**The Jerusalem Institute for Israel Studies**
The Center for Environmental Policy
Established by the Charles H. Revson Foundation

# Wastewater Treatment in Arab Villages

**Isam Sabbah, Abdallah Rayan**

**2007**

The Center for Environmental Policy Studies Series, no. 25

# Wastewater Treatment in Arab Villages

**Isam Sabbah, Abdallah Rayan**

This publication was made possible through funding by the Charles H. Revson Foundation. The statements made and the views expressed are solely the responsibility of the authors.


The Hay Elyachar House
20 Radak St. 92186 Jerusalem

http://www.jiis.org.il
E-mail: machon@jiis.org.il

# Abstract


## 1. Background

Most Mediterranean countries, from Spain to Greece, have gained a great deal of experience in the treatment of sewage and in its recycling for use in rural agriculture – usually by taking advantage of inexpensive alternatives. Yet in rural areas of the Galilee millions of cubic meters of sewage are left untreated, both posing a health hazard and endangering the groundwater.

In the framework of a previous study a survey was done of 25 Arab settlements in the Galilee and 10 settlements in the most populated region of the "Triangle" (the Arab villages located east of the line connecting Kfar Saba and Hadera, in the center of Israel). The results of the survey showed a lack of clear policy for waste treatment – in rural regions in general and in the Arab sector in particular. The villages of Mayyar and Sachnin represented the minority of Arab settlements, where there is a local system for sewage treatment and its recycling for local agriculture. The quality of the treated water in these two villages was found to be borderline, and even low, for the irrigation of olive groves.

Since Mayyar's sewage system was recently connected to that of the centralized Ramat Levanim project (by the Kinneret), the Sachnin model remains the only one of its type in the Arab sector. The model that is presented here is critical to a thorough understanding of the subject from the point of management and to its comparison to options, such as the upgrading of the system or the joining together of all the Sachnin valley settlements (Sachnin, Arabeh, and Dir Hana) to the sewage system of Carmiel.

This report sums up the information on the treatment of sewage in Sachnin and the improvements necessary to widen the scope of the use of treated sewage, given the resources currently available. It includes an estimate of the cost of the upgrading as opposed to other proposed alternatives, and a discussion of three options for sewage treatment which were studied in this work and analyzed from a financial perspective (including the costs of construction, use, maintenance, and recycling). An optimal model for recycling was run, in order to obtain maximal profit in the irrigation of olive groves and other orchards appropriate to the conditions of the Sachnin valley.

## 2. Research Goals

The overall goal of this project is to develop an all-encompassing model for a solution to the treatment of sewage and its recycling for use in the rural Arab agricultural regions.

The specific goals of the project are:

a. To propose a model for improved, local treatment of sewage and its recycling for local agricultural use;

b. To test this model as compared to two alternatives: partial treatment and connection to a centralized system, as opposed to local recycling; or the creation of a centralized treatment system for the settlements of the Sachnin Valley;

c. To test the model from a financial standpoint, as part of an analysis of the costs of each of the options.

## 3. Stages of the research

1. Collection of data on sewage treatment: statistics on the amount and quality of sewage and waste water have been amassed for each treatment system in Sachnin, at entry and exit. Some of the information was found at the research and development lab in the Galilee and at former and currently existing labs, but it was also necessary to perform tests, especially regarding the daily amount of sewage – averages, maximum and minimum. In addition estimates were made for future anticipated quantities, based on the expected population growth and the improvement in its socio-economic status.

2. Alternative proposals for sewage treatment – for the village of Sachnin in particular and for the Sachnin Valley region in general (including Arabeh and Dir Hana). This stage included an examination of the alternatives from a financial standpoint and a comparison among them based on the cost per cubic meter of treated waste. Calculations were made up to the planning year of 2020 for each of the alternatives.

3. A survey of the data on the agricultural activity of Sachnin. The survey included the following subjects:

- Current agricultural activity, quantities and types of crops irrigated with waste water from the reservoir;
- Available agricultural land that may be taken advantage of in the future;
- The possibilities for developing land not presently made use of , by way of the planting of olive trees, or other deciduous trees such as fruit trees;
- The willingness of farmers to expand the use of waste water.

## 4. Findings and Options for Action

For years, home and industrial sewage flowed into the sea, through rivers and valleys, polluting bodies of water both above ground and underground. Despite their smell and unaesthetic look, they were considered to be acceptable sources of water simply because the measurable level of pollution never passed 0.2%. These very large sources of water were available year round and seemed a safe resource. Today it is generally accepted that all raw sewage – from homes, industry, and agriculture – should undergo treatment in a sewage treatment plant.

Sewage treatment involves three basic stages:

1. The first stage involves mechanical separation of the crude sewage and primary sedimentation, to dispose of some of the solids and some of the organic material.
2. The second stage entails biological treatment and the breakdown of organic material within the sewage and some of the floating solids, as well as sedimentation of some of the sludge, (the sludge is mainly composed of bacteria that breaks down the organic material, "bio-mass"). In a system of reactivated sludge, part of the (active) sludge is returned to the biological activator, to accelerate the disintegration of the organic material. Oxygen in this sort of system is generally supplied by an electric mechanism. Large quantities of air is directed into the biological reactor (reactivated sludge) in which a biomass of aerobic bacteria are formed (which require oxygen). The organic compounds are broken down by the bacteria and release energy, and part of what is created is known as sludge. If the second stage is the last stage of treatment, it will involve sterilization to eliminate pathogenic bacteria.

3. The third stage of treatment may be comprised of one or more of the following: a process of neutrifying or de-neutrifying by biological means; the eradication of chemical or biological phosphates: physical sand sifting for the elimination of a large portion of both the floating solids and bacteria. There is a process of disinfection after the third stage.

Since it is known that intensive aerobic processes produce large quantities of sludge, appropriate treatment is required for its disposal. In systems of reactivated sludge, processes for stabilization, thickening, anaerobic digestion or extraction, or dehydration are the methods employed. The resulting material may be used as a source for improving soil as compost.

Generally speaking, one can distinguish between two types of sewage plants: intensive plants (mechanical and biological) and extensive plants (biological only).

The primary advantages of the intensive methods are:
- Less area is required;
- Higher quality waste water is produced.

The primary disadvantages of these methods are:
- Greater sensitivity to fluctuations in the quality of sewage and to the presence of poisonous components;
- High cost of treatment, including high energy consumption and high cost of maintenance;
- Trained personnel for the overseeing of the system are required;
- Large quantities of sludge are produced, since the system is aerobic.

The primary advantages of extensive systems are:
- Simple to run and therefore don’t require trained personnel;
- Very low cost;
- Less sensitivity to changes in the quantity or quality of the waste, and more efficient in the breakdown of table organic material;
- Only small amounts of sludge are produced.

The primary disadvantages of these methods are:

- Require the use of deep, anaerobic stabilization pools (without oxygen) as well as shallow pools;
- Require greater area;
- Generally are unable to provide waste waters of the same quality as are provided by intensive systems.

However, in Israel there are many areas in which upgraded versions of extensive treatment systems could serve as ideal solutions. The use of such systems – such as constructed wetlands – and systems for shortened or slow sand sifting, could in many cases supply high quality waste water after improved aerobic treatment. In terms of the climate and the quality of sewage in rural areas (and especially in rural Arab areas), anaerobic treatment may be preferable to mechanic aerobic treatment. In dry and half-dry climates, improved anaerobic treatments (of the reverse vertical type) could provide good quality primary or secondary waste waters and save space.

A combination of this type of system and a green basin or shortened sand sifting could offer high quality waste water with a certain saving in the area or land needed. Most importantly, this kind of treatment is natural, environmentally friendly, low-cost, and does not demand maintenance or supervision; it is known as biological bio-sifting. It is appropriate for small settlements, villages, animal and agricultural sewage, industrial sewage, etc.

The treatment is based on two fundamental stages: an aerobic stage as part of an improved UASB system, which eliminates 50%-70% of the organic material with chemical oxygen usage (COD), and the next stage — a biological sifting system. The breakdown of the rest of the organic material takes place in the region of the roots, in the case of constructed wetland, or in the biological biofilm in the upper strata of the sand sifting, in the case of a sand system (biofilm – a field of bacteria that forms on the surface).

Semi-intensive systems are systems that work in the middle — between extensive and intensive. These systems demand little energy, may require preliminary chemical treatment, but save in the amount of area they need and may even lessen the amount needed for extensive treatment, if a final processing is necessary (a third stage).