

# Towards Sustainable Management of Jerash Watershed: The (SMAP) Project

نحو إدارة مستدامة لحوض جرش المائي: مشروع (SMAP)

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**ABSTRACT:** With limited resources and rapidly increasing demands, sustainability is becoming an increasingly important issue, yet difficult goal to achieve in wadis (Salih and Ghanem, 2003). Sustainability of wadi systems is more complicated due to the conflicts and interactions among the different resource utilizations. Therefore, sustainability of wadi systems, and rather any natural entity, can only be achieved through an integrated management approach. In this study, an attempt is made to summarize the challenges facing sustainable development of a wadi system (Wadi Jerash) and to propose some solutions towards achieving that goal. The challenges considered in this paper include technical, socio-economic, environmental, institutional, political and legal aspects. Wadi Jerash project area, defined as the surface catchment of the Zerqa River in Jordan, is taken as an example due to its characteristics as a natural environmental set-up that need to be managed in a comprehensive and sustainable manner. The proposed methodologies are based on the outcome of wadi al Far'a and Jerash integrated watershed management project. The overall aim of the project is to create sustainable development conditions for the study area through which water resources, natural resources and human resources are protected and conserved.

**Keywords:** sustainability, wadis, hydrology, Jerash Watershed, Jordan.

**المستخلص:** إن المحدودية في المصادر الطبيعية والطلب المتزايد على هذه المصادر قد جعل الاهتمام بموضوع الاستدامة في تزايد مستمر رغم صعوبة تحقيقه في الوديان، كما أن الاستخدام المستدام لأنظمة الأودية هو أكثر تعقيداً نتيجة الخلافات والتقاطعات بين الاستخدامات المختلفة. وعليه فإن الديمومة لأنظمة الأودية يمكن فقط تحقيقها من خلال طرق الإدارة المتكاملة. تحاول هذه الورقة، تلخيص التحديات التي تواجه التنمية المستدامة لأنظمة الأودية (وادي جرش) ونقترح حلولاً لتحقيق هذه التنمية المستدامة. تضم التحديات التي تشملها هذه الورقة، نواحي اقتصادية واجتماعية، ونواحي بيئية ونواحي مؤسسية إضافة إلى النواحي السياسية والقانونية. تمت في هذه الورقة دراسة حالة حوض وادي جرش والمعروف بحوض نهر الزرقاء في الأردن، وذلك لخصائصه كنظام بيئي طبيعي بحاجة إلى إدارة شمولية ومستدامة. والحلول المقترحة فيها، هي بناءً على النتائج التي قد تم الحصول عليها من مشروع الإدارة المتكاملة لحوضي الفارعة وجرش والذي يهدف إلى خلق ظروف تطوير مستدام لمنطقة الدراسة والتي من خلالها تتم الحماية والحفاظ على المصادر المائية والمصادر الطبيعية والبشرية.

**كلمات مدخلية:** عقاقير البنزوديازيبين، التغيرات التركيبية الدقيقة، خلايا الكبدية، تتركز، تحلل دهني.

## BACKGROUND

Sustainable development may be defined as the ability to meet the needs of the present without compromising the ability to meet future needs (Serageldin, 1995). This can be projected on wadi development from different perspectives. While one might visualize sustainability as a physical concept for the preservation of a single resource (e.g. water), another perspective might consider a larger, but still purely physical scope, of conservation of a group of resources or an ecosystem (e.g. within a wadi watershed or basin). A third perspective could apply the concept through a wider vision encompassing physical-social-economic-ecological aspects (Dixon and Fallon, 1989).

The first definition of sustainability with regard to a single resource is too narrow regardless the importance of that resource. The inter-relationships between the different forms of water, from rain to surface and groundwater, and the complex processes involved of rainfall, runoff, erosion, deposition, seepage ... etc., will logically introduce other aspects such as surface and underground geology, morphology, biology, ... etc. Furthermore, it is not merely the quantity of freshwater that is relevant, but also its quality and distribution in time and space in relation to other elements of the ecosystem as defined, for example, by a watershed (Salih and Ghanem, 2003).

However, even this second definition of sustainability as a physical concept for an ecosystem is still too narrow. This is because the interest is not only in the preservation of the physical entities of the ecosystem, but also in the sustainability of potential services provided by the ecosystem's resources, and the impact of human activities and behavior on the system. This leads to the adoption of the third global view, encompassing all physical, social, economic and ecological aspects of wadi development. Thus, sustainable management of wadi systems should satisfy present objectives of society, without compromising the ability of the system to satisfy the objectives of future generations (Hufschmidt, 1993). Services provided by the system to society include support to activities such as domestic, agricultural, industrial, and recreational uses,

as well as the maintenance of the ecosystem. The value to society, in the form of economic productivity, human health, biodiversity and social equity needs to be maintained.

Based on the above and due to the existence of a multitude of interacting and interdependent systems in wadis, a truly integrated wadi management approach, which incorporate subsystems into a larger encompassing system, is essential. The approach of Integrated Watershed Management has brought about a drastic change in how to resolve environmental problems, moving from a supply-oriented, engineering bias towards a demand-oriented, multi-sectoral approach, and preferably decision making at the lowest appropriate level (Loucks and Gladwell, 1999).

The approach of Integrated Watershed Management adopted in this study, is about more than simply matching demand with resources. It entails a series of cross-cutting policy issues that are an integral part of the decision-making process. These issues relate to two core elements: sustainability and stakeholders involvement.

### Sustainability

Sustainable development is a key concept in watershed management. The following aspects of sustainability are distinguished: Technical sustainability (balanced demand and supply, no mining); Financial sustainability (cost recovery); Social sustainability (stability of population, stability of demand, willingness to "pay"); Economic sustainability (sustaining economic development or welfare and production); Institutional sustainability (capacity to plan, manage and operate the system); and Environmental sustainability (no long-term negative or irreversible effects).

### Stakeholder involvement

Stakeholder involvement objectives are to take account of public interest and to enhance the public sharing of ownership. Integrated Watershed Management takes account of: all natural aspects of the natural resources; all sectoral interests of stakeholders (inter-sectoral approach); the spatial variation of resources and demands (upstream-downstream interaction, basin-wide analysis, inter-basin transfer); relevant policy frameworks (national objectives and constraints (social, legal,

institutional, financial, environmental)); and all institutional levels (institutional framework and stakeholders (national, provincial, local)).

Within this framework, four activities were distinguished. These are:

**Resources Development:** actions, mostly physical, that lead to the beneficial use of land and water resources for single or multiple purposes.

**Resources Planning:** planning of the development, conservation and allocation of a scarce resource (sectoral and inter-sectoral), matching availability and demand, taking into account the full set of national objectives and constraints and the interests of stakeholders. Planning is only effective if all interested parties during the planning and implementation stage (stakeholders) are – in one way or another – involved in the process of decision making and feel committed. If not the project or program is likely to fail.

**Resources Management:** the whole set of technical, institutional, managerial, legal and operational activities required to plan, develop, operate and manage resources for sustainable use.

**Demand Management:** the development and implementation of strategies aimed at influencing demand, so as to achieve efficient and sustainable use of a scarce resource. Demand management should be considered as one of the most important components of Integrated Watershed Management strategies (next to institutional arrangements and physical measures). It entails a set of actions to be taken by the manager to reduce demand, which may include: Awareness and promotion; Education and training; The formulation and application of incentives to influence the demand for water.

Implementation incentives for demand management can be grouped in two main categories:

- instruments, which include: charges, subsidies, taxes, and regulations which create markets where water rights and emission rights can be traded;
- instruments, including, for example general quota or individual licenses for extraction or discharges and ambient water quality standards. Such regulations are often combined with financial enforcement incentives such as fines and penalties.

## STUDY AREA DESCRIPTION

The proposed Jerash watershed project area is defined as the surface catchment of the Zerqa River (Figure 1). It covers about 117 hectares. The catchment area consists of a main river valley with various springs fed tributaries. The Baga'a basin, a relatively flat depression, within the catchments, is the main groundwater infiltration zone. The Baqa'a basin accommodates a large settlement. The main economic activity is groundwater irrigation. The lower regions of the Zerqa region, as well as the Jordan valley itself, are subject to structural water shortages. Especially the agricultural sector here is suffering from these shortages.

The King Talal Dam, is the main physical intervention in the area. Its objective is to optimize and regulate water supply for the downstream agricultural activities in the Zerqa region and the Jordan valley, as well as generation of hydropower. To reach this objective, substantial amount of the upstream surface water runoff needs to be intercepted and stored in the reservoir. However, an already significant part of this water is currently applied for agricultural purposes upstream of the reservoir, and is lost for downstream users as a result of evapo-transpiration.

During dry periods, the dependence on the scarce groundwater resources increases, causing higher abstraction rates and increasingly lowering groundwater tables. Locally, this causes increasing salinity levels. Furthermore, large portion of the rural wastewater is discharged without treatment into the wadi systems. This causes increasing nitrate and coliform concentration in groundwater and springs.

Population growth and overgrazing are important driving forces for the erosion problems. In addition, water scarcity and abandoned agricultural lands are important causes for land degradation, desertification, and erosion.

A series of environmental themes related to the watershed problems are addressed in this study. A practical watershed management plan is urgently needed. Such a plan should be based on realistic options and alternatives, and should therefore ideally be based on experiences of a series of already implemented pilot actions. The relevance of this proposed SMAP Integrated

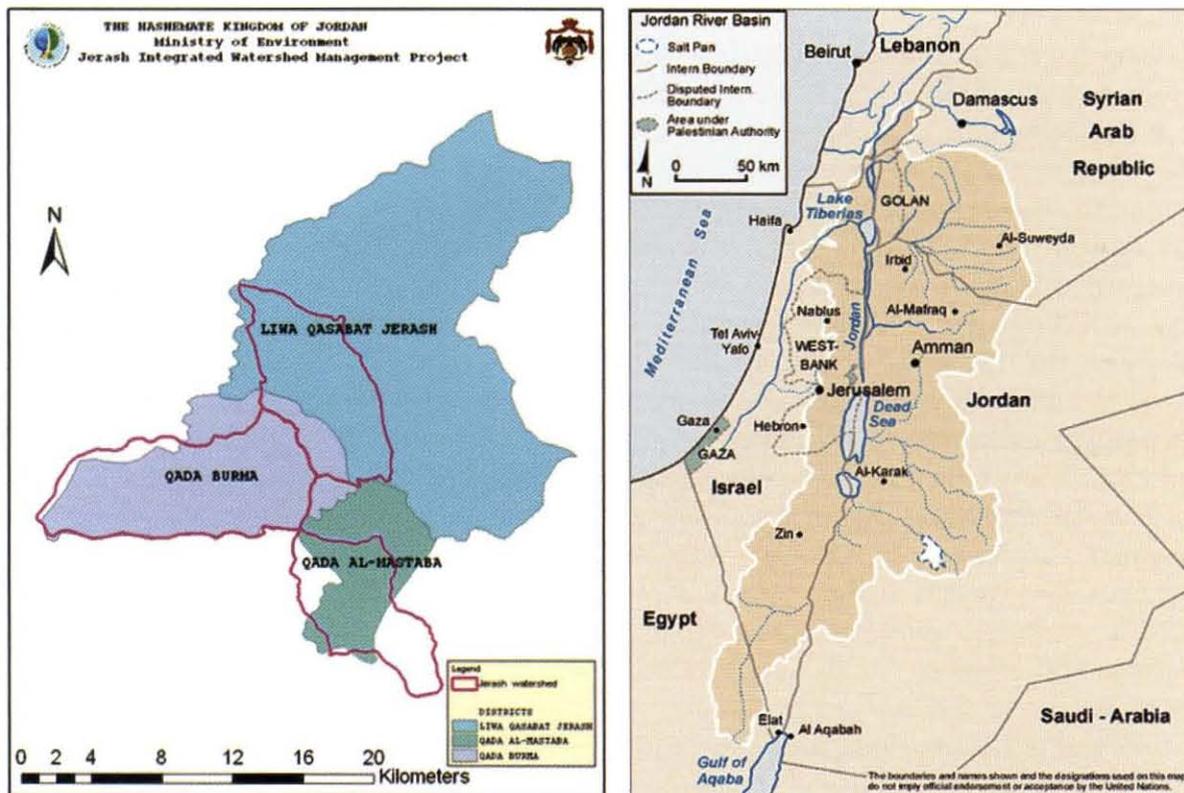


Fig. 1 : Location of Wadi Jerash catchment.

Watershed Management Project is therefore very high. The anticipated project results are urgently needed to reverse the deterioration of Jarash watersheds.

The study takes further into account the measures and actions that have already been initiated through other channels, such as the numerous small-scale rural developments projects that have been realized by other projects in the area. The project is fully in line with other programs and initiatives in the region, such as the Initiative for Collaboration to Control Natural Resources Degradation of Arid Lands in the Middle East, under leadership of the World Bank and administrated by the International Centre for Agricultural Research in the Middle East (ICARDA).

## PROJECT DESIGN

Policies and strategies, developed by ministries are often theoretical, without input from those for whom the strategies are developed. Therefore, implementation of interventions, developed at the national level, does not always lead to guaranteed success. Two-way interaction

should take place and interests and decisions at lower levels need to be carried upward to be taken into consideration at higher levels, particularly to the national level. An important element in this process is the participation of stakeholders in the decision-making processes at all levels; this requires a demand driven approach instead of a supply-driven one.

Action plans should be in line with the general strategies at the national level, but backed up by practical experiences from local level. To include experiences from local level, the project approach will therefore be "bottom up" instead of "top down".

The project teams will learn from information and knowledge from farmers and other stakeholders at local level. The project will use these information to develop methods to select and implement sustainable interventions, which will improve the living conditions of the rural population. The experiences will be transformed into action plans, using methodologies, which can be replicated in other areas. The methodologies will be tested in two watersheds (in two different countries), and exchange of experiences will improve our learning process.

### Technical Aspects

Several problems have occurred in the past due to a fragmented view of a wadi system. This is mainly because decision-makers and planners did not consider or were not aware of the nature of such systems (Wheater, 1997). Many projects are planned and executed without any consideration to the boundaries of the watershed and its physical features. Maintaining the integrity of the hydrologic whole of the wadi system in any management plan is a key factor to secure the sustainability of the plan (Salih and Ghanem, 2003). To achieve this, a scientific understanding of the system is an essential component. Physical phenomena of precipitation, runoff, evapo-transpiration, streamflow, seepage, sediment transport and deposition, and flooding should be carefully observed, measured and analyzed.

Unfortunately, the scientific understanding of these phenomena in wadi Jerash is still inadequate. Several difficulties underlie wadi exploration, including climatic conditions, difficulty to conduct measurements, and complexity and interdependency of the different processes. Further, there has been a noticeable lack of coordination of data collection activities and dissemination of information and techniques. The data collected under the Jerash project included information regarding the different elements of the natural environmental system and the socio-economic system in the region. The Jordanian Ministry of Water and Irrigation and the Ministry of Environment were the main source for water resources data. Collected water resources data included the historical data for the wells, springs, and precipitation data related to the basin. The ministry of Agriculture was the main source for agricultural data related to the irrigated lands, existing cropping patterns, agricultural practices and socio-economics of different agricultural practices.

The Jordanian Department of Statistics was the main source for the data on demography, infrastructure and socio-economics of the watershed. It was clear that the data collected can be classified as fragmented, incomplete and discontinuous. The data issue forms a main challenge to better understand the physical characteristics and processes of the Jerash catchment.

### Socio-Economic Aspects

Sustainable water resources management should be based upon the social and economic circumstances existing within the boundaries of any water project. Although the importance of this statement is stressed in many reports, few specific cases can be found where the socio-economic dimension has been given its proper share during the planning, design, implementation and management of such projects. It is true that in many water projects insufficient attention is given to social and economic aspects, such as land tenure, unemployment and involvement of beneficiaries. This has turned out to be a major constraint in water related projects in wadi Jerash.

In this project, special attention was given to this issue. Stakeholders analysis for wadi Jerash was conducted. This involved the identification of the project's key stakeholders, an assessment of their interests, and the ways in which these interests affect project viability. It is linked to both institutional appraisal and social analysis, drawing on the information derived from these approaches, but also contributing to the combining of such data into a single framework. Stakeholder analysis contributes to project design through the logical framework, and helps to identify appropriate forms of stakeholders' participation.

In wadi Jerash, the list of stakeholders includes at the local level two main groups: 1) local partners who support the project activities in the issues related to maintenance and sustainability; and 2) Agencies and NGO's actively working in the project area, which support the project in research and technical experience. At the national level, it includes the two main groups: 1) Governmental ministries and authorities that support the project in reporting, monitoring and other related activities; and 2) International consulting agencies that support the project in technical assistance and other related activities. Conducting of the above-mentioned stakeholder analysis allow the study team to better understand the socio-economic challenges within the Jerash watershed.

### Environmental Aspects

Environmental aspects consideration is the key to success of any managerial plan in wadis.

The importance of the environmental dimension has now been well recognized as of great influence on all elements of the hydrological cycle. In turn, terms like environmental hydrology are increasingly receiving global recognition. The effects of quality aspects -chemical, biological and physical - of the components of the hydrological cycle, can not at all be neglected. Real examples from wadi Jerash and based on the outcome of the projects are:

- Deterioration of groundwater and surface water quality;
- Low productivity of rain fed agriculture;
- Reduction of irrigated agriculture productivity;
- Improper management of natural resources;
- Deterioration of Public health;
- Land Degradation; and
- Improper solid waste management practices.

All these issues form a challenge to any integrated management plan within the Jerash catchment. These challenges will have to be considered in an appropriate manner in developing any future plan for the area.

### **Political Aspects (Political Will)**

So often political instability plays as the major constrain in the sustainable development of wadi systems. Many wadis in the Middle East cross political borders which, according to the international laws and principles, makes them international water courses. In these cases, international water law principles should naturally apply but due to disagreements between parties, the international laws are often replaced by Caesar's Law which says what is mine is mine and what is yours is mine. (Al-Masri, 2005).

Historically, political aspects concerning water rights in wadis and watercourses have received great attention and different international water laws and principles have been proposed and applied to different wadi systems. In general, the weakness in these laws lies in its general nature and the absence of some specific issues related to specific wadis.

### **Institutional and Legal Issues**

The institutional and legal aspects represent an important component of any sustainable management plan for wadis (Abdulrazzak,

1998). Institutional framework and the question of ownership are complex and diverse issues in many catchments including Wadi Jerash. Historically, legal aspects concerning the use of water in wadis have received great attention and the management of wadis' water resources has been well accepted ever since. Different legislations throughout history were enforced in wadi Jerash. These legislations, however, mainly addresses the legal aspects of the wadi water resources. It was always felt that there is a need for a national initiative to develop a legal framework that addresses the specific problems of wadis and groundwater. If these institutional and legal aspects are not resolved, they will form a major threat to any integrated management plan.

### **WADI JERASH MANAGEMENT PLAN**

The Ministry of Environment in Jordan is a governmental authority engaged in the planning and development of all environmental aspects in a rational manner. As mentioned earlier and among the excellent tasks performed by this authority, is its current involvement with the preparation of a comprehensive and sustainable management and developmental plan for wadi Jerash with great focus on environmental protection of the natural resources and ecosystems.

The main concern was on how to address the above mentioned challenges within wadi Jerash. For that, the project has divided its involvement into two main phases: the first one included pilot projects program with different environmental and planning themes to remove or halt environmental deterioration in the wadi, while the second task concentrated on elements related to the development of the comprehensive management plan components.

In selecting the possible interventions, the team transferred the challenges mentioned above into problem trees and then into objective trees and the causes transferred into means. Then a list of possible interventions for each core objective tree was developed through transferring the means of the core objectives into possible interventions. Later on, all the possible interventions derived from the different objective trees were combined together into one list.

A list of thirty-six interventions was developed. Based on selection criteria, Cost Benefit Analyses and Risks Identification, a priority list of interventions was developed and will be implemented to develop better understanding before the development of the integrated management plan. In addition to the priority list, a set of Performance Indicators and a monitoring system were prepared to make use of the pilot outcomes.

The pilot projects consist of: water harvesting; establishing a waste processing factory to treat goat, sheep and cows manure and turn it to a fertilizer; Developing, maintaining, and protecting water springs in the three watershed areas of Jerash; conducting an environmental assessment study to olive mills in Jerash; establishing local environmental community awareness center; and conducting an environmental degradation study in the targeted area. The pilot projects, together with the socio-economic aspects, will be integrated into a comprehensive sustainable developmental plan for the management of the wadi.

## CONCLUSION

Integrated wadi resources management is seen as the answer to sustainable development of wadi systems in that it will lead to better use of the available resources to meet current and future demands. To make the management system work, a thorough understanding of the natural resource system and detailed knowledge of its interactions with human activities, are vital prerequisites. To achieve that, one must assure the existence of some pre-requisites. They include: The full understanding of the state of the physical resources in a wadi system;

Integration and coordination of meteorological and hydrologic data collection and interpretation activities; Socio-economic analysis of different water users and the evaluation of the different socio-economic factors impact; and conducting Environmental Impact Assessment (EIA) studies as part and parcel of all processes related to the planning, implementation and operation of water projects.

Political will is definitely a key factor towards sustainable development and management of

wadi systems. Institutional reform and legislative efforts are needed to enact laws and regulations, and to address the integration of all interrelated aspects of wadi management.

The Jordanian Ministry of Environment attempt to develop an integrated management plan for wadi Jerash is a promising initiative that considers all aspects that needs to be addressed within an integrated management plan. The analysis within the project shows that different technical, environmental, socio-economic and institutional issues and concerns exist in the Jerash catchment and for that, they need to be addressed in the plan.

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