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DRAINFRAME AS A TOOL FOR INTEGRATED STRATEGIC ENVIRONMENTAL ASSESSMENT: LESSONS FROM PRACTICE†

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ABSTRACT

The Drainage Integrated Analytical Framework (DRAINFRAME) was developed by the World Bank's Agriculture and Rural Development Department to look at and act upon agricultural drainage from an integrated natural resources management perspective. The approach has been field-tested in three World Bank-funded projects: an irrigation improvement project in Egypt, a problems and opportunities assessment in relation to Pakistan's national drainage master plan, and a strategic assessment of a public–private partnership project for surface water supply to a desert region in Egypt. The latter study paved the way for a fully fledged environmental and social impact assessment. The cases provide useful lessons on the proper timing of the DRAINFRAME assessment, the role of public participation, and the influence that a proper and timely assessment can have on further development of water resources management plans. The paper links the DRAINFRAME approach to Strategic Environmental Assessment (SEA), an increasingly common tool to assess the potential social, economic and environmental consequences of policies, plans and programmes in an early and more effective manner. Copyright © 2007 John Wiley & Sons, Ltd.

KEY WORDS: SEA; integrated assessment; natural resources; DRAINFRAME; drainage; Egypt; Pakistan

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RÉSUMÉ

La méthode d'analyse intégrée du drainage (DRAINFRAME) a été développée par le Département Agriculture et Développement Rural de la Banque Mondiale pour examiner et agir sur le drainage agricole du point de vue de la gestion intégrée des ressources naturelles. L'approche a été testée sur le terrain dans trois projets financés par la Banque Mondiale: un projet d'amélioration d'irrigation en Egypte, un bilan-évaluation du programme-cadre national de drainage du Pakistan, et l'évaluation stratégique d'un projet de PPP (partenariat public–privé) pour l'approvisionnement en eau d'une région désertique en Egypte. Cette dernière étude a préparé le terrain pour une étude d'impact environnementale et sociale complète. Les cas étudiés fournissent des leçons utiles sur le moment approprié pour une évaluation par DRAINFRAME, sur le rôle de la participation publique, et sur l'influence qu'une véritable évaluation conduite en temps opportun peut avoir sur le développement ultérieur des plans de gestion des ressources en eau. L'article fait le rapprochement entre DRAINFRAME et l'Evaluation Environnementale Stratégique, un outil de plus en plus courant pour évaluer les conséquences sociales, économiques et environnementales potentielles des politiques, des plans et des programmes de façon suffisamment précoce et efficace. Copyright © 2007 John Wiley & Sons, Ltd.

MOTS CLÉS: SEA; évaluation intégrée; ressources naturelles; DRAINFRAME; drainage; Egypte; Pakistan

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INTRODUCTION

Water control systems in many instances are not designed to address simultaneously the needs of various users and thus may be the cause of conflicts between different groups in society (World Bank, 2004).The increasing complexity and interdependency in the planning of irrigation and drainage projects require an integrated land and water management perspective. Integrated water resources management (IWRM) has been defined as ''a process which promotes the coordinated development and management of water, land and related resources, in order to maximize economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems'' (Global Water Partnership, 2000). Irrigation and drainage, as parts of the water management system, have often done well on the economic and social front but have often done much less well in safeguarding vital ecosystems, key environmental processes, and other economic activities such as fisheries. The Drainage Integrated Analytical Framework (DRAINFRAME) was developed by the World Bank's Agriculture and Rural Development Department to provide a framework of thinking and a methodology for planning drainage interventions from an integrated perspective (Abdel-Dayem *et al.*, 2004, 2005). A close look at the concept reveals that DRAINFRAME can be applied not only for planning drainage interventions but can be equally applied to broad types of interventions for managing natural resources in general. In this paper we will report on further development of the DRAINFRAME approach, based on two field trials in Egypt and one in Pakistan. Furthermore, we will position the approach as a practical means to address issues raised in strategic environmental assessment at the level of policies, plans or programmes. The assessment of social, economic and environmental impacts at the level of policy formulation, or the preparation of a programme of projects provides better (i.e. earlier) opportunities to avoid negative impacts and enhance the performance of projects resulting from such policies or programmes.

THE DRAINFRAME APPROACH IN SHORT

Five main elements characterize the DRAINFRAME approach:

1. *Landscapes as the basis of analysis*. The biophysical world is composed of *landscapes* which are uniform (to a certain degree) aggregates of *natural resources* (land, water, air, and biotic elements). Each landscape generates a number of *functions,* or in economic terms, providing goods and services for society.[1] Since landscapes are specific combinations of natural resources, so the functions they provide are unique to each landscape. If the goods and services provided by a landscape are recognized and exploited by humans, they will be *value*d by these people who then become *stakeholders* in these functions. Depending on whether functions are experienced by people as advantageous or hazardous, their value will be positive or negative. Different people can value the same function in different ways;[2]
2. *Multifunctional resources*. People continuously interfere with their natural resources in an attempt to increase the positive values of preferred functions and to decrease or eliminate the negative values. They do that by day-to-day resources management *practices* (such as normal agriculture) or as one-time project *interventions* (such as building a dam). Usually, the practices and interventions that interfere with natural resources are focused on one or two functions only and are exerted by, or in the name of, a single stakeholder group. However, each landscape has many functions which most probably will all change if the resources are changed due to exploitation. Hence, the values of these functions will also change and thus resources management has an impact on all stakeholders;
3. *Exchange of resources between landscapes*. Water flows overland or underground or as vapour through the air from one landscape to another. Dust is airborne, fish and fowl migrate. If a resource in one landscape is manipulated, this may have an effect on functions in other landscapes, causing so-called *off-site impacts* on users elsewhere;
4. *Values change in time*. For functions that remain the same, the valuation by society may change. Demand for goods may change and market forces will lead to a change in the price of a commodity. Similarly, the social

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value may change over time. For example, with increasing affluence and increasing level of education, a society will change its perception of equity, safety or scenic beauty. Flaws in sector-oriented resource management are often induced by the single-purpose, single-intervention syndrome. The many functions of landscapes are often not recognized, and if they are recognized, the many cause–effect–impact chains of practices and interventions on all these functions and their stakeholders are not understood, neglected or disregarded because of the economic–political dominance of one single user group;

5. *Multiple functions—multiple stakeholders*. DRAINFRAME, to make up for the imperfections of sectoral management, propagates an integrated view on resources management. To analyse existing problems in resource management, or to assess the impacts of planned interventions, the many functions of the natural resources, their stakeholders and values attached by stakeholders to functions, should be mapped first; cause–effect–impact chains should be understood and if possible also quantified. This can only be done sensibly by engaging all stakeholders in the analysis or assessment.

Presently the DRAINFRAME approach is applied through two different flowcharts, which apply to different assessment situations. The original DRAINFRAME methodology (World Bank, 2004) was designed to assess the consequences of interventions, i.e. the impact assessment flowchart represented in Figure 1. Based on the first field trial (Hoevenaars and Slootweg, 2005), Abdel-Dayem in 2006 reported on the development of a second flowchart (Figure 2) for assessment of problems and opportunities in a specified area, without necessarily knowing the interventions. So now there are two distinct situations which determine the starting point of the assessment:

- *problem (and opportunity) analysis*—situations where interventions have not been proposed (yet) as the case in preparing national or regional master plans; the point of departure is a geographically defined area;
- *impact assessment*—situations where a certain intervention is proposed either as part of an existing development plan, or as a next step following problem analysis where proposed development alternatives have been identified.

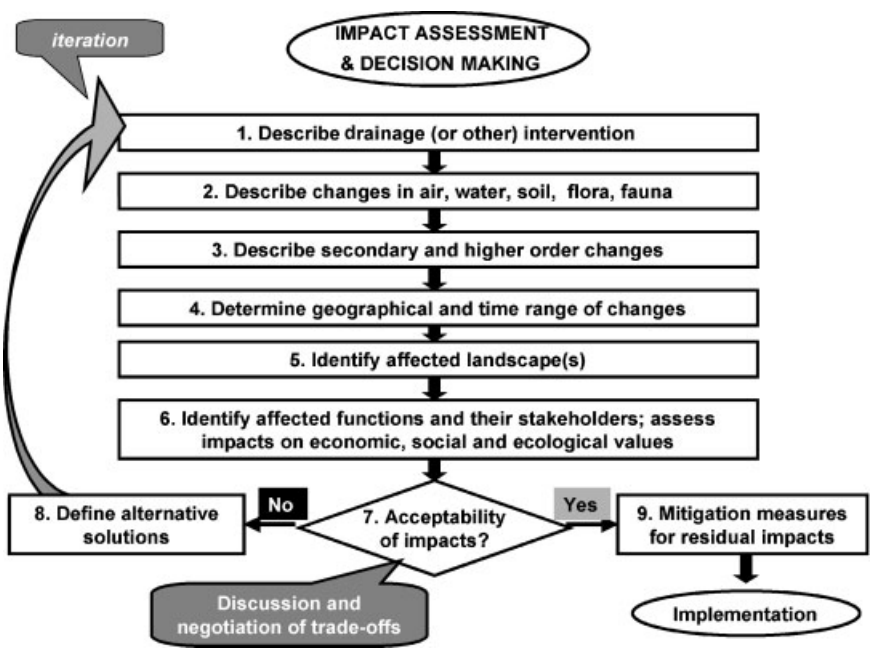

Figure 1. Original DRAINFRAME activity-oriented flowchart

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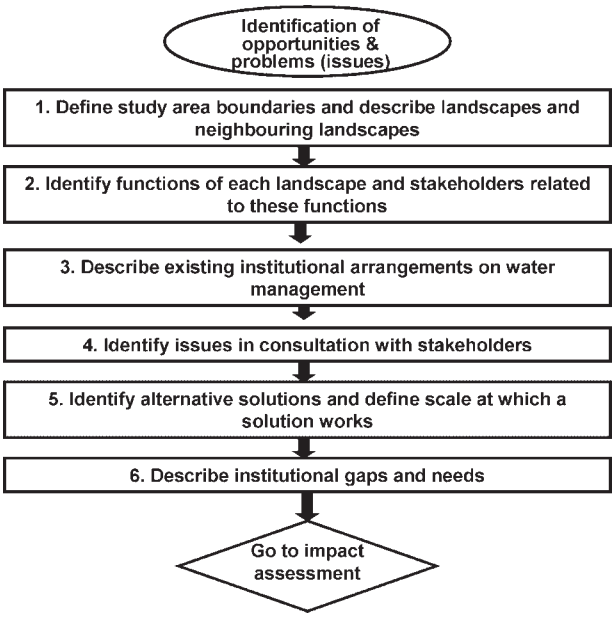

Figure 2. Additional DRAINFRAME area-oriented problem (and opportunity) analysis

FIELD EXPERIENCES WITH DRAINFRAME

Three DRAINFRAME assessments have been conducted in real-life situations: (i) the Mahmoudiya command area in the Nile Delta in Egypt where the problem analysis flowchart was developed; (ii) the Drainage Master Plan for the Indus Basin offered an opportunity for a rapid DRAINFRAME appraisal at strategic policy level; (iii) for the West Delta Water Conservation and Irrigation Rehabilitation Project (WDWCIRP) situated on the western fringes of the Nile Delta in Egypt, where the DRAINFRAME analysis contributed to a tiered impact assessment process from strategic plan to actual project design.

Mahmoudiya command area, Egypt

Setting. This area is part of the Integrated Irrigation Improvement and Management Project (IIIMP), financed by the Egyptian government with donor aid from the World Bank, KfW and the government of the Netherlands. The Mahmoudiya command area forms part of the Nile Delta and covers over 200 000 ha. The downstream end of the command borders the coastal lake Edku and the metropolitan area of Alexandria. The area primarily is watered by the Rosetta Nile Branch through an extensive canal system. The main canal also serves the Alexandria public water supply. Part of the drainage water is reused by means of mixing stations.

Lake Edku is an important area for fisheries and fish-culture. The lower part of the area is vulnerable to salinization because of saline groundwater intrusion. Improved water management is expected to lead to positive effects on water distribution, quantity, quality, equity and timeliness. This is to be effected through: (i) reduced and more rational use of irrigation water; (ii) greater and more effective participation by stakeholders in water management; and (iii) development and application of an integrated approach to planning, implementation and management of irrigation and drainage improvements (Ministry of Water Resources and Irrigation, 2005).

The DRAINFRAME analysis was conducted at the time the feasibility study of the IIIMP project was well on its way. The objectives were to:

1. Analyse the functions and values of the water resources system in an integrated manner in order to come to an overview of water resources management issues that need to be addressed and for which priorities would need to be defined;

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2. Provide recommendations on the potential use of the DRAINFRAME approach for the IIIMP project.

Methodology. The appraisal team faced the problem that the original DRAINFRAME approach was conceived on the basis of well-defined interventions (see Figure 1). The objective of the appraisal was to provide an overview of water management issues in a specific area in order to judge whether the interventions selected by IIIMP actually address the existing issues in an integrated way. This asked for an area-oriented problem analysis, leading to the additional flowchart in Figure 2 (Hoevenaars and Slootweg, 2005; Abdel-Dayem, 2006). The entry point is not an intervention, but an area possibly affected by an intervention.

The appraisal was done in two consecutive rounds. In the first round the team made a rapid inventory of potentially relevant landscapes, i.e. areas of the proposed IIIMP interventions and the landscapes hydraulically linked with them such as the wetlands of Lake Edku, including their functions and stakeholders. The information was gathered from readily available sources like topographic and thematic maps, a two-day field trip, discussions with some key informants and interviews with randomly selected water users.

In a second round the identified stakeholders were actively involved. Discussions were organized with representatives of the newly established water users' organizations in the area, with fishermen and with owners of fishponds. This second round of field visits focused on stakeholder views on issues in water management. During the Mahmoudiya assessment it became clear that irrigation and drainage systems themselves have such a diversity of functions, that it became necessary to define these as separate landscapes on their own.

Parallel to the activities described above, the team also made an attempt to map the water management institutions since the issues are rooted in imperfections of the institutional system and related management arrangements. This mapping basically was problem oriented. The last step of the appraisal was a critical review of the interventions proposed by the IIIMP with respect to the water management issues in and around the project area.

Results. By following this methodology, the team could identify the relevant landscapes, their main functions, and stakeholders related to these functions. The most important result was a comprehensive list of the main water management constraints and opportunities (= issues) in need of improvement/enhancement, not only in the Mahmoudiya project area, but also in the landscapes hydraulically linked with this command area (see Table I). The team could not arrive at a satisfactory institutional analysis mainly because of time constraints.[3]

To assess the justification of the proposed IIIMP interventions the following questions were formulated:

1. Does the IIIMP recognize the diversity of the water management situations and adapt its measures to the different situations?
2. Does IIIMP take into account the different functions of water, inside and outside the project area, their respective stakeholders and their values?
3. Are the IIIMP measures contributing to solving the basic problems of the area?
4. Will there be a systematic assessment of the impacts of the proposed measures on stakeholders inside and outside the project area?
5. Are mitigating measures considered in case of adverse effects for stakeholders inside and outside the project area?
6. Will institutions be established and function, which reflect the representation of stakeholders in planning and decision making?

With the results of the DRAINFRAME analysis in hand, these questions could be easily answered leading to the conclusion that IIIMP, although using the adjective ''integrated'', is not founded on an integrated analysis of all water management issues in the project area, nor in the areas hydraulically linked to it. In line with the mandate of the Ministry of Water Resources and Irrigation, the project is very much oriented at water quantity management in the project area for agricultural use. Hence questions 1 and 2 do not find an answer in the IIIMP project. With regard to points 3 and 4, the project addresses part of the issues inside the project area (inequity of water distribution and salinity hazard). Water quality issues remain largely unsolved. The Environmental Management Plan resulting from the Environmental Impact Assessment of IIIMP is designed for use inside the project area to address the adverse effects mentioned under question 5. Finally, a core element of IIIMP is to establish water users'

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Table I. Issues identified in consultation with stakeholders, linked to functions provided by the main landscapes under the influence of the IIIMP project

Landscapes	Functions	Stakeholders	Issues
Alluvial land in Mahmoudiya	irrigated mixed farming	- agricultural sector	low farm income
	rice cultivation	- rice cultivators	high water consumption
	animal production	- farmers	
	settlement	- households	loss of agricultural land
	maintenance of groundwater and salt balances	- farmers - housing	waterlogging and salinization hazard
Irrigation canal system (in project area and linked with off-site areas)	conveyance and distribution of irrigation water for command area	- agricultural sector	inequity of water supply
	mixing and diluting reuse water	- downstream agriculture - domestic and industry - municipality of Alexandria	low water quality
	domestic and industrial water supply	- households and industries	water quality; shortage
	solid waste dumping and transport	- households and industries - agriculture	pollution; flow obstruction
	sewerage transport and sedimentation	- households and industries - agricultural sector	pollution; flow obstruction
	natural purification of water	- all users	
	navigation	- transport sector	water depth; obstructions
	delivery of water to Alexandria	- municipality of Alexandria	water quality; shortage
Lake Edko (downstream landscape)	receiving drainage disposal	- fishermen	water quantity and quality
	purification; sedimentation		loss of environmental functions
	regulation of salt water intrusion	- upstream agriculture	threat of salinization

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organizations who will be involved in planning and decision making. However, at present there is no formal platform where users can meet to find solutions for the off-site effects of water management practices and interventions taken in the project area.

DRAINFRAME as a strategic environmental assessment. The DRAINFRAME process as described above can be interpreted as a strategic environmental assessment (SEA) for a water resources management programme in a selected area. SEA is a rapidly developing and expanding tool to assess the social, economic and environmental consequences of policies, plans and programmes and to develop plan alternatives with the most potential for development and the least negative consequences. SEA has the great advantage over traditional project-level EIA (environmental impact assessment) that it can effectively deal with the cumulative impacts of different interventions and develop adequate responses on a more strategic level of decision making.[4] The IIIMP project has many characteristics of a programme that has to make strategic decisions which ultimately result in project interventions. In its initial stage, only intervention areas have been identified. Actual activities had not been precisely defined yet; only a listing of potential activities existing at the time of the study. As shown by this case study, project-level EIA is not a suitable tool for a programme which still has to identify specific measures for various areas of intervention. In an ideal format, SEA should be an integral part of programme planning. However, in the Mahmoudiya example the DRAINFRAME analysis was carried out very late in the planning cycle and little influence could be exerted on the formulation process.[5]

Pakistan drainage master plan

Setting. In September 2004 a Panel of Experts was invited by the government of Pakistan to review the first draft of the Drainage Master Plan of Pakistan (Pakistan Water and Power Development Authority, 2004). This first draft assumed that the surplus saline drainage effluent of Punjab had to be evacuated with a Trans Basin Outfall Drain (TBOD) from Punjab, through Sindh and discharged into the sea. To be able to assess the need and design for this TBOD, and also to have up-to-date information on the overall drainage situation in Pakistan, it was proposed to delineate drainage basins and estimate the drainable surpluses of each basin. The Drainage Master Plan advocates a more integrated approach to solve drainage problems. This links on to the reform process which has been set in motion in Pakistan's water management. Decentralization and involvement of stakeholders in water boards are some of the main principles. These principles combine very well with the recommendation to put drainage problems in an integrated water management perspective and find local solutions within a drainage basin. The Panel of Experts recommended to first complete Drainage Development and Water Management Plans for each drainage basin before stepping up to a national Drainage Master Plan and proposed following the DRAINFRAME approach for this. A pilot DRAINFRAME survey was carried out by a panel of experts for the Kotri sub-basin which includes the entire left bank delta of the Indus river. The survey was carried out as a rapid field assessment in a period of 3 days. This exercise served as a test to provide reference work for Pakistani study teams that have to repeat the exercise in more detail for Kotri and all other basins (International Review Panel, 2004).

Methodology. Since no concrete water management interventions had been proposed for the Kotri Basin the appraisal started, like in Mahmoudiya, Egypt, with a problem and opportunity identification (Figure 2). As a start, secondary information was obtained from existing maps, satellite imagery, discussions with provincial water management staff and with two NGOs actively engaged in participatory water management in the basin. As was learned in the first case, the definition of irrigation and drainage networks as landscapes again proved to be useful for the analysis. Because of the time constraint and the vastness of the area, the team decided to select the Sirani Branch Drain for more detailed study during a field visit. The city of Badin was visited to appraise the problems and opportunities of a larger settlement area. A transect field tour was made to observe the toposequential gradients between the apex of the delta and the very downstream end of the reclaimed area, bordering the coastal mudflats. During the transect tour, unstructured interviews were held with farmers, fishing people and urban inhabitants. A consultative meeting was organized with different stakeholders to have more in-depth discussions about the main water management issues in the Badin region. This helped to make a rough assessment of the main institutional

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imperfections that contribute significantly to the issues. Finally a stakeholder workshop was organized to introduce water management officials and staff of NGOs to the concept of DRAINFRAME and present the results of the appraisal of Kotri Basin.

Results. The DRAINFRAME appraisal revealed the main issues in water management of the Kotri Basin connected with well-defined landscapes and their specific sets of functions. The underlying causes of these issues were found at three distinct levels: (i) the constraining resources (like limited water availability); (ii) inappropriate water use practices (like inefficient irrigation practices); and (iii) inadequacy of the water management institutions and arrangements. Based on the analysis of the main issues, recommendations for further action could be given:

- *improved drainage and flood management*. Large parts of the Kotri Left Basin suffer from waterlogging and salinity. Most of this land is found in the lower delta where flooding is prevalent during rainy periods. The poor natural drainage conditions and poor outfall conditions to the sea are aggravated by the uncontrolled drainage discharge from the Upper Delta through the Left Bank Outfall Drain (LBOD) and the tidal effect during storm surges. The problems need to be studied in more detail. The link between drainage capacity with storm water removal needs to be made;
- *improved water management*. The area faces a number of water management problems which are either closely related to the above-described drainage conditions or can best be solved in conjunction with improved drainage. This refers in particular to (i) the revision of high irrigation duties in the area to save water and decrease the inequity in water deliveries; (ii) the reuse of drainage water; (iii) the control of the disposal of industrial and household waste to improve the reuse potential of drainage water;
- *improved drinking water supply.* Drinking water supply in the area, especially during the dry season and particularly in the Lower Delta, is miserable. The canals are by far the most common source of drinking water, but at the same time they also serve as carriers for municipal and industrial wastewater. The plan is expected to identify cost-effective improvements to drinking water supply;
- *consideration of the LBOD problems*. The Left Bank Outfall Drain, the breached tidal link and connected infrastructural works pose external problems to the Kotri Basin. Solutions mainly have to be found outside the Kotri Basin;
- *improved coastal environmental management*. The coastal area has degraded rapidly, very much related to the reduced transport of sediment from the Indus. This is further aggravated by the intense use of the mangrove belt (for camel browsing, etc.). The problems with the outfall of LBOD further complicate and aggravate coastal management. The issues of coastal zone management in Sindh warrants a separate study, but it is expected that the Drainage Development and Water Management Plans for the Kotri drainage basin can identify a number of measures which contribute to solving the problems caused by coastal degradation;
- *institutional weaknesses*. In part of the Kotri Left Bank Basin new stakeholder organizations have been established under the reform processes. These new organizations are meant to improve water management, to strengthen the role of water users and create financial autonomy, but so far they have not made much inroads. The plan is expected to review the current institutional capacity and possibility for improvements, in terms of water management capacity, maintenance practice and funding.

Impact of the DRAINFRAME assessment. The rapid DRAINFRAME assessment has contributed to the idea of first having in-depth assessments of the issues at drainage basin level, aimed at solving these issues as much as possible at basin level. The Expert Panel concluded that the need for the transbasin outfall drain, a project generating intense public opposition, has not been established. The available evidence suggests that for many years to come drainage problems can be solved at basin level. This provides room for a basin-wise approach where the DRAINFRAME or similar approaches can contribute to drainage development and water management plans, taking into account the distinct features of each basin, its multiple functions and multiple stakeholders. Again, the DRAINFRAME approach fits the characteristics of SEA of such management plans, thus providing a structured means to address social, economic and environmental issues in a coherent manner during the development of a basin plan. Ultimately, the combination of all basin-level plans would lead to an overview of the need for measures at national level.

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West delta water conservation and irrigation rehabilitation project (Egypt)

Setting. The government of Egypt is preparing a public–private partnership project (West Delta Water Conservation and Irrigation Rehabilitation Project, WDWCIRP) to supply an horticultural area of 40 000 ha on the fringes of the desert west of the Nile Delta with Nile water. The reclamation of the area started 25 years ago, using groundwater for irrigation. The exploitation of groundwater turned out to be unsustainable. Water levels are dropping and water quality deteriorating. As part of the preparatory study a team of six experts was invited to conduct a DRAINFRAME assessment of the provisional project plan. At the time of study no decisions had yet been taken on the exact location and size of the project intervention area, irrigation technology, or institutional arrangements. Again, the DRAINFRAME assessment performed the role of an integrated SEA of the preliminary conceptual framework and transaction model (World Bank, 2005).

Methodology. Because the study dealt with a proposed intervention and the aim was to assess the potential impacts of such an intervention, the assessment followed the original DRAINFRAME, impact-oriented approach (Figure 1). A first round of analysis involved (i) a qualitative analysis of the expected changes due to the proposed interventions in natural resources in hydrologically connected landscapes, (ii) the identification of the affected functions linked to water and (iii) their stakeholders. In a workshop for identified stakeholders a first assessment of the relative importance of the affected functions was discussed. This resulted in the identification of the main issues. The second round of analysis included a comparison of alternative project concepts based on quantified impacts. To allow for this comparison, some of the main impacts have been quantified with the help of computational models. A farm survey was conducted to collect the necessary input data for these models. The results were presented and discussed in a second workshop with about 60 stakeholders from both the private sector and government.

Results. The innovative part of this DRAINFRAME exercise is the first attempt to quantify impacts of alternative project concepts. Relations between interventions, the changes that were expected to occur in the resources system, their effects on functions of resources, and the impact on societal values of these functions were first described. These relations in most cases were modelled in simple mathematical equations obtained from well-known sources. The team also took advantage of two existing computational models specifically designed for Egypt. One simulates water availability and yields relations for the entire Nile Delta, the other model simulates groundwater behaviour in the West Delta region, including the project area under influence of groundwater exploitation.

The DRAINFRAME study considered four alternative strategies for water supply to the project area. Strategy A0 represented the case of doing nothing, Strategy A1 used surface water for irrigation in conjunction with groundwater use for peak demands. A1 was a continuum of alternatives which needed to be optimized. Strategy A2 considered no groundwater use at all. Thus the capacity of the conveyance system should be designed to meet the peak water requirement. Strategy A3 included a planned recharge of the aquifer with Nile water during the lean period, and using it for peak periods. This strategy could not be evaluated due to lack of data. As a result of the quantification, the study could predict (i) labour opportunities, (ii) groundwater levels and quality, and (iii) the net present value of agricultural production in the project area and in the Nile Delta for each strategy over a period of 12 years.

A nested hierarchy of environmental studies. The creation of a public–private partnership for the provision of irrigation water with full cost recovery, as is the case in this project, is a relatively new procedure, and how to deal with environmental and social impact assessment in such circumstances has yet not been clearly defined. The highly participative nature of this particular process has all the characteristics of the learning by doing approach, making use of best available international knowledge, and internationally recognized tools such as SEA and EIA.

Figure 3 provides a simplified overview of the steps in project formulation and the points where impact assessment plays its role. The WDWCIRP project started with a preliminary technical assessment (the so-called PPIAF study). The PPIAF provided a general framework on how to address the predictable future problems of groundwater availability in the West Delta region by means of surface water supply through a public–private partnership (PPP) and the willingness of the beneficiaries to connect on a full cost recovery basis. This preliminary

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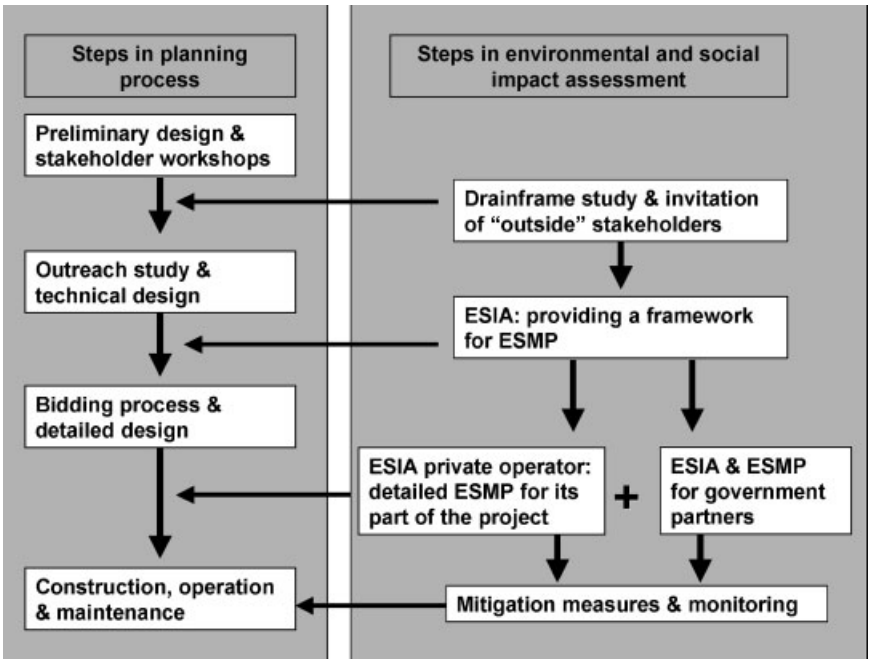

Figure 3. Project planning process including environmental and social assessment

study provided the basis for the DRAINFRAME study, which had all the characteristics of an integrated SEA. Integrated in the sense that economic, social and environmental aspects are taken into account; strategic in the sense that it offers options for decisions by policy makers at the higher levels guided by stakeholders' perceptions and the national interest in achieving sustainable development. This could help avoid costly mistakes and provide additional input to the technical, operational and institutional measures needed to guarantee the sustainability of the project. The early stages of the planning process have been highly participatory.

The preliminary PPIAF study was based on a number of stakeholder workshops and interviews throughout the project area. The focus was on identifying the needs and aspirations of farmers in the West Delta area. The DRAINFRAME study has extended participation to other stakeholders who, based on the strategic assessment, can be identified as potentially affected by the project. The outreach study made all farmers in the area aware of the process (instead of sampled groups) to guarantee broad knowledge of, and contributions to, the planning process. DRAINFRAME and outreach studies have determined the scope of a further detailed technical study. This technical study, however, is *not* a final design, but provides the boundary conditions for the bidding process.

At this stage of the process an environmental and social impact assessment (ESIA) is needed as part of the project preparation cycle. The ESIA moves from the broad overview provided by the DRAINFRAME study to more detailed project-level impact assessment. However, as the final design of the project is not yet available and many issues remain unresolved, the impact assessment in many instances cannot go further than defining the various tasks and responsibilities of both private and public partners in the remaining phases; the ESIA has to provide a framework for further work. The final design will be made by the private service provider who wins the bid for the PPP project. This entity will have to perform an EIA according to Egyptian law, but will be able to make use of all material already available. This EIA study consequently can focus on a detailed environmental and social management plan (ESMP), including monitoring and mitigation measures for the activities under the responsibility of the private operator. Similarly, government has to play its part in the impact assessment process by elaborating an ESMP for the tasks under its responsibility. The use of SEA at the earliest possible stage of project formulation has guaranteed the incorporation of environmental and social issues in the design process. The information collected during the process is effectively used to reduce the workload in the next stages. In this respect the approach is

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nearing the ideal situation in which assessments constitute a ''nested hierarchy'' of studies, each step making use of and building further on the earlier step.

LESSONS AND RECOMMENDATIONS

Three main lessons with respect to the DRAINFRAME approach itself can be drawn. (i) In order to handle all situations in water management the methodology of assessing the impacts of specified interventions needs to be extended with an approach for a more open problem analysis. This approach is elaborated in the first two examples. (ii) A further lesson is that landscapes (being physically defined areas with a coherent set of functions) should be defined precisely. Water bodies, including irrigation and drainage canals, should be considered as separate landscapes having their own specific set of functions. Similarly, settlements of a certain magnitude are landscapes with a specific set of functions. (iii) Interventions should not be taken only as one-time project events but should also include current and future management practices. This corresponds with repeated lessons from impact assessment studies that impact assessment should be considered more as a process resulting in continued monitoring and adjustment, and less as a one-time exercise resulting in a report which usually disappears into a drawer. The flowchart in the last case (see Figure 3) provides the best illustration of a continuing process, even though the Pakistan case could potentially also develop into an example of good impact assessment practice. It would be interesting to follow the implementation process closely.

Stakeholder participation provided relevant information for the identification of functions, as shown in all three cases. Different levels of participation are required in different steps of the DRAINFRAME assessment. In the early stages of plan development, formal stakeholders such as government bodies and representative bodies for individual stakeholders, should be involved, as the planning process cannot be driven by individual stakeholders' concerns. At a later stage, when location and activity become more visible, the actual affected stakeholders can be identified and invited into the process. In the DRAINFRAME approach this element has not received enough attention and requires elaboration. Again a similarity occurs with impact assessment procedures where SEA usually deals with formal (government) stakeholders, while project-level EIA provides opportunities for individuals to participate in the process.

The DRAINFRAME approach recognized three main settings: (i) the biophysical environment, (ii) human society and (iii) the institutional setting. An institutional analysis should be part of the DRAINFRAME analysis, as many of the issues encountered are rooted in the institutional setting. The DRAINFRAME exercises so far have performed very well in establishing the linkages between the biophysical environment and human society. Conversely, only limited results have been attained on the institutional aspects. In both the Mahmoudiya and Pakistan studies it became clear that we have no conceptual framework ready for use which includes an institutional analysis; furthermore, it also was obvious that an institutional analysis takes more time than we had available. In the last case the institutional responsibilities had not yet been entirely defined because of the early stage and the new context of a public–private partnership. In the follow-up stages this will become clear and further lessons may be drawn from this case.

The results of a DRAINFRAME assessment are as good as the available information. Quantification of values attached to functions (not only economic values, but social and ecological as well) provides useful information for decision making. Quantification of impacts, of course, requires more time than a qualitative analysis. The advantage of DRAINFRAME is that it allows for rapid assessment with good qualitative results, as well as for in-depth analysis.

The input that can be expected from a DRAINFRAME analysis in a project preparation process depends to a large extent on timing. The Mahmoudiya study revealed that because the exercise was done late in the planning cycle (mid-feasibility stage), there was no significant influence on project preparation. In the Pakistan case the exercise was done much earlier, in a phase where alternatives were still being discussed. Here the DRAINFRAME approach was adopted for further elaboration of the Drainage Master Plan at sub-basin level searching for local solutions. In the WDWCIRP project DRAINFRAME was applied at a stage where major decisions on location, size and technology still had to be taken. The DRAINFRAME assessment was done early enough to influence the project set-up significantly. Moreover, the results created the boundaries for the environmental and social impact assessment which is being produced at the moment of writing of this paper.

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CONCLUDING REMARKS

DRAINFRAME offers a useful approach and methodology to analyse water management situations in an integrated manner at basin level. The approach can be used for rapid appraisals as well as for elaborate and quantitative impact assessments. The approach now gives the freedom to start with a wide-ranging problem and opportunity analysis or to start directly with impact analysis of certain proposed interventions in the resources system. With the three case studies it has been demonstrated that DRAINFRAME can offer useful contributions to the project planning cycle, given a timely application. It is also clear that the approach needs a more systematic elaboration of participation of the stakeholders and a mature methodology for evaluation of the institutional setting of water management situations.

The approach has in none of the three cases been used as an impact assessment tool in the formal sense, i.e. it has not been applied as a result of an SEA or EIA requirement. Nevertheless, as stated at various instances, DRAINFRAME does follow the logic of SEA and does provide a practical tool to carry out such formalized assessments for the water sector, providing a basis and guidance for ESIA at a following stage.[6] There is not one single approach to SEA; moreover SEA is seen as a family of tools. DRAINFRAME can be considered a tailor-made application of SEA for integrated water resources management.

It can be argued that the water sector should be more aware of the advantages provided by EIA and even more so by SEA. Impact assessment at a strategic level (i.e. at the level of policy, plan or programme, when individual project activities are not yet defined) provides a large range of alternatives, thus providing real choices in which environmental and social sustainability issues can be taken into account without running into the problem of having to redesign a project. In this respect it is noteworthy to point out the similarities between DRAINFRAME and the approach described in the guidelines for the integration of biodiversity in SEA and EIA, recently adopted by over 180 signatory countries to the Convention on Biological Diversity (CBD, 2006).[7] One can conclude by stating that the DRAINFRAME approach is fully compatible with the CBD guidelines on impact assessment. Since 180 countries have agreed to proceed along the lines of these guidelines, the water sector has strong reasons to proceed with further implementation and enhancement of the DRAINFRAME approach.

NOTES

[1]In this paper we will maintain the original DRAINFRAME terminology. However, since the appearance of the widely publicized UN Millennium Ecosystem Assessment (2003) the common denominator for ''functions'' or ''goods and services'' has become ''ecosystems services''.

[2]An example of differences in valuation of a similar function: depressions along a river can be considered a landscape type. One of their functions is to receive and store peak water discharges of the river (which is another landscape). The submersion of the land deprives farmers of a full season of agricultural production. Hence they place a negative value on the annual flooding. But fishermen see their fishing grounds expanded for a season and they also know that fish are breeding and feeding in the depressions. Fishermen value the flooding of the depressions positively. Inhabitants of a downstream riverside city would experience flooding of their city without the flood-dampening effect of the upstream depressions. Hence they also value the flooding of the upstream depressions positively.

[3]Functions of the water resources system are managed by humans by either informal or formalized institutions. Usually these institutional arrangements are characterized by a number of layers. In the delta agricultural lands, the following levels can be distinguished, with examples of formal or non-formal types of institutional arrangement: field (individual farmers), tertiary canal or *mesqa* (water users' association), branch canal (water board), and command level (district water board). The concept of institutions encompasses a wide variety of aspects, such as actors, organizations and their interactions, property rights, governance mechanisms, regulation, control, monitoring and enforcement.

[4]SEA has been adopted by virtually all industrialized countries; in some 20 developing countries it is common practice and in another 30 it is evolving (OECD, 2006). It is generally acknowledged that SEA is most effective

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when integrated as much as possible within the planning process. Core values of SEA are (i) the provision good quality information, (ii) participation of stakeholders, and (iii) transparency in decision making.

[5]Within the mandate of the Ministry of Water Resources and Irrigation, water quality management is limited to monitoring and law enforcement. The scope of the project cannot include actions like liquid waste treatment and solid waste management except from the awareness point of view. Implementation is another ministry responsibility. However, the integrated approach of the project couples with the objectives in the National Water Resources Plan, triggering a rural sanitation project in the same command areas which is under preparation with World Bank support. The DRAINFAME study outcome was useful in making this decision. Both projects will share the same user organization.

[6]For readers not familiar with the concepts and procedures of EIA and SEA two websites provide excellent background reading. The World Bank has produced widely used and praised Environmental Assessment Sourcebooks, including a number of updates (http://go.worldbank.org/9LF3YQWTP0). Recent development in SEA have been well captured by Dalal-Clayton and Sadler (2005) and OECD (2006). Another important source of recent information is provided by the International Association for Impact Assessment (www.IAIA.org).

[7]The background document to the CBD decision (Slootweg *et al*., 2006) provides a conceptual framework similar to the DRAINFRAME approach. Not surprisingly so, since biodiversity constitutes the living part of the same biophysical environment that is addressed by DRAINFRAME. Moreover, since the appearance of the Millennium Ecosystem Assessment it has become common thinking that the link between biodiversity and society is created by ecosystem services, being a synonym for the concept of functions that we have suggested for the DRAINFRAME approach. Even the distinction between an area-oriented and an intervention-oriented approach as made in the DRAINFRAME approach is described in the CBD guidelines.

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