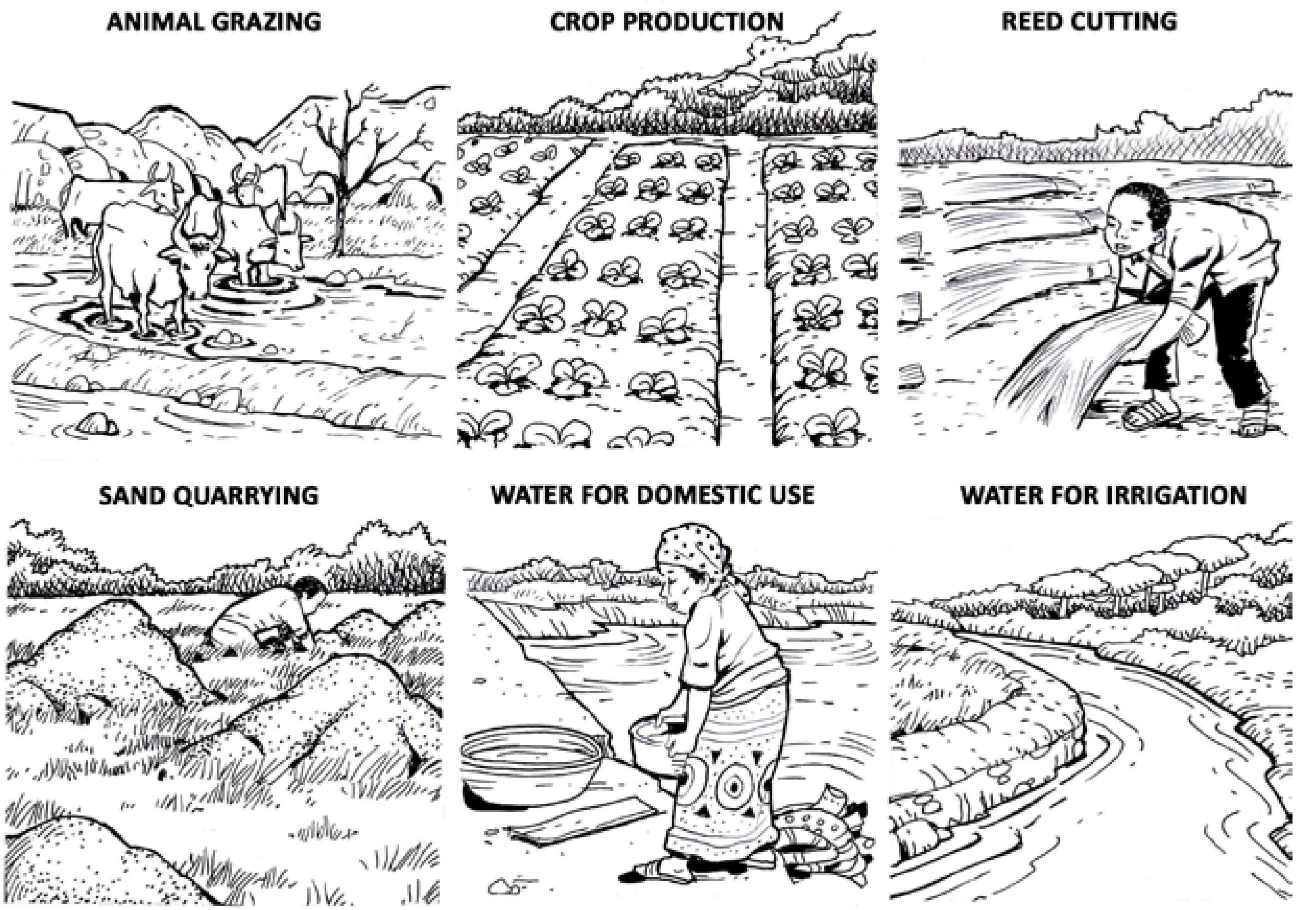
Framework and Tools for Wise Use and Management of Wetlands



Unplanned conversion of wetlands can lead to degradation and compromise the livelihoods and other benefits derived from them.

In areas with long dry seasons, wetlands represent an important water and agricultural resource helping to mitigate the impact of drought on crop production and food availability. Altering wetlands through unplanned conversion to croplands, however, can lead to degradation and compromise the livelihoods and other benefits derived from them.

To manage wetlands is to manage variability and unpredictability. There are at least two reasons for this. First, they are part of a wider socio-economic and political context with key drivers that are not ecological in nature–e.g., markets and societal values. Second, they are complex and variable, exhibiting patterns that are not entirely predictable. These characteristics make them resilient or adaptable. The Integrated Framework for Wetland Inventory, Assessment and Monitoring (IF-WIAM) of the Ramsar Wetlands Convention evolved with these perspectives in mind, among many others. The framework integrates

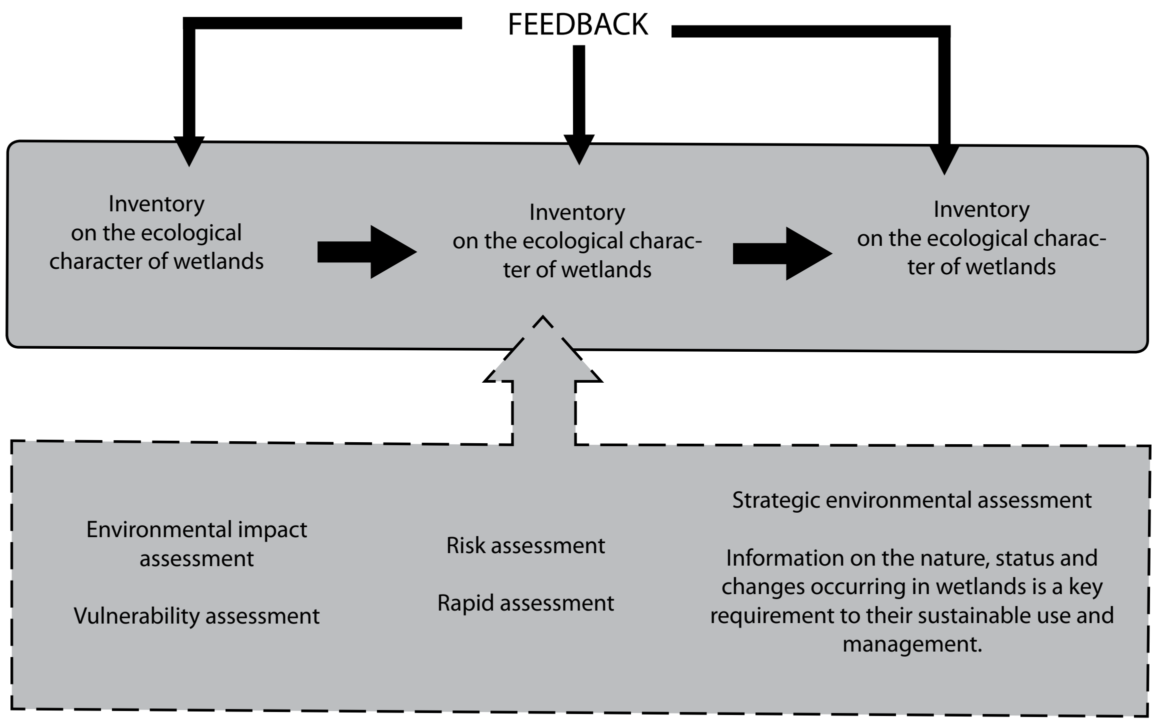


Figure 1. The Integrated Framework for Wetland Inventory Assessment and Monitoring (re-drawn based on Finlayson and Pollard, 2009).

a) complementary approaches for determining information needs at different scales given available resources; and b) tools for collecting and assessing information for the sustainable use, conservation and development of wetlands.

Wetlands are complex and variable ecosystems that can also be changed by non-ecological forces such as markets and politics. Managing wetlands is managing this variability and unpredictability.

A framework for building up wetland information

The IF-WIAM integrates three inter-related processes for collecting and evaluating biophysical and related information necessary for the wise use and management of wetlands: inventory, assessment and monitoring. They are distinct but overlapping processes (see Figure 1).

Wetland (baseline) inventory is the collection of information to describe the ecological character of wetland, whereas assessment is determining the status of and threats to wetlands. The latter takes into account the pressures and associated risks of adverse change in the ecological character of wetlands. Documenting information on the extent of any change in wetlands especially resulting from management actions based on assessment activities is the function of monitoring. Monitoring also updates assessment and inventory data, thus completing the circular relationship of the three components. Taken together, these processes provide the information needed for establishing strategies, policies and management interventions to maintain the defined wetland ecosystem character and hence ecosystem benefits/services.

A. Wetland inventory

The inventory provides information on the ecological components, processes and ecosystem services in wetlands. Early inventories have not included ecosystem services because wetlands Convention has only recently considered them to be part of the ecological character of a wetland. The Ramsar Convention Handbook lists 13 steps for designing a wetland inventory. Setting the objective/s is the first of these steps since this, plus the resources available, are major factors for the design of the inventory. More than providing information, objectives of a wetlands inventory may include (Costa *et al* 1996):

- Identifying where wetlands are, and the priority sites for conservation;
- Identifying the functions and values of each wetland;

Wetland Ecosystems Services

Provisioning: source of food, fuelwood, fiber and timber

Regulating: benefits in terms of water partitioning, pest regulation, climate regulation, pollination

Cultural: spiritual, recreational, aesthetic, educational

Supporting (factors important for producing above 3 services): water cycle, soil formation, nutrient cycling, primary production

- Establishing a baseline for measuring change in a wetland; and
- Providing a tool for planning and management.

The manner in which an inventory is to be conducted depends on the objective/s and thus, there is no specific inventory method suggested. Practitioners need to work through the steps to develop the suitable inventory method, including identification of training needs and planning for contingency measures in support of the method. In the end, however, a well-planned inventory is only as effective as the personnel engaged to do it.
If resources are not enough for extensive data collection, it is still useful to undertake a simple inventory for particular wetland sites as in the Limpopo Southern Africa. Such site-based inventories are valuable in the absence of a regional inventory, provided the methods and information used go beyond specific wetland boundaries.

B. Wetland assessment

Six of the more common and inter-related assessment tools are risk assessment, vulnerability

13 STEPS TO WETLAND INVENTORY DESIGN (Ramsar Convention Secretariat 2007b)

1. State the purpose and objectives on which decisions on methods and resources are to be made.
2. Review existing knowledge and information for their relevance to the proposed inventory work.
3. Review existing inventory methods for suitability to the stated purpose and objectives. Methods include ground-survey, aerial photography, topographical maps and satellite imagery.
4. Determine the scale and resolution of the maps to be drawn according to the minimum acceptable accuracy—e.g., 1:50,000 for a specific wetland site.
5. Establish a core or minimum data set for delineating/characterizing major wetland habitats to include its biophysical and management features.
6. Establish a habitat classification based on landform and water regimes plus other features such as vegetation, soils, water quality and size.
7. Choose an appropriate inventory method in relation to purpose and objective, the terrain, resources and time available.
8. Establish a data management system for collecting, recording and storing data in electronic and hardcopy formats. It should enable future users to determine source, accuracy and reliability of data.
9. Establish a realistic time schedule and the level of resources required, taking into account special features of the terrain, sampling techniques to use and available funding and resources.
10. Assess the feasibility and cost effectiveness of the project based on availability of trained personnel, specialized equipment needed and support for any project continuation, among others.
11. Establish a reporting procedure. Reporting of results should be timely, cost effective and in a form readily understood by others.
12. Review and evaluate the inventory. At a predetermined time, the entire process should be re-examined and necessary modifications made.
13. Plan a pilot study to fine-tune the methods and steps, adjust the time schedule and assess other needs before launching the actual inventory.

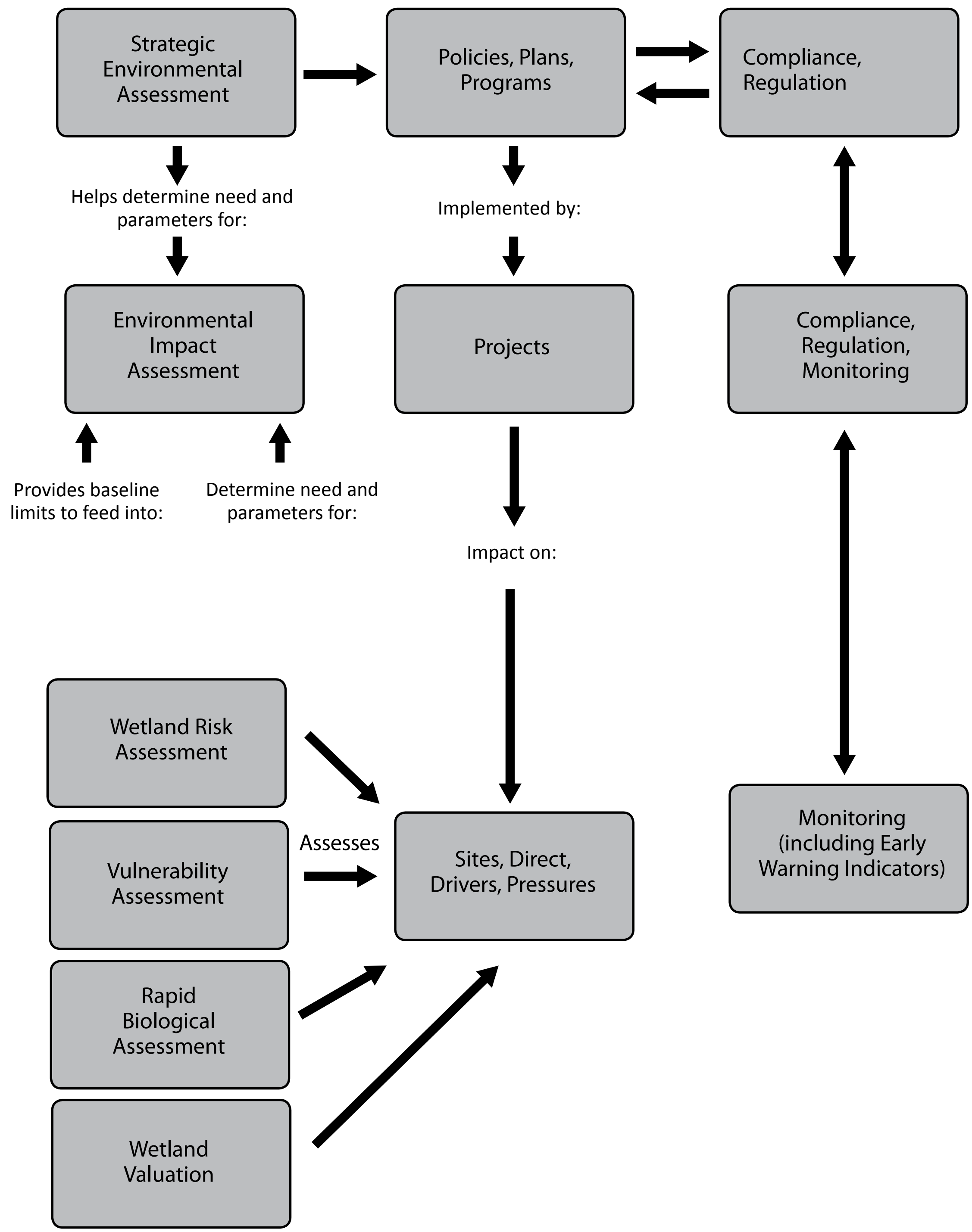


Figure 2. Relationships among the different assessment tools

Source: Ramsar Resolution IX.1.e. An Integrated Framework for Wetland Inventory, Assessment and Monitoring (IF-WIAM). 9th Meeting of the Conference of the Parties to the Convention on Wetlands (Ramsar, Iran, 1971). Kampala, Uganda, 8-15 November 2005.

assessment, rapid assessment, economic valuation, environmental impact assessment and strategic environmental assessment. Figure 2 shows how these tools relate to each other. The first two are discussed in the next sections with respect to assessing risks and developing options for risk management.

1. Risk assessment

Wetland risk assessment evaluates the likelihood of adverse ecological effects occurring due to exposure to one or more pressures. It guides one on how to predict and assess changes in the ecological character of wetlands and promotes the use of early warning systems for determining when change may occur. The pressures or drivers of change include changes to the water regime, water pollution and eutrophication, physical modification to the wetland, overexploitation of biological products or fresh water and introduction of exotic species. Risk assessments observe these six steps (Ramsar 1999).

1.1 **Identification of the problem.** This is information on the characteristics of the pressure, what is to be affected and what is to be protected.

1.2 **Identification of the effects.** Field data are appropriate for assessments of multiple pressures, thus, identifying the effects best derived from field studies. Depending on the pressure(s) and resources, these range from quantitative field experiments to qualitative observational studies.

1.3 **Identification of the extent of the problem.** This involves estimating the exposure to a pressure Through information about its behavior and extent of occurrence. Information is obtained through field surveys, use of historical records, simulation modeling and field/laboratory studies.

1.4 **Identification of the risk.** This estimates the likely level of adverse ecological effects resulting from exposure to the pressure. A qualitative matrix may be used to do this. Multiple opinions or lines of evidence can help quantify the qualitative nature of assigning the risk and reduce the uncertainty associated to it. Uncertainty must be described and the risks sufficiently defined to support a risk management decision. The output, however, need not be a quantitative estimate of risk.

1.5 **Risk management and reduction.** This process utilizes information from the previous steps and attempts to minimize the risks without compromising the societal, community or environmental values. Each risk-reducing action

Table 1. A matrix for qualitative assigning of risk based on the likelihood and consequences of exposure.

LIKELIHOOD OF EXPOSURE	CONSEQUENCES OF EXPOSURE		
	Little	**Serious**	**Catastrophic**
Low	Very low risk	Low risk	Medium risk
Medium	Low risk	Medium risk	High risk
High	Medium risk	High risk	Very high risk

is assessed with respect to the political, social, economic and technical factors, as well as the benefits and limitations.

1.6 **Monitoring verifies the effectiveness of risk management decisions.** The choice of indicators to measure (i.e., what will be monitored?) is critical in this regard. They may or may not be the same as those used for effects characterization.

2. Vulnerability assessment

Vulnerability assessment determines the extent to which a wetland is susceptible to, or unable to cope with, adverse effects of climate change and other pressures such as changes in land use and cover, water regime, over-harvesting and invasion by alien species. It determines the probability of a risk event occurring and its effect on a system given its level of sensitivity, resiliency and coping capacity. It is also about developing options to reduce the adverse impacts from the risk event and formulating the desired outcome for the system within an adaptive management framework.

Gitay *et al* (2009) suggested a framework for vulnerability assessment. It has three major components: assessment of risk, risk minimization or management and monitoring and adaptive management.

2.1 **Risk assessment. Status, trends and perceptions about risks are established through** a) identification of past and present drivers of change and of existing hazards; b) assessment of present condition and recent trends in the ecological character of wetlands; c) conduct of a stakeholder analysis with the people to be affected by the changes; d) determining sensitivity and resiliency, including adaptive capacity of wetlands; e) identifying wetlands and groups most vulnerable to the changes; and f) developing scenarios with stakeholders given the risks from and interactions between the change drivers.

In any assessment, the certainty associated with the outcome should be recorded and kept in mind when making management decisions. One decision could be to undertake further monitoring to reduce any uncertainty and to use new information to reassess the risk.

2.2. **Risk minimization or management. This component has two important aspects.** The first is the identification of the specific wetlands and groups of people that are most vulnerable (i.e., with low adaptive capacity) to the risks associated with adverse changes. The second is developing the response options and determining which would best minimize the risks from changes in the ecological character of wetlands so the ability to provide the ecosystems services that people depend on can still be maintained. Response options can be regulations, strategic environmental planning, infrastructure/engineering works, rehabilitation and restoration, developing education material, improving community awareness and, developing integrated management plans. Trade-off analysis helps choose between the response options given constraints such as institutional capacity, available information and financial capacity. The desired outcomes are then specified based on the chosen option. A large adaptive capacity, high resiliency and low sensitivity of the system may sometimes mean there is no need for a management response.

A system can be vulnerable at a particular time but may not be at other times—e.g., vulnerability to fire increases during the dry season.

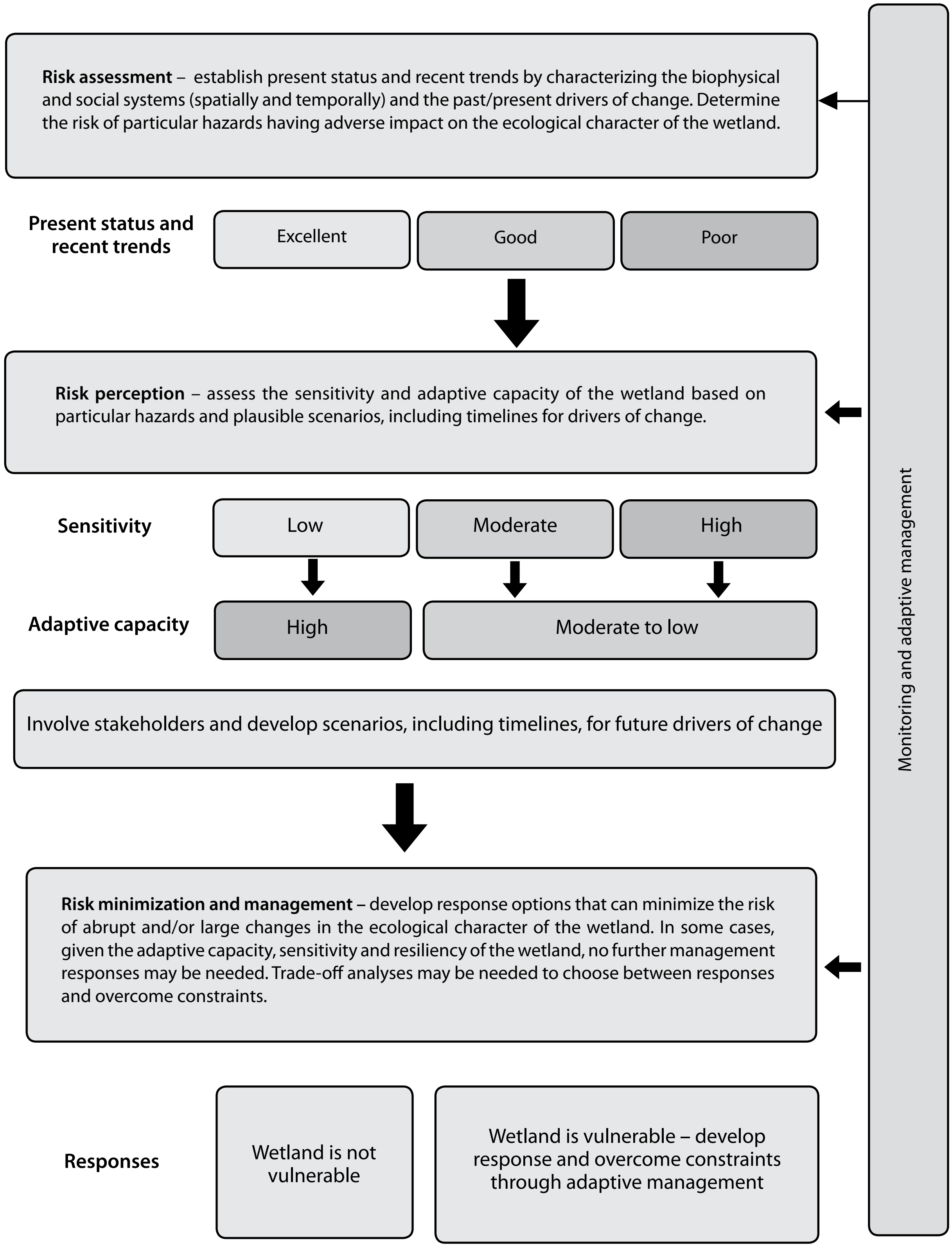


Figure 2. Relationships among the different assessment tools

In the CGIAR Challenge Program on Water and Food (CPWF) Wetlands Welfare and Environmental Security project in the Limpopo Basin in Southern Africa (CPWF Project Report, 2010), trade-off analysis was done with a computer- based simulation model called WETSYS. The model simulates the impacts of alternative wetland management strategies and external pressures on wetland ecosystem functioning and community well-being. It has five interactive sectors: hydrology, crop production, natural resources, land use and community well-being. A sixth sector controls annual and seasonal cycles of activities. Wetland management options, which can be simulated using the model, include introduction of crops more adapted to wetland environment, reduction of artificial drainage, development of ecotourism and imposition of controls on wetland resource use. There were two main challenges in the development and use of the model. The first was the limited time-series data available to calibrate it, especially socio-economic information. The second was the difficulty in quantifying narratives about past land-use changes.

Table 2. Relationship between sensitivity, resiliency and vulnerability of a wetland

SENSITIVITY	RESILENCE	
	High	**Low**
Low	Not vulnerable	Vulnerable
High	Vulnerable	Very vulnerable

2.3 **Monitoring and adaptive management throughout the process**. This includes the means for measuring and making adjustments in the path to the desired outcomes. The process involves acting on early warnings, checking results of past actions and modifying project objectives and indicators in response to new findings.

C. Wetland monitoring

Monitoring addresses the issue of change or lack of change through time (Ramsar 1996) at particular places through systematic data collection over time. According to Finalyson (1996), its overall purpose is to determine the extent of change in the ecological character of a wetland as per hypothesis and objective derived from the assessment of the pressures or threats facing the wetland. In monitoring, the identification, effective measurement and use of early warning indicators are important for managers to determine whether intervention or further investigation is needed before the adverse change occurs. The earlier the signal, the more time for appropriate management responses.

The Ramsar Convention offers a structured approach for designing a wetland monitoring program at multiple scales from site-based to provincial, national and regional.

When resources are insufficient or not available for an effective monitoring program, it may still be useful to do an initial surveillance program to guide and support initial management decisions. This has been done in the Limpopo Basin project (CPWF PN 30). Table 3 on the next page presents results specific to the Missavene Wetland of the Limpopo project to show the types of information that may be generated from such initial activities. The first five columns are the results of the assessment activities, while the last column accordingly focuses on the monitoring aspects.

Table 3. Assessment and monitoring for Missavene Wetland, Mozambique
(Compiled by: S. Bandeira and D. Juizo, Universidade Eduardo Mondhlane, Maputo, Mozambique)

Identify main threats/issues in no particular order	**Outline the cause of the threat**	**Describe what part of the wetland is under threat – Which components or processes or services, and where?**	**Outline how the assessment was done – What tools or processes were used?**	**What management action can be taken?**	**Describe what monitoring is in place or proposed – What indicator is being used? What is the threshold when further action will be taken?**
Reeds (*Phragmites muaritianus*) and bulrush (*Typha capensis*) being cut	Too many people cutting reeds for building toilets and bulrush for making mats and boats	Extent of reed and bulrush being reduced Activity is unsustainable given the amount present and growth dynamics	Observation	Limit number of people harvesting resources. Limit period of cutting to allow re-growth. Allow cutting in half of reed areas only	Map distribution of reeds and bulrush per season Estimate: ◆ Growth dynamics ◆ Demand for resources Test time and place ban of cutting Test limit of % of cut.
Fires	Extensive and uncontrolled coverage of fire	Fauna and plant diversity reduced	Observation	Sensitize community to good and bad practices about fire. Consider ban on fire for small area of Missavane wetland	Document and evaluate wildfire frequency, causes and effects Ban some wildfire causes Propose guidelines on how to manage fires
Increased number of fields for crop production	Made at the expense of natural vegetation and species (some nearly extinct)	Native species being reduced Area with native vegetation also reduced	Observation and comparison	Consider increasing crop yield per area instead of increasing crop area	None so far
Reduction of grassland habitat	Too many cattle in wetlands Expansion of cropping into grasslands	Grassland		Land-use planning to consider area for agriculture development and for cattle pasture	First understand from users/ stakeholders which areas they would prefer for agriculture, pasture and other development

Lessons learned

Users and managers of wetlands face many challenges. This is because wetlands are part of a wider socio-economic and political context with key drivers that are not ecological in nature e.g., markets and societal values. A multi-faceted approach that incorporates both social and technical issues is therefore needed for the wise use and management of wetlands. The IF-WIAM has taken this into account.

The local level is the most logical entry point for effective and sustainable wetland management. This is because while wetland rules and regulations are formulated and passed at the national level, wetlands management still takes place at the local level where rules, sanctions and penalties are applied and enforced. Strong partnership with the communities is therefore essential. One partnership activity that may help reduce the pressure on wetland resources is improving the earning capacity of people from non-resource-based livelihood activities.

While the thrusts of the Ramsar Convention and the IF-WIAM are geared towards national to regional/global application, resource limitations dictates that simple inventories at individual wetland sites may be all that is possible. To maximize and expand the value of interventions at local or individual sites, the following are suggested:

- When undertaking wetland inventory, assessment and monitoring (WIAM) at individual sites, methods to be used and information to be generated should be compatible with and support the information needs at national/regional levels.

- Strong partnerships with the communities and involvement of local government officials can help ensure that wetland management

An early warning indicator is a measurable biological, physical or chemical response to a particular stress, preceding the occurrence of potentially significant adverse effects on the system of interest. An early warning provides opportunity to determine if further investigation is needed and not necessarily firm evidence of larger scale degradation. (van Dam et al. 1999).

Attributes of effective early warning indicators (van Dam et al. 1999 in Finlayson and Pollard, 2009)

Early warning indicators should have these attributes:

- **Anticipatory: provides indication of adverse change before serious harm occurs**
- **Sensitive: detect low levels/early stages of change**
- **Diagnostic: sufficiently specific to provide confidence in identifying the cause**
- **Broadly applicable to a range of causes**
- **Timely: provide information quickly enough to initiate management prior to impacts**
- **Cost-effective while providing maximum amount of information per unit effort**
- **Regionally relevant to the ecosystem being assessed**
- **Socially relevant: of value to and observable by stakeholders.**
- **Easy to measure: uses standard procedure with known reliability and low error**
- **Constant: can detect small changes, and can clearly distinguish the source**
- **Non-destructive to the ecosystem being assessed**

programs developed are appropriate and therefore sustainable. This will ascertain that the local uses of wetlands and the accrual of benefits to the locals are seriously considered. This ensures long-term awareness and incorporation of local concerns into management programs.

- Joint implementation with university partners— e.g., getting graduate school students to do research related to the wetland project can result in more in-depth analysis of specific issues on wetlands management/IF-WIAM.

Conclusion

The framework, processes and tools presented are not recipes for doing WIAM. Rather, they are to serve as a guide for developing and undertaking WIAM particular to one's context. However, since global trends such as climate change influence local settings, adaptation of the IF-WIAM at individual wetland sites must ensure that the methods and information therein can synchronize and complement with those at regional/global level as prescribed in the Ramsar Convention. This way, the various local efforts and results taken together can contribute to forming the bigger picture at the national level at the least. If this happens, then more suitable country policies and programs for the wise use and management of wetlands may be developed. For these national policies to be implemented, enforced and sustained at the local levels, strong partnerships with the communities must be ensured. However, considering the inequities among the different stakeholders in terms of technical knowledge, understanding of institutional contexts, financial means and political power, involvement of the government is critical. Among other things, wetland management policies should include strategies to broaden the livelihood options of the poor, depending on wetlands if pressure on wetlands is to be reduced.

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Tags: PN30; Wetlands Welfare and Environmental Security

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