National Centre for Flood Research

Southern Cross University

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Enabling Delta Life

Social inclusiveness in floods and droughts

How social variations in impacts and responses can be taken into account

working paper

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Karen Meijer[1*,3], Caroline Sullivan[2], Judith Blaauw[1], Femke Schasfoort[1], Bouke Ottow[1], Diana Morales[1]

[1] Deltares, Delft, the Netherlands

[2] National Centre for Flood Research / Southern Cross University, New South Wales, Australia

[3] Copernicus Institute of Sustainable Development, Utrecht University, The Netherlands

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Preface

‘Water for Society – including all’, is this year’s theme of the World Water Week, which is related to the theme ‘Leaving no-one behind’ from the World Water Day and the World Water Development Report. The core of these messages resonates the recognition that impacts of too little, too much or too dirty water are not the same for everybody. That differences in impacts exist for different social groups. In our view “Water for Society – including all” should mean inclusiveness in water management, aimed at ensuring that changes in a water resources system, either man-made or natural, do not result in an unequal distribution of costs and benefits over different groups in society across a river basin and its tributaries.

Access to drinking water and sanitation and the inclusion of marginal groups in water management processes have been at the core of activities on socially inclusive and equitable water management. Notwithstanding the importance of this work, we identify a gap: insufficient attention is paid to socially inclusive outcomes of managing extreme events: flood and drought risk reduction.

Different groups in society have a different exposure and vulnerability to extreme events. Not only will they experience the extreme event risk differently, they may also respond differently. In this paper we argue that it is not only necessary, from ethical, legal, economic and political stability points of view, but also possible, to better account for these societal differences. Indeed, doing this does not have to be difficult or complex.

With this paper we intend to make a start with mainstreaming inclusiveness assessments into broader integrated water resources management and disaster risk reduction. We hope it provides inspiration to the readers and invite them to interact with us and together share good practices, expand the conceptual thinking and identify further concrete steps to effectively make water management more inclusive across the entire spectrum of ways water impacts on us and our diverse environments.

1. Scope for improving inclusivity of dealing with extreme water-related extreme events

1.1 Impacts of water management interventions are different for different groups of people

Some groups in society are more vulnerable to extreme water-related events such as floods and droughts than others (Hallegatte et al., 2015, Winsemius et al., 2015). However, also the impacts of interventions meant to reduce vulnerability to these extreme events are unevenly distributed over different societal groups.

Three examples:

1. Research into evacuation of New Orleans residents before Hurricane Katrina hit in 2005 revealed that not having access to a car or other transportation, not having received or understood the evacuation order, and being physically unable to leave featured among the major reasons why particularly socially vulnerable residents did not evacuate (Fussel, 2018).
2. The Master Plan for the National Capital Integrated Coastal Development programme (NCICD) was envisaged to protect Jakarta from coastal flooding. However, preparations of a seawall were stalled when possible negative impact on water quality and fisheries became apparent. According to a group of NGOs, the seawall is likely to threaten the livelihoods of tens of thousands of people who rely on the local fishing industry. This means that the people who rely on the fishing industry in Jakarta Bay are further marginalized while at the same time the real estate projects for the rich are realized in the same bay (Bakker et al., 2017).
3. Large dams have been built for centuries to deal with natural climate variability by storing excess water during wet seasons and releasing water in dry time. In the second half of the 20th century the negative social and environmental impacts became apparent. Various studies found that while dams could be beneficial for hydropower generation, as well as for flood protection and water supply, only a limited number of, generally better-off, people benefitted, while large groups of people upstream as well as for long distances downstream, would lose land and ecosystem services-based livelihoods (World Commission on Dams, 2000, Moran et al., 2018, Scudder, 2012, Richter et al., 2010)

These are just some examples that show that many interventions undertaken to reduce vulnerability to extreme events do not play out in the same way for different societal groups. Some groups may be better protected than others, or worse, the protection of some may result in reduced wellbeing or livelihood opportunities for others. This situation can be seen across the world in many places where individuals or groups take action to reduce their own risk (e.g. build levees), but this results in increased flood risk in different parts of a basin. We argue that it is not only necessary, but also possible to better address the inclusiveness aspects of the management of floods and droughts.

In this paper we therefore discuss how inclusiveness can be addressed in the planning and management of water resources and in the reduction of flood and drought risks.

1.2 Inclusiveness is fair, legally required and creates socio-economic welfare and stability

It is important to address this uneven distribution of impacts and strive for more inclusive management of water resources and disaster risk reduction for four reasons:

First: fairness and ethics. The moral ground to simply not discriminate or not benefit at the expense of others. This is backed by various religions and belief systems. An example of an institutionalization of this is the Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Water Convention) (UNECE, 1992). This document takes an important step by increasing recognizing the rights of all riparian states.

Second: legal. It is not just about fairness; these rights are formally embedded in internationally binding human rights law. Not only does the Universal Declaration of Human Rights (UN General Assembly, 1948) elaborates in 30 articles what is summarized in its first article: "all human beings are born free and equal in dignity and rights", access to water and sanitation has been recognized as a specific human right as well in 2010 (United Nations, 2010).

Three: socio-economic welfare. Societies not addressing inequality may end up with higher social costs through reduced labour participation, higher costs of social welfare and health care systems or increased criminality.

Four: political stability. Extreme poverty and inequality between groups can result in social tensions, violent conflict and – forced or voluntary – migration. Social, political and economic stability can thus benefit from more inclusive societies, which includes inclusive water resources management.

These ideas regarding the importance of inclusiveness are also captured in the Sustainable Development Goals (United Nations, 2015). Gupta and Vegelin (2016) found that 11 of the 17 goals address inclusiveness, although they also note that 'growth' features more prominently which brings the risks that trade-offs between financial gains and equal distribution may favour the former. SDG6 on water only mentions 'equitable' in relation to drinking water and sanitation (SDG 6.1 and 6.2, (United Nations, 2015). Regarding water shortage, SDG 6.4 states: "By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity" (ibid). Although there is no mention of equity or inclusiveness, the explicit mentioning of the number of people rather than the economic efficient use water is an important step towards more inclusive distribution of water resources, by addressing its societal value.

1.3 It is possible to make the management of floods and droughts more inclusive

In this paper, we present different ways of how the inclusiveness of outcomes of water resources management and disaster risk reduction efforts can be quantified in order to support better inclusivity-informed decision-making. We focus on assessing the inclusiveness of outcomes, while realizing that this will require an inclusive process, and ideally an inclusive team to conduct the assessment. Approaches presented range from simply taking a different perspective in an assessment, starting with understanding what groups may be impacted differently and where they live, using different indicators to assess alternative interventions, for example through social alternatives to economic damage calculations, all the way to quantitatively modelling how different societal groups respond to water-related risks.

What we aim to convey with these illustrations is that working towards social inclusiveness is not about *adding* some elements, it is about asking *different questions* and looking through a *different* *lens.* This different lens will require a different set of tools for a more inclusive outcome and process where the vulnerable, poor and underrepresented groups are integrated in adaptive water management and planning for extreme events. Partly these tools have been around for some time (e.g. the Climate Vulnerability Index (Sullivan and Meigh, 2005)) partly these tools are new, also facilitated by increased availability of data and processing capacity (e.g. earth observation, google earth engine).

We start by discussing how different characteristics of social groups make them more or less vulnerable to water-related extreme events. We then give a brief overview of how these concepts are already being addressed in water-related policy and guidance documents. Next, five steps are proposed to concretely and quantitatively address inclusiveness in assessments. We then move on to discussing how doing such assessment can be further mainstreamed in commonly used approaches in practice.

Lismore Camera Club – Children sign

2. Societal variations in how water-related events impact people

How one is affected by water-related extreme events or by structural changes in water availability depends on a variety of factors (Sullivan, 2002, IPCC, 1998, WWAP, 2019). Definitions of inclusion, and of many related terms such as equity and diversity, list many characteristics of people or social entities that make them more or less vulnerable to changes in water resources systems and extreme events. In this section we divide them into three categories (Figure 2.1): 1) individual characteristics, 2) group characteristics, and 3) livelihood characteristics. Each of these will be discussed below and illustrated with examples that show how the characteristics can result non-inclusive water-related outcomes. In addition, we discuss inclusiveness on different spatial and temporal scales. Table 2.2 summarizes the possible differences during floods and per group. A column is dedicated to societal variations in water quality. Water quality-related disasters can be man-made, such as chemical spills, or can be the result of floods or droughts, when pollution is flushed into surface water, or concentrations of pollutants go up when water levels are low.

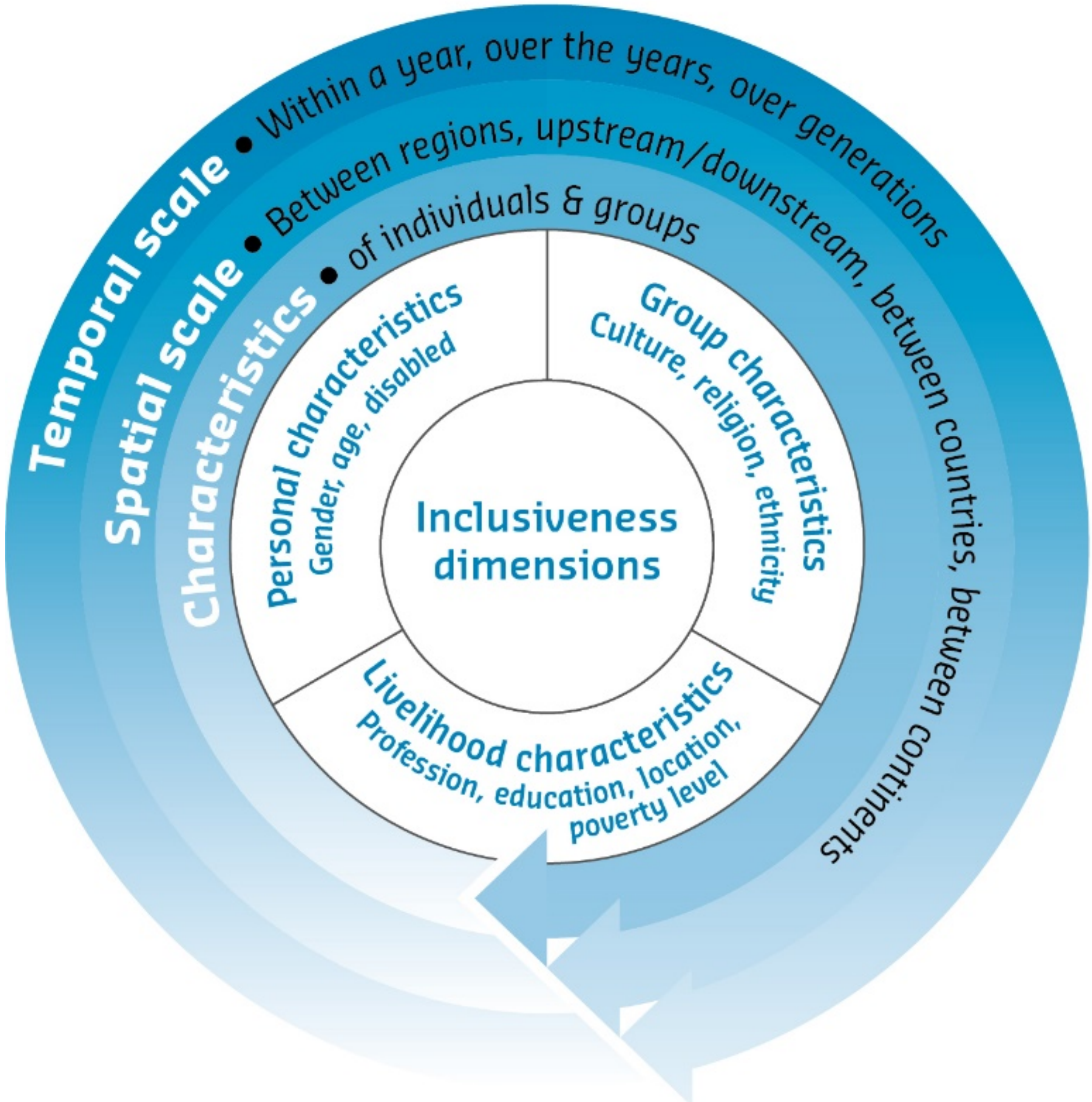

Figure 2.1 Dimensions of Inclusiveness

2.1 Individual characteristics

Individual characteristics could include age, gender, education and disabilities, and even such things as personal past experience.

Children are more vulnerable than adults and aged people are more vulnerable than younger people

Approximately 75% of the people who lost their lives in the aftermath of Hurricane Katrina were over 60 years old, while this population only accounted for 15% of the population in New Orleans (Sharkey, 2007). In Bangladesh, as a result of cyclone-induced flooding from Cyclone Gorky in 1991, women outnumbered men by 14:1 in mortality rate, which was mainly induced by cultural norms and behavioral patterns. Similarly, in the 2004 Indian Ocean tsunami, 70 percent of the 250.000 fatalities were women (Alam and Rahman, 2014). They found that many women did not leave their houses during the flood, because religious and cultural values prohibited outdoor activities of women.

A recent study found relationships between child nutrition and precipitation extremes (Cooper et al., 2019). These links were strongest in areas with poor governance and political instability. Undernutrition is especially harmful for children because it can lead to impaired growth (stunting).

Women are more vulnerable to floods and droughts than adult men

Disabled people are more vulnerable than able people

2.2. Group characteristics

Group characteristics can be anything that distinguishes one group of people from other (groups of) people, such as ethnicity or religion. In Sri Lanka and India, access to certain water points is regulated by caste: only members of specific castes can go to certain points and only members of other castes can go to other points. For example, in some areas of Sri Lanka, such as the rural communities of Agarauda and Tissawa this has meant that members of lower castes have more access to good quality water, whereas, unexpectedly, the members of higher castes have to resort to water points where water quality is lower (Sullivan et al., 2002). Such counter-intuitive outcomes demonstrate how social characteristics can have a dramatic effect on who benefits from water access. Such group characteristics can also apply positively in situations where social and religious practices are designed to be inclusive. For example in Bali, the very regular religious ceremonies held in all the Hindu temples on the island ensure that the poor and disenfranchised are assisted in times of need.

2.3 Livelihood-related characteristics

A livelihood comprises the capabilities, assets (including both material and social resources) and activities required for a means of living (Chambers and Conway, 1992). Sustainable livelihoods are said to depend on five capital types, namely human, social, physical, financial and natural (Scoones, 1998). All livelihood-related characteristics are represented in this framework, and can be illustrated by profession or education (human capital), existence of institutions such as emergency services (social capital) poverty level (financial capital) and geographical location (natural capital). While geographical location is specifically important in relation to water, because it determines where water resources can be found, it also depends significantly on physical capital (infrastructure) and social capital (political organization) to determine who ultimately has availability to that water, or who are exposed to floods to a greater or lesser degree.

Poor people are more vulnerable than rich people

Clearly, differences exist between the rich and the poor, with the rich generally availing over more secure water supplies, sometimes even at lower costs than what is available to the poor. For example, in New Delhi currently a drought is amplifying the inequality between India's rich and poor. Politicians, civil servants and corporate lobbyists who live in houses and apartments in central Delhi pay very little (between $10-$15) to get limitless supplies of piped water. However, in the slum areas in the inner city, or a housing estate on the outskirts there is a daily struggle to get and pay for very limited water of which the price is rising when water levels drop. Community taps and hand pumps are too toxic to use, forcing people to queue up for a government tanker that comes just once a day. As a result, fights frequently break out when people sprint to the tanker, last year killing at least three people in New Delhi (Circle of Blue, 2019). It is well known that across the world, the poor pay more for water through the imputed cost of the time they spend to collect it, or through its purchase from small scale water vendors.

Both urban and rural poor often live in locations most vulnerable to floods, such as floodplains or gullies, that may be dry for several consecutive years. Yet, when floods do come, these people are likely to lose all they possess (Alderman et al., 2012, Walker and Burningham, 2011) as their households are swept away in flood water. This can also be seen in developed countries where poorer segments of society often live in much more vulnerable locations or housing types.

Making matters worse, urban and rural poor are impacted in other ways as well. Since the rural poor depend more directly on ecosystem services, they are directly affected in periods of drought. However, the urban poor spend a large part on their income on food (Hallegatte et al., 2016). They are hit when food prices go up as a result of crop failure. Allegedly, the bread riots in Cairo in 2011 were the result of drought-induced crop failure in Russia the year before, leading to cancellations of export of Russian wheat on which Egypt depends (Sternberg, 2011).

Farming and fishing are two rural professions that are strongly dependent on access to water resources, yet in different ways. Many examples exist of cases in which water was regulated or diverted from natural rivers to irrigated areas, benefiting farmers over fishermen and over other groups whose livelihoods depend on natural ecosystems, such as pastoralists. This has been observed in situations such as on the slopes of Mt Kilimanjaro in Tanzania, where nomadic Masai herders have found spring water they have used for generations has been diverted to supply small scale settlements. Surprisingly, similar water resource-based conflicts have arisen in developed countries where demand for water resources has outstripped supply, both in industrial areas (UK) and in farming contexts (Australia). Indeed, these kinds of situations are found in many parts of the world, where for example irrigated farming receives various (often hidden) subsidies while rainfed farmers get little support. Similarly, large scale commercial farmers often get more support than small subsistence farms (for example in South Africa), while farms at the heart of main irrigation schemes have more influence and greater benefits than those near the tail end of the system, possibly having to deal with intermittent water supplies. Such differences have been observed in parts of the Murray Darling Basin, once heralded as a model of equitable and sustainable IWRM.

2.4 Spatial scale

Although inclusiveness often seems associated with poor and marginalized communities, and within these, particularly women, children and elderly, we want to stress that inclusiveness be considered at multiple scales. It is important to identify at the scale of a management issue under consideration, that different groups may have different dependencies on water and can be affected differently as the combined results of various factors (Sullivan et al., 2006). This can be at intra- and intercommunity level as well as at intra and interstate level (Table 2.1).

Table 2.1 Inclusiveness aspects across spatial scales

Spatial scale	**Societal groups to be distinguished**
Community	women, children, disabled, less and more well off, tail end of irrigation systems, differences in housing quality , poor communication
Sub-national/sub-basin	pastoralists, fishermen, agricultural communities competing over resources
Country	upstream irrigators, downstream, different rules in different jurisdictions, eg subsidies or compensation schemes in one place but not others
Transboundary basin/supra-national	upstream-downstream issues: flood propagation, lack of water, poor quality, lack of information provision between different states

2.5 Temporal scale

A key notion of Sustainable Development is that current development should not compromise the "ability of future generations to meet their own needs" (Brundtland et al., 1987). There is thus also an intergenerational aspect to inclusiveness. Preventing over-exploitation and preventing the crossing of planetary boundaries (Rockström et al., 2009) is not just important from an environmental or conservation perspective, but to ensure the very existence of human kind. Population growth and lifestyle changes continue to increase pressures on resources, while climate change increases uncertainties about future availability and distribution of resources. Inclusiveness assessments need to address these temporal scales.

2.6 Combinations of characteristics further enhance vulnerability of societal groups

All these characteristics can mean that individuals or societal groups have a high dependency on water or related ecosystem services for their livelihoods and well-being, making them vulnerable to changes in the water system. Importantly, groups often combine characteristics. For example fishermen in Bangladesh inhabit the lower, more flood-prone areas near rivers, while farmers settle on higher lands (Meijer, 2007). Fishermen were also often Hindu and relatively poor, while farmers were Muslim and relatively affluent. Of course, within these groups there are differences as well. For example, widowed females or landless farmers were worse-off and more vulnerable compared to farming families owning land.

Table 2.2 Overview of inclusiveness dimensions in relation to floods, droughts and water quality

		floods	**droughts**	**water quality**
Individual characteristics	Age	Older people have lower mobility during evacuation, while displaced children may lose contact with families or suffer from post traumatic stress.	children more vulnerable to reduced food availability children to spend more time on fetching water	Children and older people are both more vulnerable to low quality water
	Gender	women more effected by inadequate sanitation; in some communities women are less likely to be able to swim. Women less able to cope in deep or strong flowing water	Women likely to spend more time on fetching water and have less food	Pregnant women more vulnerable to poor water quality
	Disabled	lower mobility during evacuation	Less able to seek alternative resources	Less able to seek alternative resources
Group characteristics	Etnicity	Certain ethnicities may be marginalized. See poverty level.		
	social status/caste	Lower socio-economic groups likely to live in more vulnerable areas	Less likely to be able to seek alternative resources	access to water points may be determined by caste but not always related to water quality
	Religion	Groups with strong religious base may help their own members but not those from other groups, can result in community tension	Religious support can be divisive in communities if selective assistance is provided.	
Livelihood characteristics	Employment	Some sources of employment will be more badly affected by flood impacts (eg farming, retail etc)	water dependency varies between professions, some groups more impacted than others	Water quality has a big impact on some occupations, eg aquaculture, fisheries etc
	Education	More educated people can understand and respond better to meteorological information, and better informed about insurance, and have more flexible ability to find work elsewhere		More likely to be able to respond better to poor water quality
	Location	Influenced by population density, location in floodplains or gullies	downstream vs upstream – may have less access to places to escape to	downstream vs upstream access to good quality water
	Poverty level	lower quality houses; no place to go as evacuation; no means of transport for evacuation	Small farmers have less access to loans to invest in e.g. irrigation or to supplement household income	Poor more likely to have no alternative to poor quality sources of water whereas richer communities can make use of alternatives.

3. Inclusiveness in policy and guidance documents to deal with water-related extreme events

3.1 Disaster Risk Reduction

It is now well accepted that weather events are becoming more commonplace, and more extreme. Dealing with extreme events is the focus of activities of disaster risk reduction (DRR). DRR activities include both dealing with floods and droughts (and other hazards), and are aimed to reduce risks, defined as probability of a hazard times exposure to that hazard times vulnerability.

It has been recognized that often the poorest people have highest degree of exposure and vulnerability (World Bank, 2002) (World Bank, 2002). In response to this, the Sendai framework (UNDRR, 2015) addresses the need for a broader and more people-centered preventative approach to disaster risk. That, in order to be efficient and effective, disaster risk reduction practices need to be multi-hazard and multisectoral, inclusive and accessible. However, although indicators have been developed to assess risks at different levels, these efforts seem to be aimed at monitoring changes of over time (UNDRR, 2019).

3.2 International Financial Institutions and bilateral donors

The element of inclusiveness is mentioned in several initiatives and approaches of financial institutions and bilateral donors. The OECD Water Governance Indicator Framework, through the 12 OECD Principles on Water Governance (OECD, 2015), describes amongst others principles of stakeholder engagement which pays attentions to under-represented categories, by specifying the need to make sure voices of the under-represented and vulnerable and their motivations are involved in governance processes. These principles are welcomed by the ministers of the various OECD countries and are currently in the process of being implemented (OECD, 2018). The Asian Development Bank recently released the report Accelerating Progress: An empowered, inclusive, and equal Asia and the Pacific (Asian Development Bank, 2019), which explores how empowering people and ensuring their inclusion in social, economic, and political activities can accelerate progress towards the Sustainable Development Goals (SDGs). The World Bank underlines the importance of additional work in measuring social inclusion and emphasizes the importance of *asking why* poor outcomes continue to persist for some groups, before designing instruments with which to combat exclusion (World Bank, 2014). Currently the World Bank engages in different initiatives to bring social inclusion into projects and make social inclusion components in projects more evident, for example in a running pilot action plans are developed to enhance social inclusion in Disaster Risk Management projects in five Asian countries.

3.3 Social Impact Assessments

As part of the process to decide on investments in infrastructure, Social Impact Assessments (SIA) are usually carried out. In guidance documents on how to execute Social Impact Assessments for new water related investments, clear steps are described, for example on the importance of understanding the issue, through identification of the 'social area of influence' of the project, a thorough community mapping, a strong inclusive participatory design and agreements on impacts and benefits are proposed (Vanclay et al., 2015).

3.4 High ambitions yet little concrete guidance on 'how'?

Looking at all the different documents that have been published over the past decades, inclusiveness has been in the minds of those involved. However, it has not always been made explicit how inclusiveness can be made tangible in the practice of developing inclusive water management and disaster risk reduction practices. Moreover, financial institutions and donors are emphasizing the importance of inclusiveness and are aiming at a better understanding of why vulnerable groups are more prone to be confronted with poor outcomes of hazards or might not be as supported by planned interventions as expected. Despite the good guidance available on social impact assessments, it is not always clear how the socially differentiated outcomes of interventions can be quantified in order to be able to give them equal weight in decision-making processes.

Lismore camera Club – Flooded street

4. Five steps to account for socially differentiated risks and responses to achieve inclusive outcomes

This section proposes five steps to practically account for inclusiveness in water management and disaster risk reduction assessments (Figure 4.1): 1) look with a different lens, 2) identify different groups of people, 3) conduct risk assessments per group, 4) use inequality-adjusted metrics, 5) assess human response to water-related shocks and extreme events. Below, each of these are elaborated and illustrated with examples in textboxes. These examples show that different ways of looking at water resources systems, using new data or using data in a different way can lead to the identification and selection of different strategies than would have been the case if these approaches were not applied.

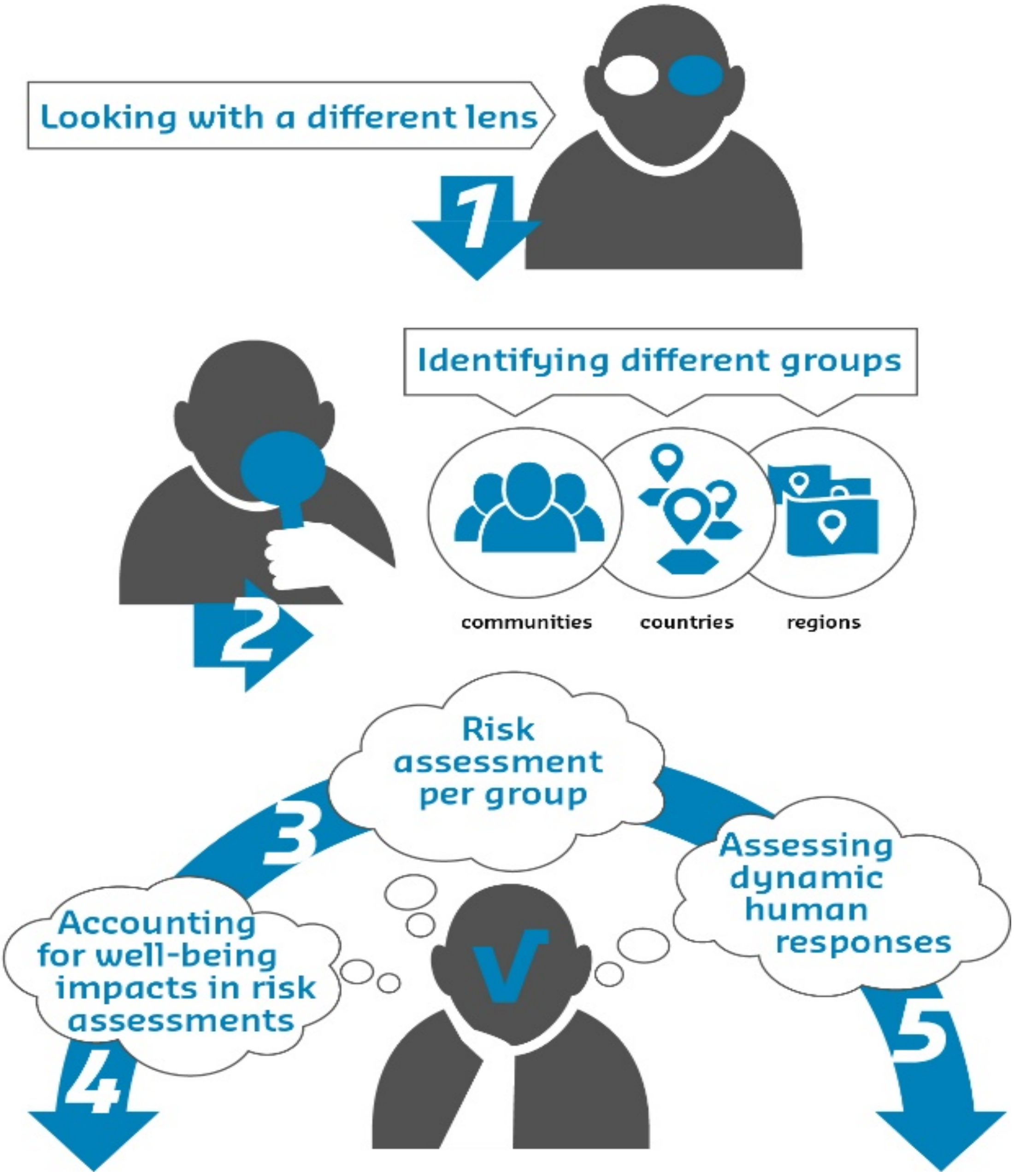

Figure 4.1 Five steps to account for societally differentiated risks and responses

4.1 Looking with a different lens

In general, for water management and disaster risk reduction to be effective and efficient towards inclusive results, social equity should be a key element in planning approaches and assessments. It should be an intrinsic part of the full IWRM or DRR cycle from the problem identification, to planning phase, to implementation to monitoring and evaluation. This requires that risk and policy analyses look at the water resources system and its interaction with society in a different manner. Questions as 'Who is impacted?' (section 2 below), 'How are they impacted?' (sections 3 and 4) and "How will they respond?' (section 5) should take in a central role in water management and planning.

For professionals to be able to apply this different lens, it is important that they are *aware* that different groups of people are impacted differently and *willing* to give this the attention it deserves.

4.2 Identifying different groups of people

A first necessity for more inclusiveness in water management and disaster risk reduction would be the identification and involvement of the different societal groups that are impacted differently by changes in water resources management and planning. A very obvious, yet neglected, activity in assessments is a structured assessment of which societal groups are likely to be impacted by an intervention *in different ways*. This may be an iterative process. This starts by identifying areas to be affected, and the societal groups present in the area, and subsequently understanding how their lives and livelihoods depend on or are threatened by water, to be able to assess exposure, vulnerability and risks. The six dimensions proposed for a climate vulnerability index (Sullivan and Meigh, 2005) help identify these groups: 1) resources, 2) access, 3) capacity, 4) use, 5) environment and 6) geospatial. To elaborate the fourth point, it is important to understand in what ways water is import to people. The national water security index (NWSI) that was developed by the Asian Development Bank distinguishes five key dimensions: household, economic, urban and environmental security and resilience to water-related disaster (Asian Development Bank, 2016). Common methods to carry out this step typically consist of mapping and conducting surveys, although for some indicators data are available through online data sets with near global coverage. Increasingly, earth observation methods can enhance information collection on different groups, as Example 4.1 illustrates for the case of mapping household poverty levels using earth observation.

Example 4.1 Socio-economic status and poverty mapping in Sri Lanka

In order to account for socially differentiated risks, it is essential to know where people with different socio-economic status are located. Yet, reliable datasets on the spatial distribution of people and their socio-economic status are both scarce, and often inaccurate. Outcomes of a traditional flood risk management study in Colombo, Sri Lanka, resulted in a number of strategies that decreased the overall expected annual damages, however also revealed an increase in flood risks in other areas where likely the poorest and most vulnerable people live. In order to better take these risks into account, the first step is to understand and estimate the probability of a certain socio-economic status in a certain location, ideally at building level. We developed an approach that uses both open source spatial data and local (census) data to estimate a certain socio-economic status level in a certain location. Key open source data used are for example distance indicators and key infrastructure. These indicators are used in a random-forest machine learning algorithm to estimate a certain socio-economic status level per grid-cell, such as accurate building classification. This method is currently being applied to the entire city of Colombo.

The figure below shows an example of a single district in Colombo, but current work is addressing a larger spatial scale to predict socio-economic status for all districts of Colombo.

SES distribution Kotuvila

Figure 4.2 Density map of Kotuvila

4.3 Assessing socially differentiated water-related vulnerability and water-related risks

Risk-based approaches are commonly used to choose between alternative management options for different types of hazards. For example, these risk-based approaches combine the probability of a hazard (e.g. high discharges in a river), with the level of exposure to this hazard (e.g. will a house indeed be inundated or is it protected by a dyke), and the vulnerability of those exposed (e.g. what is the likely damage (in some cases the possibility of compensation from public funds or insurance is considered but in many places in both the developed and less developed countries of the world, this is often not the case).

Vulnerability may be expressed in monetary terms, and as a result risk is often expressed as expected annual damage (USD/year). This approach may be problematic due to issues relating to value of life, changes in exchange rates, purchasing power parity issues etc. As a result, it has been argued that vulnerability can be expressed in other ways as well. The water poverty, water vulnerability and climate vulnerability indices are dimensionless indices in which resource availability, access to the resources and capacity to cope with variations in availability are, together with other information, calculated into an area and group specific measure of vulnerability to water-related shocks and trends. The Water Poverty Index (Sullivan et al., 2002) made it clear that water poverty, which goes beyond water availability and demand by including access and capacity of different societal groups, varies socially, see Example 4.2.

Example 4.2 Water poverty index and water vulnerability index

The Water Poverty Index, and related Climate Vulnerability Index were developed originally for the UK Department for International Development by a large multidisciplinary team led by Sullivan (Sullivan, 2002, Sullivan et al., 2003, Sullivan, 2011). Designed to be applied at a range of scales, the composite index based approach built on the sustainable livelihoods framework of Sen (1985), Chambers and Conway (1992) and Scoones (1998).

Extensive local and international consultation resulted in a composite index of water poverty, based on five components: *resources, access, capacity, use and environment.* 12 case studies were carried out to test this and other methods of measuring water poverty, in South Africa, Tanzania and Sri Lanka. From this, indicators of each component of these were identified and generated from publicly available date from 178 countries across the world, to demonstrate how this approach could be used in any country or situation. On the basis of the variability of the different component values, it is possible to identify the key causes of water poverty in the location of interest (Sullivan et al., 2002, Sullivan et al., 2003) This approach was then later extended to take account of climate change, resulting in the Climate Vulnerability Index. Both of these tools have been widely used in a range of countries.

Later work was then carried out to develop a *Water Vulnerability Index*, to take account of the fact that people of all locations and of different socioeconomic standing may be vulnerable to variations in water resrouce availability, including floods and droughts (Sullivan, 2010). This approach, while still based on a composite index, has been designed more on the basis of a supply and demand model and applied at the local government scale, as illustrated below:

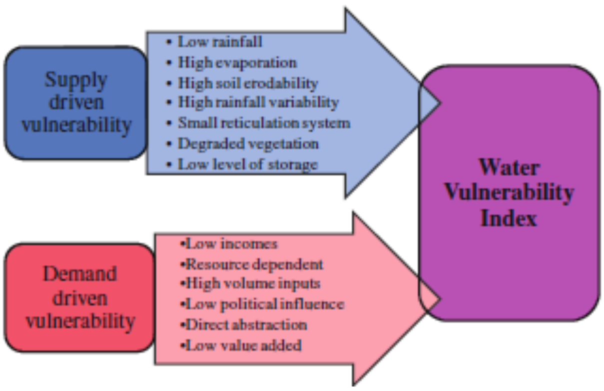

Figure 4.3 Supply and demand model

An illustration of this approach applied to 10 municipalities in South Africa is provided to demonstrate the way this method can be used to highlight sources of vulnerability.

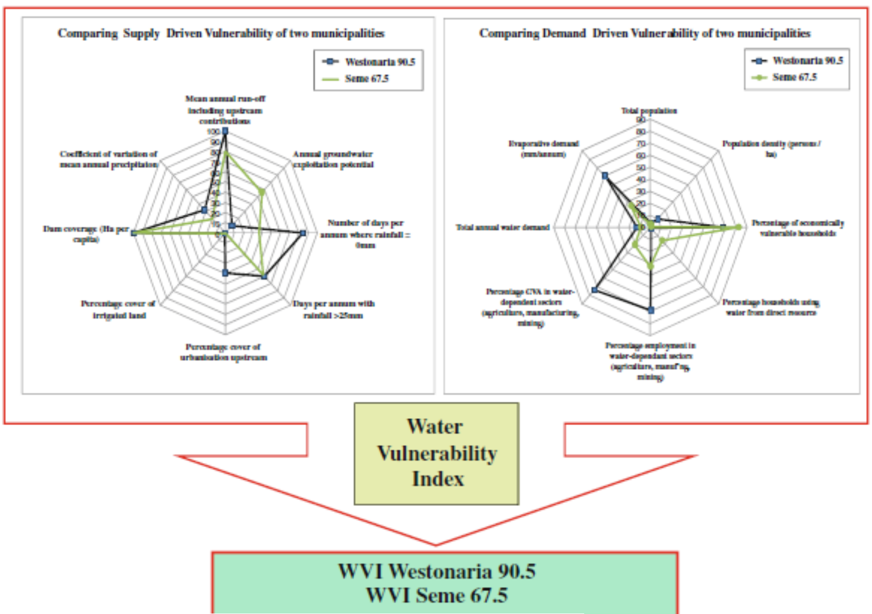

Figure 4.4 illustration application supply and demand

To understand the impact of their operations on ecosystem and society, Kimberly Clark and Deltares developed a tool that shows spatially and socially differentiated water risks, see Example 4.3.

Example 4.3 WaterLOUPE

For a socially differentiated assessment of water scarcity-related risks in the basins where Kimberly-Clark operates, Kimberly-Clark and Deltares jointly developed the 'WaterLOUPE' approach. It supports multi-actor decision-making and collaborative action for water stewardship. It provides information on the availability and use of water in scale and over time.

WaterLOUPE combines data on hydrology, exposure and vulnerability at the sub-national level. The underlying models run the risk assessment for each actor-group separately, instead of providing one generic risk assessment per basin. This type of assessment gives insight in who is at risk and how that risk can be explained. For example, for the case of the sub basin of Rio Palo in Cali, we can observe that the type of stakeholder with the highest risk are the self-subsistence farmers (Figure 4.5), while industries and business show no risk at all. This can be explained by the fact that 79% of the land is used for agricultural purposes and that there are very high rates of poverty and extreme poverty in the sub-basin, which are probably the main drivers for risk in this area (Figure 4.6).

This type of assessment allows a more inclusive view on identifying drivers and looking at risk and may help identify solutions to water scarcity that are not just in the physical domain, but also in the social domain.

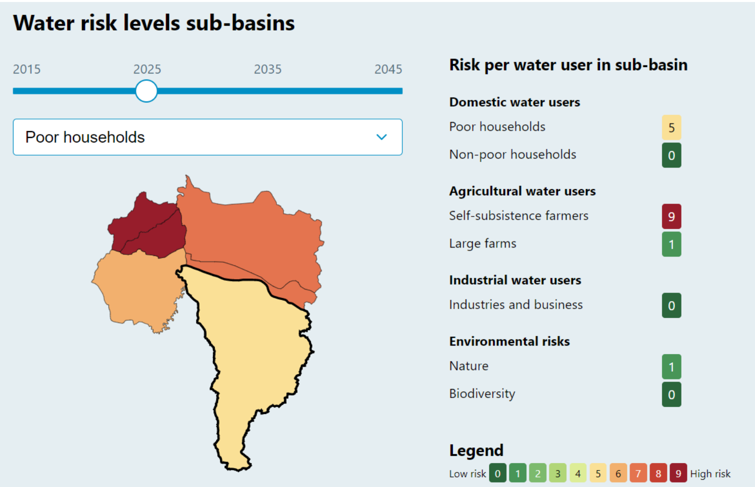

Figure 4.5 Water risk levels sub-basins

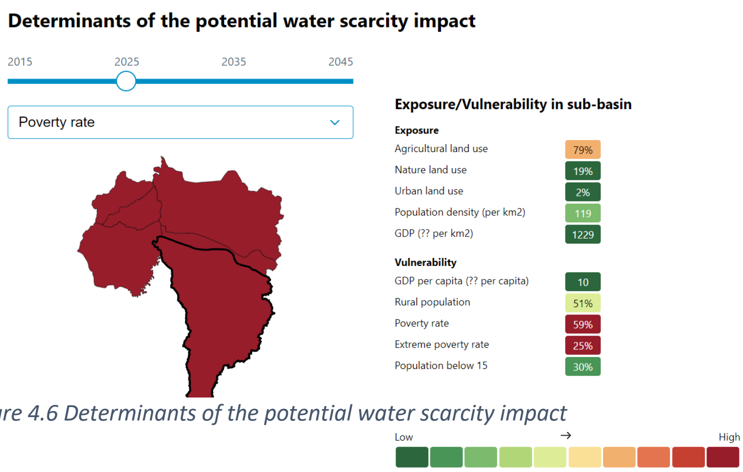

Figure 4.6 Determinants of the potential water scarcity impact

More information can be found at:
https://www.deltares.nl/en/projects/waterloupe-mitigating-water-risks-improve-livelihoods-reduce-costs/

4.4 Accounting for wellbeing impacts in risk assessments

Risk-based approaches to assess flood and drought risk typically express risk as annual expected damage. Since the economic value and -accordingly- the damage of poor households is generally lower than the economic value of rich households, the examined flood or drought risk is lower for poor households This justifies investments in flood protection in rich areas and oppose investments in poorer areas, or in prioritization of water supply to high value cash crops. However, the relative value of these assets for the level of welfare and well-being of these poor households is often very high.

Due to the higher levels of vulnerability experienced by poor households, the benefits of risk reduction are likely to be higher for poorer than for richer households. Furthermore, the marginal utility of income is higher for poor than for rich households, meaning that a loss of one dollar of income has more impact on welfare for a poor person than for a rich person. Kind et al (2017) showed that accounting for these relative well-being levels in cost-benefit analysis would result in different choices being made in terms of flood risk management. Similarly, Meijer and van Beek (2011) showed that accounting for the relative importance of water-related ecosystem services for different well-being aspects to rural households (income & food, health, and perception & experience of the environment) would lead to different valuations of water and extreme event management alternatives.

4.5 Assessing dynamic human responses

How will people respond to water related risks, especially when they are not evenly distributed between different social groups, and thus likely to increase societal inequalities? Risk assessments assess how different groups are impacted by certain changes, however, people do often not simply undergo these impacts, but they will respond to them. How groups and individuals will respond is understood to be a combination of social, economic, political and personal factors. Developing a better understanding of the dynamic nature of human behaviour in response to both shocks and trends will help to understand societal impacts over time, and can help to identify new ways to intervene and reduce negative impacts. Poverty, food insecurity, unemployment and inequality are quoted in the scientific literature as important driving forces for violent conflicts and migration. (Brinkman and Hendrix, 2011, Kett and Rowson, 2007, GSDRC, 2011). Droughts, flooding and water quality problems might affect these drivers, enhancing the risk of violent conflicts and stimulating migration. Inclusive water management can help avoid such consequences by reducing impacts on potentially already marginalized groups and by distributing impacts more evenly to avoid increased inequality. Two examples of assessing human behaviour are included in Examples 4.4 and 4.5.

Example 4.4 Modelling human responses to drought in the Inner Niger delta in Mali

The Inner Niger Delta in Mali is a large wetland of around 15,000 km^2. The annual regime of inundation and recession is important to sustain the ecosystem services on which around 2 million people depend (Zwarts et al., 2005). These people base their livelihoods on pastoralism, fishing and farming. The situation in the Inner Niger Delta is already insecure, with violent conflicts and attacks happening frequently. If the ecosystem and the livelihoods would be further stressed, this may further deteriorate the security situation.

During a workshop in January 2019 as part of the Water, Peace and Security project financed by the Duthc Ministry of Foreign Affairs, the links between water, ecosystem services and human responses were discussed with a small group of representatives from government and civil society. These discussions formed a first indication of causal links between water and insecurity, as displayed in Figure 4.7.

Most socio-professional groups belong have one of the three activities mentioned above as their main activity and identity, and practice some of the other activities for additional food or income. Changes in the flooding regime, either natural or man-made, as well as population growth in the delta, have resulted in increased pressures on the availability of resources, loss of income and social status and increased competition over resources. Partly blaming the national government for the degradation of the wetland, in favour of irrigation upstream, and with the rising of jihadist influence from the north, the response of some groups was violent extremism or criminal activities. These led to an insecure situation, in which the law was no longer enforce and these activities could continue unpunished. Some people chose to migrate as a combination of loss of income and increased violence.

Understanding these dynamics and how different factors combine to trigger certain responses is important to understand how changes in water resources management, such as building a new dam, could worsen the situation, as well as to understand what actions, either water-related or not, could help break the vicious cycles and reduce triggers for violence and criminality.

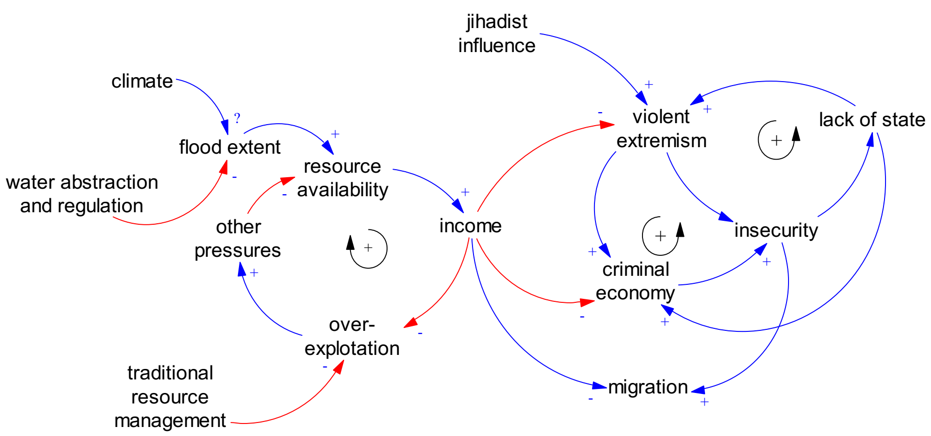

Figure 4.7 Graphical representation of discussions on links between water and conflict in the Inner Niger Delta in Mali.

Example 4.5 Socio-economic impact monitoring and assessment of water system interventions

Tools that support the selection of effective and efficient interventions include cost-benefit analysis and multi-criteria analysis. Often these tools do not comprise long-term socio-economic impact on different groups (e.g. cultural groups, poor/rich), whereas insight in these impacts can support inclusive decisions making. One of the reasons is the lack of information on the long-term socio-economic impact due to the absence of (long-term) socio-economic monitoring. Furthermore, impacts of shocks or interventions on behavior and human adaptation is not always well-understood, while this determines socio-economic impact.

Agent based modelling is a tool that can support the assessment of long-term human responses to shocks or interventions. In the Water Management Knowledge and Innovation Program (WMKIP) an agent-based model was developed to assess the long-term impacts and upscaling potential of pumped drainage in polder systems in Bangladesh. The project monitors human behaviour before and after installation of pumped drainage by conducting surveys and focus group discussions. The subsequent human characteristics and behavioral rules were included in an ABM resulting in an indication of the short- and long-term impact and upscaling potential of the intervention 'pumped drainage' in different polders systems. The assessed impacts include inequality, food security and poverty amongst different groups. The method supported to provide an indication of socio-economic impacts of an intervention for different groups without long-term socio-economic monitoring.

Feedback from presenting an initial version of the ABM developed, was that the persons involved with a background in water management, realized that the polder was not inhabited by a homogenous group of farmers, but rather by different types of farmers, with different behavior on which an intervention has different impacts. In turn, this has led to the identification of potentially arising conflicts, as the intervention mainly benefits the arable farmers, which may lead to conflicts between the -more wealthy- fish farmers and arable farmers. These insights are meant to support the implementation process of the intervention, as well as to support the identification of additional policies that can take away the negative impacts for some of the stakeholders.

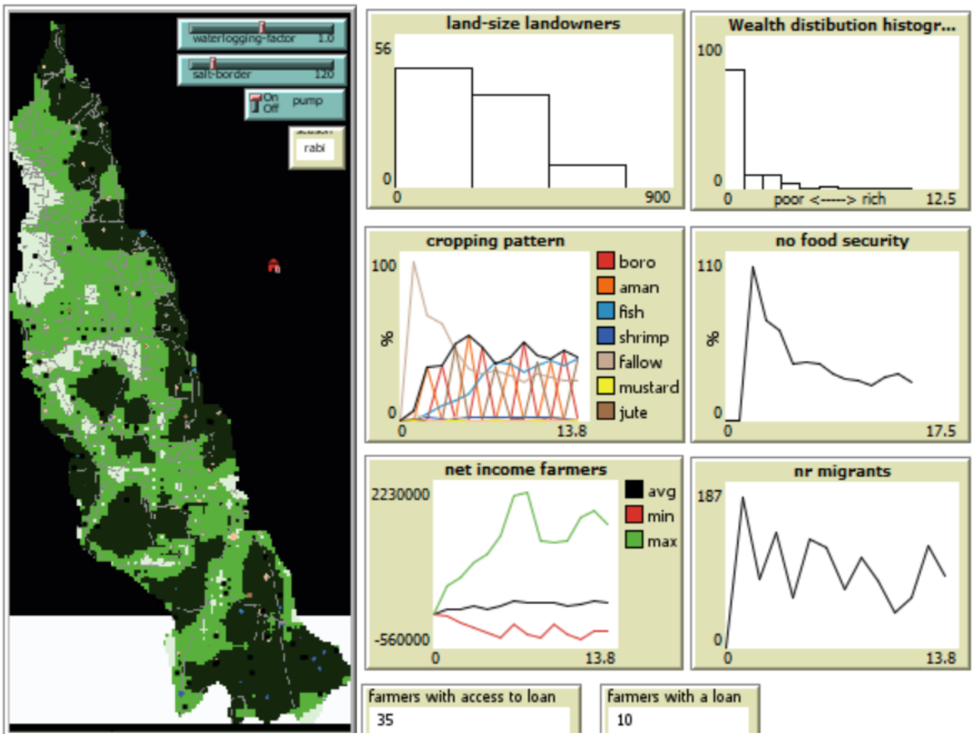

Figure 4.8 Variations in land use and drainage congestion in pilot polder and initial model results over time (Source: Schasfoort and De Groen, 2019)

5. Mainstreaming assessments of inclusive outcomes in planning process for water management and disaster risk reduction

The previous section suggested five steps to assess socially differentiated risk and responses in relation to water-related extreme events. We believe that understanding risks and responses is an important prerequisite for more socially inclusive water management and disaster risk reduction. However, to facilitate the actual application of these approaches a number of aspects required attention. Here we briefly discuss five of these aspects.

First, it is important that an assessment of socially inclusiveness is done following an inclusive approach, in which the people concerned are explained what the assessment is about and be given the opportunity to participate in the process.

Second, it may require clarification/guidance on how to fit these methods in existing planning approaches. Most planning approaches consists of cycles of steps that include activities like setting objectives and choosing indicators, conducting a situation analysis, assessing future risks, and assessing effectiveness of interventions/strategies. The above-mentioned approaches can fit nicely into this step by choosing alternative indicators, data collection and assessment methods. The additional data collection and new ways of assessing risks or studying human responses, will likely take more time and effort, but if this is integrated in the approach from the beginning this does not have to be extensive.

Third, it will help when institutional procedures and criteria to allocate funds explicitly ask for a socially differentiated assessment of risks and benefits of proposed investments.

Fourth, a reason why non inclusive interventions are chosen may be that very seldom a proposed intervention scores well on all three dimensions of sustainable development: economic efficiency, social equity and environmental sustainability. Almost always different interests are traded against one another. Choosing a longer time scale to incorporate future performance of interventions and assessing dynamic responses that could undermine the short-term economic benefits may help change the outcome of such trade-offs.

Five, additional research on these dynamics will be required, and monitoring of actual human responses as a result of implemented interventions will be the best way to learn. The recent developments in the Murray-Darling basin, where complex conflicts have arisen between irrigators, other farmers, communities, conservationists and indigenous people (McKay, 2011, Sullivan, 2014, Vertessy et al., 2019) show that even the best laid-out plans may not yield the intended result. Only continuous monitoring, and adaptive management, will help reduce the gap between theory and practice.

6. Next steps

Addressing inclusiveness is important, has a legal and ethical basis, can support economies and maintain or create political social stability. More inclusive dealing with water-related extreme events starts by understanding how different groups in society may be impacted differently by changes in the water system and how they impact this system themselves. This can be done by looking through a different lens, asking different questions, using different metrics, and disaggregating results per societal groups.

Approaches to make inclusiveness more tangible range from mapping different groups and exposure to extreme events, alternative ways to account for impacts on livelihoods and well-being, and to quantitatively modelling human responses to theses impacts. The better the impacts are understood, the better suitable interventions can be identified and assessed. This type of results can facilitate a more inclusive decision-making process for policy development, program and project design not only for IWRM, but also for tailoring better responses to the pressing and dangerous impacts of extreme events. With a more inclusive approach to evaluation of the impacts of water related events on different components of society can help decision-making to be better informed regarding social impacts of different options and trade-offs.

Achieving inclusiveness subsequently requires that the groups of people concerned are given a voice to express what they need, how they can govern, and are involved in the identification of problems and potential solutions. An inclusive process is thus required to ensure that the interests of those impacted are well represented. Moreover, it is important that the approaches such as the ones described in this brief paper can be integrated in commonly used assessment methods, appeal to investors and decision-makers. To achieve the latter, it is required that there is willingness and awareness: of the need, the reasons why and the ways how to account for inclusiveness in water resources management and disaster risk reduction. In addition, to ensure that this is achieved within the constraints of planetary boundaries, it is important that our concept of inclusion also recognizes the biodiversity that underpins the vital functioning of the Earth system that keeps us all alive.

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