Chapter 29
System Harmonisation of Land and Water Resources in Peri-urban Regions: Lessons from Western Sydney, Australia

B. Maheshwari and B. Simmons

Abstract In this study, Western Sydney region was used as the 'laboratory' for understanding issues and options to harmonise rapidly changing peri-urban landscapes and identifying options for regional water security and land use planning. The main focus of the study was to engage and work with a range of stakeholder and government agencies to identify issues that impact on the use of potable water, stormwater, effluent and groundwater. The study involved transdisciplinary research and system harmonisation approach to understand the role of water in primary production, identifying opportunities and constraints as influenced by water quantity and quality, analysing market options and mechanisms to improve water productivity and environmental outcomes, review water policies, institutional barriers and community aspirations and identifying changes needed to improve water security. In this chapter, we discuss how the system harmonisation approach was applied to a peri-urban catchment in the Western Sydney region and a number of lessons that emerged from this study and the relevance of this approach to engaging stakeholders and government agencies and carrying out transdisciplinary research in peri-urban landscapes.

Keywords Stakeholder engagement · Water planning · Water security and system harmonisation

29.1 Introduction

Water in peri-urban landscapes around metropolitan cities and regional centres in Australia is one of the important essential ingredients for producing fresh food locally, keeping parks, gardens and sporting ovals green and sustaining local

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B. Maheshwari et al. (eds.), *The Security of Water, Food, Energy and Liveability of Cities*, Water Science and Technology Library 71,
DOI: 10.1007/978-94-017-8878-6_29,

businesses and job opportunities. Land and water availability in peri-urban regions strongly influences the health of the river systems, the supply of fresh fruit and vegetables, operation of water dependent businesses and commercial fishing. Metropolitan cities, particularly Sydney and Melbourne in Australia are now facing complex problems of peri-urban planning. It is now being increasingly realised that without proper land and water planning, we cannot achieve local food security, job security, growth in tourism, adequate opportunities for sport and leisure activities and an overall quality of life.

One significant challenge we face in peri-urban regions is to devise options for using potable water, stormwater, effluent and groundwater in way that will enhance security of water supplies for human consumption while ensuring environmental needs of water. We also need tools and framework that will assist in exploring options for 'integrated water resources planning' and in having meaningful dialogue with stakeholders. This requires understanding the role of water for different uses, water quantity and quality issues, market options and mechanisms, current water policies, institutional barriers and community aspirations. The above aspects are critical for any regional land and water planning, infrastructure development, cost-benefit analysis and implementation strategies in peri-urban regions.

The main aim of this chapter, using the system harmonisation approach, is to understand the complexity of peri-urban issues and challenges and draw out some key lessons from a four year-long study of stakeholder engagement supported by a number of hydrologic, social, economic and institutional analyses.

29.2 Western Sydney Region

The Western Sydney region is part of the Sydney metropolitan area and includes 12 local government areas (LGA). These LGAs are Cities of Auburn, Bankstown, Baulkham Hills, Blacktown, Blue Mountains, Camden, Fairfield, Hawkesbury, Holroyd, Liverpool, Parramatta and Penrith (Fig. 29.1). The region stretches over nearly 9,000 km^2 of residential, industrial and rural lands. The climate in the region is characterised by warm, wet summers and cool, relatively dry winters. Rainfall in summer is typically associated with thunderstorm activity and the region receives less rainfall than the coastal areas of Sydney. There is also significant variations in rainfall across the region, and the average annual value of rainfall is 856 mm while evapotranspiration 1373 mm (UPRCT 2004).

It is projected that the population in Western Sydney would increase significantly over the next 20 years. The proposed North–West and South–West Growth Centres will add about 600,000 people to the 400,000 already living in the South Creek Catchment—a significant area of Western Sydney. It is likely that there will be further population growth in this period, due to the natural increase within existing land use zones, placing additional pressure on water that is available for non-potable uses. This might pose a threat to commerce; industry; and most

Fig. 29.1 The south creek catchment

importantly agriculture as well as recreational sites, such as playing fields and reserves that require significant amounts of water to sustain their user-friendly quality.

The climatic conditions of the region are moderate with warm to hot summers, cool to cold winters and reliable rainfall throughout the year. The average temperature varies from high, around 28–30 °C in January to low, around 2–5 °C in July. On individual days, day temperature may rise up to 40–43 °C in summer months (January–February), and fall lower than or close to 0 °C in winter months (July–August). The average annual rainfall is about 750 mm with fairly uniform distribution over the catchment. The rainfall during summer, which is characterized by thunderstorms, is higher than that occurring over long durations in the winter months.

29.3 Complexity of Land and Water Issues

A large part of the Western Sydney region is part of the Hawkesbury-Nepean River Catchment. The region is currently facing important challenges arising from urbanisation, limitations on water allocation for irrigation, discharge of nutrient runoff from market gardens and other areas into the river system, community issues related to use and reuse of water. Being close to a large metropolitan area, both effluent use and management and urban irrigation play important roles in the overall water use and management in the catchment.

Water and waterway quality of the Hawkesbury-Nepean River system has been considered poor (HMCMA 2007) due to the impacts of increasing urbanisation and other factors. In particular, the river water quality is compromised due to

extraction of water on a daily basis to meet the water demands for domestic, industrial and urban and peri-urban irrigation in the region. While the extraction considerably reduces the flow volume, pollutants discharged into the river as sewage effluent and urban and agricultural runoff lower the quality of water in the river. A study by the Hawkesbury-Nepean River Management Forum (2004) concluded that environmental flows need to be managed properly to maintain the health of the river system.

There have been a range of ongoing efforts from different government agencies in New South Wales and specific projects funded by the Federal Government to protect the river system and its dependant activities. So far, most initiatives have been undertaken in isolation and have not adequately taken into account the complex interrelationships between the various biophysical, socio-economic, institutional and policy factors that influence the region's water resource management and the overall liveability. There is need for a holistic and integrated land and water planning to maintain the health of the river system and sustain it as a valuable future asset for the Sydney Metropolitan area.

The population growth and the subsequent urbanisation also had a significant impact on the region's farming land. A large part of this region was originally used for agricultural production, both dryland and irrigated. However, over time the area under agriculture has been reduced as fertile agricultural land has been converted for housing and industry. Market gardens and farms in the region produce more than 1/10th of NSW's agricultural production on 1 % of the state's agricultural lands (Knowd et al. 2005). Therefore, urbanisation is challenging food production and other related activities in a complex manner and need new thinking and research approach to secure sustainable land and water use in peri-urban areas.

The projected changes in rainfall and higher evaporation rates due to climate change are likely to reduce flow in streams (CSIRO 2007), and thereby decrease the sustainable yield of Hawkesbury-Nepean catchment which contributes nearly 80 % of Sydney's Water System. The growing population and reduced rainfall in the region is putting considerable pressure on fresh water resources and is forcing the water authorities to revisit their water use and management strategies. There exists a need for integrating water management approaches that consider system water supply, demands, economic impacts of change, as well as overall effects on social, cultural, institutional and political realms.

29.4 Peri-urban Challenges and Transdisciplinary Approach

Depending upon the complexity and purpose, research approaches can be disciplinary, multi-disciplinary, interdisciplinary or transdisciplinary (Hadorn et al. 2008). In case of peri-urban issues and challenges we face now, the approach taken to solve a problem or improve a situation determines the outcome of research. The

complexity of issues related to water recycling and regional water security in peri-urban landscapes is undoubtedly beyond a disciplinary approach and perhaps cannot be handled adequately by multidisciplinary and interdisciplinary approaches.

In multidisciplinary approach, research teams make use of the expertise of individuals from different disciplines, with each discipline approaching the underlying problem from their own perspective. There is generally no clear mechanism or purpose for integration of different disciplines and researchers from each discipline have their own assumptions and methodology. They may work in parallel but do not blend to create a shared knowledge. On the other hand, interdisciplinary approach is based on a collaborative focus and the integration of research between disciplines is embedded in the approach. This means, researchers from different disciplines will work together in teams to share learning about the research problem.

A transdisciplinary approach also involves integration of different disciplines that cut across the boundaries of two or more disciplines but it focusses on 'real world' problems or issues and will inevitably include the interests and involvement of government and non-government agencies, businesses, politicians and community groups. What sets transdisciplinary approach apart from the others, particularly in the context of peri-urban regions, is its emphasis on stakeholder engagement, investigation and team work to deal with some pressing problem that breaks disciplinary boundaries while respecting disciplinary expertise. It is also about bringing the knowledge and learning from different disciplines together, which will most likely result in insights and understanding that is beyond the realms of individual disciplines.

29.5 The WISER Project

The **W**ater and **I**rrigation **S**trategy **E**nhancement through **R**egional Partnership (**WISER**) was a project was one of the four regional projects established by the Cooperative Research Centre for Irrigation Futures (CRC IF) under the System Harmonisation Program. This program was focussed on developing a strategy to improve cross-organisational communication and system-wide management to improve production and environmental outcomes in the context of a whole catchment (Khan et al. 2008). The main objective of the system harmonisation program was to engage key agencies and interest groups and carry out relevant research that will assist in regional planning (Fig. 29.2).

The WISER project was designed to assist water users and water dependent businesses by establishing an integrated water resource management and planning framework, development of business partnerships and implementation process for infrastructure development for Western Sydney. The research in the project focussed on the analysis of the region's water cycle components, water productivity, and environmental, social, cultural, institutional and policy issues and

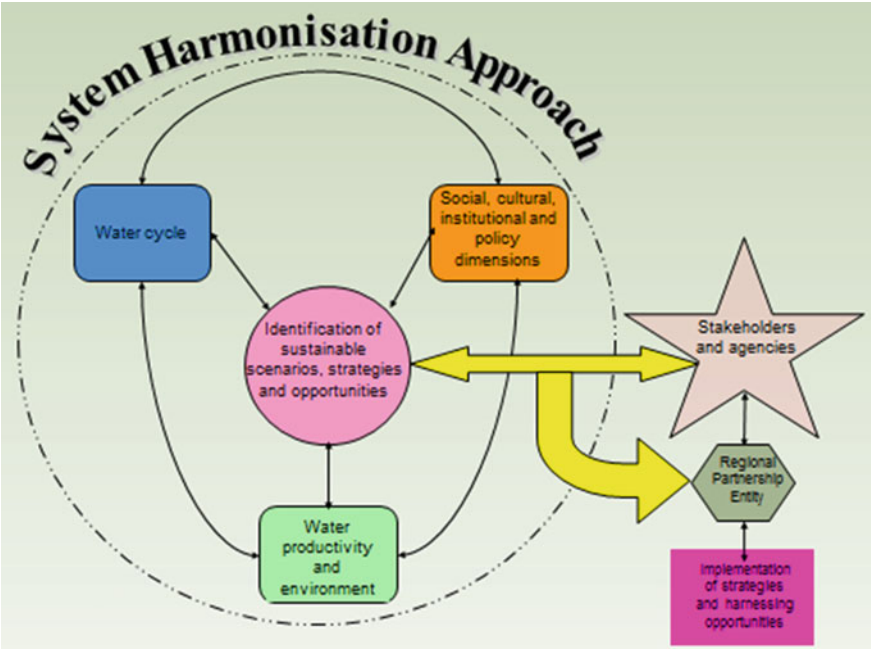

Fig. 29.2 System harmonisation approach in the WISER project

challenges. The analyses helped, in consultation with key stakeholders and government agencies, in identifying and evaluating scenarios, strategies and opportunities for sustainable use of the region's water resources in the longer term. The project was also designed to facilitate the formation of a regional partnership that continues beyond the life of this project. The partnership thus formed provides key input into the implementation of actions identified through this project.

The project involved three major activities: stakeholder engagement; modelling and analysis of hydrologic, environmental, economic, social, institutional and policy aspects. The tasks that were pursued to develop collaboration with stakeholders included undertaking workshops to determine values and water needs in the area. They have also been involved in developing committees to progress and guide the development of regional water business partnership. Stakeholders considered for such workshops were water users and agencies associated with water management.

29.6 Peri-urban Is Different

At the commencement of the WISER project, we realised that in peri-urban context an irrigation-only focus of the system harmonisation was too narrow, especially for peri-urban regions such as Western Sydney where there are so many stakeholders, agencies and users and interest groups that drive the region's water

planning and future. Compared to urban or rural water scenarios, the project revealed that, there are numerous natural resources management entities associated with managing or influencing water management and planning in peri-urban regions and there is a limited co-ordination among them. Also, natural resources and other data required for peri-urban water planning are scattered in different agencies and are of variable quality.

29.7 Lessons from the WISER Project

There have been a number of key lessons learnt from the WISER project, and these lessons may have relevance to other peri-urban regions in Australia and overseas. One major lesson was that engagement of stakeholders involved in peri-urban landscapes is not easy. We invited and worked with stakeholders in a series of meetings and workshops during the four years of project to create an ongoing dialogue. In very early during the engagement process, we recognised the complexity and conflicting nature of the peri-urban landscape and engaged a facilitator to steer the process. In spite of a great deal of goodwill and support of the various stakeholders, it was often difficult to have a constructive dialogue among the various parties involved. In particular, governmental agencies sometimes did not see beyond technical details and ministerial directives. Further, they were more concerned with their department's role and responsibility and were not able to adequately appreciate the bigger picture of the water cycle and the needs of the very people they are hoping to serve. This sometime created mutual distrust among local councils, irrigators groups, government agencies and community at large. In this project, we focussed on co-learning to understand the local problematic situation and share information and knowledge for a planned intervention. Further, we found that our persistent efforts and personal approach helped us to keep the motivation of stakeholders, agencies and community and help them to continue with a dialogue with each-other about pressing local peri-urban issues and solutions.

An interesting realisation in this project was that it is unrealistic to expect all stakeholders to start talking and collaborating at the beginning of the project. The most likely reasons for this are related to the lack of a clear understanding of the issues and differences in power and authority. Also, conflicts among the various parties involved in the management of peri-urban water is unavoidable in the stakeholder engagement processes, and therefore it is important to state this point explicitly so that the perceptions and interests are considered appropriately in exploring practical and acceptable solutions (Leeuwis 2000). With this approach, the stakeholder engagement processes therefore become a mix of 'learning and fighting' (Butterworth et al. 2007).

During the WISER project, we observed that when government agencies are the initiator of the process, there was the possibility of mistrust and confusion due to the perception of stakeholders that the agencies have their own agenda and are not neutral. On the other hand, as researchers in WISER project, we were able to play

the role of neutral facilitator between government agencies and stakeholders and eventually were able to bring different interests and parties together for a dialogue.

We have learnt that effective and sustained stakeholder engagement requires us to respect the views of stakeholders and provide caring facilitation while not manipulating the process. Water issues in peri-urban regions are multifaceted and so require more holistic thinking, and so it is unrealistic to expect everyone to think the same and reach an agreement on options or point of view at the beginning of the dialogue. Therefore, it is important in the stakeholder engagement process to work in harmony and develop solutions that are jointly owned by government agencies, stakeholders, researchers and community at large.

We have also learnt that the engagement is an ongoing task to keep the momentum and allow development of a deeper relationship among themselves, e.g., by signing of a Memorandum of Understanding and working on joint funding application. Such relationships are of great value at the regional level in building social and networking capital and do help in regular sharing of ideas, getting rid of preconceptions about each-other and providing confidence and positive connections.

29.8 System Harmonisation Approach: Did It Work?

System harmonisation is a powerful concept and involves science, but not science on its own. It is explicitly focussed on bringing all different types of science together with economics, environment and communities to solve wider and practical problems (Bristow and Stubb 2010). For system harmonisation to succeed, it was evident from the WISER project that we need team with strong disciplinary skills and are keen to work collaboratively. Also, for system harmonisation to work properly the science needs to be flexible, not in terms of the rigour of the process or the statement of the findings but rather in the way the issues are approached and communicated to stakeholders. Also, the research that needs to be done, particularly what type of science input is needed and at what point it is needed must be driven by the needs of the stakeholders and a range of environmental, social and economic consideration related to region involved. Further, the science should be allowed evolve as researcher gain deeper understanding of the issue and the community to understand the system more clearly.

We observed that the science made a difference in the process of system harmonisation in the WISER project. The study highlighted that researchers still struggle to connect and communicate their science in way that will enable effective dialogue with stakeholders. The experience in the WISER project indicates that there were significant difficulties in engaging with stakeholder in the beginning. The enthusiasm and persistence of a key people to continually engage with existing and potential stakeholders and community ensured the progress in the project. They were also committed to evolving the program to develop something that was in line

with the general direction of system harmonisation approach and that also fitted the local physical and community landscapes (Bristow and Stubb 2010).

The chair of any transdisciplinary project steering committee plays an important role and we learnt that it is important to appoint a person who has deep interest in issues being investigated and who has wide support and respect from the stakeholders. This was possible by attracting a well-known local person as a paid chair. Although the amount paid to the chair was insignificant when compared with the total budget of the project, this helped to get full attention and support for the project from the chair. The leadership and support from different stakeholder groups is equally important, particularly form the four Western Sydney Councils and the Sydney Metro Water Directorate.

Overall, the WISER project was able to define what was important to research with the help of stakeholders and work with stakeholders to make sense of the research done for practical application, and so the project has achieved a level of system harmonisation. Further, the system harmonisation helped people to think different, work out the best ways to work together to address and resolve issues which they would not be able to resolve as individuals (Bristow and Stubb 2010).

29.9 Conclusions

Sydney like all growing cities is expanding into adjacent rural lands (peri-urban areas). The system harmonisation approach could be an important vehicle to establish dialogue among stakeholders for effective and long-term water resources planning at a regional scale. However, the process of system harmonisation is significantly different in peri-urban landscapes, and it is more difficult due to complexity of issues and the range of stakeholders, agencies and interests involved. The most important issues for system harmonisation in peri-urban landscapes include the reuse of water, management of the water cycle for a range of water users (including the environment) in the face of expanding urban needs. For achieving long-term regional water security in peri-urban landscapes, undoubtedly we need effective engagement of stakeholders, regional water managers and land-use planners for developing common vision and long term planning.

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