important technologies such as reverse osmosis and membrane technology. Most importantly, governments need to implement such systems to keep with the increase in population and water scarcity expected by 2025. Lastly, this paper discusses good government and implementation of policies, and holds that foreign direct investment can put pressure on governments to adopt good governance practices. In regards to the good governance heading, this paper advocates the need to respect and consult with cultural and Aboriginal leaders and people in order to increase the understanding of the value of water and its increased scarcity in the near future.

**Integrated Water Resource Management**

Integrated Water Resource Management is an approach that is well defined in history and aims at improving water management and equitable development of water resources. The goal of such an approach is to maximize social and economic welfare. However, maximizing social and economic welfare can clearly come at a cost so one of the key points of IWRM is the need to balance those goals against environmental sustainability. As a result, a key principle underpinning the approach is balance, and also preparing for the future of water management.[[1]](#footnote-1) Poignantly, this approach involves good governance, and risk management because water is the most important resource. As Biswas has identified water management is composed of a number of interrelating elements, and in order to understand water management it is important to understand it from inter-disciplinary perspective. For example, water management relates to natural hazards, the environment, population growth, health and welfare, pollution, education and training, and regional and international cooperation.[[2]](#footnote-2)

Further, a number of international conferences regarding IWRM have occurred over the years and document its growth as a theory and as an approach. Most notably, the International Conference on Water and the Environment in Dublin, Ireland held in 1992 was pivotal because it identified that fresh water is finite and vulnerable.[[3]](#footnote-3) Moreover, the conference was also pivotal in the sense that it identified gender-based issues relating to the management of water and how women play a very important role in the safeguarding water. The Germany Bonn Conference also was pertinent because it identified the ever increasing important principle of knowledge sharing when it comes to governance of water. Finally, the Kyoto Forum held in 2004 drew a crowd of 24,000 people and primary issues on the table were clean water for all, capacity building and public participation.[[4]](#footnote-4) Basically, IWRM is based on principles such as social equity, which means that everyone deserves adequate quantity of quality of water. Note that equity is different from equality in that, in places where access to water is limited, governments in such area need to create systems to better support citizens from being able to access such water. While these are necessary principles to govern water management, in order to translate these principles into action the role of institutions, and governance, and monitoring play a huge role in actual management over a period of time.

Therefore, IWRM has been evolving, and some of its key messages is the basin approach which focuses on region to region governance, and also that an integrative approach needs to occur in order to improve water management. As Beveridge and Monsees argues, this paper advocates that IWRM needs to be implemented sensitive to the institutional and political realities fundamentals to the country in context. In fact, what IWRM needs is a more pragmatic approach to “integration” which is one of the main principles of the approach.[[5]](#footnote-5) The reason why pragmatism is important is that in order to achieve integration the complexities of water management has to be recognized as well as the unique political, social, cultural and economic realities of a particular region. Therefore, one of the main themes of this paper is being sensitive to such contextual factors in order to achieve IWRM success. For example, in the European Union has developed the Water Framework Directive (WFD) which attempts to institutionalize river basin management for the protection of water.[[6]](#footnote-6) In the developing world the IWRM approach has also been used in order to increase access to safe drinking water and sanitation. On a more global level, the approach has been aimed at alleviated poverty, and improving social and economic conditions in the developing world. Moreover, Global Water Partnership, the World Bank, national governments, the UN and the World Water Council have all backed such an integrative approach.[[7]](#footnote-7)

Although the principles of IWRM are clear, are these principles being effectively translated into action? Jønch-Clausen found that IWRM had made positive change. However, scholars such as Biswas and Butterworths have also acknowledged that while implementation of the IWRM approach has been high in cost, the benefits have been limited. [[8]](#footnote-8) Butterworths asserts that one of the reasons why this approach has attracted criticism is that its concepts are vague.[[9]](#footnote-9) Why is this the present case, despite the fact that IWRM has been around for so long? Beveridge and Monsees have found that IWRM often has been implemented in the form of, “externally assisted, donor funded projects and planning and scoping processes.”[[10]](#footnote-10) Furthermore, even though IWRM have been incorporated in legislation and even constitutions of a number of countries, the key problem is the translation from legislation into action. Despite the scholars’ criticism of IWRM, there have been a number of action-based events such as China's new water policies, Brazil's wastewater reform, and Uganda creating new policies for water resource management. In fact, the “IWRM projects in specific basins, are, however, present in many other developing countries in Africa and Asia.”[[11]](#footnote-11)

Further, Beveridge and Monsees identify a number of key challenges in the implementation into action approach. Firstly, they identify that there is a general inconsistency between the needs and conditions in developing countries. In fact, the IWRM approach is based on a river basin focus, establishing rights to water, and demand management. However, they argue that these goals are more appropriate to the developed world and are not as suitable for the developing world.[[12]](#footnote-12) Allan argues that developing countries differ starkly from the developed world due to water shortages and unstable supply of water and these are major issues, therefore, 'IWRM policy packages' may not be as suitable for the developing world.[[13]](#footnote-13) Some scholars argue that the River Basin approach requires considerable changes in institutional structure and in laws; and therefore is not an easy undertaking. Problems can arise as was the case with the River Basin of South Africa where a RBA was established, “on top of existing institutions with different jurisdictional boundaries, such as the Rural Development Council, the Provincial Government and the District Council.”[[14]](#footnote-14)

Furthermore, what needs to occur in developing policies in the developing world are understanding the context, and creating implementation that fits with the region. This encompasses that there needs to be a greater emphasis on the tradition of the region and also the informal institutions. In fact, there needs to be more sensitivity to inform institutions which can help to increase participation of the community. Participation is important, but accountability and monitoring of institutions is equally as important. One has to be mindful of the fact that in developing regions there may be a lack of resources, and so rushing to implementation may not be in the best interests of the region. Van Koppen et al have shown that it is necessary to understand community based water laws and practices governing water in communities. Thereafter, regions can build upon such community based water laws.[[15]](#footnote-15) As a result, the critical point to understand is that in applying the IWRM it is necessary to take a contextual approach in order to create policies that further IWRM objectives.

**Investing in Agricultural Water Management**

World wide there are over 850 million rural people who are involved in agricultural activities and live on less than $2 per day, and therefore this paper asserts that one of the key issues affecting water management today is improving agricultural water management which can in turn assist in improving poverty.[[16]](#footnote-16) Poverty is often associated with deprivation of rights, such as rights in the political and social sphere, poor access to resources, unable to meet basic needs and to provide for one self and one's family. One has to be mindful of the fact that water scarcity in the developing world has an effect on the productive and consumptive capacities of the people of the developing nations. Water management is an extremely important issue because water mismanagement can lead to further poverty. Moreover, external events such as droughts and flooding have the effect of limiting poor people's access to quality water. Namara et al point the relationship between agricultural management and poverty linkages. As Namara et al indicate, “Access to reliable water improves production and productivity, enhances employment opportunities, and stabilizes income and consumption”.[[17]](#footnote-17)

Agricultural water management encompasses a number of practices such as wetland development, moisture conservation, full and partial irrigation.[[18]](#footnote-18) Furthermore, water harvesting is a part of the set of practices within this approach, and techniques of AWM are often conducted in arid or semi arid areas. AWM practices focus on dealing with excess water and flooding, and also overcoming the possibilities of unreliable rainfall.[[19]](#footnote-19) As Namara et al find in their research there is a correlation between poverty reduction and water scarcity as their observation was that most of the poverty stricken areas in the world also experience water scarcity, and this may not be only due to lack of water but also lack of implementation in order to propel that water.[[20]](#footnote-20) Therefore, this paper argues that it is worthwhile investing in AWM can have the effect of improving poverty in a number of different ways.

Firstly, investing in AWM allows for the potential of increase production and productivity of crops, and improved yields. The benefits of improved yields are manifold. With investment comes an increased employment opportunity, which is positive for people in poor regions because it helps to increase the economy. Due to improved yields of crops there is also the potential of having improved quality of crops due to better irrigation and more consistent water management. As a result, more yields in foods could potentially cause food price to drop.[[21]](#footnote-21) Overall, nutrition and health of the citizens in the region with increased investment could improve due to the fact that there would be a nutritive effect due to having different kinds of crops and better quality of output. It has also been found that agricultural water can also be used for other things, such as replenishment of aquifers, sanitation and drinking.[[22]](#footnote-22) However, mismanaged irrigation systems could cause adverse consequences, such as spreading waterborne illnesses, and more advanced systems could cause increased chemical use.

Another component of AWM is access to water. Although access to water is related to implementation of technologies to harness or clean water, access to water also involves higher level government institutions to take an active role to secure access to water.[[23]](#footnote-23) For example, in places like India and Sri Lanka there exists an equitable pro poor system.[[24]](#footnote-24) This system guarantees a minimum amount of quantity to all. Access to water in the developing world is so important not only for the present, but also for the future due to population growths; and therefore access to water is related to the development and use of appropriate technologies to clean water, and use it in the most efficient manner when it comes to agriculture.

With respect to agricultural technologies, “basic needs are usually best met through the use of relatively inexpensive, locally driven, culturally appropriate and gender based technologies.”[[25]](#footnote-25) For instance, the trade pump is an example of an agricultural technology, which started on the regional level in Bangladesh and has expanded globally. Over a 15-year period Bangladesh implemented such a technology, and within this period 1.5 million were purchased and installed by small farmers with a total investment cost of 49.5 million.[[26]](#footnote-26) This is in contrast to the possible creation of a canal or dam system, which would have been over a billion dollars. Therefore, this example highlights that low cost irrigation systems have considerably assisted small farmers as the system provides a source of water that is consistent, and improved quality of output crops. Despite the use of low cost agricultural technologies, it is important to highlight the overall problem that lack of technology in the developing world is a problem and therefore requires the support of governments. For example, in Nicaragua the hillsides have waters sources, however families do not have access to make best use of the streams due to a lack of technology.[[27]](#footnote-27) Further, some agricultural systems are in desperate need of upgrades, such as rain fed systems.[[28]](#footnote-28) Therefore, investments are needed for large agricultural and irrigation systems, and for small-scale system. By investing in such systems there is a greater potential to reduce poverty by providing better access of water to the poor, and such systems would require efficiency by using water better in a more sustainable manner.

**Technologies for Producing Reusable and Clean Water**

In addition, this paper asserts that fresh water supply of water is limited, and therefore one of the key issues in water management in the present day is developing and implementing technologies for producing reusable and clean drinking water. Over 2 billion people have limited access to safe water, and this is often a surprising figure if one is from a country such as Australia, America, Canada, or a European nation. However, the reality is in the developing world clean water is still a critical issue and is expected to be a critical issue due to the expected increase in population. One of the most poignant issues in the clean water debate is the cost of water purifying systems. Purifying systems in order to be effective should be sustainable, and treatment process should occur with locally available materials.[[29]](#footnote-29) As Zaman asserts that it is important to identify some “unique low-cost sustainable technologies available or in use,”[[30]](#footnote-30) such as riverbank, natural filtration, solar disinfection, membrane filtration, and bio-sand filtration.[[31]](#footnote-31) With respect to riverbank filtration, it involves a process of pumping wells and involves “physical, chemical and biological process take place between surface and ground water, and with subsurface” which has the effect of pollutant removal.[[32]](#footnote-32) The benefits of this system are that water flowing through an aquifer is positive because the aquifer acts as a barrier. This barrier is important to off set any pollutants that may have seemed into the water. Furthermore, riverbank filtration also results in river water variations in temperature.[[33]](#footnote-33) One of the drawbacks of the RBF process, “is the clogging of the bed and the banks of the river, which de-creases the hydraulic conductivity in the hypothetic zone”*.'*[[34]](#footnote-34) Membrane filtration technology is technology where a membrane of a sieve or semi-permeable layer is required for the water to go through and this has the benefit of not allowing viruses, bacteria, and chemicals to pass through.

Moreover, rapid and slow sand filtration is a technology often used with other processes to purify water, and can be used to remove flocculants.[[35]](#footnote-35) Solar distillation is another process used for the purification of water and it basically involves the use of solar energy in a closed system, which evaporates water. These technologies provide insight that there are methods that can be utilized but the key is for a region to utilize the most advantageous system after a cost benefit analysis is conducted.

More specifically, reverse osmosis desalination is an important technological technique applied to a number of salt-water resources.[[36]](#footnote-36) Seawater reverse osmosis and brackish water reverse osmosis are two key methods that are used globally. Such desalination process is either related to membrane or thermal processes. Desalination has been used for clean drinking water, but the Middle East has most notably utilized this process the most. With respect to brackish water sources they are often from ground water, and usually have organic content levels that are typically low and also low colloidal.[[37]](#footnote-37) In particular, countries like Australia have used desalination systems powered by solar energy and can be helpful in areas where fresh water is limited. The major drawback of such a system is that it takes a lot of money to start up because a reverse osmosis plant is required, and also monitoring of the site is required.[[38]](#footnote-38) As Greenlee notes membrane technology has increased and improved. Seawater and brackish systems have features, which just require adjustment changes in a system design. However, Greenlee also notes that further research is required in the area of membrane technology in order to deal with energy usages. Such investment into the development of technology, which aims at reducing the cost of the systems to make it more manageable in terms of cost, will allow for reverse osmosis to be better utilized and implemented in rural settings.

In addition, Carlevaro and Gonzalez hold that water sustainability in low-income communities are dependent on a number of factors, such as water source. Water source relates to the source of the fresh water, whether it comes from evaporation methods, ground water or surface water. Another key component of water sustainability is collection, which requires facilities that pump water which are collected from surface water sources.[[39]](#footnote-39) Therefore, water source is a factor in determining the kind of purpose of a particular type of technology.

Further, India is facing large water shortages, and this is even the case in China. Furthermore, there is substantial polluting in Chinese rivers with heavy metals that is extremely difficult to use them.[[40]](#footnote-40) One of the most important future changes in the technological world include removing of pharmaceutical, organic compounds, and different ion products which come from electronic products. These products are usually discharged in the ground.[[41]](#footnote-41) Despite all the technological efforts, reducing the costs of gaining fresh water also still needs to happen. The Seawater Engineering & Architecture of High Efficiency Reverse Osmosis (SeaHERO) is a project implemented by Korea in order to improve production of freshwater. It also aims to reduce the cost of such development and the use of energy.[[42]](#footnote-42) At present, the reason why membrane technology is so interesting is that membrane operations may be integrated.

**Knowledge Sharing and Water Policies**

Poddar et al conduct a comparison of water policies for sustainable irrigation in Australia and India and their study highlights a key point in the water management discourse that knowledge sharing of effective and not so effective water policies can have an important effect of arming planners with information.[[43]](#footnote-43)

Their comparative study is based on sustainable irrigation management and they assert that India, specifically, has adopted a participatory irrigation management approach (PIM).[[44]](#footnote-44) Australia, on the other hand, has adopted the irrigation management transfer program (IMT) to deal with problems such as use of water resources, and environmental flow problems. India faces the problems of, “low irrigation water efficiency and under utilization of irrigation water potentials”.[[45]](#footnote-45) In India, the total amount of water that is usable comes from surface water first, and thereafter groundwater. Water stress is evident in India due to the expected population increase by 2025.[[46]](#footnote-46) In Australia, water is mainly used for irrigation of agriculture and this is largely due to the fact that Australia is a heavy food exporter to the rest of the world. India's policy is based on the National Water Policy of 2002, with an emphasis on development that is planned. With the expected population rises to 1.39 billion in 2025, the capacity of old irrigation systems need to be reviewed*.* In fact, it has been held that PIM has had slow growth and as the India Ministry of Water resources identifies, there are a number of problems with water management in India, most notably lack of leadership, lack of legal policy and system problems.[[47]](#footnote-47) Moreover, the issue of water markets has also come up which refer to the use of water markets to help promote the use of water more efficiently. Overall, it has been found that the PIM system could be better utilized through better-defined water rights, and due to infrastructure problems.[[48]](#footnote-48)

Water markets require a system that is governed and overseen.Unlike India, Australia relies on water markets have been used to allocate and reallocate water in the competitive market.Although in Australian ground water management is not as big as a problem as in India, it still needs considerable attention. Although India has adopted the participatory irrigation management approach to manage demand issues related to water, the results have been mixed. Further, although Australia has created water markets, it is questionable whether such market would actually work in India due to the social, economic and land conditions. Australia’s irrigation management transfer system has had some success in addition to clear institutional arrangements, and corporate style of management.[[49]](#footnote-49) Therefore, it is important to highlight the fact that different countries have been utilizing different policies to manage water. Keeping in line with the IWRM contextual approach, India can learn from Australian and other experiences relating to water policy reforms and style of management in order to better equipped them to deal with their own agriculture systems. Although Poddar et al acknowledge that India's irrigation policy aims at growth and equity, sharing of knowledge is extremely important in order to identify how to move forward for the future. If water scarcity is going to hit desperate levels that regions have to learn from each other in order to best meet the needs of the people in their own regions through utilizing ideas within their own contexts.

**Water Management and Good Governance**

Bahauddin discusses environmental governance in Bangladesh and his research provides some important insights in service delivery of environmental sustainability.[[50]](#footnote-50) It was found that institutions face challenges because of lack of coordination between a number of ministries, and the coordination between governmental and non-governmental organizations is poor. This is an important point to emphasis because non-governmental organization in developing countries plays an extremely important role in the delivery of water management, in providing research and the like. Non profit organization are not for profit and so they often assist where there is a lack of government funding for particular areas of research for example, and can supplement governmental work. Therefore, communication problems between these entities could cause a major break down in service. Bahauddin also found that more emphasis needs to be placed on inter-organizational meetings.[[51]](#footnote-51) Inter-organizational meetings are needed because meetings are often schedule to review goals, set new goals, and discussing planning. Furthermore, accountability and transparency of meetings is necessary and that environmental information should be better shared with the public.[[52]](#footnote-52)

Further, Bahauddin investigates the current mechanisms in Bangladesh related to decision making to provide some insight into how countries like Bangladesh are dealing with obstacles regarding environmental management. It was found that good governance “generally improves management of natural resource and implementation of environmental legislation.”[[53]](#footnote-53) Although this point certainly seems like a truth, but it goes deeper than that because environmental sustainability is often related to a wider issue such as justice and rights. By officials taking environmental governance seriously, then it symbolizes that they are taking individual rights seriously. Environmental governance relates to training, mandates, protocols, innovation, and managing resources. Often times, it also includes institutional upgrading, and certainly budgeting to set aside necessary funds to pay for upgrades. Furthermore, knowledge sharing is a key point in good environmental governance.

**a. Triggering Better Water Sustainability Governance**

As a result, one of the key issues in today's water management debate is whether the international governance institutions need to put more pressure on governments for better environmental governance. In this day and age, what needs to occur now is effective action. Environmental law is an interdisciplinary field encompassing not only environmental law, but also treaty law, energy law, and aboriginal law. An understanding of the relationship between corporations, treaty law, foreign direct investment and environmental law is necessary to truly understand how water management can be better administered. Treaty law is composed of international investment agreements. These agreements known as IIAs, or bilateral investment agreements govern the relationship between host governments and companies. Within these agreements contain a number of rights that a company acquires. For example, rights to be compensated in the face of expropriation, discrimination rights and the like. The rights are designed to protect the company, and create incentives for large companies to directly investment in a country by establishing operations in developing countries. Foreign direct investment into developing nations could have the effect of bringing in more money and opportunity into a country, which a developing nation would not take for granted. Another important aspect of foreign direct investment is that it helps to spur on technology growth. In fact, this was found by Liu and Wang who found that after conducting researching into Chinese industries that foreign direct investment has the effect of introducing “advanced technology” into the country.[[54]](#footnote-54) Usually, when a company wants to build a wastewater management plan, or develop a mine of some sort they are locked in for a number of years and so growth can happen over this period of time. This could have the effect of better increasing management of resources such as water resources. Therefore, it is necessary to explore how better water and environmental management can be triggered, and foreign direct investment has that effect. What foreign investment may also do is increase pressure for governments to get their acts together to improve water management. Should a company enter a country without a reasonable effective water management system, a smart company would realize that they may also be the brunt of water mismanagement and therefore may not choose to invest. This argument has been raised because it identifies that pressures on governments are necessary at times to spur action. In the environmental governance context, and in looking at the statistics at water scarcity by 2025, water scarcity is not some far away threat but something that is near. Pressure by the international community and system of punishment for government not taking environmental water management seriously may be a consideration. Furthermore, considering the grim statistics of overuse of water in the more developed nations, pressure also needs to occur in order to better manage water supplies.

**b. Water Management and Custom**

Briefly, this paper asserts that it is important to take into account the cultural, aboriginal and customary ideas regarding water and management. In canvassing how water management needs to happen it is important to take into account leaders in such communities to get their perspective. The reason why this is important is that Aboriginal law, for example, differ from traditional ideas about water. Aboriginals usual deem waters to be “sacred givers of life” and water use needs to be shared, without any use being paramount.[[55]](#footnote-55) As a result, the idea of water is no longer a commodity but something that is living. Considering the fact that water scarcity is on this rise, educating people to adopt such a notion of water could help to create a conscious shift on people viewing water. People in developed nations take water for granted, and this in stark difference to people in the developing world. Clearly therefore, a shift in consciousness needs to occur in the developed world to not take for granted water. Education and promoting respect for water, and the environment needs to happen through education. Through years of conditioning, many people in the developed world will surely not grasp the importance of water maybe until it is too late. However, educating people can help them to understand the consequences of water scarcity and mismanagement. That is why government and leaders of cultures play very pivotal roles in helping people change their views on water, and appreciate it. This paper asserts that this is an extremely worthwhile cause and is also necessary and one of the key issues in water management in today's world. Changing views on water, as well as international legal governance to put pressure on countries could work in tandem in addition to developing technologies. Therefore, good governance also includes community collaboration.

**Conclusion**

This paper critically discusses four key issues that affect water management in the present day. Firstly, this paper asserts that the Integrated Water Resource Management approach has evolved in recent decades and propounds a number of important principles regarding integration and water management principles. Although some scholars have found that such principles have not translated into action, it is necessary to have such principles underpinning any water management approach. IWRM has clearly led to some important initiatives. The key is to assist with translation and it has been found that what needs to happen is better sensitivity to the regional environment. Although the River basin approach is a key feature of IWRM, the developing world suffers from financial inequity compared to the developed world and therefore IWRM principles need to be applied contextually. This paper also critically evaluates agricultural water management and asserts that investment into AWM practices in developing countries has manifold benefits including potentially reducing poverty through the creation of jobs, better quality crops, and market changes. From the discussion of AWM it is clear that the need for cost effective technology that recycles and cleans water is extremely important. Science and research into the development of reverse osmosis technology is necessary in order to reduce costs so that the developing world can better take advantages of such technology. Moreover, knowledge sharing, and learning from other countries as in the India and Australia example are important in order to develop water management plans. Lastly, this paper discusses good governance strategies and hold that good governance relating to water management first starts with an understanding of the value of water, and the incumbent threats, learning from other nations, and the need for organization and strategic planning to meet goals. Leaders of cultural groups and aboriginal peoples have an important voice regarding water, and these voices need to be listened to. What is also necessary is pressure internationally, and this paper proposes such pressure can be effective. Similarly, foreign direct investment can be a trigger for better water management.

**Bibliography**

David Laidlaw and Monique Passelac- Ross, 'Water Rights and Water Stewardship: What about Aboriginal Peoples' (2010) The University of Calgary Faculty of Law <<http://ablawg.ca/2010/07/08/water-rights-and-water-stewardship-what-about-aboriginal-peoples/>>.

Fabrizio Carlevaro and Cristian Gonzalez, 'Costing improved water supply systems for developing countries' (2010) 164 *Water Management*, 123

Giordano Lautze, 'Transboundary water law in Africa: development, nature and geography' (2006) 45 *Natural Resources Journal* 1053

Khalid Bahauddin, 'Environmental system management and governance needs in a developing country' (2014) 34 *Environment Systems and Decisions* 342

John Butterworth, J Warner, P Moriarity, S Smits, C Batchelor*, '*Finding practical approaches to integrated water resources management' (2010) 3.1 *Water Alternatives* 68

Lauren Greenlee, Desmond Lawler, Benny Freeman, Benoit Marrot, PhillipeMoulin, 'Reverse osmosis desalination: Water sources, technology, and today's challenges' (2009) 43 *Water Research* 2317, 2318-2319.

Muhammad Manzur Rahaman, and Olli Varis 'Integrated water resources management: evolution, prospects and future challenges' (2005) 1.1 *Sustainability: Science, Practice & Policy* 15

Rajendra Poddar, 'A comparison of water policies for sustainable irrigation management: The Case of India and Australia'28 (2014) *Water Resource Management* 1079

Regassa Namara, Munir Hanjra, Gina E Castillo, Helle Ravnborg, Lawrence Smith, Barbara van Koppen, 'Agricultural management and poverty linkages' (2010) 97 *Agricultural Water Management* 520

Ross Beveridge and Jan Monsees, 'Integrated water resources management: institutional and political challenges in developed and developing countries' (2012) 37.7 *Water International* 727

Sharmin Zaman, 'Low Cost Sustainable Technologies For The Production Of Clean Drinking Water – a Review' (2014) 5 *Journal of Environmental Protection* 42

SA Tiwari, D Goswami, S Prabhakar, PK Tewari, 'Assessment of an ultrafiltration pre-treatment system for a seawater reverse osmosis plant' 2.2 (2006) *International Journal of Nuclear Desalination* 132

H Winters, 'Twenty years experience in seawater reverse osmosis and how chemcials in pretreatment affect fouling of membranes' 110 (1997) *Desalination* 93

Xiaohui Liu and Chenggang Wang, 'Does Foreign direct investment facilitate technological progress' (2003) 32.6 *Research Policy* 945, 954.

Y Zhou and RSK Tol, 'Implications of desalination for water resources in China- an economic perspective' 164 (2004) *Desalination* 225

1. Muhammad Manzur Rahaman, and Olli Varis 'Integrated water resources management: evolution, prospects and future challenges' (2005) 1.1 *Sustainability: Science, Practice & Policy* 15, 15. [↑](#footnote-ref-1)
2. Ibid,16. [↑](#footnote-ref-2)
3. Ibid. [↑](#footnote-ref-3)
4. Ibid. [↑](#footnote-ref-4)
5. Ross Beveridge and Jan Monsees, 'Integrated water resources management: institutional and political challenges in developed and developing countries' (2012) 37.7 *Water International* 727, 727. [↑](#footnote-ref-5)
6. Ibid, 728. [↑](#footnote-ref-6)
7. Ibid. [↑](#footnote-ref-7)
8. John Butterworth *et al, '*Finding practical approaches to integrated water resources management' (2010) 3.1 *Water Alternatives* 68, 69. [↑](#footnote-ref-8)
9. Ibid. [↑](#footnote-ref-9)
10. Ross Beveridge and Jan Monsees, 'Integrated water resources management: institutional and political challenges in developed and developing countries' (2012) 37.7 *Water International* 727, 728. [↑](#footnote-ref-10)
11. Ibid. [↑](#footnote-ref-11)
12. Ibid, 729. [↑](#footnote-ref-12)
13. Ibid. [↑](#footnote-ref-13)
14. Ibid. [↑](#footnote-ref-14)
15. Regassa Namara et al, 'Agricultural management and poverty linkages' (2010) 97 *Agricultural Water Management* 520, 520-522. [↑](#footnote-ref-15)
16. Ibid, 520. [↑](#footnote-ref-16)
17. Ibid. [↑](#footnote-ref-17)
18. Ibid. [↑](#footnote-ref-18)
19. Ibid, 521. [↑](#footnote-ref-19)
20. Ibid. [↑](#footnote-ref-20)
21. Ibid, 522. [↑](#footnote-ref-21)
22. Ibid, 525. [↑](#footnote-ref-22)
23. Giordano Lautze, 'Transboundary water law in Africa: development, nature and geography' (2006) 45 *Natural Resources Journal* 1053, 1053-1054. [↑](#footnote-ref-23)
24. Regassa Namara et al, 'Agricultural management and poverty linkages' (2010) 97 *Agricultural Water Management* 520, 524. [↑](#footnote-ref-24)
25. Ibid. [↑](#footnote-ref-25)
26. Ibid, 523-525. [↑](#footnote-ref-26)
27. Ibid, 525. [↑](#footnote-ref-27)
28. Ibid. [↑](#footnote-ref-28)
29. Sharmin Zaman, 'Low Cost Sustainable Technologies For The Production Of Clean Drinking Water – a Review' (2014) 5 *Journal of Environmental Protection* 42, 42. [↑](#footnote-ref-29)
30. Ibid. [↑](#footnote-ref-30)
31. Ibid. [↑](#footnote-ref-31)
32. Ibid, 45. [↑](#footnote-ref-32)
33. Ibid. [↑](#footnote-ref-33)
34. Ibid, 46. [↑](#footnote-ref-34)
35. Ibid, 47. [↑](#footnote-ref-35)
36. Lauren Greenlee et al, 'Reverse osmosis desalination: Water sources, technology, and today's challenges' (2009) 43 *Water Research*  2317, 2318-2319. [↑](#footnote-ref-36)
37. Ibid, 2326. [↑](#footnote-ref-37)
38. Ibid. [↑](#footnote-ref-38)
39. Fabrizio Carlevaro and Cristian Gonzalez, 'Costing improved water supply systems for developing countries' (2010) 164 *Water Management*, 123, 123-124. [↑](#footnote-ref-39)
40. F Macedino, 'Efficient Technologies for world wide clean water supply' 51 (2012) *Chemical Engineering and Processing*, 2, 2. [↑](#footnote-ref-40)
41. Ibid. [↑](#footnote-ref-41)
42. Ibid, 14. [↑](#footnote-ref-42)
43. Rajendra Poddar, 'A comparison of water policies for sustainable irrigation management: The Case of India and Australia'28 (2014) *Water Resource Management* 1079, 1080. [↑](#footnote-ref-43)
44. Ibid, 1082. [↑](#footnote-ref-44)
45. Ibid. [↑](#footnote-ref-45)
46. Ibid, 1080-1085. [↑](#footnote-ref-46)
47. Ibid, 1082. [↑](#footnote-ref-47)
48. Ibid, 1081-1084. [↑](#footnote-ref-48)
49. Ibid, 1089. [↑](#footnote-ref-49)
50. Khalid Bahauddin, 'Environmental system management and governance needs in a developing country' (2014) 34 *Environment Systems and Decisions* 342, 350. [↑](#footnote-ref-50)
51. Ibid, 342. [↑](#footnote-ref-51)
52. Ibid, 354. [↑](#footnote-ref-52)
53. Ibid, 352. [↑](#footnote-ref-53)
54. Xiaohui Liu and Chenggang Wang, 'Does Foreign direct investment facilitate technological progress' (2003) 32.6 *Research Policy* 945, 954. [↑](#footnote-ref-54)
55. David Laidlaw and Monique Passelac- Ross, 'Water Rights and Water Stewardship: What about Aboriginal Peoples' (2010) The University of Calgary Faculty of Law <http://ablawg.ca/2010/07/08/water-rights-and-water-stewardship-what-about-aboriginal-peoples/> . [↑](#footnote-ref-55)