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WASTE MANAGEMENT AND A VIABLE ECONOMY

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FOREWORD

Efficient waste management has become imperative for all countries, but especially so for such densely populated islands as Malta and Gozo. Separation, recycling, landfilling and incineration are amongst the indicated methods to handle solid waste, but all approaches pose their own environmental issues and economic challenges. Similarly, the treatment of wastewater, especially for re-use, is no less problematic.

Conscious of these pressing matters, APS Bank dedicated its ninth Annual Seminar held on 22nd February 2008 to "Waste Management and a Viable Economy". This seminar was organised in collaboration with the Ministry for Rural Affairs and the Environment, the DG Environment of the European Union, the Food and Agriculture Organisation of the United Nations, the Malta Environment and Planning Authority, Wasteserv Malta Ltd and our own subsidiary APS Consult Ltd.

The speakers dealt with various aspects of the chosen topic, including policy, viable strategies and recommended practices; some focusing on the Agriculture and Fisheries Sectors in Malta. The discussion that followed the presentations amplified various aspects of the subject

treated and indicated issues that have to be explored further.

The papers discussed in the Seminar are being presented in these Proceedings in order to enable wider debate on these subjects. It is only in this way that an appreciation of the themes can truly come about and public participation effectively achieved.

E. Cachia
Chief Executive Officer
APS Bank

Address of Welcome by E. P. Delia, Chairman APS Bank

WASTE MANAGEMENT AND A VIABLE ECONOMY

Excellencies, Ladies and Gentlemen

On behalf of APS Bank, I welcome you to the Ninth APS Bank Seminar on the Development of Agriculture and Fisheries in the Maltese Islands. This annual meeting has been an occasion for the critical review of several key factors that condition the performance of agriculture and fisheries in a re-defined economic space, pre- and post-EU membership for the Maltese Islands and pre- and post- international negotiations on various trade issues under the auspices of the World Trade Organisation. Negotiations at these two fora lead to the establishment of new sectoral objectives and to the identification of financial, trade and economic tools that were meant to attain them.

Insurance in the sectors of agriculture and fisheries and the optimal use of water resources were taken up on two separate occasions. Both themes implied new commitments by farmers and fishermen, and therefore costs of compliance that were expected to bear on the profitability of economic activities in both sectors. A wider context was taken when assessing the sustainability of fisheries in the Mediterranean. There is an emerging tendency to

over-fish certain species, which may eventually lead to their extinction. Besides, unless timely countervailing measures are taken, Malta's artisanal fishing may be at risk of disappearing. In this context, the role of institutions that support farmers and fishermen, like co-ops and other units, has to be examined with the new realities in mind. Such institutions have to be self-critical with the aim of being in a position to instigate sectoral adaptation. This evaluation may imply a re-generation of the institutional network.

This year's subject again raises the issue of economic viability in terms of waste management. Waste management is a wide area that has been attracting greater attention world wide for a variety of reasons, but primarily because of relative shortages of energy generation factors and people's health. Member countries in the European Union are guided by a series of Directives that set time frames and standards. Meeting such directives involves substantial investment in capital infrastructure, its subsequent maintenance and constant education to explain the rationale behind the heavy resource demands that waste management policies instigate.

Ideally, at all times throughout the implementation programme and beyond, economies remain competitive in order to generate resources not only to meet the new commitments but also to look to the demands of a changing demographic profile that is representative of both the European Union and the Maltese Islands. Economic growth is a prerequisite for a community that is ageing relatively fast. A competitive output generation over time is therefore a condition that facilitates the attainment of expectations for a better life, in terms of income and quality of life. Harnessing technology and re-using resources are tools enabling the reaching of this objective.

Output produces waste as a spillover effect. Such effects, referred to in economic literature as externalities, are accidental, direct by-products that are not accounted for through the price system. They are not priced-in, whether they are positive or beneficial effects or negative/harmful effects. They arise gradually over time in the absence of clear identification of property rights, with the result that no one seems interested to claim for damages caused or charge for salutary benefits.

Besides, governments that are meant to look after the common good or 'collective welfare' turn out to be themselves key players in the creation of waste. The end result is that there are no on-going rectifying forces in a community that look after the efficient disposal of waste, independent of its origin. Once this issue grows sufficiently to attract attention, and people become aware of the urgency to do something about it, the task at hand would have grown large. Hence, it becomes costly, threatening the economic viability of the production and distribution systems. It is for this reason, primarily, that reluctance to act collectively and individually becomes widespread, postponing decision-taking and rendering adjustment in the future even bigger and probably more expensive. Costs may be contained somewhat as technology advances enhance the waste management processes and the regeneration of energy.

Agriculture and fisheries, like other economic sectors, produce their own waste. These sectors have been protected for a long time from trade competition, particularly agriculture and the related agro-businesses. They have now been subjected to a changing world and single-market scenarios in the EU's economic space, one that includes commitments to meet conditions related to the production, commercialisation, distribution and

disposal of residues. They are being assisted to undertake the necessary restructuring. But it remains a fact that market parameters keep changing as demand and supply conditions evolve over time and respond to new trade and financial arrangements. It is to this combined series of activities that we refer this morning.

In order to understand the complexity that producers and traders in the fisheries and agriculture sector are facing, we invited a team of speakers who will present the issues from various perspectives. Their contributions represent an attempt to offer participants (and later on to readers of the published proceedings) a wide view of the matters at hand. Such comprehensive rendering, in turn, will lead to a sounder appreciation of the respective tasks.

Mr Györzö Kenéz, from the office of the European Delegation in Budapest, expounds the main tenets of the Waste Management Directives; these are the main guidelines that condition regional waste management strategies in the EU and they are bound to affect a sector's profitability and competitiveness. Mr. Kenéz will be illustrating the application of these policies/ strategies with reference to Hungary's experience. Mr. Kenéz is followed by Ms. Sasha Koo-Oshima, from the FAO's Water Quality and Environment Unit, who illustrates with examples issues that countries have to face while pursuing their quest for wastewater re-use in agriculture. The examples cited build on experience in the Mediterranean and elsewhere, and indicate the wide range of considerations that arise in the formulation and execution of such measures.

The third speaker, Ms Yvette Rossignaud, comes from the local regulator, Malta Environment and Planning Authority. She will review the main tenets of the Waste

Management Directives and comment on issues that arise in the local context. It is the regulator that has to monitor the evolution of the legal tools that are meant to lead to a more amenable and healthy environment for all. Hence, considering the regulator's views on waste management policy and the realities of every-day implementation is bound to be a positive learning exercise; it sets us thinking.

Regulators' views are important; but so are the opinions of those regulated. To help us understand life as seen by the regulated, we have Ms Mary Grace Micallef, from Wasteserve Malta Ltd, who highlights the daily search for practicable solutions in a demanding and costly area. Operators often have to provide themselves the answer to attaining the set long-term objectives while remaining competitive. But they would prefer to be guided and assisted such that daily operations may become technically and financially lighter.

Ms Micallef is followed by Ms Joanne Bianco Muscat, a consultant on behalf of APS Consult Ltd., who reviews the cost effectiveness of waste management in Malta's agriculture. It reflects the experience of Maltese farmers and breeders. Her presentation is based on several case-studies from Malta and Gozo. Ms. Bianco Muscat completes the picture from the point of view of users.

I thank the speakers for accepting to participate at today's seminar and also the organisations that allowed their presence this morning. The views expressed are their own, but I am sure that these views will be listened to carefully, pondered upon, and serve as a guide for both further questioning and action.

I would also like to thank both the Honourable Minister Mr George Pullicino and officials at the Ministry of Rural Affairs and the Environment for their constant support for

this annual event. Special thanks also go to Ms Ritienne Bonavia, Malta's Alternate Permanent Representative to the FAO, for her interest during the Bank's communications with the FAO, and to Dr Joanna Drake, Head of Representation of the European Commission in Malta, and staff at her office. They were instrumental in finalising the organisation of this seminar.

A very special 'thank you' goes to Mr Vince Magri, CEO of Wasteserve Malta Ltd., for accepting to stand in, at the last minute, for Minister Pullicino. The Minister had to cancel his participation due to unforeseen circumstances. I now ask Mr.Magri to open this morning's presentations.

Vince Magri, CEO, WasteServ Malta Ltd

IMPLEMENTING WASTE MANAGEMENT POLICIES IN MALTA AND GOZO

Not many years ago, local 'experts' in the field of waste management were still arguing about the definition of waste. The prevailing concept was: how could Malta manage waste without a proper and agreed on definition? This was easily solved when EU Directives began to be used as our reference guidance.

In order to offer a better standard of living to the local population, the Government commissioned consultants to prepare a draft for a National strategy to tackle this difficult and sensitive issue for the management of our solid waste. The National Strategy for the Management of the Solid Waste in the Maltese Islands was completed and approved by Government in October 2001.

The Policy was mainly supporting the three Rs and having the landfilling activities rated as the least preferred option. Though Incineration rated higher ranking of preference, it was not considered as forming part of the preferred technologies as it was linked with encouragement to produce more waste and avoid waste separation.

The formation of the entity I come from is a direct result of the consensus reached with the stakeholders when adopting this Strategy.

The most difficult task since WasteServ started operating was to identify the locations of the required major waste management facilities and to have the sites permitted for development and for operations. We are all familiar with the "not in my back yard" syndrome, and since this proved to be a difficult task to overcome in large countries like Germany, Italy and England, we knew what was in store for us on our densely populated islands. Basically, there is no locality where we could establish even the smallest waste management facility without finding resistance mainly due to the negative experience we all had with landfilling.

We have all travelled a long road since 2001! Many achievements make us proud but we never thought of slowing down in our active contribution to the implementation of this plan.

Our country is densely populated and distance separating communities are very short. Negative impacts in any area will impinge on others, hence, the corporate responsibility to protect our environment. The closure of the active landfills in Malta and Gozo, and the control of their aerial emissions, is rendering a cleaner environment to the public in general.

The management of our solid waste was based on landfilling and in order not to disrupt the ongoing waste disposal activities, engineered landfills were established to receive non-hazardous waste as from the date of our becoming members of the EU.

The ongoing development of the hazardous waste treatment facility, will be providing a proper disposal means of many hazardous waste fractions. This will have potential emissions controlled and damage to the environment avoided.

The major fraction of the waste generated locally is that resulting from the Construction Industry. Records show

that 80% by weight of our normal 1.5 million tonnes of waste which used to be received at the public landfill facility was Inert material having some 80% clean material resulting from excavations and being disposed due to not having use for this mineral. The introduction of the diverting of the Inert waste to rehabilitate spent quarries and be stored for future requirements helped significantly to eliminate the old practice of co-disposal and the spreading of contamination from other waste streams.

The development of the Bring-in Sites and the Civic Amenity Sites is giving the opportunity to the public to participate and contribute towards the recovery of our dry waste fractions for recycling and avoiding the reliance on land filling. This measure is being complemented by the introduction of an additional door-to-door separated waste collection per week. This service should enable waste separation at homes where the residents have difficulties to reach our bring-in centres.

The introduction of another 200 Bring-in Sites at Schools, together with a strong educational campaign, are managing to produce the required change in our culture of waste management.

The upgrading of the only established Solid Waste Treatment Plant, at Sant'Antnin Marsascala, is to introduce modern efficient technologies and eliminate emissions into the atmosphere to avoid inconveniences to residents and Carbon emissions. This modern technology will help us extract energy from organic waste fraction before producing compost for use in our agricultural industry.

The inauguration of a modern Material Recovery Facility will help us sort and pre-treat the ever increasing dry recyclables being recovered by the general public and other organised schemes.

The recent introduction of the first compliant Waste Thermal Treatment Facility has eliminated the use of the mobile incinerator at the Civil Abattoir in Malta and has enabled the decommissioning of the incinerators at St Luke's Hospital and at the General Hospital in Gozo.

The next challenge of the Government's Policy is the effective implementation of the Producer's Responsibilities for the pollution generated from the many items we consume to maintain a good standard of living. The unpopular Eco-Contribution was the first step to put value on waste and its management. A case in point is the large number of tyres we generate in our country. All these spent tyres used to find their way to rest at our landfill and contribute for the maintenance of the ongoing fires and to enrich the cocktail of toxic gases released from the landfill. With the revenue generated from the Eco-Contribution, paid for the new tyres, we are supporting a local contractor to receive and treat all the tyres, rendering the products produced as raw material for use in the local market. The same may be stated for so many other items which have avoided significant waste deposit at our landfill.

The introduction of various schemes involving all stakeholders is promising an encouraging future for the effective implementation of this sensitive task.

Together with the help and the contribution of the public in general and of many entities, Malta has managed to complete the implementation of most of the urgent tasks and important milestones in the Strategy of Waste Management.

This augurs well to the next challenge to update our Strategy and plan to keep offering the opportunity to improve the standard of living of our country.

Kenez Győzö, EU Team Europe, Hungary

COMPETITIVENESS AND ENVIRONMENTAL COMPATIBILITY

Ladies and gentlemen,

It is both a pleasure and a privilege for me to have been invited to this traditional APS Bank sponsored and APS Consult managed seminar, and to address this distinguished multinational audience. Just two weeks ago Malta hosted a significant pioneering event, the first Conference of Climate Change Diplomacy. The common point of these two events was the environmental challenge. One of the differences is that today, we can afford to be less diplomatic, more outspoken and pragmatic, than diplomats had to be. At the same time we have to think, utter and act under the same awareness of our responsibility for protecting nature, searching for less harmful solutions, and promote measures leading to a higher level of resource sustainability.

But before I proceed, allow me to clarify a few issues related to my participation. I am a member of Team Europe, an alliance of independent speakers, advisors, and workshop contributors. We are present in most member-countries of the European Union, and operate under the auspices of the European Commission. We are provided with information material directly from sources of the Commission. But we act

in our own capacity. We strive to convey the Commission's position in the most accurate manner, thereby contributing towards European integration.

Today I shall be sharing my personal views, both for and against, certain measures. I shall be conditioned in my presentation by a civil conscience, ethical standards and the experience of the past fifteen years related to funding from the Euroepan Union. I shall be supporting my views with relevant references and quotations.

The term 'environment' as applied in my presentation refes to the natural and the human environment, with some hints at the business environment as well. This non-uniqueness of the concept became clear to me when Hungary was preparing for membership of the European Union, and we had to revise and redefine this notion of the 'environment' in its complexity. The term has been revalued due to Union's standards concerning environmental features, indicators, and charges as well as environmental protection and the formulation of preentive measures.

Fellow bankers attending our seminar this morning will hopefully understand and forgive me, a renegade banker, that after a career of twenty-three interesting years in the branch I felt attracted by a special appeal: to turn to EU funding as an area of interest, in particular to financing environmental and transport sector infrastructure, rehabilitation and construction.

This new challenge meant facing and dealing with matters that were unprecedented in the Eastern Central European hemisphere. These included transplanting relevant regulations of the European Union into Hungary under the frame of legal harmonisation. It signified an assessment of the environmental impact, the implementation of handling and monitoring systems,

giving due regard to issues concerning protection, prevention and mitigation.

Let me give you an example of the 'changing times'. In 2004, we were preparing for the utilisation of EU funds for developing infrastruture. We submitted an application to the European Commission for the modernisation of the civil aviation traffic control system in Hungary.

Soon after that, during the period of the so-called interservice checking procedure launched by the Commission, we got a telephone call from Brussels. An anxious official from the Directorate General for Regional Policy, or, more likely, DG Environment, asked whether the construction works at one of the three radar stations would threaten the nesting haven of sqacco heron, a rare, protected wild fowl. We had to deliver and present satisfactory evidence of the project respecting the rights and habits of these fowls. More seriously, we had to demonstrate the project complying with the relevant regulations and agreed norms of the Union, including Natura 2000, a set of guidelines that Hungary and the other new members that joined the Union in 2004, like Malta, had adopted. Believe me, it was not easy to convince the officials in Brussels.

Putting it in broader terms: based on our own traditions of protecting nature we had to re-qualify ourselves to a generally higher, more solid, more complex level of environmentalism, a new culture, if you wish. This concerned waste-handling as well.

Another aspect worth elaborating on would be energy. But this would go far beyond my actual address. So I shall consider briefly to some aspects that have to do directly with waste management.

I cannot resist mentioning that in our world or, better to say, in Europe the own primary sources of energy might

well be exhausted within the next thirty years given the accelerating exploitation of them. So, if we intend to become and remain globally competitive, we have to reconsider our relevant approach and rethink what is waste, and what does wasting mean.

At the end of the nineties, the fifteen members of the EU realised the relative limited competitive position of some of the members and came up with the Lisbon Stategy, agreed in 2000, in order to boost employment throughout the union. At the same time, the member countries had to modernise knowledge-based economies and strengthen social cohesion. Today, the growth potential of the EU of twenty-seven countries is undoubtedly higher than that of the EU-15 adopted as a base at the time. More working capital, more investments, more trade and jobs, higher revenues and, therefore, consumption imply automatically more waste that has to be managed. Since competitiveness remains a top priority for the EU, waste management has to assume a key role while improving cost efficiency.

Waste Defined

What is and what is not waste ?

An ancient and wise Transsylvanian saying defines 'waste' as follows.

What people do not eat, can still be good for animals. What they will not take, might be good for the soil. If not apt for the soil, it might serve for making fire. And what remains after all this, has to be stored as a potential input for something useful in the future. The rest, if any, is probably waste, in real terms.

Was not this definition adequately environment–minded? It definitely was, at a much better level of

sustainability! Let me spell out the context that we have to address.

The draft waste management strategy of Hungary, a country of ten million people and medium-sized by EU standards, envisages for the years 2007-2016 the following capital stock:

Selection mills for 373 million kilograms; compost pilers for 283 million kilograms; pre-manipulators to the mechanic and biological handling with a capacity of 1,120,000 tons; and waste deposits for 13,247,000 tons. All this in full compliance with up-to-date, twenty-first century level EU regulations, of course.

And this was just Hungary. Just solid waste, not waste water, no dangerous waste either. The need for rehabilitating actually functional waste deposits (2,232 sites) represents a rough 1 billion euro funding demand out of the government budgets between 2007 and 2013. The rather complex problem of waste water had to be addressed in addition to this.

Under the frame of a derogation concerning the Water Framework Directive of the Union dated 2000, Hungary, as well as several other environmentally handicapped East-Central european countries, have undertaken, beyond the legal harmonisation, to catch up with the drinking water-waste water standards of the EU – a huge and moving target itself!

It happened on purpose, that launching the ISPA funding in 2000, (i.e. a mini-precursor to the now available Cohesion Fund) , half of the resources were designated and committed for improving the waste management systems in Hungary, both solid and 'liquid'.

By the time of the accession a huge investment project could be launched in Budapest:1.7 million inhabitants and other users produce 600,000 cubic meters of waste

water daily, out of which some 300,000 cubic meters enter the Danube river for being carried away, partly even to the Black Sea, 1600 kms away, in untreated shape.

This huge quantity of water has to be taken care of by the future treatment plant, now under construction. Its capacity will go far beyond 300,000 cubic meters, and, in addition to this there will be a capacity for mechanic cleaning up to 900,000 litres per day. We need this, because rainwater is connected to the same pipe system. I have no intention of boaring you with technical details. But it is worth mentioning that in the fermentation phase of processing, biogases will be generated: a fuel for gas engines to produce heat and electricity.

The project underwent in the preparatory phase an unprecedented careful chain of feasibility, environmental, technical, urbanistic and other analyses – relying in the process of evaluation on the particular skills of experts from the European Investment Bank, from consultancy firms, from the Commission, and from local firms.

The plant is probably the largest one of its kind in East-Central Europe. The investment costs come up to 460 million euros, out of which 65 per cent is being funded by the Euroepan Union, and the rest from the Hungarian government and municipality budgets. These investments are time consuming, and absorb a vast amount of funding resources. They entail commitments, respect of the transport sector as well. But, at the same time, they contribute to abolishing certain infrastructural handicaps that East-Central European countries suffer from, to a greater extent than the EU average. Thus, they contribute to the improvement of the region's standard of living.

These investment projects , settled under the framework of public procurement, mean employment, followed

by tax revenues, and a growing domestic demand for materials and manufactured goods. On the other hand, they absorb a high amount of resources for too-long time, compared to equally urgent needs for development funds in other areas.

As some of you may have experienced, problems arise with income generating projects. The more they are profit orientated, and profitable, the lower the percentage of EU funding. In respect of the Cohesion Fund, the EU share might reach 80-85 per cent, whilst in case of profit-making units it must not exceed 50 per cent.

Eligible costs of investment

This aspect is often ignored by planners of national or municipality budgets. They count on the maximum of support from the EU. This attitude is not realistic.

In attempting to enhance competitiveness, many decision makers adopt measures that in many cases turn into a risk for the environment. Companies search and often find ways and means of deviating from the environmental EU norms or resort to unacceptable solutions to technical and other particular problems. One example suffices to illustrate this point.

By the time of Hungary's accession, waste managers from Germany together with their local counterparts smuggled in hundreds of tons of solid communal waste to East/Central European countries. This type of free movement of 'goods'. or rather 'bads', is definitely not the way by which competitiveness should be achieved.

Another example: Hungary and Austria are neighbours with some border-crossing rivers. Austrian leather-processing plants dispose of their heavily polluted

industrial waste water in the rivers. These enter Hungary and flow further down the Danube. Austrian firms remain competitive by keeping investment costs artificially low, thereby reducing their production costs.

Present EU regulations contribute to the reduction of the number of these situations. The room for manouverability for respective parties is being constrained. Companies and countries are no longer entitled to export waste to the territory of another member state, thereby ignoring the so-called 'target country' approach.

Mitigating measures and final solutions are enforeable in a 'European manner' with these types of conflicts. No detected actors, no national authorities can remain indifferent for long. The parties inside the EU have to come to terms and come out with a solution: physical, environmental and, where appropriate, even with a financial restitution. No country should be cleaned at the expense of some other country!

The European Union is in a delicate situation. As the rapporteur of the European Parliament on the Lisbon Strategy, Mr. Lehne, pointed out recently: 'Europe has to become a globally competitive knowledge based economy that maintains its high level social and environmental norms. This involves the kernel of a global conflict for the EU, namely, that higher social and environmental norms are usually accompanied by lower cost efficiency. The room for manoeuvring for EU-members is limited, given the fact that environmentally and socially 'oblivious' countries outside the EU have more opportunities to attain enhanced competitiveness at lower labour costs and a very slack approach to the environment. This is especially so for South East Asian countries.

One of the key issues surrounding waste management is culture, which is transmitted through long educational

and learning processes. It may take decades to change the negligent attitude of individuals and especially of industrialists, who believe in boosting consumption rather than the consciousness of consumers to environmental affairs. Such attitudes automatically lead to additional waste generation that has to be addressed accordingly.

Ninety eight years ago, a European banking institution began emphasising the need to 'inculcate saving habits among the working classes'. It was a pleasure to trace environment-mindedness under the goals set for themselves by the same credit institution, namely, APS Bank. People need orientation and technical help. Let me illustrate.

Selective waste handling had limited tradition in Hungary twenty years ago, except in farmers' households with a low level of consumption. In the year 2001, eight hundred islands of selective communal waste collection have been set up in Budapest for metal, transparent glass, dark glass, paper and p.e.t bottles. After advertising campaigns, within five years, the volume of re-collected and re-cycled waste grew by twenty times. In 2006, 450 million kilograms of paper were re-cycled and utilised as second-hand industrial raw material. The largest paper mill itself re-cycled 380,000 tons of it.

Re-orientating people and firms requires time, energy, and financial resources that are worth invested, promising a long-term return. Best-practice examples should also be taught and implemented. This is the way to reduce sooner or later the charges put on the environment by industries, households, and individual consumers. Competitiveness and envirionmental compatibility remain conflicting for a long time. Economic development and enhanced living conditions including environmental sustainability are only feasible via compromises. Optimalisation is a moral

obligation that all of us have to face when confronted with the needs of future generations.

Thank you for your kind attention.

Sasha Koo-Oshima, Food and Agriculture Organisation of the United Nations, Land and Water Division

WATER RESOURCE ALLOCATION STRATEGIES: OPPORTUNITIES FOR WASTEWATER RE-USE IN AGRICULTURE

Introduction

The concept of Integrated Water Resources Management (IWRM) which encompasses all aspects of water resources development, management, and use is applied in FAO's wastewater re-use programmes in agriculture to augment available water supply. The World Summit on Sustainable Development in 2002 called for all countries to develop IWRM and water efficiency plans. A multiple-uses approach underpins the planning and development of strategies for the provision of water services and rehabilitation of infrastructure that include: (1) assessment of water needs in collaboration with end users, (2) examination of the water sources available – from rainwater to wastewater to piped systems, and (3) match water supplies to needs based on the quantity, quality and reliability required for the various purposes.

Planned water reclamation and reuse for agricultural uses is a strategy gaining wider acceptance in many parts of the world. In many water scarce countries, wastewater services have become important in attaining the equilibrium between demand and supply of adequate

quantities and quality of water. Although the drivers for reuse in the developed world are somewhat different to those in the developing nations, general pressure towards greater sustainability, increasing population and food demand, water shortages, and concerns for environmental pollution make reclaimed wastewater a valuable resource. Water re-use requires changes in the traditional water allocation frameworks, funding structures, water-quality standard-setting, regulatory frameworks, and institutional mandates. It involves good governance at all levels in order to develop a holistic approach and sets of consistent policies aiming for an economically efficient, socially equitable, and environmentally sustainable water allocation plan that meets multiple user needs while engaging the stakeholders in a participatory process.

Global Outlook On Reuse And Policy-Setting

Currently, there are over 3,300 water reclamation facilities worldwide with varying degrees of treatment and for various applications: agricultural irrigation, urban landscaping and recreational uses, industrial cooling and processing, and indirect potable water production such as groundwater recharge (Aquarec 2006). It is estimated that, within the next 50 years, more than 40% of the world's population will live in countries facing water stress or water scarcity. Growing competition between the agricultural and urban uses of high-quality freshwater supplies, particularly in arid, semi-arid and densely populated regions, will increase the pressure on this ever scarcer resource. Wastewater is a reliable year-round source of water, and its value has long been recognised by farmers not only for its water resource, but nutrients for

plant growth and soil conditioning properties. Currently, the total land irrigated with raw or partially diluted wastewater is estimated at 20 millions hectares in fifty countries, which is approximately 10% of total irrigated land (FAO Wastewater Database). Recycling and reuse of wastewater further reduces downstream environmental impacts on soil and water resources.

In Europe, most of the reuse schemes are located in the coastal areas and islands of the semi-arid Mediterranean regions and in the highly urbanized areas. Water scarcity is a common constraint in the Mediterranean region with varying precipitation, sometimes below 300 mm to 500 mm per year in southern parts of Spain, Italy, Greece, Malta, and Israel. At times, water resources may fall below the chronic water scarcity level of 1000 m^3 per inhabitant per year. Long distances between water source and user also create serious regional and local water shortages, and water scarcity may worsen with the influx of peak summer tourists to the Mediterranean coasts, demographic growth as well as drought and potential climate change-related impacts.

Limited numbers of European countries have guidelines or regulations on wastewater reclamation and re-use although with some exceptions in the southern countries. The main reference to wastewater reuse is article 12 of the European Wastewater Directive 91/271/CEE which states: "treated wastewater shall be re-used whenever appropriate." The term 'appropriate' still lacks legal definition, and the EU countries themselves are to develop their own national regulations. Nevertheless, water re-use is a useful measure to implement the European Water Framework Directive (WFD) that emphasizes the need to integrate health, environmental standards, service provision and financial regulation for the water cycle,

in order to achieve overall efficiency and protection of the water cycle (Okun, 2002). The WFD encourages the integration of water re-use options in an integrated water supply and disposal system, as its mandates are the following (Aquarec 2006):

- Municipal water conservation plans, emphasizing re-use.
- The development of financial incentives for local governments, developers, and property owners to adopt water conservation and re-use measures and implement public education programs. Incentives can include tax incentives, tax credits, grants and low interest loans. If there is an absence of subsidies, incentives to improve environmental performance by forcing users to innovate or reduce water use might be considered.
- By 2010 water pricing policies be introduced that provide incentives to efficient water uses, helping to achieve a good ecological status of the water bodies.
- More accurate identification of the least expensive water supply alternatives that provide the highest level of water sustainability at the river catchment level.
- In pricing conventional and alternative water supplies, it should be ensured that the user bears the costs of providing and using water, reflecting its true costs. This implies a stricter application of two major principles: the *polluter-pays principle* and the *full cost-recovery principle*, which means that: "the recovery of the costs of water services including environmental and resource costs associated with damage or negative impact on the environment should be taken into account" when applying the polluter pays principle. This implies that tariffs related to conventional and alternative water sources will have to be reviewed and adjusted. The

financial, social and environmental burdens of effluent disposal to the environment should be considered in the economic analysis; thus the true value of reclaimed water reflected net of externalities.

Health and Environmental Concerns in re-use

Many countries adopt a combination of the California and WHO guidelines as the first publications on rules and regulations in reuse of wastewater were the California standards. For many years, they were the only legal valid reference for reclamation and reuse with zero risk goal and expensive compliance requirements. The California criteria, for example, stipulate that unrestricted re-use of wastewater requires after secondary treatment, additionally advanced treatment with a coagulation/ filtration step followed by chlorination/de-chlorination to strive for a 0 Fecal Coliform/100 mL limit to produce an effluent that is virtually pathogen-free. This technology is coined as the Title 22 benchmark technology and is considered the yardstick for unrestricted irrigation, against which all other systems are evaluated because of its long history of successful practice. In Europe, more than half of the tertiary treatment technology is derived from this concept even though the full Californian Title 22 treatment is applied only limitedly in few installations.

In contrast to the California guidelines, the 1989 WHO guidelines on the safe use of reclaimed wastewater in agriculture and aquaculture dealt almost exclusively on microbial pathogens and were less restrictive. The guidelines were later improved, jointly with the FAO, in the 2006 edition where risk management approaches under the Stockholm Framework were applied. This provides a

harmonised framework for the development of health-based guidelines and standards in terms of water- and sanitation-related microbial hazards. An analysis of the health protection measures is discussed in the 4 volumes of the guidelines with references to the level of wastewater treatment, crop restriction, wastewater application method and human exposure control. The health based targets applies a reference level of acceptable risk of 10^{-6} Disability Adjusted Life Years (DALYs). The DALY is the only quantitative indicator of 'burden of disease' that reflects the total amount of healthy life lost; that is, the quality of life reduced due to a disability, or the lifetime lost due to premature mortality. A variety of measures that are adoptable and achievable, given the local socio-economic and technological conditions, are possible for health protection: (a) waste treatment, (b) crop restriction, (c) irrigation technique and application time and (d) human exposure control. In so doing, partial treatment to a less demanding standard may be sufficient if combined with other risk reduction measures to achieve the $\leq 10^{-6}$ risk. Figure 1 shows the options for risk reduction from pathogens (i.e., viruses, bacteria, protozoa, helminths) in recycled water used for irrigation (WHO 2006). A major observed risk from pathogens in reclaimed water used for irrigation purposes is that from helminths in developing countries where sewage effluents are used with no or minimal treatment. Epidemiological studies from Mexico have reported children of farmers who live near fields irrigated with untreated wastewater to have higher prevalence of round worm infections than the general population (Peasey et al. 2000). Infection rates decreased with treatment of sewage effluent and at a rate linked to the level of treatment as well.

Table 1 describes health-based targets for agriculture

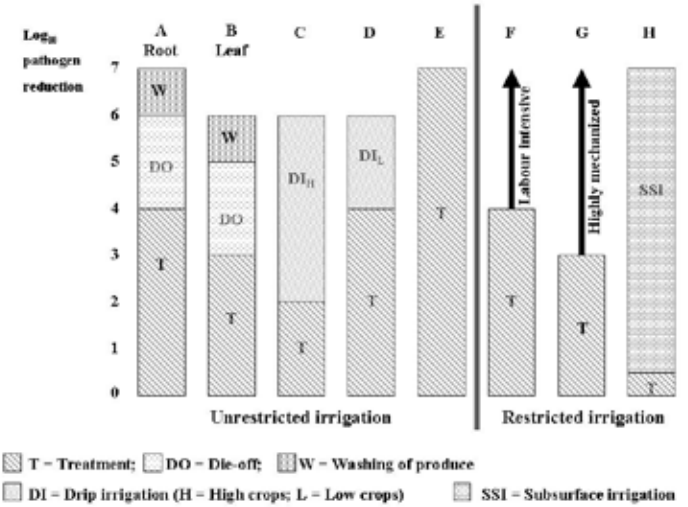


Fig.1. Examples of options for the reduction of viral, bacterial and protozoan pathogens by different combinations of health protection measures that achieve the health-based target of ≤10^{-6} DALYs per person per year.

in the WHO-FAO Guidelines. The health-based targets for rotavirus are based on Quantitative Microbial Risk Assessment indicating the $\log_{10}$ pathogen reduction required to achieve 10^{-6} DALY for different exposures. To develop health-based targets for helminth infections, epidemiological evidence was used. This evidence demonstrated that excess helminth infections (for both product consumers and farmers) could not be measured when wastewater quality of ≤1 helminth egg per litre was used for irrigation. This level of health protection could also be met by treatment of wastewater or by a combination of wastewater treatment and washing of produce to protect consumers of raw vegetables; or by wastewater treatment and the use of personal protective equipment (shoes,

gloves) to protect workers. When children less than 15 years old are exposed in the fields, either additional wastewater treatment (to achieve a wastewater quality of ≤0.1 helminth egg per litre) or the addition of other health protection measures (e.g. vaccination treatment) is recommended.

Table 1. Health-based targets for wastewater use in agriculture

Exposure scenario	Health-based target (DALY per person per year)	Log_{10} pathogen reduction needed[a]	Number of helminth eggs per litre
Unrestricted irrigation	$\leq 10^{-6}$ [a]		
Lettuce		6	≤1[b,c]
Onion		7	≤1[b,c]
Restricted irrigation	$\leq 10^{-6}$ [a]		
Highly mechanized		3	≤1[b,c]
Labour intensive		4	≤1[b,c]
Localized (drip) irrigation	$\leq 10^{-6}$ [a]		
High-growing crops		2	No recommendation[d]
Low-growing crops		4	≤1[c]

[a] Rotavirus reduction. The health-based target can be achieved, for unrestricted and localized irrigation, by a 6–7 log unit pathogen reduction (obtained by a combination of wastewater treatment and other health protection measures); for restricted irrigation, it is achieved by a 2–3 log unit pathogen reduction.

[b] When children under 15 are exposed, additional health protection measures should be used (e.g. treatment to ≤0.1 egg per litre, protective equipment such as gloves or shoes/boots or chemotherapy).

[c] An arithmetic mean should be determined throughout the irrigation season. The mean value of ≤1 egg per litre should be obtained for at least 90% of samples in order to allow for the occasional high-value sample (i.e. with >10 eggs per litre). With some wastewater treatment processes (e.g. waste stabilization ponds), the hydraulic retention time can be used as a surrogate to assure compliance with ≤1 egg per litre.

[d] No crops to be picked up from the soil.

Thus, instead of focusing only on the quality of wastewater at its point of use, the WHO-FAO guidelines recommend defining realistic health-based targets and assessing and managing risks along the continuum – from wastewater generation to consumption of produce cultivated with wastewater – to achieve these targets. This allows a regulatory and monitoring system in line with socio-economic realities of the country or locality.

In the EU, recent developments through the Aquarec project proposes seven quality categories for different types of reuses (Table 2) and compiled microbial and chemical limits for each category (Table 3) (Salgot et al., 2006). The limits are based on recently published guidelines and risk estimations for the information obtained and the most important microbial parameters are listed in Table 3.

In addition to microbial contaminants in wastewater, chemical contaminants can also be expected from inorganic salts, nutrients, heavy metals to organic matter, detergents, trace pollutants, pesticides, chlorination by-products such as N-nitroso-dimethyalamine (NDMA), chloroform, and endocrine disrupting chemicals/pharmaceuticals. Highly saline irrigation water can severely degrade soils as well as high boron concentrations (>0.4 mg/L) with plant toxic effects. The list of proposed EU limits for chemicals for various uses is shown in Table 4. In addition, the WHO guidelines present the maximum soil concentrations for different chemicals that impact agricultural activity based on health risk assessment, and they are listed in Table 5.

Table 2. Water quality categories for different final uses of reclaimed wastewater defined by the Aquarec project (Salgot et al., 2006)

Microbial category	Chemical category	Specific final use
I	1	Residential uses (gardening, toilet flushing, home air conditioning systems, car washing)
	-[4]	Aquifer recharge by direct injection
II	1	Bathing water
III	1	Urban uses and facilities: irrigation of open access landscape areas (parks, golf courses, sport fields…); street cleaning, fire-fighting, ornamental impoundments and decorative fountains; greenhouse crops irrigation -Irrigation of raw-consumed food crops. Fruit trees sprinkler irrigated; unrestricted irrigation.
IV	1	Irrigation of pasture for milking or meat animals; Irrigation of industrial crops for canning industry and crops not raw-consumed. Irrigation of fruit trees except by sprinkling; irrigation of industrial crops, nurseries, fodder, cereals and oleaginous seeds
	2	Impoundments, water bodies and streams for recreational use in which the public's contact with the water is permitted (except bathing)
V	1	Irrigation of forested areas, landscape areas and restricted access areas; forestry
	2	Impoundments, water bodies and streams for recreational use in which the public's contact with the water is permitted (except bathing)
	3	Aquifer recharge by localised percolation through the soil
VI	2	Surface water quality, impoundments, water bodies and streams for recreational use, in which the public's contact with the water is not permitted
VII	4	Industrial cooling except for the food industry

[4]Direct aquifer recharge should be drinking water quality, potable water should not be produced from reclaimed wastewater without advanced tertiary treatment like reversed osmosis or percolation through the soil (i.e. indirect aquifer recharge).

Table 3. Overview of the compiled microbiological limits for reclaimed water reuse (bacteria in cfu=colony forming units, abs=absent, nonbacterial in pfu=plaque forming units).

Use	Total bacteria	Faecal coliforms	*Clostridium perfringens*	*Legionella*	*Enterococci*	*Salmonella*
I	<1,000-<10,000	abs	abs - 0	<100	abs	abs-1,000
II	<1,000	<20-<1,000	abs - 10	-	<1,000	abs – 1,000
III	<10,000	abs - <1,000	<1	<100	<20	Abs – 1,000
IV	<10,000-<100,000	abs – 10,000	<10	abs	<1,000	<1
V	<100,000	abs - <10,000	<100	-	<10,000	<0.1
VI	<10,000	<200 - <10,000	<1	-	<20	abs – 1,000
VII	<10,000	abs – 10,000	<10	abs - <100	<1,000	<1

All values expressed in (cfu/mL)

Use	Enteroviruses (pfu/L)	*Coliphages* (pfu/L)	*Cryptosporidium* and *Giardia* (cyst/50mL)	Nematode eggs (eggs/L)	*T. saginata* (egg/L)	*T. solium* (egg/L)
I	Abs - 10	<1	<1	<1 – 10	-	-
II	Abs – 10	<1	<1	<1	-	-
III	<1 - <100	<1,000	<10	<1	-	-
IV	-	-	-	<1	-	-
V	-	-	-	<1	<1	<1
VI	<100	<1,000	<10	<1	-	-
VII	<1 – 0.04	-	-	<1	-	-

Table 4. Overview of compiled and proposed chemical limits from existing guidelines depending on use (mg/L)

Parameter/chemical category	Unit	1 Private, urban irrigation	2 Environmental and aquaculture	3 Indirect aquifer recharge	4 Industrial cooling
pH		6.0 – 9.5	6.0 – 9.5	7 - 9	7.0 – 8.5
BOD	mg/L	10 - 20	10 - 20		
COD (or TOC)	mg/L	100	70 – 100 (1)	70 - 100	70 (1)
Dissolved oxygen	mg/L	>0.5	>3	>8	>3
AOX	µg/L			25	
UV 254 absorbance	l/m	20	20	10	
Electr. conductivity	µS/cm	3,000	3,000	700	
TSS	mg/L	10	10		10
Active chlorine (only if chlorination)	mg/L	0.2 – 1.0	0.05		0.05
Total Kjeldahl N	mg/L	15 – 20	10 – 20		10
Ammonium-N	mg/L	2 – 20	1.5	0.2	1.5
Parameters of medium analytical frequency (monthly – once per year)					
Sodium absorption ratio (SAR)	$mmol/L^{0.5}$	5	5		
Na	mg/L	150	150 – 200		200
As	mg/L	0.1 – 0.02	0.1 – 0.02	0.005	
B (total)	mg/L	0.4 -1.0	0.4 – 1.0	0.2	
Cd	mg/L	0.005	0.005	0.003	
Cr (total)	mg/L	0.1 – 0.01	0.1 – 0.01	0.025	
Cr III	mg/L	0.1	0.1		
Cr VI	mg/L	0.005	0.005		
Hg	mg/L	0.001 -,0.002	0.001 – 0.002	0.0005	
Pb	mg/L	0.1	0.1	0.005	
Nitrate	mg/L			25	
F(total)	mg/L	1.5 – 2.0	1.5 – 2.0		
Chloride	mg/L	250	250 – 400	100	400
Suphate	mg/L	500	500	100	
Total P	mg/L	2 – 5	0.2		0.2
Surfactant (total)	mg/L	0.5	0.5		
Mineral oil	mg/L	0.05	0.05		
Parameters of low analytical frequency (once per year – once per 5 years)					
Al	mg/L	1 – 5	1 – 5		
Ba	mg/L	10	10		
Be	mg/L	0.1	0.1		
Co	mg/L	0.05	0.05		
Cu	mg/L	0.2 – 1.0	0.2 – 1.0		
Fe	mg/L	2	2		
Li	mg/L	2.5	2.5		
Mn	mg/L	0.2	0.2		
Mo	mg/L	0.01	0.01		
Ni	mg/L	0.2	0.2	0.01	

Parameter/chemical category	Unit	1 Private, urban irrigation	2 Environmental and aquaculture	3 Indirect aquifer recharge	4 Industrial cooling
Parameters of low analytical frequency (once per year – once per 5 years)					
Se	mg/L	0.01 – 0.02	0.01 – 0.02		
Sn	mg/L	3	3		
Th	mg/L	0.001	0.001		
V	mg/L	0.1	0.1		
Zn	mg/L	0.5 – 2.0	0.5 – 2.0		
CN (total)	mg/L	0.1 – 0.05	0.1 – 0.05		
Pesticides (total)	mg/L	0.05	0.05		
Pesticides per subst.*	mg/L			0.0001	
Pentachloro phenol	mg/L	0.003	0.003		
Synthetic complex-forming subst., per subst. (e.g. EDTA)	mg/L	0.0001	0.0001	0.0001	
Chloride solvent**	mg/L	0.04	0.04		
Tetrachloro ethylene, Trichloro ethylene	mg/L	0.01	0.01		
Disinfection (by)products (only if chlorination)	mg/L	0.0001			
NDMA	mg/L	0.03	0.03	0.0001	
Trihalomethane	mg/L	0.5	0.5		
Aldehyde (total)	mg/L	0.01	0.01		
Aromatic organic solvent (total)	mg/L	0.001	0.001		
Benzene	mg/L				
PAH (total)	mg/L	0.00001			
Benzene(a)pyrene	mg/L	0.1	0.00001		
Phenol (total)	mg/L	0.0001	0.1		
Endocrine active substances (E-screen)	mg/L	0.0001	0.0001	0.0001	
Pharmaceuticals***	mg/L		0.0001	0.0001	

*and their metabolites (country specific) **(total, if AOX > limits) *** (per subst, e.g. Carbamazepine, X-ray contrast) proposed value

Table 5. Maximum tolerable soil concentrations of various toxic chemicals based on human health protection

Chemical	Soil concentration (mg/kg)
Element	
Antimony	36
Arsenic	8
Barium[a]	302
Beryllium[a]	0.2
Boron[a]	1.7
Cadmium	4
Fluorine	635
Lead	84
Mercury	7
Molybdenum[a]	0.6
Nickel	107
Selenium	6
Silver	3
Thallium[a]	0.3
Vanadium[a]	47
Organic compound	
Aldrin	0.48
Benzene	0.14
Chlordane	3
Chlorobenzene	211
Chloroform	0.47
2,4-D	0.25
DDT	1.54
Dichlorobenzene	15
Dieldrin	0.17
Dioxins	0.000 12
Heptachlor	0.18
Hexachlorobenzene	1.40
Lindane	12
Methoxychlor	4.27
PCBs	0.89
PAHs (as benzo[*a*]pyrene)	16
Pentachlorophenol	14
Phthalate	13 733
Pyrene	41
Styrene	0.68
2,4,5-T	3.82
Tetrachloroethane	1.25
Tetrachloroethylene	0.54
Toluene	12
Toxaphene	0.0013
Trichloroethane	0.68

[a] The computed numerical limits for these elements are within the ranges that are typical for soils.

Assessing safety and product quality

A variety of health protection measures can be used to reduce health risks to consumers, workers and their families and local communities. Hazards associated with the consumption of wastewater-irrigated products include excreta-related pathogens and some toxic chemicals. The risk from infectious pathogens is significantly reduced if foods are eaten after thorough cooking. Cooking has little or no impact on the concentrations of toxic chemicals that might be present. The following health protection measures have an impact on product consumers:

- wastewater treatment;
- crop restriction;
- wastewater application techniques that minimize contamination (e.g. drip irrigation);
- withholding periods to allow pathogen die-off after the last wastewater application;
- hygienic practices at food markets and during food preparation;
- health and hygiene promotion;
- produce washing, disinfection and cooking;
- chemotherapy and immunization.

There are various treatment processes for wastewater based on treatment efficiency required for the desired end use of the recycled water. It is not the intent of this paper to discuss these various treatment technologies. Nevertheless, dual membrane (micro-filtration and reverse osmosis) tertiary treatment has been considered to obtain the highest quality recycled water (Aquarec 2006) although expensive, suited for high value cash crops, and is used for groundwater recharge purposes. In general, as discussed previously wastewater is treated to the use

level or "fit-for-purpose" and varies depending on a range of factors such as the potential for human contact with the irrigated water, the end use of the crop such as whether it is eaten raw, peeled, cooked, used for fodder, industry (cotton, biofuels), or fruit trees, etc. Various crops can be irrigated with reclaimed water and they are listed in Table 6. However, knowledge of agronomy and water quality is used for all stages of a reclaimed water irrigation project that include considerations and guidelines on soil characteristics, suspended solids, salinity, sodicity, specific ion toxicity, trace elements, nutrients, and appropriate crop selection. FAO publishes various reports such as *Water Quality for Agriculture* as well as salt tolerance of various crops under the Irrigation and Drainage report series. They are available from the website:
http://www.fao.org/nr/water/infores_pubs_quality.html.

*Table 6. Examples of Crops Irrigated with Treated Wastewater**

Types	**Examples of crops**	**Treatment requirements**
Field Crops	Barley, corn, oats	Secondary, disinfection
Fiber and seed crops	Cotton flax	Secondary, disinfection
Vegetable crops that can be consumed raw	Avocado, cabbage, lettuce, strawberry	Secondary, filtration, disinfection
Vegetable crops processed before consumption	Artichoke, sugar beet, sugarcane	Secondary, disinfection
Fodder crops	Alfafa, barley, cowpea	Secondary, disinfection
Orchards and vineyards	Apricot, orange, peach, plum, grapevines	Secondary, disinfection
Nurseries	Flowers	Secondary, disinfection
Commercial woodlands	Timber, poplar	Secondary, disinfection

*Adapted from Lazarova and Asano (2004)

The FAO and WHO expert group to the Codex Alimentarius Committee on Food Hygiene for fresh produce developed a "Code of Hygienic Practice for Fresh Fruits and Vegetables." The expert group identified that there are clear needs for a food chain approach, assess risks from farm to fork, that takes into account all aspects from primary production to consumption of crops. This includes inputs to primary production, i.e., the farm environment (soil, wildlife, proximity to urban or industrial development, waterways, susceptibility to run-off), irrigation water source such as wastewater, manure, soil amendments, pesticides and even the seeds or plants themselves. In addition, the workers (growers, pickers) and transport from the field to the packing/processing houses, post-harvest manipulation of fresh produce, are also considerations for risk assessment. The entire food chain presents potential sources of contamination, and examples of hazards include pathogenic bacteria (Salmonella, enterohaemorrhagic Escherichia coli, Campylobacter, Listeria, Shigella, Yersinia), parasites (Cryptosporidium, Cyclospora, helminths) and viruses (hepatitis A, noroviruses). Due to the relative recent emergence of problems linked with pathogens in fresh produce including the associated public health and trade implications reported in a number of countries, data gaps regarding the source of hazards and the role of various inputs in contamination of the fresh produce have been identified by the expert group. Leafy greens were accorded the highest priority based on the ranking criteria and pose the greatest concern in terms of microbiological hazards. Leafy greens are grown and exported in large volume, have been associated with multiple outbreaks with high numbers of illnesses in at least three regions of the world and are grown and processed in diverse

and complex ways ranging from in-field packing to pre-cut and bagged product. Such post-harvest activities contribute to the possibility of amplification of foodborne pathogens. The standard-setting process of the Codex Alimentarius is well recognized worldwide as a science-based process involving all interested parties. International standards such as Codex Alimentarius play a critical role in protecting the health of consumers and facilitating international trade.

Considerations for irrigation system selection

Irrigation systems are selected and based on the crop types, water quality and quantity, site characteristics, and management costs and skilled labour requirements. These systems can be classified as gravity surface flow, gravity subsurface flow, pressurized surface application systems, and pressurized subsurface systems. Besides special attention to ensure public health protection, other considerations for irrigation systems include irrigation efficiency and the prevention of clogging. When freshwater with high suspended solids is used, a screening filter and/or sand separator are commonly used to remove the solids that are likely to cause emitter clogging. Suspended solids in treated wastewater are mostly biological flocs and their concentration usually is low; however, in drip irrigation systems with low water velocity, biological growth and chemical precipitation may clog the system. Measures to prevent irrigation system clogging include water quality monitoring, selection of appropriate emitters, control of flow rates, filtration, and maintenance of the irrigation system with periodic flushing and chlorination (Metcalf and Eddy and Asano et al. 2007). Leaching also

needs to be controlled to prevent salt accumulation in the plant root zone. The leaching requirement is defined as the fraction of the water entering the soil that must pass through the root zone to prevent soil salinity from exceeding a specific value, and can be expressed by leaching fraction (LF) defined as the ratio of depth of water leached below the root zone (drainage water in mm) to the depth of water applied at the surface (irrigation water in mm). Maintenance of the drainage system is needed in prevention of salinity built up in the soil.

Irrigation water demand varies with climatic conditions and reclaimed water storage may be necessary, and storage facilities can be lakes, ponds, or tanks. Otherwise, the excess reclaimed water can be discharged to receiving waters and is subject to discharge/environmental permits. Monitoring is also paramount to ensure public health protection and healthy plant growth. Normally, samples are taken and analyzed by qualified laboratory either as a continuous 24-hr composite or grab sampling at two control points: the point where reclaimed water leaves the reclamation system, i.e., treatment plant plus storage; and the final point of use.

Implementation and economics of reuse in agriculture

Water resource allocation strategies are needed for a more economically efficient and sustainable water utilization with special regard to reusing poor quality waters in agriculture. The economic aspects of a more rational water use will play a central role as cost-efficient strategies are to be realised in practice. Of special interest in this context is the re-use of wastewater to improve the economic efficiency of water use for agricultural irrigation,

and the true value of reclaimed water reflected net of externalities. Based on polluter-pays principle, reclaimed water users should be charged for the benefits obtained by investing in reclaimed water for productivity, done at the net of externalities, such as protection of potable water supplies, removal of effluent disposal outfalls, etc. Farmers should benefit and be given economic incentives when they are providers of service in reuse of wastewater in pollution control and conservation of water resources and by augmenting the potable water supply. The benefits and costs (externalities) of wastewater re-use projects by farmers translate into savings in the following:

1. Cost savings in constructions to capture and store freshwater;
2. Cost savings in water purification and distributing water;
3. Re-use of nitrogen, phosphorous and sludge in agriculture;
4. Increases in water availability;
5. Prevention of water overexploitation and pollution;
6. Augmentation of river flows; and
7. Conservation of wetlands and river habitats.

Cost-effectiveness and cost-benefit analyses are tools utilised to assess economic efficiency at the farm level and resource allocation at the watershed level, respectively. Cost-effective analysis focuses on changes in irrigation practices from wastewater reuse at the farm level, against other options for farmers such as pumping groundwater, joining networks that convey water from remote resources, changing crop patterns, etc. On the other hand, cost-benefit analysis refers to wastewater re-use at the watershed level and the various strategies for intersectoral water transfer between agriculture and cities. By applying

the cost-benefit analysis, a combination of measures may be found that maximises the difference between costs and benefits resulting from such an intersectoral water transfer. For example, the assessment of additional costs of using treated wastewater in agriculture and the economic benefits for non-agricultural water users in their saved costs from potable water treatment, from water development and conveyance of remote water resources, from water storage, and prevented expenditures for protection or restoration of the required ecological status of water bodies (e.g. costs of works to ensure minimum stream flow in rivers).

Options for financing the re-use of poor quality water: economic incentives for farmers

The implementation of economically efficient combinations of measures in promoting the reuse of poor quality water in agriculture requires policies that stimulate farmers to change their water utilization. Two options should be analysed: Firstly, the determination of the total economic value of water by considering the costs of providing water services (such as water supply and wastewater treatment), the environmental and resource costs. This total economic value of water is sometimes called opportunity costs of water or water user costs. Even though difficulties exist especially for the estimation of environmental and resource costs, it is intended to approximate the total economic value of water in the analysed regions. The purpose of such an assessment is to provide an idea on the economic value of high quality waters to decide whether the release of those waters by farmers using treated wastewater would be worthwhile.

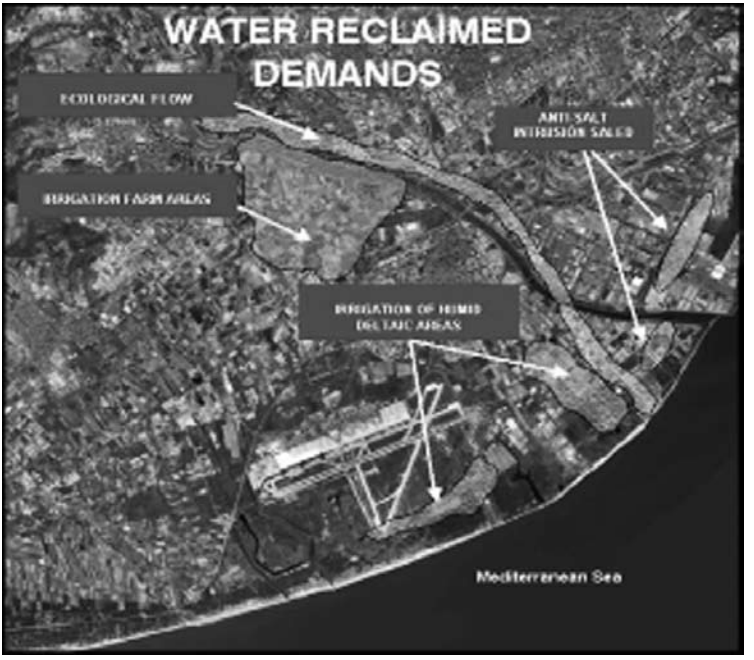
According to the user pays principle charging farmers with this economic value of water could stimulate them to re-use treated wastewater. In applying this option the total economic value of water may be used as an indicator to assess high-quality waters. Another approach to determine the compensation payments to farmers is to compare the costs and economic benefits resulting from using poor quality water in agriculture. Provided the economic net benefits are positive, non-agricultural water users will be in the position to contribute to the costs of reusing poor quality water in agriculture. Negotiations between farmers and, for instance, municipal water agencies will be analysed as an appropriate policy instrument. In addition, the significance of financial supports provided by governments to encourage farmers in changing their water utilization can thus be assessed. Box A provides an FAO case study on economic framework for wastewater reuse of wastewater reclamation project in Southern Barcelona where reclaimed water supply policy is being implemented for water conservation in wetland restoration, enhancing ecological flow, agricultural irrigation, as well as barrier to seawater intrusion.

Appropriate cost recovery mechanism and the degree of cross subsidising from the water sector strongly rely on policy objectives. Especially relevant is the extent to which water re-use is useful for pollution control and/ or conservation of the water resources. A rational cost allocation based upon usage and benefit can however only be achieved in the presence of a good level of horizontal and vertical integration. In Malta with the new wastewater treatment plants built to release 14 Hm^3/yr of treated reclaimed water, there are much opportunities in irrigation and groundwater aquifer recharge. It is critical that the treated effluent meets these uses based on real

and perceived health considerations, cost of production, storage and distribution, and the quality of water produced.

Box A. Llobregat Delta, Water Competition in Barcelona, Water Reclamation Project

The use of water from the wastewater reclamation plant serving the South of Barcelona, Spain will contribute with new resources to help to solve the water scarcity problem that the Barcelona metropolitan area plant is scheduled to reuse 50 Mm3/year of reclaimed water that will be used for supplying the ecological flow in the lower part of the Llobregat River, irrigation of farm areas, and supplying water to wetlands in the river deltaic areas. Another scheduled use aims to solve the salt-intrusion problem in the Llobregat lower delta aquifer through the implementation of an hydraulic barrier using reclaimed water. For obtaining water with the quality required for all the re-use purposes, it



is necessary to modify the existing biological treatment to remove nutrients (nitrogen and phosphorus) and the construction of a tertiary reclamation facility, which for recharge purposes includes a reverse osmosis plant.

A pumping station and pipelines for transporting the reclaimed water to the different application areas and a different pipeline for transporting the water to the injection wells where it is introduced into the aquifer at a depth of 60 m are being built.

The defined reuse project will improve ecological conditions in the lower part of the Llobregat River Basin, contribute to reduce water scarcity in the Barcelona metropolitan area and help to avoid seawater intrusion into the delta aquifer. In order to obtain the required water quality for reuse, two different tertiary treatments are built with technologies most suitable in each case, and energy recaptured to fuel the operational cost. The water quality aimed for ecological flow, wetlands, and irrigation are:

BOD5 $\leq$ 10 mg/L

SS $\leq$ 5 mg/L

Turbidity <5 NTU

Fecal Coliform <10 UFC/100 ml

nematode eggs <1_/100 ml

Residual Chlorine > 0.6 mg/L

Dissolved Oxygen $\geq$7.5 mg/L.

The treatment of water that will be used for the barrier to seawater intrusion is produced by tertiary treatment: microfiltration (MF), regulator basin, Reverse Osmosis (RO), disinfection, pumping into infiltration wells with depth 150 m, flow speed is 20,000 m3/day, or 7 Hm3/yr.

Pipelines of 1600 mm diameter and total length of 18.8 km are needed to carry reclaimed water to place of use.

Budget for this project is 100 Mil € with operational costs estimated at 0.07€/m3 when tertiary treatment is lamellar clarifier, filtration and UV disinfection and 0.30 €/m3 when the tertiary treatment is MF and RO.

This project is the most important water re-use project in the Mediterranean coast and it is the first seawater intrusion built in Spain.

Summary

The current paper has provided a few insights into the issues related to wastewater re-use in agriculture with main benefits such as fertilising capacity or increased farm production. In addition, environmental and resource benefits linked to water recycling need to be accounted for in the evaluation of the merits of a water reuse project with increases in availability to the potable water supply:

1. Urban water supply benefits (savings in capital, operation and maintenance costs);
2. Urban wastewater benefits (savings in discharge pump stations and in treatment and nutrient removal costs); and
3. Environmental water quality benefits (reduction in freshwater diversions, reduction in pollutant discharges, reductions in seawater intrusion in case of groundwater aquifer recharge).

In addition to the technology in water reclamation and on-farm irrigation systems, public perception and acceptance toward the use of reclaimed water need to be assessed. Public acceptance, health, agricultural produce and markets and environmental risks, and water reliability are also very important issues to promote water reuse. Ecological effects associated with water resources improvement, seawater intrusion decrease, restoration or increase of streams flow, vegetation increase-parks, recreational zones, changes on land characteristics, biodiversity changes, air quality and groundwater quality and quantity are issues that should be considered in a comprehensive environmental feasibility study. In terms of policy options for reclaimed water applications, one option is to fund and increase water re-use projects, and

another is to eliminate the use of high-quality freshwater for applications where high quality water is not needed. The full application of the 91/271 EU Directive for urban wastewater treatment will contribute a very important source of an alternative water supply with high quality.

The cost of water re-use depends on the application, level of treatment required, distribution facilities, infrastructure, and monitoring. It is important that the public understands the water balance and supply and the quality needed for the different uses, and the diminishing and degradation of the current supply; as well as the wastewater and crop management context in terms of re-use in agriculture and overall hydrological system benefits. Public participation in planning and a sound pro-active communication and education programme are essential in satisfying user (households and farmers) needs, gaining public support, developing a broad market for agriculture and water productivities, and for improving project implementation. Stakeholders are generally more supportive of water reclamation proposals if they are able to identify and understand the problems that the project intends to address and the urgency or the need to do so. As such, the re-use organisation has a major role in demonstrating that a viable future is dependent on conserving water and protecting groundwater overexploitation as is the case for Malta. For stakeholders to have confidence in a project they will need to be aware that it will operate in accordance with strict public health, agriculture and safety regulations of the EU. and would also need to be informed of the high level of treatment and testing for reclaimed water at various stages of the service chain.

Finally, the fact that water re-use in agriculture and groundwater recharge is successfully practised in many other parts of the world provides a powerful and positive

endorsement for stakeholders of potential new schemes. Successful practices in places such as California, Spain, Israel, and Australia with comparable social, economic and environmental climate of arid and semi-arid zones can be highlighted. The process of promoting a unifying national water policy in Malta needs to be implemented to reverse negative trends in over-exploitation of freshwater resources and groundwater pollution and abstraction. Reclaimed water projects for sustainable agricultural and water resources development can go hand-in-hand in the overall diverse economic growth and environmental benefits for Malta.

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POLICIES AND PROCEDURES ON WASTE MANAGEMENT IN MALTA

The increase of waste being produced within all countries including Malta results in the unnecessary depletion of natural resources and hence unnecessary costs, as well as damage to the environment we live in. The prevention and management of waste in an environmentally sound manner is, hence. necessary and is at the heart of sustainable development, which basically would include the use of resources in a more efficient manner in view of the fact the amount of waste is increasing continuously, usually at rates comparable with economic growth. The type of waste generated varies from waste from manufacturing, from energy production and water supply, from the construction sector and municipal waste, as well as significant amounts of waste produced by agriculture, fisheries, quarrying, and the service and public sectors.

Sustainable development meets the needs of current generations without jeopardising the future generations' potential to meet their own needs; and reducing waste and making better use of resources that will eventually bring economic as well as environmental benefits.[1] As a matter of fact the Rio definition of sustainable development, Chapter 21 of Agenda 21 provides a solution as to the

reconciliation of waste management with adequate levels of environmental protection, by stating that 'Environmentally sound waste management must go beyond the mere safe disposal or recovery of wastes that are generated and seek to address the root cause of the problem by attempting to change unsustainable patterns of production and consumption'.[2]

The Environmental Risk Unit's role at the Malta Environment and Planning Authority include following EU policy and advice on transposition into national legislation, the assistance to Ministry in policy formulation, providing input to the Development Control, raising awareness, enforcement, and ensuring implementation of legal legislation. The latter of which includes the introduction of measures for waste prevention, ensuring that waste is managed without endangering human health and the environment, and the permitting of facilities.

The European Union's main strategic document guiding community waste management policy is the Thematic Strategy on the Prevention and Recycling of Waste, endorsed by the Council, to adapt the EU waste policy approach to this new reality. This strategy provides for measures regarding emphasis on prevention, encouragement of recycling, and reduction of waste disposal, to move Waste Management in EU towards improved practices.[3]

The Community Waste Strategy which includes the Waste Framework Directive as the main framework legislation and the Directive on Hazardous Waste and the Regulation controlling the Supervision and Control of Transfrontier Waste Shipments, as well as others specific directives namely those concerning waste treatment operations and different waste streams, requires the need for every Member State to transpose the directives.

The main types of waste that is generated by agriculture include slaughterhouse waste; animal manure, animal bedding, slurry and waste water from animal husbandry; vegetable residues; plastic waste arising from the use of micro-irrigation techniques and protected cropping; and empty agro-chemical containers. A list of such wastes can be found under Chapter 2, Schedule 1 of the European Waste Catalogue as laid down in Legal Notice 337 of 2001.4

Waste Management in Malta

Local legislation that relates to agriculture include the Environment Protection Act (Act XX of Ch.45), the Waste Management (Permit and Control) Regulations, 2001 as laid down in Legal Notice 337 of 2001, the regulations concerning the Protection of Ground Water against pollution caused by Nitrates from Agricultural Sources Regulations, 2001 as laid down in L.N. 343 of 2001[5], and the Waste Management (Activity Registration) Regulations, 2007 as laid down in L.N. 106 of 20076.

The Waste Management (Permit and Control) Regulations[4] cover several aspects, some of which include the storage, collection, sorting, transport, treatment, recovery, and disposal of waste, including public cleansing activities, whether these activities are carried out on Maltese land or in Maltese territorial waters; the arrangement for brokerage and supervision of such operations on behalf of a third party; the ownership, management and after-care of sites used for the storage, treatment, recovery, deposit or disposal of waste; and any other activity which is deemed by the competent authority to constitute waste management.

Movement of waste within Malta

The Waste Management (Permit and Control) Regulations also require that a waste producer must have a valid permit and a consignment note in order to dispose of/transport his waste, which must accompany waste consisting of hazardous waste, certain biodegradable waste or some non-hazardous waste. The consignment note procedure is divided into two stages, the waste consignment permit application and the waste consignment note application. The Waste Consignment Permit Application (CP) is used in order to obtain a permit for the disposal of waste, while the Waste Consignment Notes (CN) is used during the transfer of waste, once the permit would have been issued.

Permitting

Permitting involves obtaining a development permit before any environmental permit may be even processed. Such a permit is issued under the Development Planning Act (1992) with the purpose of regulating, for example, structures built within the farm complex (e.g. animal units, cesspits, manure clamps). Once the development permit is obtained, an environmental permit could be applied for. There are namely three types of environmental permits, an Integrated Pollution Prevention and Control permit, a waste management permit or a registration procedure. Other kinds of permits include those issued by other authorities. Waste management permits are usually renewed every year to ensure continual adequate waste management.

The registration procedure mentioned here above takes place in accordance with Legal Notice 106 of 2006 – the

Waste Management (Activity Registration) Regulations, 2007.[6] Schedule 1 lists several activities that are covered by this legislation. Waste management activities on farms are permitted in accordance with this Legal Notice. The main activities related to farms include Activity 2, Activity 31, Activity 42 and Activity 43, which include the:

- generation and management of wastes by the establishment,
- spreading of manure on land,
- generation and management of waste in establishments holding animal livestock including farms,
- operation of cesspits other than for storage of farm waste.

The activities laid down in the legislation vary since some require no registration at all, others require registration only, whereas other activities require registration with confirmation; and its intention is to facilitate the process instead of having to obtain a full waste management permit.

Activities which involve the generation and management of wastes by the establishment, such as farms for example and the spreading of manure on land are not subject to registration. However the latter activity is subject to the quantity and the quality of manure spread on land being in line with EU Directive 91/676/EEC, as well as that the storage and management for land spreading in line with the Code of Good Agricultural Practice should be carried out between 16 March and 14 October.

With regard to the generation and management of waste in establishments holding animal livestock including farms requires registration with confirmation as well as submission of all relevant information. This activity covers the generation and management of wastes by the

establishments generating the waste; the operation of manure clamps; the use of cesspits for foul water generated by establishments holding animal livestock; the operation of authorised slaughterhouses, meat cutting facilities and meat processing units; and the onsite treatment of waste generated by the same establishment. Some conditions regarding the generation and management of waste in establishments holding animal livestock including farms (42) include the keeping of animals and waste management on farms following the guidelines of the Code of Good Agricultural Practice as published by the Agriculture Department. As regards the activity controlling the operation of cesspits other than for storage of farm waste registration only as well as submission of all relevant information is required. Specific conditions also apply for the cesspit.

Manure clamp

The waste holder shall prevent escape of waste from his/her control and shall ensure that waste is safely stored and presented for collection, and safely contained.

The manure clamp is to be constructed of an impervious material and contaminated waste-water generated in the manure clamp is to be directed into a cesspit, which is not the same cesspit as that used for waste arising from facilities aimed at for human use.

The volume of the manure clamp has to be large enough to store manure to be produced by the full quota of animals that the establishment can legally support.

No manure produced by the establishment is to be spread on land during the period between 15th October and the 15th of March. During this same period, no

manure is allowed to be stored in areas other than a manure clamp.

Cesspit

Cesspits are to be constructed in such a manner so as not to allow any leakages or spillages to the surrounding environment, and are designed in such a manner as to safely contain the type of waste that they are designated to store.

Cesspits should be appropriately ventilated so as to avoid the accumulation of explosive, toxic or corrosive gasses.

The area surrounding the cesspit should be rendered impermeable and the ground laid to fall towards the cesspit.

Waste water is to pass through a settling tank prior to being channelled into a cesspit, in order to separate any slurry present in the waste water and preventing sediment from accumulating in the cesspit.

Settling tanks should be connected to the cesspit by means of a T-shaped pipe, half H pipe thereby enabling any solids present in the waste water to remain in the settling tank.

Cesspits are not to be connected to the main sewer but are to be emptied by means of a pump into a tanker, or by a vacuum.

The cesspit is to be emptied regularly at the waste holders expense so as to prevent overflowing and so as not to constitute a threat to human health and the environment.

At any particular instance the applicant can be requested by the Malta Environment and Planning Authority to

submit assurance from a competent professional that the cesspit conforms to all above conditions.

Farms having an authorised slaughtering unit should have a grease trap outside the slaughtering unit, connecting to the cesspit via a settling tank.

In the case of dairy farms a separate cesspit/reservoir will have to be used to store waste water containing cleaning detergents that are used to clean the milking machine and coolers. When the detergents used for cleaning are caustic soda and/or hypochlorite in heavily diluted concentrations, water from this cesspit/reservoir may be recycled for use in the cleaning of other farm surfaces.

Public conveniences on farms should be connected to the sewerage system or to a separate cesspit other than that collecting liquid waste generated on the farm.

In addition to the above mentioned conditions dead or fallen animals and slaughterhouse wastes are to be transported to the public abattoir incinerator for incineration or any appropriate management as may be directed from time to time by the Food and Veterinary Regulation Division, and the operator of the establishment is requested to keep records of the amount and volume of solid and liquid waste as well as information on where such wastes are directed to. No waste is to escape in any way into public areas at any time from the time the waste is being generated to the time the waste is being disposed of in an appropriate manner, and a Waste Management Plan to the satisfaction of the Authority has to be submitted together with the registration.

Waste carriers and waste brokers are required to register with confirmation is required, as well as all relevant information required needs to be submitted. Additional obligations are imposed on both the registered carrier

and the registered broker. Slaughterhouse waste carriers fall under Class C, and cover the transportation of waste by householders transporting their own waste to civic amenity or bring-in facilities or to another authorised waste collection/disposal point.

Agriculture is the largest single land use and a major contributor to the environmental character and quality of the rural landscape.[7] Although some may see legislation as being a burden on people requiring and controlling more obligations, one must understand that this should not be seen through this lens since in the end adequate waste management is in our interest and in the interest of the future generations. The main aims of Council Directive 86/278/EEC on the Protection of the Environment, and in particular of the Soil, when Sewage Sludge is used in Agriculture as amended by Directive 91/692/EEC for example requires Member States to ensure that the use of sludge in agriculture complies with limit values for the concentrations of heavy metals in soil, to prohibit that concentrations of heavy metals in the soil exceeds specific limit values, and to analyse sewage sludge and soil to ensure that the proper limits are adhered to. The Malta Environment and Planning Authority is committed to ensure that land use and the protection of the environment meet the needs of today's society and future communities and that a quality of life that will be in harmony with our natural, cultural and built environment. In so doing we are seeking to implement sustainable development that safeguards the environment by preventing and managing waste without endangering human health and the environment.

Notes

1 United Nations; Development and International Economic Co-operation: Environment – Report of the World Commission on Environment and Development "Our Common Future"; 1987.
2 UN Department of Economic and Social Affairs, Division for Sustainable Development; Agenda 21: Earth Summit – The United Nations Programme of Action from Rio; 1992.
3 Commission of the European Communities; Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions; Taking sustainable use of resources forward: A Thematic Strategy on the prevention and recycling of waste; COM(2005)666 final; 2005.
4 Waste Management (Permit and Control) Regulations; Legal Notice 337 of 2001; http://www.mepa.org.mt/environment/legislation/LN_337_2001_E.pdf
5 Protection of Ground Water against pollution caused by Nitrates from Agricultural Sources Regulations, 2001; Legal Notice 343 of 2001; http://www.mepa.org.mt/environment/legislation/LN_343_2001_E.pdf
6 Waste Management (Activity Registration) Regulations, 2007; Legal Notice 106 of 2007; http://www.mepa.org.mt/environment/legislation/LN106of07.pdf
7 Rural Development Department, Ministry for Rural Affairs & the Environment; Scoping Report on the Strategic Environmental Assessment on Malta's National Rural Development Plan for the Programming Period 2007-2013; 2007 http://www.environment.gov.mt/htdocs/docs/Assessment.pdf

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WASTE MANAGEMENT FOR THE AGRICULTURE AND FISHERIES SECTOR

WasteServ Malta Ltd

WasteServ Malta Ltd (WSM Ltd) was established in November 2002 and was delegated the responsibility to implement the Solid Waste Management Plan (2001) that covers the generation, storage, collection, transportation, treatment, reuse, recovery and disposal of waste according to EU legislation. It is a limited liability company, 100% of the shares owned by the government. Some of the employees are directly employed by the company while others have been seconded from the civil service. As a semi-autonomous company, WSM Ltd was assigned the role of a waste management coordinator and facilitator for the islands of Malta. WSM Ltd is responsible for the management of the existing waste management facilities (landfill and composting plant etc), together with planning the implementation of new/upgraded facilities in accordance with national laws and regulations and EU directives, regulations and standards. Among the Waste Management Sites that WasteServ is currently operating, one finds the Ghallis Engineered Landfill, the Sant'Antnin Material Recovery Facility and Mechanical Biological

Treatment Plant (Digestion Plant), the Civic Amenity Sites and Bring-In Sites, Gozo Transfer Station and the Thermal Treatment Facility.

Agriculture Waste

In Commission Decision 2000/532/EC (Chapter 02), an attempt was made to categorise the main waste streams that can be classified as waste arising from ***agriculture, horticulture, aquaculture, forestry, hunting and fishing, food preparation and processing***. This council decision has replaced decision 94/3/EC establishing a list of wastes pursuant to Article 1(a) of Council Directive 75/442/EEC on waste and Council Decision 94/904/EC establishing a list of hazardous waste pursuant to Article 1(4) of Council Directive 91/689/EEC on hazardous waste. The list of possible waste streams is subdivided into seven sub-sections. Each waste stream is given a classification code which distinguishes whether it is hazardous or non-hazardous. A typical hazardous waste stream generated from agricultural industry is ***02 01 08* - agrochemical waste containing dangerous substances*** which includes pesticides.

Waste streams generated from animal husbandry and food preparation and processing may also fall under regulation 1774/2002/EC. This regulation lays down animal and public health rules applying to the collection, transport, storage, handling, processing and use or disposal of animal by-products. It also covers the placing on the market, export and transit of animal by-products and derived products. For example, waste classified as '02 01 02 animal-tissue waste' can be categorised as category 1/2/3 according to regulation 1774/2002/

EC. The disposal or treatment of this waste depends on the category of the waste under which it is classified. For example waste falling under category 1 needs to be incinerated.

Collection of Agriculture Waste Streams

Due to the different types of waste streams generated through this industry, collecting the individual waste streams separately enables WSM Ltd to better manage this waste. Different properties can be attributed to every waste stream and hence its treatment can vary from one waste stream to the other. Waste can be recyclable or non-recyclable, organic and/or compostable, hazardous, infectious material, and so on.

In order to collect and treat waste separately, WSM Ltd has implemented a number of projects, as described hereunder. These include the introduction of Civic Amenity Sites, Bring-In Sites, the Agricultural Plastic Collection Service and the Thermal Treatment Facility. WSM Ltd is planning to start operating in the near future the Mechanical Biological Treatment Plant at Sant'Antnin for organic material and is also planning to construct an Amenity site at the Pitkalija specifically to collect biodegradable material like vegetable leftovers, wood, plastics and cardboard and pesticides from farmers and vegetable retailers.

Civic Amenity Sites

Civic Amenity Sites were set up to optimise the collection of certain types of waste and increase the recovery of

secondary materials. These sites are supervised facilities to which members of the public can bring and discard a variety of segregated bulky household waste to be placed in designated containers. These sites are open from Monday till Friday between 7:30am till 5:30pm.

Maghtab Civic Amenity Site

The target is to build four such sites in Malta and another site in Gozo.
Typical waste streams that can be disposed in such facility include:,

- Paper and Cardboard (Newspaper, magazines, circulars, telephone books, office paper)
- Plastic Film and Plastic Bottles
- Glass Bottles/Containers
- Metal and Aluminium cans and Steel
- Tyres
- Wood
- Mattresses (Sofas, Armchairs, Bolsters)
- Electrical and Electronic Equipment (WEEE)
- Construction Waste
- Textiles (clothes and shoes)

Hazardous waste that is accepted at the Civic Amenity Sites includes:

- Poisonous waste such as pesticides, weed killers, rat poison and others.
- Batteries and car accumulators
- Fraction "C" – High energy, organic chemical waste
- Lubricating waste oil
- Edible waste oil

Agricultural Plastic

A project was set up by WasteServ back in 2005 to collect low density polyethylene (LDPE) agricultural plastic film. This material is being widely used in agricultural operations as greenhouse covers, row covers and mulch film. This project started off as a Pilot Project at Mgarr (Malta). With the assistance of the Farmers Co-operative and with the help of the Mgarr Local Council, WasteServ placed a 40 ft container at Mgarr where farmers could take their plastic waste at their convenience and place the material in it. Once the container was filled up, WasteServ baled this plastic and exported it for recycling.

The 40ft container placed at Mgarr (Malta) where farmers could dispose of their Agricultural Plastic material at their convenience

In the successive years, this project was eventually extended to cover other localities where agriculture is the predominant industry of the locality. Such localities that were willing to take part in this project included Mellieħa, St Paul's Bay, Dingli, Rabat, Żabbar, Siggiewi and Żebbug.

Figures show that every year this project proves to be very successful. Looking at the figures of the quantity of agricultural plastic collected during the period August-September, during year 2006 the quantity of plastic collected was approximately 26.678t while during the following year, the plastic collected increased to 48.24 tonnes. Hence, there was an increase of 80.8% from 2006 to 2007.

Before the introduction of this project, this plastic was either burned in the fields by the farmers themselves or else landfilled causing a detrimental environmental impact both on the environment and on the residents living in the nearby vicinity.

Thermal Treatment Facility

In 2004, the Civil Abattoir installed a temporary mobile incinerator to treat category 1 waste. Through the Italian Protocol, they started the process to build a proper Thermal Treatment Facility capable to handle Category 1 & 2 waste according to the ABP regulations. This facility could incinerate up to 12,910 tonnes of animal waste. This volume of waste was necessary to ensure that the incinerator would operate all year round.

Between 2001 and 2006 animal waste quantities decreased so the plant had an over-capacity. WSM Ltd was asked to upgrade the Plant in order to use its spare

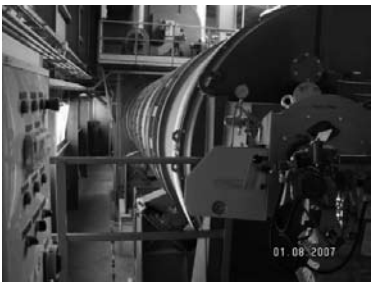
The mobile incinerator procured by the Civil Abattoir to treat fallen animals that fall under category 1 according to the ABP regulation.

The Thermal Treatment Facility currently operated by WSM Ltd

capacity to treat other problematic waste streams without a negative environmental impact and at the same time aim to operate it more economically. Modifications to the permitted plant could make it more feasible and would fulfil Government's requirements to treat hazardous waste, including Clinical Waste and pharmaceutical waste.

The Thermal Treatment Facility was designed to incinerate 1650kg of Abattoir Waste per hour. Waste is incinerated in the Primary Combustion Chamber (PCC) at a temperature of 850°C and the flue gas produced is further treated in the Secondary Combustion Chamber (SCC) at a temperature of 950°C. Following this, the flue gas generated is cleaned before it is released into the atmosphere.

The Incineration Process commences when the waste producer delivers the waste to be incinerated to the Facility. Abattoir waste is stored in the fridge to avoid odours due to waste degradation. The waste passes automatically into a shredder where it is minced and fed gradually into the PCC for Incineration. With the Abattoir Waste, Residual Derived Fuel (RDF) and Clinical Waste



The Rotary Kiln where incineration of animal by-products takes place

are co-incinerated since the latter have a better calorific value than Abattoir Waste.

Flue gas generated pass through the SCC where any incomplete combusted gases are incinerated at a temperature of 950°C. Bottom ash generated in the PCC are collected separately in a 20ft container.

The flue gas passes through a waste heat recovery boiler where the temperature of the flue gas is reduced from 950°C to160°C. At this point Sodium Bicarbonate and Activated Carbon are injected to react with the pollutants found in the flue gas. The flue gas with the chemical reactants passes through the reactor and finally through the Bag House Filter. The reagent neutralises the acidic gases and heavy metals generated after the waste combustion and the filters do not allow dusts to pass through the bags and out of the chimney. Hence all the dusts are captured in this filter bag. A continuous emissions monitoring unit is installed to measure all emissions going out of the chimney and to ensure that they are within the IPPC emission limits.

Conclusion

Although waste management in agricultural and fisheries sector involves the management of various waste streams

with different properties, sustainable waste management is possible with the co-operation of the waste producers including farmers and the local councils involved. Experience showed that farmers are very knowledgeable about the impact on their environment caused by their waste and they are willing to strive and enhance the environment. However, costs for waste disposal have to be kept at a minimum, possibly even covered in their totality. Besides, education plays an important role in developing an effective waste management policy. People have to understand the reason why certain measures are needed and we are confident that they will respond positively to targeted educational programmes.

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AGRICULTURE AND WASTE MANAGEMENT: AN ENVIRONMENTAL PERSPECTIVE

Introduction

The aim of this paper is to present case studies in environmental planning with outlooks on current practices in waste management and agriculture. Figure 1 indicates the location of the case studies: one is based at Qormi in mainland Malta, more specifically at Sqaq Awzara, while the other three are based in Gozo – at Kercem, Ksajjem, limits of Gharb and Mgarr ix-Xini. Appendix 1 gives the land use settings for each case.

Location of case studies

Agriculture as a Natural Asset in the Local Environmental Economics

Malta is the smallest Island Member State in the European Union with the highest population density. Although agrarian land accounts for 47.8% of the total area of the Maltese archipelago, urbanisation and socio-economic marginalisation of the agrarian sector is rendering agriculture to a part-time activity, largely family-run "… and possibly lacks the dynamism that a more commercial organisation set-up would bring" (Ministry for Rural Affairs and the Environment, 2007). Land fragmentation and abandonment has become a feature of the agrarian landscape with the average area of an agricultural holding standing at 0.1-0.5ha, significantly limiting its economic viability (National Statistics Office, 2003). These factors lead to a reduction in arable land and the agrarian sector has now a minor contribution to the national direct economy.

However, unlike other Member States, computations on local natural areas often include arable land, given the low net percentages of purely natural areas. Thus, although strong pressures from other land users push agriculture to a minor economic activity, its significance as a major contributor to the quality of the rural landscape, notably its ecological, touristic, recreational and environmental health value has amplified. The UNESCO Convention on the Protection of the World Cultural and Natural Heritage emphasises that present generations have the obligation to conserve natural assets to future generations (Council of Europe/UNEP, 1996). Although agriculture may be a receding economic activity if there is no collective effort for regeneration, its inherent stewardship of the rural environment cannot be underestimated within the specific local context.

Landscapes Defined

Defining landscapes is perplexing. Some view landscapes as the biophysical characteristics of a given area in flux while for others it is merely the superficial, visual aspect of same. Landscapes are the expression of the relationship that develops between the human and the natural environments. In the most popular use of the term, landscapes are merged with the notion of countryside and hence with natural landscapes, even though untempered natural landscapes are nowadays rare. This is due to changes in the sociological fabric, namely the radical move towards urban conglomerates and the renewed interest in the rural and relaxing landscapes. Another facet of rural landscapes is the cultural aspect, the 'local character' which gives identity to a nation.

The character of the Maltese natural landscape is primarily a Mediterranean sclerophyllous biome and, being geographically an archipelago, with relatively high species richness. Agriculture has been the major anthropogenic activity to transform the natural landscape since prehistoric times into a semi-cultural plagioclimax with a significant reduction in the fauna and flora, but rendering the landscape with a distinctive Mediterranean character, the focus of the Mediterranean Landscape Charter (Zoido Naranjo, 1998). This Charter, drawn in preparation to the European Landscape Convention in view of the unique setup and greater sensitivity of Mediterranean landscapes and their transforming agents due to uncontrolled urban sprawl, tourism and loss of landscape values, aims at including the landscape dimension in all the stages of policy making and planning, and at increasing awareness and appreciation of the Mediterranean landscape values for their better protection.

The European Landscape Convention was drawn due to concerns "to achieve sustainable development based on a balanced and harmonious relationship between social needs, economic activity and the environment" and aims at protecting, managing and enhancing European landscapes (Council of Europe, 2000). Malta is a Signatory State implying it expressed a collective wish to consolidate the European identity through the protection and management of the diverse landscapes and that it acknowledged the importance of landscapes as "an important part of the quality of life for people everywhere…" and "a key element of individual and social well-being":

> … the landscape has an important public interest role in the cultural, ecological, environmental and social fields, and constitutes a resource favourable to economic activity and whose protection, management and planning can contribute to job creation [and that] developments … are in many cases accelerating the transformation of landscapes

Local legislation does not expand on this theme, except at policy level where specific areas are designated as Areas of Landscape Value with little legal implications. Within the Mediterranean context, terracing is the singular transforming activity of the rural landscape, expanding agrarian activity to marginal areas, such as steep slopes. The major legal tool pertaining to the conservation of the rural landscape is Legal Notice 169/04 regarding the protection of rubble walls as important cultural and landscape features, as soil retaining structures and for their ecological value.

Preserving the Rural Landscape should be the Focus of all Development Proposals

The first case study is located at Mgarr ix-Xini, one of the most panoramic sites at the south-eastern coast of Gozo. The area is embedded in a contemporary agrarian setting within a landscape where its ecological, geomorphological and cultural significance have long been acknowledged. The area is characterised by dryland farming with a number of dairy units at the mouth of the valley. Mgarr Ix-Xini Valley, including its tributary, is a steep-sided valley running north-west to south-east to the fjord-like inlet of Mgarr Ix-Xini, the galleys' haven for part of the fleet that besieged Gozo in July 1551. The Valley is rich in biodiversity and supports ecologically significant plant communities and the entire Mgarr ix-Xini/Wied Sabbara area is considered of conservation value (Schembri et al, 1987). Central government acknowledged the natural import of Mgarr ix-Xini when the Malta Environment and Planning Authority scheduled the area in November 2001 as Areas of Ecological Importance, levels ranging from Level 1 for the watercourse to Level 3 for the valley sides. The valley is scheduled as a Level 1 Site of Scientific Importance (Geomorphology) (Government Gazette, 2001). In the Explanatory Memorandum of the Structure Plan, it is emphasised that "a general presumption against development" will prevail in Areas of Ecological Importance and Sites of Scientific Importance, which areas are actually encouraged to be included in international listings of protected areas (Ministry for Development of Infrastructure, 1990).

The Malta Environment and Planning Authority has established the National Ecological Network of Special Areas of Conservation, as part of the Natura 2000

programme of the European Union, where a number of sites of ecological significance are highlighted and management plans drawn as action plans for their conservation. Mgarr ix-Xini is conspicuously missing in the official Network, even though its characteristics fit the criteria of the Natura 2000 network.

To safeguard this rich legacy, the Sannat and Xewkija Local Councils set up the Mgarr Ix-Xini Regional Park, a joint initiative which is listed in the COST A27 of the Cultural and Scientific Programme of the European Union. The rationale behind the Regional Park is to include any social and economic activity taking place within its boundaries, in accordance with the recommendations of the IUCN categories of Protected Areas whereby the concept of the Park serves as a catalyst to further the appreciation and improvement of the ecological and cultural perspectives of the landscape.

Yet, the Malta Environment and Planning Authority has issued WasteServ Malta Ltd, a Government-owned, semi-autonomous company, established in 2002 to construct and operate waste management facilities, an outline permit for a Waste Transfer Station and a full development permit for a Civic Amenity Site at Tal-Kus, that is in the middle of the Regional Park, when the cost effectiveness of both proposals was seriously questioned, given their location and the relatively small quantities of waste generated by Gozo. Still, WasteServ Malta Ltd views the proposals as a "positive shift towards a more sustainable and environmentally friendly system of waste management".

Waste Management as a Central Role in Environmental Sustainability

The role of waste management as a central tenet in environmental sustainability has been highlighted a number of times for the last decades, creating a crescendo in the Johannesburg World Summit on Sustainable Development in 2002, echoed and expanded by the Sixth Environmental Action Programme of the European Union where waste management was established as a Thematic Strategy.

Through the accession process to achieve the status of a Member State, Malta underwent a number of policy transitions to endorse the principles of waste hierarchy, proximity principle and self-sufficiency. The Solid Waste Management Strategy for the Maltese Islands states that

> Preventing and managing waste is at the heart of sustainable development. Waste means unnecessary depletion of natural resources, unnecessary costs and environmental damage that could be avoided. Sustainable waste management is about using resources more efficiently.

Waste transfer stations and civic amenity sites are the resultant of Malta's encompassing the Action Programme of the European Union on environment. However, due to their potential to induce negative environmental impacts, the Malta Environment and Planning Authority had long endorsed safeguards at policy level against waste management facilities in environmentally sensitive areas, such as Policy SWM13 which promotes the location of such facilities in central places, preferably in industrial sites or within existing networks of major waste arisings, and Policy WDC5 which prohibits the location of such facilities within areas of ecological, scientific, landscape,

cultural and agrarian value (Planning Authority, 2001). The same authority had specifically set up a list of planning and environmental considerations for the site selection exercise of such facilities – landscape, visual intrusion, conservation of the natural and cultural heritage and proximity to waste arisings are some of the criteria.

Agricultural Waste Management as a Sustainable Activity

The main emphasis of the Common Agricultural Policy has shifted from productivity to marketing, product diversity, animal welfare and environmentally sound and sustainable practices. The current strategy is cross compliance whereas farmers who fail to comply with established standards risk incurring a reduction in subsidies or direct payments; indeed, compliance with a minimum set of environmental standards is a condition for eligibility for support of rural development measures. The aim is to fuse the rationale of environmental and agricultural policies. The Common Agricultural Policy makes it mandatory for Member States to offer agri-environmental schemes to farmers to meet such measures. Failure to respect established environmental measures could mean the reduction or withdrawal of direct assistance through the European Agricultural Guidance and Guarantee Fund (EAGGF).

Central government, through the Rural Development Programme, has acknowledged the important role that agriculture has in safeguarding the rural environment, especially its import on the landscape value. Specific agri-environmental measures have been drawn to increase the farmer's awareness on environmental issues, turning the

farmer into a guardian of the cultural and natural heritage. The Programme endorses the concept of sustainability in agrarian activities, given the fragile nature of natural habitats and emphasises the need for environmentally sound practices to protect such natural resources as water and soil.

The second and third case studies, one based at Qormi and the other at Kercem, are planning permits for livestock units in areas where the predominant land use is agrarian with about 5% of the area dedicated to animal husbandry, specifically poultry, pig rearing and dairy. Both areas are aquifer protection zones, but most of the livestock units were set up prior the establishment of the protection status of the area.

It is now mandatory for livestock units to incorporate agricultural waste depots and treatment facilities to meet the requirements of the Malta Nitrate Action Plan as specified in the Code of Good Agricultural Practice, which code deals with fertiliser applications with specific measures on manure and slurry management. The Code has been drawn since agriculture is identified as a major contributor to groundwater degradation and groundwater, more specifically the mean sea level aquifer, is the main source of potable water in Malta. Agriculture donates to this degradation namely by overpumping of the groundwater for irrigation and other commercial activities inducing sea water intrusion, and mismanagement of livestock wastes and organic and inorganic fertilisers causing nitrate leaching. In line with the Nitrate Directive, Legal Notice 233/04 designated the entire territorial area of the Maltese archipelago as a Nitrate Vulnerable Zone since mean nitrate values in groundwater are above the stipulated level. Inevitably, manure management is a central tenet for attaining the

stipulated standards of the Groundwater Directive and Legal Notice 343/01 on the protection of groundwater from agricultural practices.

Solid and liquid discharges from livestock units are limited to manure and cleaning water. The normal practice is that liquid wastes are discharged to an on site cesspit while manure is processed and used as an agricultural fertiliser or soil conditioner. A number of government reports acknowledge that local soils are largely deficient in organic matter, which deficiency is linked with soil erosion, a major problem in the local rural environment, as acknowledged by the Rural Development Programme. Applications of processed manure to soil increases its organic matter, may act as an organic fertiliser and significantly improves the soil structure, an approach sometimes used to combat soil erosion. The use of treated manure as a slow release fertiliser is a central practice in organic farming, which activity is identified by the same Programme to be a "major benefit" with respect to surface and ground waters due to a decrease in leachates.

The planning trend is to locate animal husbandry units in close proximity to minimise pollution risks by concentrating polluters in one area, implying a greater control of groundwater management. Yet, there is no concerted effort to link groundwater pollution from mismanagement of agricultural wastes, notably from livestock units. For example, in one of the case studies, the Water Services Corporation had recommended that "premises be connected to the public sewers", a highly unsustainable practice, especially from the environmental health point of view. Still, a cesspit was constructed in accordance with Legal Notice 8/93 (Sewerage Discharge Control) which does not allow the disposal of farm wastes into public sewers.

The setting up of regional depots of agricultural solid and liquid wastes should create the right infrastructure for a more cost effective and efficient processing of manure prior utilisation as an essential soil conditioner, at a time when groundwater pollution is a serious cause for concern. The small scale of most agricultural holdings warrants that central government provides the right infrastructure to establish regional manure depots and processing units, a more cost effective solution. Unfortunately, this is not emphasised in the Rural Development Programme. Creating the right infrastructure for adequate agricultural waste management and reusing such waste to combat environmental problems is the highlight of sustainability, a common practice at a global level.

Waste Management may be used to Enhance the Rural Landscape

The restoration of disused mineral excavation sites and their concomitant rehabilitation to a landscape sensitive land use is a global solution to the problem of inert waste. Traditionally, disused quarries were rehabilitated to arable land. In more recent decades, Malta dragged its feet to renew the process and now there is enough legal and financial incentive for the practice to gain momentum. The fourth case study focuses on the rehabilitation of a disused quarry in the north western part of Gozo, in the vicinity of the village of Għarb and the hamlet of Għammar. The area is dominated by the dry valley system of Wied il-Mielah with dryland farming along heavily terraced fields. The planning application was for the rehabilitation of a disused softstone quarry. The restoration philosophy centred around landscape

archaeology whereby the recommended scheme involved various phases including the infilling of the site with inert building construction waste, the alignment of the infill along established contour lines and reclaiming the site for agricultural purposes to complement the existing landscape features.

The objective of the scheme was to use waste management as a tool to enhance the agrarian landscape of the area. Mineral excavation is a major activity that alters a terrain. Utilising a disused quarry as a temporary inert waste depot to rehabilitate it to standards that complement the surroundings is a highly sustainable activity. The recommended scheme, together with other recommendations such as safeguards to protect the groundwater during the restoration process, was endorsed in its entirety by the Malta Environment and Planning Authority in the issue of the development planning permit. However, none of the recommendations were enforced and the result of the restoration effort is a far cry from recommended standards.

Conclusion

In the fashion of pragmatism, policies and plans should be tested in practice by assessing whether they achieve the desired result. Although Malta is a Signatory State to a number of important international conventions and European Union directives have been amalgamated within the local legislative framework, oftentimes, the actual message that regulators are sending to the international community and society at large on our corporate responsibility to safeguard the environment for posterity, is mixed and confusing. Although agriculture

is a relatively small economic sector in the Maltese Islands, as a Member State, Malta has environmental obligations to fulfil. Failure on the part of government to provide the right infrastructure could translate in withdrawal of direct aid to this economic sector. The reluctance for collective action is driving the quality of the rural landscape towards inferiority and unsustainable practices with lost opportunities in other economic sectors. Although a number of agri-environment measures have been established as an effort to stall the degradation of the rural environment, agriculture is far from being environmentally sustainable and collective, synchronised effort of regulators is mandatory.

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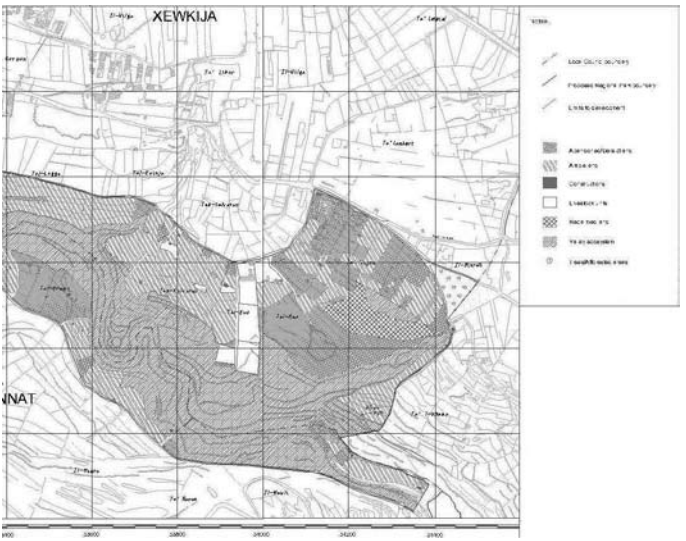
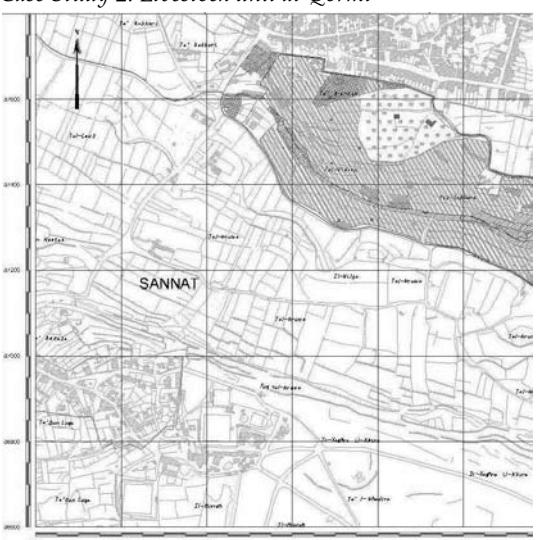
Appendix 1

Land use settings of the four case studies

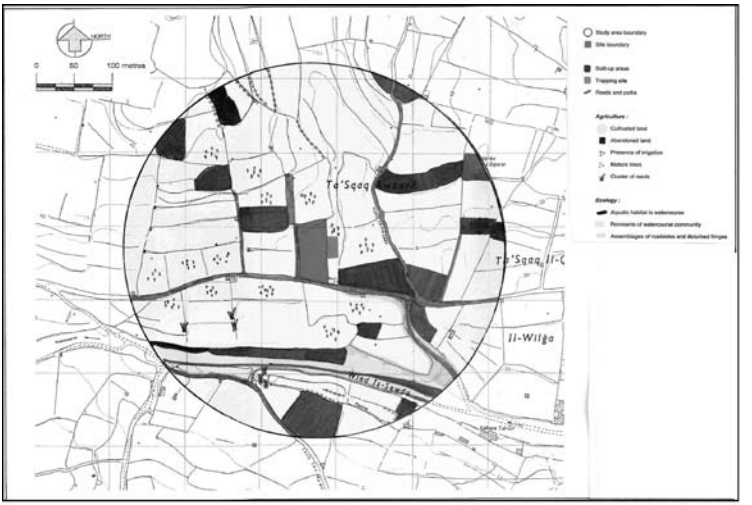
Case Study 1: Mgarr ix-Xini Regional Park



Case Study 2: Livestock unit at Qormi



Case Study 3: Livestock unit at Kercem, Gozo



Case Study 4: Disused quarry at Tal-Ksajjem, limits of Gharb, Gozo

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