

Guidelines for managing wetlands in forestry areas

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For the Mondi Wetlands Programme



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1 PURPOSE OF THE GUIDELINES

In many forestry estates, wetlands occupy much of the unplanted riparian corridors between plantation compartments, forming the “backbone” of the plantation’s natural open areas. As with all land-uses, there are environmental impacts associated with timber production, including the following:

- Water use by the plantation trees, thereby diminishing the supply to wetlands
- Invasion by alien plants
- Harmful burning practices, especially annual early winter burns of wetlands
- Roads, which may potentially increase sediment loads and disrupt water flow patterns
- Reduction in the connectivity that individual wetlands possess with other natural areas in the landscape

The key question then is how, within the context of national legislation, are these impacts to be avoided and, where this is not possible, to be minimized and mitigated? Furthermore, timber producers also have opportunities for promoting the sustainable use of their wetlands (e.g. for craft production), particularly where this is linked to social upliftment and support of livelihoods.

Over the last decade or so, timber producers such as Mondi have made great strides in addressing some of the key impacts highlighted above, particularly in the removal of trees from the buffer surrounding wetlands and in improving roads to minimize their impacts within the catchment. It is recognized, however, that much still remains to be done. In order to determine whether Mondi is achieving its environmental management objectives, it is imperative that systems are in place for setting measurable management targets against which the success of open area management can be measured.

The guidelines given in this document are aimed at supporting Mondi in fulfillment of its policy of minimizing the impact of all forestry and other operations (e.g. burning) on wetlands, by applying best management practices. They also aim to promote and facilitate the sustainable utilization of Mondi’s wetlands (e.g. through grazing or craft production from wetland plants).

The guidelines are closely linked with the environmental guidelines (Forestry Industry Environmental Committee, 2002) and Mondi’s Open Area Management (OAM) and the OAM Plans that have been developed for individual forestry estates. They are also designed to aid the company in meeting its

environmental responsibility as specified by the Forestry Stewardship Council and in National legislation and policy.

The guidelines consist of three main Sections

- **Section 1** introduces the system and its purpose
- **Section 2** provides a general overall adaptive management framework, including procedures for:
 - Developing a management vision and objectives
 - Assessing and selecting different management options
 - Setting operational goals and key performance indicators
 - Monitoring and auditing
- **Section 3** provides guidelines for limiting the primary impacts of forest plantations, including:
 - Buffer recommendations to limit the extent of water use by the plantation trees, which diminishes the supply of water to wetlands and the catchment
 - Control of invasive alien plants
 - Burning of wetlands
 - Roads, especially where they cross wetlands
 - Maintenance of corridors to enhance the connectivity that individual wetlands possess with other natural areas in the landscape
 - Rehabilitation to redress some of the previous impacts on wetlands

Section 3 also provides guidelines for promoting the sustainable use of wetlands for the following uses, which may be very important from a livelihood point of view:

- Livestock grazing
- Harvesting of sedges and grasses for crafts and construction
- Harvesting of medicinal plants
- Use of wetlands for cultivation

For recommendations on other land-uses not included in the guidelines see WETLAND-USE, a wetland management decision support system by Kotze and Breen (2000). In these guidelines you will find recommendations on planted pastures, dams, infilling, mining, infrastructure, powerlines, ecotourism, hunting and fishing, wastewater treatment, solid waste and water-associated parasitic disease control) Kotze *et al.* (2001) provide guidelines for planning, implementing and monitoring wetland rehabilitation.

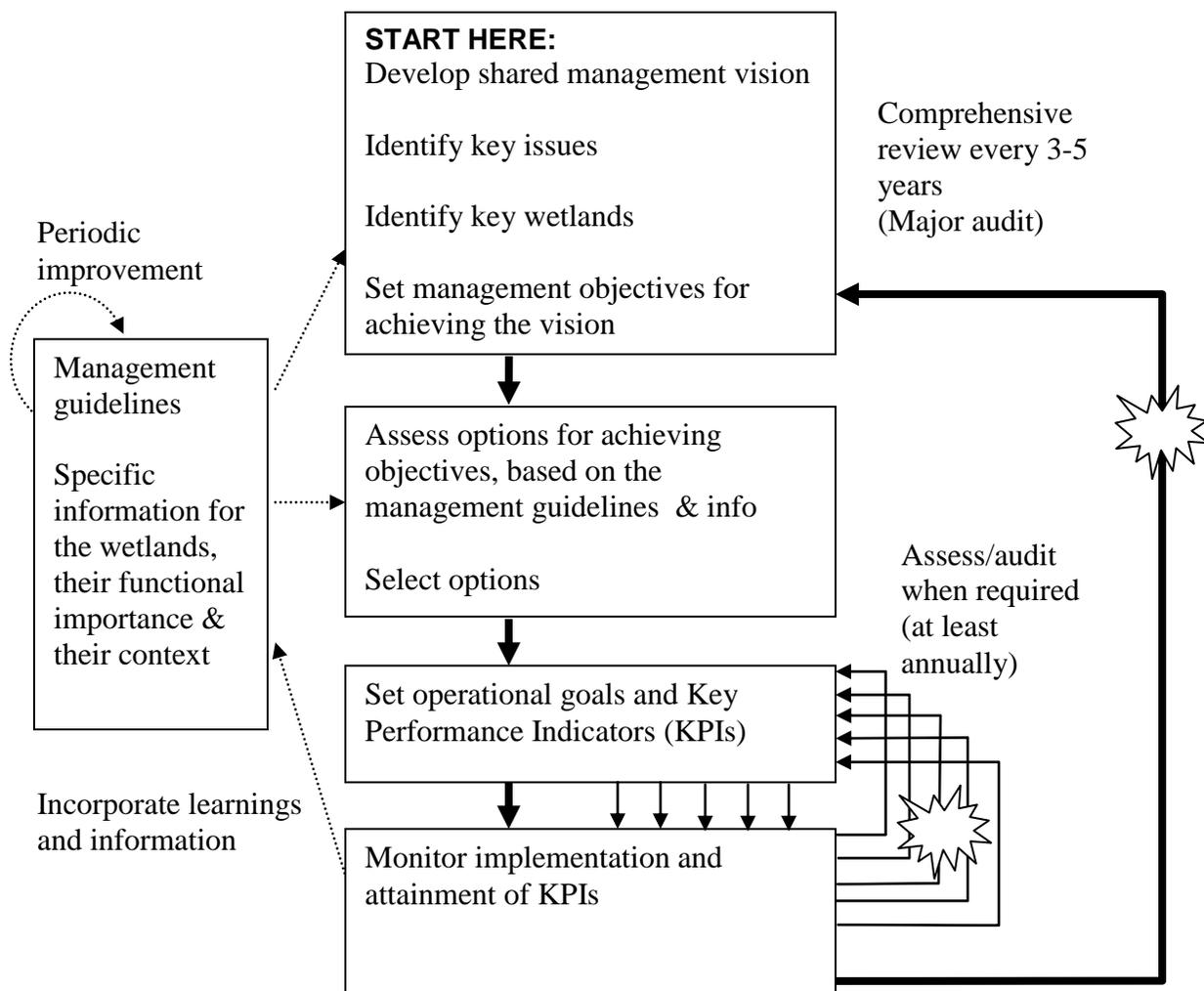
2 AN OVERALL MANAGEMENT FRAMEWORK

2.1 The structure of the overall management framework

Natural resource management is typically a “wickedly messy problem”. Natural systems such as wetlands are often very dynamic, changing from season to season and year to year. Cause and effect are not always clear and may operate over long time periods and across great distances. Furthermore, management often involves many different stakeholders, with differing perceptions, values and

interests. A management system, described in Section 2.2, has been developed to try and assist in coping with this complexity.

An overall management framework has been designed around organizational and time scales appropriate for Mondi (Fig 2.1). The system is hierarchical, with three levels. At the uppermost level is the overall vision, which sets the stage for the subsequent levels; at the next level are the management objectives specifically designed to achieve the vision. Finally, the lowermost level contains the specific details and targets, including timeframes and responsibilities required to operationalize each objective. The uppermost level of the system operates over long time periods (e.g. a review every 3-5 years) and generally at high organizational levels. The lowest level deals with many short term activities undertaken at a more localized scale (i.e. at the scale of an individual forestry estate).



 Points at which stakeholders may have input in the management process

Fig. 2.1 An overall adaptive management framework for the management of open areas by Mondi (based on Kotze and Breen, 2000; Rogers and Bestbier, 1997; Ramsar Convention Bureau, 1997; 2002;)

Central to the system is an adaptive management cycle, involving setting management objectives, selecting and implementing actions to achieve the objectives, monitoring the outcomes and returning to the objectives and adjusting where required. The adaptive management structure facilitates learning from action, and allows for the incorporation of new understanding and information over time. In addition, the system allows for the incorporation of stakeholder input. A cornerstone of FSC is that stakeholders, both within the company and from outside have opportunity for input. This input may be at a variety of organizational levels and at different points in the management process. Stakeholders may raise a concern about a very localized issue requiring swift action (e.g. breeding grass owls discovered in an open area compartment scheduled to be burnt). Alternatively, it may be a more strategic issue (e.g. the system employed by Mondi for monitoring alien plants is identified as being deficient). Short term actions may also highlight the need for longer term strategic revisions to the way that management is conducted.

It is important to remember that Mondi do not manage their wetlands in isolation, and should keep in touch with the following that have relevance:

- The National Water Act, Biodiversity Bill, etc. that provide the national legal and policy framework within which Mondi manages their wetlands
- Environmental initiatives involving voluntary participation. These often include many different stakeholders and operate at various levels, including local (e.g. the local conservancy), provincial (e.g. KwaZulu-Natal Wetland Forum), national (e.g. South African Wetland Action Group and Working For Wetlands) and international.

This will allow the company to keep abreast of current developments and to identify opportunities to support their wetland management objectives (e.g. the rehabilitation of key wetlands through the Working for Wetlands Programme).

2.2 Identification of key issues and key wetlands

The identification of key issues should be undertaken based on consultation with those within the organization closely involved with environmental management, relevant government officials (e.g. from provincial nature conservation departments) and visits to a variety of different estates. This was undertaken during the second quarter of 2003 to arrive at the list of issues given in Section 1. With time, the issues are likely to change somewhat, and thus this process should be repeated at least every time that there is a comprehensive review of management.

Key wetlands are those wetlands which deliver a high level of goods and services, including the following: flood attenuation, streamflow augmentation, trapping of sediments, nutrients and toxicants, erosion control, source of natural products (e.g. crafts woven from wetland plants), maintenance of biodiversity (through the provision of habitat for wetland dependent species, including Red Data species), recreation and tourism, and socio-cultural significance. Wetlands are also considered key if they are threatened by degradation which is likely to lead to significant environmental impacts, aside from any goods and services that they may be currently delivering. This potential degradation would be a function of both the inherent features of the wetlands (e.g. highly erodible soils) and the particular use to which the wetland is being subjected (e.g. extensive cultivation).

It is recommended that searching for key wetlands be undertaken based on the following levels of search intensity.

- **Level Zero**, involving identifying key wetlands based simply on the knowledge of Mondi staff familiar with the different regions. This will take only a day or so, and should be completed before the end of March 2004.
- **Level One**, involving identifying key wetlands based on a systematic desktop-based description of all known wetlands using interpretation of remotely sensed images (with some ground verification); interrogation of relevant databases (e.g. the provincial conservation authorities' databases for threatened species); and consultation with individuals having good local knowledge. This will take a few months, and should be completed before the end of 2004.
- **Level Two**, involving identifying key wetlands based on a systematic rapid assessment of all wetlands in the field. This will take a few years, and should be completed before the end of 2010.

It is recommended that WETLAND-ASSESS (Kotze *et al.*, 2004) be used for undertaking a Level One and Level Two search. WETLAND-ASSESS is a tool to assist decision makers, government officials and educators in undertaking rapid assessments of wetlands and revealing these goods and services, so as to highlight their importance and allow for more informed planning and decision making (see Appendix 1). WETLAND-USE provides for two levels of assessment, which correspond to the two levels of search intensity referred to above. A cornerstone of WETLAND-ASSESS is describing the hydro-geomorphological setting of the wetland, which has a profound influence on wetland functioning and the goods and services that the wetland provides (see Appendix 1).

2.3 The vision and objectives

A vision is a broad statement of intent regarding a particular system (in this case, Mondi's wetlands). It usually describes the state that you desire for the system, and should reflect the values of the organization that developed it. The vision then needs to be "fleshed out" into more detailed and explicit management objectives specifically designed to achieve the vision, while at the same time addressing the key issues relevant to the vision.

A vision and objectives are not "cast in stone" - although over short time periods, they generally remain fairly constant, it would be important to re-examine them at least every 3-5 years.

Below is the management vision regarding Mondi's wetlands (which relates strongly to Mondi's policy statement on wetlands) and management objectives tailored to address the management issues highlighted in Section 1. It should also be added that objectives can be set for lower levels of management (e.g. at the level of an individual forestry estate).

Overall management vision

The integrity of Mondi Forest's wetlands is maintained, together with the natural functions that these wetlands perform and the benefits that they supply.

Overall management objective

Minimize the impact of all forestry and other operations on wetlands, by applying best management practices and promote and facilitate the sustainable utilization of Mondi's wetlands

Secondary objectives designed to achieve the overall objective

- Ensure that by 2010 all forest plantations comply with the recommended buffer requirements designed to limit water use by the plantations (Section 3.1)¹.
- Reduce and maintain the extent of invasive alien plants within wetlands at acceptably low levels (i.e. below 5% cover by 2010) (Section 3.2).
- Ensure that burning of all key wetlands complies with the Best Management Practices (BMPs) designed to limit potentially harmful burning practices such as extensive annual early winter burning (Section 3.3) and attempt as far as possible (within the constraint of addressing fire hazard) to follow the BMPs for all of the other wetlands².
- Ensure that roads comply with recommendations designed to limit their impacts on the catchment, especially where it is necessary for roads to cross wetlands (Section 3.4)³
- Manage, protect, and rehabilitate where necessary, all key wetlands to ensure that their integrity and natural functions are maintained (see Section 3.5).
- Promote sustainable wetland-use by ensuring that harvesting of sedges and grasses (for crafts and construction) and medicinal plants and grazing by livestock comply with recommended limits, (see Section 3.6-3.8)⁴.

¹ The presence of buffers around wetlands is also recognized as contributing to linkages between wetlands and other natural areas, particularly given that wetlands are often the backbone of the open area system. Although this is not included as an explicit management objective, promoting linkages amongst natural areas in the landscape is included as part of Mondi's Open Area Management System. But as yet, this system does not measure the connectedness of natural areas. Thus, the effectiveness with which management is affecting landscape connectivity is not known. The development of a practical system that accounts as best as possible for the different ways in which different species are affected by different levels and configurations of connectivity in the landscape (both within Mondi and in neighbouring lands) is needed. Given the complexity involved, supporting research will be required.

² It is recognized that fire hazards are very high in some estates, making it extremely difficult to comply with the BMPs given in Section 3.3.

³ A process is currently underway as part of the road management plan for Mondi's estates whereby all roads will be assessed for their necessity. Those found unnecessary will be decommissioned and all those retained will be assessed for their compliance with environmental standards. Specific management targets for roads have not yet been set in this process. This needs to be undertaken in order that management effectiveness can be assessed

2.4 Examining and selecting management options for achieving the objectives

In order to translate objectives into operational goals, different management options should be examined and those selected which are compatible with the overall vision and management objectives. Section 3 will assist in the selection of management options by providing: general management guidelines and best management practices. These need to be applied by building them into the specific operational goals for each estate, where the particular circumstances of the individual estates are accounted for. For example, if an estate includes wetlands with peat soils susceptible to burning then particular attention needs to be given to those recommendations given in Section 3 designed to prevent peat fires taking place (e.g. if a given year is particularly dry then the compartment containing the wetland should not be burnt).

Finally, it is important that the management options be revisited periodically to accommodate new understanding and knowledge.

2.5 Setting operational goals and Key Performance Indicators (KPIs)

Management objectives describe “where you intend going”. What you need to do now is to plan the details of “how you are going to get there” (your operational goals) and how you are going to measure your success along the way (your KPIs).

Operational goals should contain milestones and roles and responsibilities defined. The operational goals for alien plants would specify which alien plant clearing methods are to be applied, the sequence in which open area compartments should be cleared (including details regarding follow-ups) who is responsible for specific actions and target dates for completion. The KPIs would specify the target levels of alien plant abundance for the specific compartments being cleared.

2.6 Monitoring and auditing

Monitoring is required to determine whether you are achieving your objectives and operational goals. In order to structure your monitoring programme and decide what information to gather, see Kotze (2001a), a system for monitoring wetlands in forestry areas. The system has two levels of monitoring. Level 1 applies to all wetlands and requires the description of broadly important issues, notably alien plant infestation and burning, that can be readily described. Level 2 applies only to key wetlands, for which additional features will need to be described (e.g. status of a Red Data species present).

It is essential that monitoring provides the information to determine whether the KPIs are being met. This is the next step in the management cycle, referred to as auditing. A frequent (i.e. annual) audit is

⁴ In order to reap the potential benefits from allowing for the utilization of wetland resources, it is important to maintain effective working relationships with neighbouring communities. A great deal may also potentially be gained from a poverty relief and sustainable use point of view by providing effective support for business development amongst rural crafters utilizing wetland plants in forestry areas. Management targets should be set for both of the above, the attainment of which will require an investment of time and resources, with the SDFs playing a central role.

undertaken of attainment of the operational goals and a long term (i.e. major audit) every 3-5 years is conducted to determine attainment of the management objectives. If the management objectives are not being met then this highlights the need to re-examine and adjust the operational goals (i.e. adapt) and possibly also the objectives. Each successive management cycle yields an improved understanding and information base.

3 Guidelines for limiting impacts and promoting sustainable use

3.1 A buffer around the wetland

Box 1: Impacts of forestry plantations on the hydrology of wetlands

In wetlands, the water table is characteristically shallow and water is therefore freely available to transpiring plants. Because of this high availability of water and the high use of water by trees, the effect of forest plantations in wetlands on reducing baseflows of streams may be considerable. Thus, forest plantations are considered unacceptable within wetlands. Any forest plantations within wetlands and their immediate surrounds should therefore be withdrawn, as will be explained in the guidelines below.

A key mechanism through which the impacts of plantation forestry on wetlands and streamflows are being mitigated is by specifying a 20 m buffer around all wetland areas and through the removal of all plantation trees from this buffer⁵.

A system of “give and take” is considered acceptable when withdrawing existing plantations from the designated 20 m buffer areas. In order to ensure that the concept of “give and take” does not become one of “take and take” in practice, the following must be undertaken.

- Within all forestry estates, all wetlands and their associated 20 m buffers must be delineated. A minimum mapping scale of 1: 10 000 or smaller should be used, recognizing that some of the smallest wetlands may be missed.
- All buffer areas “taken” *must* be compensated for by an increased buffer elsewhere on the same estate of **an area equivalent to or greater** than that “taken”.
- All buffer areas “taken” must be substantiated and documented in an auditable format that is available to the Responsible Authority, as defined in the National Water Act (Act 36 of 1998) or registered certification bodies (e.g. FSC).
- Only under well justifiable circumstances should the buffer be reduced through a system of give and take. These circumstances may include the case where a wetland will remain non-functioning even with the provision of a 20 m buffer (e.g. the overall water table has been lowered to such an extent, as has occurred in some of the coastal plain aquifer, that the “shallowest” wetlands no longer function as wetlands [see Fig 3.1]). Better returns would generally result from withdrawing an equivalent area of plantation from other larger, more consolidated and/or functional wetland areas. This is by no means to say that all small wetlands

⁵ However, it must be recognized that under certain circumstances, plantation trees situated far outside of the immediate buffer around a wetland can still significantly reduce the baseflow supply to a wetland. In other words, there will be some wetlands for which adherence to the 20 m buffer will still fall substantially short of preventing significant hydrological impacts to the wetland and other areas further down the catchment. This would apply particularly to the following situations:

- Wetlands supplied predominantly by groundwater (e.g. seepage slopes and wetlands with catchments having sandy soils with high hydraulic conductivity)
- Wetlands particularly sensitive to a reduction in water input (e.g. peatlands which may desiccate, leaving their soils very susceptible to destruction through ground fires)
- Where plantation trees occur in areas with relatively shallow water tables, albeit that the water tables are not sufficiently shallow to be classified as wetland (e.g. if the water table occurred predominantly between 800 mm and 2000 mm which is unlikely in itself to result in the area being considered a wetland).

are of little value. It is recognized that some may be of particularly high value, especially from a biodiversity conservation point of view.

- The give and take system should not be applied indiscriminately across an estate. At least 80% of the buffer around the wetlands in an estate should conform to the recommended 20 m.

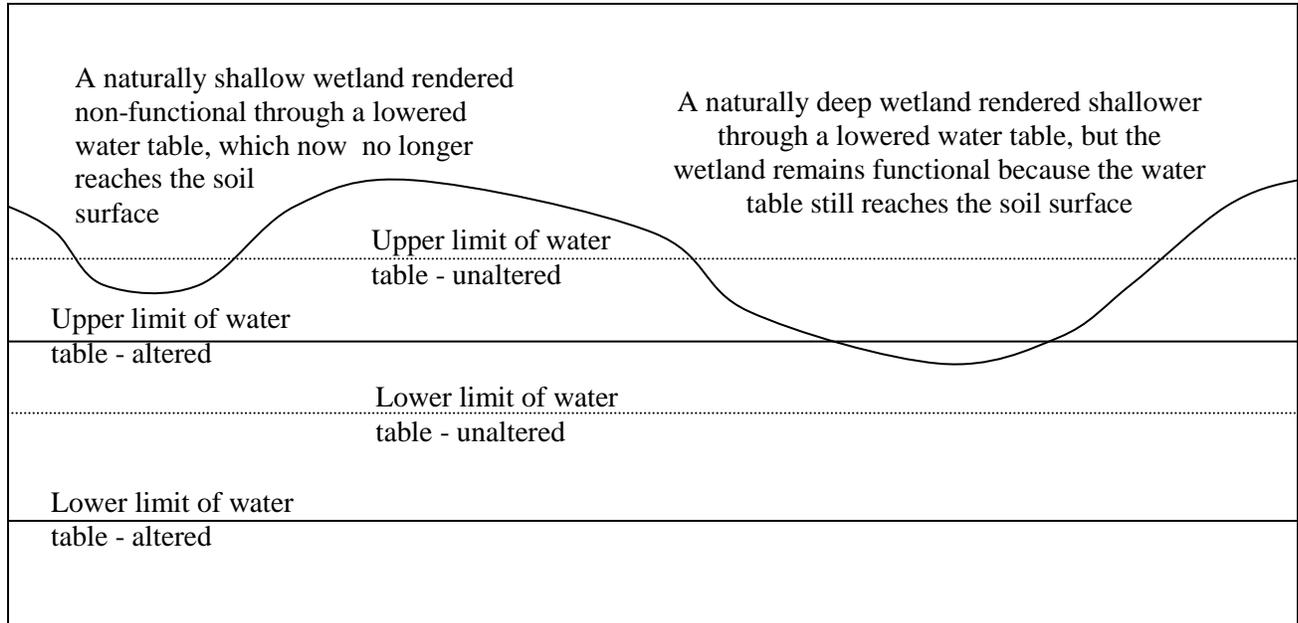
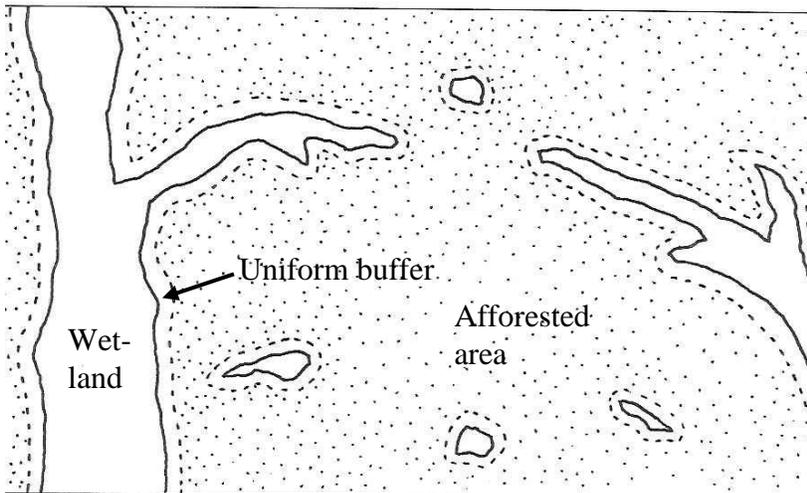
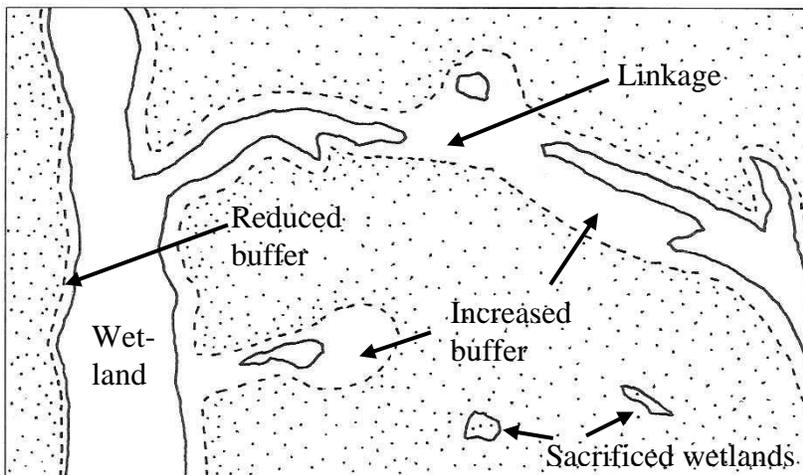


Fig 3.1 The effect of lowering of the water table on functionality of two different wetlands on the Zululand coastal plain. Both wetlands have closed surface drainage but the first wetland is positioned higher (i.e. “shallower”) relative to the water table than the second, and its functioning is therefore more severely affected by a lowering of the water table.

To illustrate the “give and take” system, two scenarios are compared for the afforestation of a hypothetical area with 6 wetlands (see fig 3.2). Scenario 1 has an “across-the-board” 20 m buffer around all wetland areas. Scenario 2 is a “give and take” scenario where the buffer width is varied in accordance with the local circumstances. In Scenario 2, two small isolated wetlands have been completely “sacrificed”. However, it is important to note that the functioning of these wetlands is severely compromised in Scenario 1, owing to their being completely surrounded by plantations and by having most of their catchments afforested. In addition, the impacts on the functioning of the other two small wetlands would be considerably less in Scenario 2, given the much greater buffering of the two small wetlands in this scenario. Furthermore, linkages amongst the 4 buffered wetlands are considerably better in Scenario 2 than in Scenario 1. Overall, therefore, the functioning of the wetlands has been less severely affected in Scenario 2 than Scenario 1, despite the sacrifice of 2 of the small wetlands. The assumption, of course, is that neither of the sacrificed wetlands contains any outstanding features such as a Red Data species.



Scenario 1



Scenario 2

Fig. 3.2 Two scenarios of afforestation planning in relation to wetlands. The first is an “across-the-board” 20 m buffer around all wetland areas. The second is a “give and take” scenario where two small wetlands have been sacrificed and the buffer width reduced on one of the margins of the widest wetland and, in return, the buffer has been expanded around the other two small wetlands and an extended narrow wetland and two linkages have been created to effectively link all four of the buffered wetlands.

3.2 Alien plant control

Box 2: Impacts of alien plants on wetlands

Invasion by alien plants, which out-compete the indigenous plants, may greatly reduce the goods and services provided by a wetland because:

- The quality of habitat and the biodiversity support benefits provided by the wetland are reduced
- Many alien plants (e.g. wattle trees) are less effective in binding soil and controlling erosion than many of the indigenous plants in wetlands, which are specifically adapted to high energy flood events. Owing to the greater loss of soil, particularly when the plants are uprooted and washed away, alien plants are also therefore generally less effective in enhancing water quality.
- Some alien plants use more water through transpiration than the indigenous plants, which leads to a reduction in the natural flow in streams
- The grazing value of most alien plants is lower than the indigenous grasses and sedges that they replace.

Invasion by alien plants of open areas in forestry estates is a major management problem. Further adding to the magnitude of this problem is the very favourable environment created in the so called transitional areas which develop following the withdrawal of trees from wetland and riparian areas.

Clearing alien plants in wetlands should be closely integrated with the overall alien plant clearing programme. Mondi Forests (in prep) provides details concerning assessing alien plant extent, selecting appropriate clearing methods and evaluating their success. These guidelines are relevant to all ecosystem types encountered within forestry areas, including wetlands. Below, are a set of key general points with which to structure an overall clearing programme.

1. **Conduct a full survey** of alien plants in the estate **every 3-5 years**, by referring to the Mondi Forests alien plant clearing guidelines. For each open area polygon an estimate should be given of total percentage cover of alien plants, and a listing of the common species.
2. **Prioritize clearing** based on the survey and draw up a **5 year alien plant clearing programme** with explicit KPIs. Priority should be given to:
 - a. Areas that require follow-up work from previous year(s) clearing programmes,
 - b. areas where plantation trees have recently been withdrawn from wetland areas, given that these transitional areas are very susceptible to invasion and that it is more cost effective to control these early than to leave infestations to reach an advanced stage where an extensive canopy of alien plants has developed suppressing the growth of herbaceous indigenous vegetation,
 - c. areas high in the catchment, given that several alien plant species tend to spread more readily down the catchment than up the catchment, and
 - d. areas with low and intermediate levels of infestation, given that this allows overall infestations to be better controlled than if clearing is focused immediately on the densely infested areas.

3. **Select appropriate methods** (e.g. by referring to Mondi Forests [in prep] and the WfW alien plant clearing manual) and undertake a **cost estimate** of the clearing operations. At this point it may be necessary to revise the 5 year clearing programme in the light of cost implications.
4. In the **intervening years** between the full survey, **conduct surveys of cleared areas** to determine success of clearing and evaluate the particular requirements for follow-up clearing operations.

3.3 Burning

Box 3: The positive and negative effects of burning wetlands

Burning of herbaceous wetlands using a correct burning plan has several potential positive effects, including: assisting in alien plant control; increasing plant productivity by removing old dead material; improving the habitat value for wetland dependent species and improving grazing value. However, burning incorrectly may have several negative effects. The young of wetland-dependent species are particularly vulnerable to the direct effects of heat and asphyxiation. Most species are summer breeders and are therefore little affected by winter/early spring burns. Some species, notably the wattled crane, are, however, winter breeders. In South Africa, fire is one of the most important causes of wattled crane egg failure and chick mortality. Fire may also negatively affect autumn/early winter breeding species such as the grass owl. Furthermore, fire may contribute to increased levels of erosion, especially where it occurs every year and attracts high concentrations of grazing animals. Thus, it is important that the guidelines in the following section are followed.

Many wetlands in afforested areas are burnt annually in early winter because of the fire risk that wetlands pose to the trees. Early winter burns generally have greater impacts on the hydrological and ecological benefits of wetlands than late winter/early spring burns. Absence of loose surface and standing plant litter (removed by the early winter fire) for the entire winter is likely to result in a significant increase in the evaporative loss of water from wetlands.

Late summer/winter breeding species, notably the threatened grass owl, the African marsh harrier and the marsh owl may be severely affected by early winter fires. An absence of cover during the winter is also likely to be to the disadvantage of other wetland dependent fauna. The high frequency of burning (i.e. annual) further adds to the impact, particularly when it occurs extensively, leaving little unburnt areas remaining as cover for wetland dependent fauna.

Fire may play a very important role in maintaining the diversity of wetlands, particularly in areas supporting a mix of forested and herbaceous wetlands, such as on the Zululand coastal plain). This plain comprises a mosaic of coastal grassland (the herbaceous component) and forest patches (the woody component). Wetlands occur as both herbaceous and woody types within this mosaic. Fire plays a critical role in maintaining the herbaceous component of these ecosystems. Where fire is excluded, the herbaceous areas will tend to be transformed through succession into forest. This will result in a loss of herbaceous habitat and the many different species these areas support, including critically endangered species such as *Kniphofia leucocephala*. Ultimately, the overall diversity of the landscape would be considerably reduced. On the Zululand coastal plain, where forest plantations are withdrawn, it should be determined which areas were originally in an herbaceous state and these should be returned to this state. Under forest climax conditions, transitional areas earmarked as herbaceous are likely to require particularly frequent burning for their development into herbaceous wetlands. Without this fire, forest species are likely to rapidly establish and dominate within a few years (R van Wyk, 2003. *per. comm.*).

The ultimate impact of each individual fire will, of course, depend in part on the type of wetland and its state at the time of the burn. Especially important are wetlands with peat soils, particularly when the wetness of these areas has been diminished (e.g. through afforestation of the wetland's catchment). Under these conditions, the wetland becomes very susceptible to sub-surface fires, and the destruction of the peat. An attempt is made to account for these conditions in the recommendations given below.

In order to minimize the impacts of autumn/early winter burning, the following recommendations should be referred to relating to: (1) planning and (2) implementing burns (e.g. optimal weather conditions).

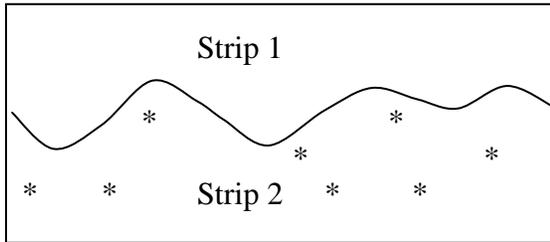
Planning burns

1. Identify on the estate map all non-commercial compartment areas to be burnt.
2. Demarcate the firebreak areas where annual burning is considered necessary for fire protection purposes.
3. Identify areas requiring special treatment, including:
 - a. Peat wetlands requiring particular caution to prevent ground fires, especially in years with low rainfall
 - b. Transitional areas identified as needing to be maintained as herbaceous and which if infrequently burnt would follow a successional path to forest (This applies mainly to wetlands on the coastal plain). These historically herbaceous areas should be identified based on historical knowledge or on past aerial photographs.
 - c. Swamp forest areas which require total protection from fire.
4. Designate the remaining demarcated areas to be burnt on a biennial basis
5. Note the location of any breeding areas of late summer/autumn and winter breeding birds, which have special requirements (see Boxes 3 and 4)
6. Re-examine the designation of the annually burnt firebreak areas to see if some of these could be re-classified as biennially burnt portions without compromising the fire protection of the plantations. Annual burning is only acceptable where absolutely necessary. Wide wetland areas and wetland areas adjacent to grassland can potentially be burnt biennially using strip burning⁶.

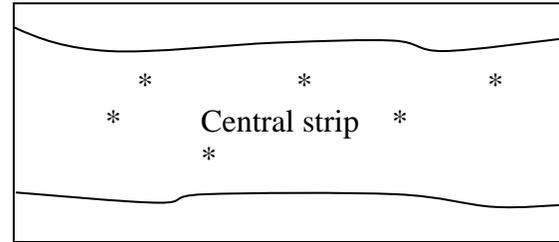
Strip burning can be carried out in two ways. (1) The wetland corridor is divided into two parallel strips, which are burnt alternatively. If a stream channel is present, this can be used as a convenient natural tracer line between the two strips. (2) The wetland corridor is divided into a central strip and two outer strips, which are burnt together, alternating with the central strip. Roads may often provide a useful tracer line for demarcating the outer strips from the central strip.

⁶ The narrower the wetland and the buffer around the wetland, the more limited will be the scope for strip burning, and the greater will be the tendency for management to annually burn the wetland to eliminate the fire hazard it poses to the trees. Therefore when withdrawing trees to create and expand the buffer around wetlands, an important factor to consider is the extent to which this will allow the increased extent of areas rotationally rested from burning

Strip burning using two parallel strips and a central stream as a trace



Strip burning using two outer traces and a central strip



When planning the burning system and setting management objectives it is important to have a broad landscape view. Think in terms of optimizing the total area of wetland rotationally rested from fire within the estate. It is difficult to prescribe acceptable levels, as these will be strongly affected by the extent to which a particular estate has been planted to trees and the risks of arson and runaway fires, which serve to restrict the extent to which open areas can be left un-burnt in a particular year. The severity of both of these factors may vary considerably from estate to estate. As an absolute minimum, every estate should aim to have at least 50% of the wetland area burnt biennially.

Remember that the situation both within the estate and in neighbouring lands is dynamic. For example, the hazard from arson fires may change over time. Therefore the fire plan is likely to require a periodic review.

Implementing burns

The following generally applicable recommendations are made, aimed at reducing the extent, intensity and damage caused by fire.

- Aim to promote a cool and patchy burn by burning when the relative humidity is high and the air temperature is low, preferably after rain. Such fires, result in more vegetation cover remaining for wildlife.
- Head fires (burning with the wind) are generally preferable to back fires (burning against the wind). Temperatures at ground level tend to be higher in back fires and consequently the impact on the growing points of plants is greater. Although the fire front advances less rapidly in a back fire, direction is more difficult to predict. Also, because the fire front advances more rapidly with head than with back fires, particularly if the wind speed is high, the fire has less time to spread laterally. Thus, head fires can be used more effectively for burning only portions of the wetland without the use of fire breaks. However, this method of burning portions of a wetland is dependent on many factors outside the manager's control, such as wind direction changes, and cannot be relied upon for consistent block burning.
- If conditions are unfavourable for burning (e.g. if the soil is very dry and susceptible to sub-surface fires, which is particularly important for peatland areas) delay burning until the following year.

- Give preference to burning areas with abundant dead (moribund) stem and leaf material that is obviously limiting new growth.
- Protect areas known to be important bird breeding areas (e.g. reed marsh areas used by herons or sedge marsh areas used by ducks) but even these may need to be burnt every fourth or fifth year to stimulate new plant growth.

Box 4: Burning recommendations to account for the grass owl (*Tyto capensis*), marsh owl (*Asio capensis*) and African marsh harrier (*Circus ranivorus*)

In areas in which these species breed, burn rotationally through block burning and check before burning by having 'beaters' 10 m apart walking through the area and then closely examining all localities where these birds are flushed (Johnson, *Pers comm.*, KwaZulu-Natal Nature Conservation Services). Leave areas unburnt where chicks have still not fledged, or, if possible, delay burning for that year.

Box 5: Burning recommendations to account for the wattled crane (*Bugeranus carunculatus*)

The wattled crane is a winter to early spring breeder. Thus, if this species is breeding in the wetland then:

- If a nest with eggs is present temporarily remove the eggs and place in a small incubator (an insulated box warmed with hot water bottles can be used but do not place the eggs directly on the hot water bottles).
- Consider delaying burning until the chick can fly and therefore escape the fire
- If burning cannot be delayed long enough then attempt to catch the chick, perform a patchy burn and then release the chick after the burn. Alternatively, if the chick cannot be caught (which will probably be the case, observe where the chick is at the time of the burn and burn strategically, sometimes having to burn a break around where the chick is hiding.
- In all cases it is vitally important that a patchy burn is performed so as to leave sufficiently tall vegetation areas for the chick to hide from predators.

For information about cranes and burning, contact the Southern African Crane Working Group 033-2632750

3.4 Roads, including bridges and culverts

Box 6: Impacts of road crossings on wetlands

A road through a wetland may greatly modify local water flow patterns in wetlands. The road may impact negatively on the area immediately upstream of the crossing either: (1) by damming the area if insufficient culverts are incorporated or (2) drying out the area if drains are dug to direct the flow through the culverts. The downstream portion may similarly be dried out. A concentration of flow at the crossing site may also result in serious gully erosion, detracting from the ecological and hydrological values of the wetland, and threatening the road itself. In the areas adjacent to roads, there may be additional impacts, including disturbance of animals, particularly large birds such as cranes which may breed in the wetland and the washing in of sediment and other pollutants from the road surface. The building of a road through a wetland requires that, according to the National Environmental Act, application be made to the relevant authority.

See the Environmental Guidelines for Commercial Forestry Plantations in South Africa, which provide general principles for minimizing the environmental impacts of roads, and the manual on the maintenance of forest roads (Forest Engineering Technical Department, 2002) which provide detailed specifications for the construction of forestry roads. Below are a set of general points to help plan, construct and maintain road crossings through wetlands.

- Examine the location of all roads planned to pass through wetland areas to see if each road is necessary or if the road could be diverted around the wetland. If no other option exists but to cross the wetland then follow the recommendations given below.
- Ensure that the location and orientation of the crossing has minimal impact on the wetland (e.g. if a stream is present, it should be at right angles to the stream and located below a straight and stable section of the stream).
- Ensure that the type of crossing is appropriate for the type of road (i.e. low usage roads, used only for planting, maintenance and timber extraction operations, or high usage roads, which also used as general thoroughfares within the estate) and the specific circumstances at the crossing site (including factors such as the intensity of expected stream discharges, stability of the soil, slope, etc).
- It is essential that the road crossings must have minimal disruption to flow patterns, both upstream and downstream of the crossing. In the case of a raised causeway, for example, adequate culverts/pipes are required so as to have minimal impact on water flow patterns through the wetland. Concentrating water flow is one of the easiest ways for erosion to start.
- Ensure that the approach to the crossing has minimal impact on the wetland, particularly in terms of sediment from the road washing into streams (e.g. by avoiding steep approaches, maintaining effective side drains which lead water off the road and disperse it at least 10 m away from the wetland, etc).
- Do not proceed with any construction before obtaining the necessary permission from the relevant authorities, as this is required for the construction of any new road through an environmentally sensitive area such as a wetland.

- Construction must be undertaken with the minimal impact on the wetland (e.g. by constructing during the non-rainy season, minimizing disturbance in the wetland, blocking any drains dug for the purposes of construction, etc.)
- Ensure that ongoing use of the crossings is controlled (especially ensuring that a low usage crossing does not become a general thoroughfare or used for the transport of timber with heavy timber trucks) and that crossings are maintained, particularly through the repair of damage caused by storms).

3.5 Rehabilitation of wetlands

Box 7: Some key issues concerning the rehabilitation of wetlands

Rehabilitation refers to a series of actions promoting the recovery of ecosystem functions and values in a degraded system so as to move the system closer to what it originally was but usually not fully attaining its original state.

Two of the most important on-site factors having resulted in the degradation of wetlands are erosion and artificial drainage. Although wetlands are areas where sediment is characteristically trapped, sometimes wetlands erode and more sediment is removed from the wetland than is trapped. Wetlands with high erosion hazards (e.g. those with erodible soils and steep slopes See Section 3, Descriptor F12) are the most susceptible to erosion. The most common erosion problem in wetlands is gully erosion. The head of a gully may move rapidly into a wetland particularly if the area is disturbed by cattle, sometimes advancing several metres in a single storm. The erosion of channels, both natural and artificial is another common problem in wetlands.

Erosion of gullies and channels not only increase the amount of soil lost by the wetland but, as with drainage channels, they also dry out a wetland. Thus, they detract greatly from the indirect benefits supplied by the wetland, and rehabilitation of eroded areas (particularly areas which are currently actively eroding) and drained areas (particularly areas which are not being used for production) should be considered. Rehabilitation can be very costly. Thus, choose priority wetlands which will supply the greatest increased benefits from rehabilitation. When prioritizing wetlands for rehabilitation it is important to have a broad catchment and landscape view, where rehabilitation is generally focused in catchments and portions of catchments with water quality problems and in ecoregions (i.e. Veld Types) where the transformation of natural vegetation has been high (i.e. rehabilitation is located where it is needed the most).

Several methods are available for rehabilitating eroded or drained areas. However, before rushing to rehabilitate what appear to be important problems in a wetland, reference should be made to Kotze *et al.* (2001a) a manual for planning, implementation and monitoring of wetland rehabilitation. The manual has been designed to provide practical guidelines for the following:

- Understanding the processes underlying the formation of South African wetlands and the deposition and erosion of sediment within these systems.

- Prioritizing wetlands for rehabilitation
- Describing the type and severity of erosion in a wetland and choosing and planning rehabilitation methods appropriate for the erosion problem and the wetland's catchment and management context
- Monitoring the success of wetland rehabilitation
- Understanding the legislative context within which wetland rehabilitation takes place

It should also be highlighted that besides erosion and drainage, other factors such as alien plants (see Section 3.2) and roads (Section 3.4) may contribute to the degradation of wetlands and the concept of rehabilitation also encompasses addressing these factors.

3.6 Grazing of wetlands

Box 8: The impacts of grazing on wetlands

Many wetlands evolved with grazing by indigenous animals such as buffalo, which would have had an important effect on the habitat provided by the wetlands. Where these indigenous animals no longer occur, domestic livestock may have a similar and therefore positive effect in maintaining habitat diversity. This is particularly so where a diversity of tall and shortly grazed areas result from the grazing. However, where wetlands are grazed heavily and uniformly short, the quality and diversity of habitats provided is likely to be decreased.

Wetlands with high erosion hazards may also erode easily when disturbed by excessive trampling and grazing, with the soils being particularly susceptible when they are wet. The flow concentration zone of a wetland is often the most sensitive part of the wetland and disturbance of this area by cattle may cause gully erosion to advance into the wetland, drying it out and destroying much of its value. Thus, it can be seen that the impact of grazing depends on grazing intensity and timing and location relative to sensitive areas. Therefore, it is important that the guidelines in the following section are followed to avoid the negative effects and maximize the positive effects.

Stocking rate

Potential grazing capacity, which refers to the amount of grazing that can be sustained in a particular area, varies according to bioclimatic region. Contact your nearest Department of Agriculture office to obtain the recommended potential grazing capacity for the bioclimatic region in which the wetland falls. As a general guideline, a conservative stocking rate of not more than 70% of the potential grazing capacity for the temporarily wet areas can be taken. Exclude the wetter areas of the wetland (i.e. seasonal and permanent) from the calculation.

Take the following example: the total area of wetland in an estate was 600 ha and approximately 50% of this was temporarily wet and the potential grazing capacity for the bioclimatic region was 0.4 Animal Units per hectare. Then the number of Animal Units the wetland area in the estate could support during the grazing season would be $(600 \times 0.5) \times (0.4 \times 0.7) = 84$ Animal Units

For more detailed recommendations see WETLAND-USE, wetland management guidelines compiled by Kotze and Breen (2000) and WETLAND-FIX, guidelines for wetland assessment, management and restoration (Wyatt, 1995) which were developed by the Mondi Wetlands Project. To obtain free copies of WETLAND-FIX contact the Mondi Wetlands Project at P O Box 338, Irene, 0062.

The grazing system

In forestry areas it is generally not practical to fence off wetland areas into camps. It is necessary, therefore, to rely on strategic burning and herding to achieve resting of wetland areas. At least 25% of the grazeable wetland area should be rested from grazing in each year. These rested areas should be selected from those areas rested from burning and should be rotated on a yearly basis in accordance with the location of the areas rested from fire. This can usually be easily implemented given that livestock will tend to select those areas recently burnt because these areas contain the newest plant growth.

Use the wetlands as much as possible in the early grazing season before they become particularly wet. This can usually be easily accommodated in a grazing system because when the need for grazing to supplement non-wetland grazing is high it is usually in dry periods when the wetland soils are acceptably dry for use. When wetland soils are too wet for use it is often during wet periods when non-wetland forage production is relatively high. If downstream water users are present it is particularly important that the wetland not be grazed when flooded as livestock may contaminate the water through defecation and urination.

Stock watering

The movement of livestock to water sources may cause severe erosion, particularly of stream banks. If there are indications that such a problem is developing, an alternative must be sought. This can be achieved either by piping the water to a point away from the stream, or designing and hardening a path to the water source.

3.7 Harvesting wetland sedges and grasses for crafts and construction

Box 9: Craft production from wetland plants as a low impact use of wetlands for promoting rural development

Several different wetland plant species are currently used for weaving crafts, including the salt marsh rush, *Juncus krausii* (incema) and the freshwater sedges: *Cyperus latifolius* (ikhwane), *C. textilis* (imizi) and *C. sexangularis* (imizi). These species are used for making sleeping mats and sitting mats, and a variety of other products such as traditional beer strainers. Not all of these species are found in abundance on all Mondi estates, *J krausii* is restricted to low altitudes (generally <100m above mean sea level [a.m.s.l.]). *Cyperus latifolius* is the most abundant, occurring in dense stands from sea level to up to 1000 m.

The harvesting of wetland plants for craft and construction purposes represents one of the simplest examples of management for sustainable resource utilization, mainly because the plants being exploited are generally very productive and resilient to harvesting. They are fast growing and have

high regenerative capacities compared with hardwoods, for example, which regenerate very slowly. Handcraft production from wetland plants has many benefits as a development option in poor communities, particularly for uplifting rural women. It makes use of local traditional skills; it requires a low capital input and has the potential for immediate cash returns; it increases the net inflow of financial resources into rural communities and increases the self esteem of those engaged in the craft business (see Appendix 1). Furthermore, by increasing the financial benefits to the users, it reduces the incentive to transform the utilized wetland, thereby contributing to the conservation of natural habitats. However, the activity and associated income are obviously dependent on harvesting the wetland plants on a sustainable basis (see recommendations below).

The cutting of natural reeds, sedges and rushes generally has a considerably lower impact on a wetland in comparison to cultivation because there is minimal disturbance to the soil and the plants rapidly re-grow. In fact, if carried out correctly, cutting will have a positive effect on the wetland. It is important, however, that a few basic guidelines are followed. If harvesting is beyond the resource's capacity for renewal, the resource will be degraded and the benefits derived by the users will be lost.

- If the wetland is also grazed by domestic stock then no more than 30% of any wetland vegetation type (e.g. incema marsh) should be harvested in any one year. If the wetland is not being used for grazing then this amount may be increased to 40%.
- It is best to cut by hand as this disturbs the wetland less than mechanized cutting.
- Harvesting should preferably take place after or towards the end of summer when most bird species have completed breeding.
- Rather than cutting a single extensive large area it is better to break up the cut area into several small areas, which provides more suitable habitat for wetland dependent species.
- Material which is cut and discarded should be spread out rather than being left piled on-top of plants. Piled up, this material forms a dense mat of litter that slows down new growth.
- Minimize the amount of discarded material by, as far as possible, selecting and cutting only that material which you will be taking away. This applies particularly to highly sought after species such as *Juncus krausii* (incema).

In wetlands where the removal of leaf material through other factors (e.g. grazing and burning) is limited then cutting is likely to improve the habitat benefits provided by the wetland. Cutting would reduce the standing dead material, which would otherwise develop under a very infrequent burning regime. Such dead plant material reduces plant productivity and restricts the movement of secretive wetland birds such as flufftails (Taylor P B, 1997 *Pers. comm.* Department of Zoology and Entomology, University of Natal, Pietermaritzburg).

3.8 Harvesting of medicinal plants

Box 10: Impacts of harvesting medicinal plants

A wide range of plants are harvested for medicinal purposes. Although little is understood about the details of exactly how harvesting affects populations of particular species, it is well known that harvesting is having very severe impacts on wild populations of many medicinal plant species. The harvesting of particular plant parts may have potentially much greater impacts than harvesting others parts (e.g. the harvesting of bulbs generally has greater impact than harvesting of leaves, which usually re-grow more readily). It is also important to highlight that certain medicinal plant species are much more threatened, and therefore require more stringent protection, than other species (see Diederichs *et al.* 2002).

Some general guidelines for the harvesting of different general types of plant parts should be followed are given below. However, before allowing the harvesting of medicinal plants, contact your provincial nature conservation department concerning the particular species and amounts

Bark. Never take more than 1/20 of the bark of a tree and always harvest the bark from side branches rather than the main trunk, particularly near its base where extensive harvesting may cause the tree to be ring-barked and die.

Rhizomes, tubers and bulbs. Never take more than 1/8 of the material in an area in a particular year

Leaves If only young leaves are harvested then never take more than 1/3 of the young leaves; and if mature leaves are harvested then never take more than 1/2 of the leaves in a particular year (See Section 4.5).

In the case of all the different plant parts, if the supply of the resource is decreasing in a particular area then harvesting should be stopped until it recovers. Also, it is preferable to grow indigenous plants and use the wild plants for replenishing the supply of cultivated plants. This applies particularly to slow growing species. See “Knowing and Growing Muthi” by Diederichs *et al.* 2002.

3.9 Management guidelines for crop production

Box 11: The impact of cultivation on wetlands

Drainage and the cultivation of crops in wetlands has several potentially severe impacts on wetlands and most of the indirect benefits of a wetland area are lost if it is cultivated. The removal of indigenous plants greatly reduces the habitat value for most wetland dependent species. Drainage channels speed up the movement of water through the wetland, reducing its effectiveness in regulating streamflow and purifying water as well as increasing the danger of erosion. The addition of fertilizers and pesticides further reduces the effectiveness of the wetland in purifying water. The disturbance of wetlands for cultivation is strongly discouraged by conservation and environmental bodies. There are two important regulations, the Conservation of Agricultural Resources Act and the Environmental Conservation Act, which are applicable to wetland disturbance and must be adhered to (see Kotze and Breen, 2000).

It must be added, however, that the potential impacts of traditional subsistence hand-cultivation methods are significantly lower than large-scale mechanized cultivation, provided that guidelines such as those given in the following Sections are adhered to.

Cultivation in wetlands should only be permitted where it is for subsistence purposes and has a critical role in the livelihoods of nearby communities for the purposes of food security. Before agreeing on this course of action the following procedure should be followed.

- Establish contact with those households already cultivating in the wetlands or who have expressed the wish to do so.
- Explore alternatives to cultivation (e.g. cultivation of nearby non-wetland areas; income generation from alternative less disruptive uses such as harvesting of plants for craft production)
- If the decision is taken to continue then expert advice should be sought regarding: areas of low erosion risk and Best Management Practices (BMPs)
- Obtain agreement from local cultivators regarding where they will cultivate and the practices that they will follow.

Recommended best management practices for minimizing the impacts of cultivation within wetlands must be followed, including the following.

- Do not cultivate more than 10% of the area of wetland within an estate
- Grow crops such as madumbes (*Colocasia esculenta*) which are tolerant of waterlogging, in preference to crops with low tolerance, as this minimizes the need to reduce the wetness of the soil.
- Do not use artificial drains.
- Till and harvest by hand, which results in less soil compaction and disturbance than with mechanical tillage and harvesting.
- Do not use any heavy machinery.
- In the case of shifting cultivation, leave areas fallow for at least 2 to 3 years for every year cultivated.
- Add mulch to reduce soil organic matter depletion and associated problems (e.g. increased erosion hazard).
- Leave strips of indigenous vegetation between crop patches, which would assist in reducing flood water velocity, thereby reducing the loss of the crop (a short-term loss) and loss of soil (a long-term loss of the productivity of the area).
- Stagger the cultivation of crops within the cultivated area to avoid extensive bare ground area/s, which pose an erosion hazard
- Do not use of pesticides and artificial fertilizers, thereby reducing the impact on water quality.

Regular monitor is required to ensure that any cultivation taking place conforms to the above guidelines.

For more information contact your provincial department of agriculture and for information on ecological agriculture contact Damian Walters of the Mondi Wetlands Project (Tel: 083 – 684 8000)

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Appendix 1: WETLAND-ASSESS (Kotze *et al.*, 2004) a rapid assessment procedure for describing wetland functions

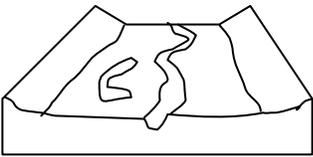
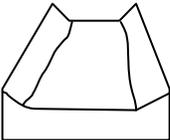
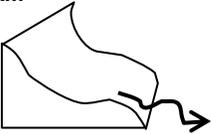
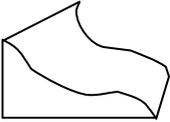
The overall goal of WETLAND-ASSESS is to assist decision makers, government officials and educators in undertaking rapid assessments of wetland goods and services, so as to highlight their importance and allow for more informed planning and decision making. The system includes the following goods and services: flood attenuation, streamflow augmentation, the trapping of sediments nitrates phosphates and toxicants, erosion control, biodiversity support, and the provision of resources (e.g. grazing plants for crafts, etc.). WETLAND-ASSESS provides for two levels of assessment.

Level 1 is undertaken as a desktop assessment. It is based primarily on the identification of each individual wetland's hydro-geomorphic type. This can be reliably conducted based on stereoscopic interpretation of airphotos of a 1: 30 000 scale or greater, together with ground verification. The functions assigned to the wetland will then be those that have been shown (based on previous studies and experience) to be generally associated with that particular hydro-geomorphic type to which the wetland belongs. For example, floodplains are characteristically associated with the attenuation of floods and the trapping of sediment. There will inevitably be some wetlands which, for reasons that would only become apparent at a more detailed level, will be incorrectly assigned particular functions. Nevertheless, the desktop level assessment provides a useful overview at a catchment scale.

Level 2 is undertaken based on a rapid field assessment (1-4 hours per wetland depending on the size and complexity of the wetland). Each function is assessed based on a list of relevant characteristics (e.g. slope of the wetland). Each characteristic used in the system has an information box which provides the rationale for the choice of characteristics together with directions on how to assign scores. Therefore the logic behind the system is open to scrutiny.

Central to WETLAND-ASSESS is a description the hydro-geomorphic type of the wetland (see Table 1). This encompasses three key elements: (1) geomorphic setting (i.e. the landform, its position in the landscape and how it evolved (e.g. through the deposition of river-borne sediment); (2) water source (i.e. where does the water come from that is maintaining the wetland?) of which there are usually several sources including precipitation groundwater flow, streamflow, etc. but their relative contributions will vary amongst wetlands; and (3) hydrodynamics, which refers to how water moves through the wetland. There is common perception that wetlands are confined to valley bottom settings. But describing the hydro-geomorphic setting of a wetland highlights the fact that many wetlands are found outside of these settings (e.g. on hillslopes).

Table 1 Wetland hydro-geomorphic types typically supporting inland wetlands in South Africa (modified from Brinson, 1993; Kotze, 1999, and Marneweck and Batchelor)

Hydro-geomorphic types	Description	Hydrological benefits/services
<p>Floodplain</p> 	<p>Valley bottom areas with a well defined stream channel, gently sloped and characterized by the alluvial transport and deposition of material by water, and oxbow depressions or other characteristic floodplain features such as natural levees.</p>	<p>Flood plain wetlands generally contribute significantly to slowing down flood waters (and therefore reducing the severity of floods), trapping sediment and removing nutrients and other pollutants washing from upstream. The vegetation in these wetlands is generally important in binding soil and preventing erosion.</p>
<p>Valley bottom with a channel</p> 	<p>Valley bottom areas with a well defined stream channel, usually gently sloped and characterized by the alluvial transport and deposition of material by water. May have steeper slopes and more limited sediment deposition. Water inputs from main channel (when channel banks overflow) and from adjacent slopes. Lacks characteristic floodplain features</p>	<p>Valley bottom wetlands may contribute significantly to slowing down flood waters but this tends to be less than the above setting owing to a general lack of depressional features and narrower width. Some trapping sediment and removing nutrients and other pollutants washing from upstream may also be performed. The vegetation in these wetlands is generally important in binding soil and preventing erosion.</p>
<p>Valley bottom without a channel</p> 	<p>Valley bottom areas of low relief, alluvial sediment deposition and having no clearly defined stream channel. Water inputs mainly from channel entering the wetland and also from adjacent slopes.</p>	<p>As above, although there is no incised channel. Indeed, one of the wetlands main functions is to stabilise the valley bottom so that incision of a channel does not take place. This results in the greater retention of water on the land and consequent water regulatory functions.</p>
<p>Hillslope seepage feeding a stream</p> 	<p>Slopes on hillsides, which are characterized by the colluvial (transported by gravity) movement of materials. Water inputs mainly from subsurface flow and outflow via a well defined</p>	<p>Seepage wetlands regulate the flow of shallow groundwater, releasing it slowly over extended periods. In this way they regulate the supply of water to streams. The potential is high for these wetlands to trap nitrogen and other pollutants, as water moves downslope within the upper layers of the wetland's soil. The vegetation in these wetlands is important in binding soil and preventing erosion.</p>
<p>Hillslope seepage isolated from any stream</p> 	<p>Slopes on hillsides, which are characterized by the colluvial (transported by gravity) movement of materials. Water inputs mainly from subsurface flow and outflow either very limited or through diffuse subsurface and/or surface flow</p>	<p>This landform setting tends to be much less important than the above landform setting in terms of streamflow augmentation, owing to its lack of a connection with any stream. However, as above, the potential to trap nitrogen and preventing soil erosion is high.</p>
<p>Depression (includes Pans)</p> 	<p>A basin shaped area with a closed elevation contour that allows for the accumulation of surface water (i.e. it is inward draining). It may also receive sub-surface water. An outlet is usually absent.</p>	<p>Depression wetlands act to effectively collect water during wet periods and store this water. Although much is lost through evapotranspiration, this stored water may aid in ground-water recharge. Depressions may be effective in trapping nutrients but if isolated from the stream network they are unlikely to have a great positive contribution to water supply and quality in the catchment.</p>

¹ Precipitation is an important water source and evapotranspiration an important output in all of the above settings

Electronic copies of Wetland-Assess are available for free, and may be obtained by email from the Mondri Wetlands Project at info@wetland.org.za

Appendix 2: Promoting social upliftment and small business development based on crafts from wetland plants

Always find out what raw materials are readily available within the local wetlands and, as far as possible, work with these rather than relying on materials that have to be transported into the area. Where a high local demand exists for high value materials which are not locally available then assess the feasibility of cultivating them locally. Incema (*Juncus kraussii*) generally has the highest priority from a cultivation point of view and the methods of cultivation are well established (see Kotze *et al.* 2002). Undisturbed, natural wetlands should not be used for cultivating these plants. Instead, use degraded wetlands (e.g. those previously used for cultivating sugar cane or other crops). One such site on Mondi land on which incema was established is at Fairbreeze on the North coast of KwaZulu-Natal. Also remember that cultivation of incema requires a lot time and care (see Kotze *et al.*, 2002)

Although tremendous potential exists for expanding craft industries based on wetland plants, several constraints to business development are holding back the development of the craft sector in South Africa.

1. Poor diversity and differentiation of products
2. Poor access to appropriate communication, transport and infrastructure
3. Limited opportunities for skills development
4. Problems with quality, volumes and deadlines
5. Donor-dependent philosophy of many craft developers
6. Poorly developed market strategies
7. Some difficulties in obtaining raw materials
8. There is a lack of coordination among stakeholder organizations

Kotze (2001b) provides guidelines, which give examples and practical advice on overcoming these constraints. The following key questions are included in the guidelines to assist fieldworkers in best focussing the particular support they provide to individual craft groups.

1. Are there identified markets for those products currently produced by the crafters?
2. Are there identified markets for new products that could readily be produced by the crafters with some adaptation and assistance?
3. Is there a secure, well-managed natural resource base for the crafts?
4. Do the crafters currently possess the correct equipment and the basic technical skills for production?
5. Do the crafters have an effective means of marketing their products and are they well known to buyers in the identified market/s?
6. Are the crafters well organized (i.e. with a constitution, effective office-bearers and conflict resolution mechanisms)?
7. Is there effective communication between the crafters and buyers?
8. Is there an effective financial system in place?
9. Is an effective transport system in place for supplying buyers?

Based on the focal areas identified, the guidelines of Kotze (2001a) provide advice such as that given below.

1. Start by working with a small number of reasonably experienced crafters.
2. Gain an understanding of:
 - (a) The materials available locally
 - (b) The different types of weaves suited to the available materials
 - (c) The local weavers' ability for producing these weaves
3. Seek market opportunities for the particular materials and skills in the group. Start with materials that are readily available, requiring skills that local crafters already possess.
4. Based on the opportunities, identify specific marketable products.
5. Produce prototypes of the identified products. Be strict on quality.
6. Obtain feedback from buyers in the market concerning the prototypes.
7. Based on the feedback, refine the prototypes.
8. Go into early production with small orders. Again quality is of the utmost importance!

The guidelines of Kotze (2001a) also identifies some of the key organizations (government, non-government and businesses) involved with crafts from wetland plants.