

THE COST OF SOIL REPLACEMENT: A MALTESE CASE STUDY

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Abstract

Soil erosion only enters national accounting systems when soil loss is reflected in lost agricultural productivity, or becomes manifest with costs sustained by damage through flooding, siltation of dams, landslides, and other associated phenomena. On islands that are prone to desertification, however, soil loss needs to be better accounted since the costs of soil replacement and rehabilitation are often prohibitively expensive. Circumscribed agricultural space provides the necessary incentive for investment in soil conservation measures and, in certain cases, a long history of such measures results in a wealth of soil retention structures.

Soil conservation has been practised in the densely populated Maltese islands for several hundred years. Slope terracing and armouring of the terrace face with retaining dry stonewalls represents a rich resource which has not yet been quantified. Yet the cost of maintaining such soil conservation structures is becoming increasingly prohibitive despite the downstream costs of their eventual failure.

Legislation has been enacted aimed at preserving rubble walls since these are now also regarded as a unique

landscape feature but well-targeted economic incentives and support infrastructures are crucial in this regard.

In fact, the Maltese Government has, over the past few years, promoted rubble wall repairs by creating groups of skilled workers trained in the craft of rubble wall building. Malta's joining the European Union in May 2004 also means that EU funds would be utilised in this regard but this needs careful management.

Despite such state initiatives, alternative non-state subsidies need to be identified and this demands the identification of net beneficiaries of soil conservation. The most easily identifiable stakeholders are farmers but the tourist sector and water management authorities should also be enlisted within soil conservation management. Other stakeholders include those sectors that are adversely affected by soil erosion. In this case, insurance companies and road maintenance agencies should also be involved in soil management initiatives.

Introduction

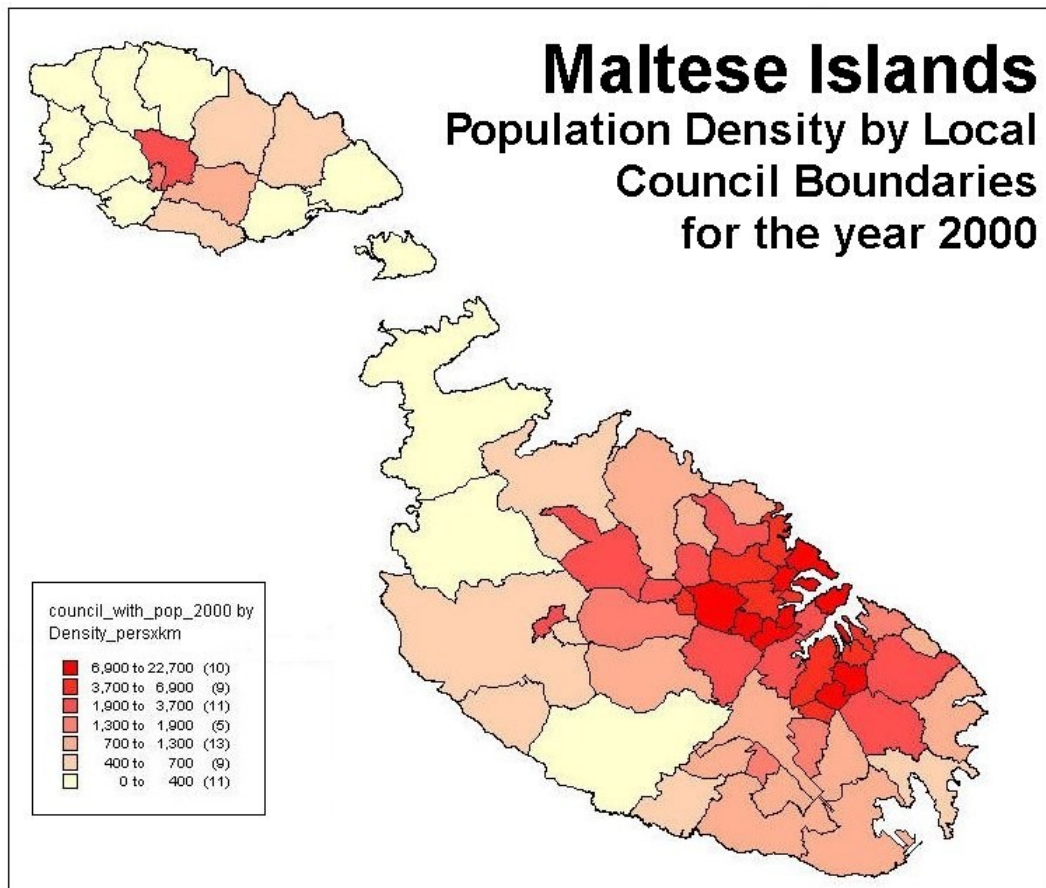
The Maltese islands form an archipelago located within the central part of the Mediterranean and have one of the highest population densities in the

world. Over centuries, the islands have played a historic and strategic role in the Mediterranean but their food supplies were often critically compromised during wartime. In this respect, there has long been a need to utilise every parcel of land that may be useful for arable cultivation. Terracing and the construction of retaining dry rubble walls, allowed the extension of cultivation up slopes that would have been considered marginal.

Circumscribed agricultural space thus continues to provide the necessary incentive for investment in soil conservation measures and, in certain cases, a long history of such measures has resulted in a wealth of soil retention structures. Terraces and their distinctive rubble walls are now perceived as a vital part of the Maltese rural landscape and, at present, constitute an important tourist resource.

On the other hand, highly urbanised island states, like Malta, have particular sets of problems since the rural environment is severely impacted by the urban and peri-urban environment. Land speculation and recreational activity constitute alternative, and more lucrative, land uses which often lead to the decline of agricultural activity in certain areas.

Such processes lead to severe soil erosion; especially in areas where terraced cultivation predominates. Therefore, it is becoming increasingly obvious that we need to explore new, and reinforce existing, mechanisms, which yield a sustainable income to the rural community while delivering sound soil conservation.



Conditions for Soil Erosion and Land Degradation

In most cases, soil erosion and associated land degradation processes, are brought about by misguided agricultural and mining practices. These are the activities that produce land degradation on the substantial scale required for recognition. In the case of Malta, it is the process of urbanisation that is causing land degradation, superimposed upon a pattern of degradation that has been going on for several millennia.

The Maltese islands possess a semi-arid type of climate and they have a long history of human occupation. In fact, the megalithic temple cultures show sustained human occupancy for at least 8,000 years. The islands are now completely deforested and show little traces of the original post-glacial sclerophyllous forest cover.

There is also evidence that land degradation has been occurring for a very long time. The garrigue community and steppe vegetation communities may be seen as remnants of once forested areas. It is evident that parts of Malta have lost most of their soil cover possibly following deforestation practices which must have occurred several hundred, if not thousands, of years ago.

Part of the process of land degradation in Malta, is due to the over-development and over-reliance on the tertiary sector of the economy. This has somewhat diminished the relative importance of the agricultural base and the re-orientation of an outward-looking society based on trade and the servicing of military garrisons.

This dates as far back as the times of the Knights of Malta – a rich European Religious Order largely dependent on the revenue generated by the vast estates that it owned on the European mainland.

These imports were supplemented by the activities of the corsairing sector, which, once again, obtained wealth from Ottoman shipping in the eastern Mediterranean and North Africa. This seems to have set the scene for future development on the islands when the French, and subsequently the British, replaced the Order as foreign rulers of the islands.

This over-reliance on external sources of wealth and agricultural potential was never demonstrated more starkly as during the Second World War when the islands were practically starved into near-submission. Tourism replaced the military garrison during the late '70's as the focus of the service economy and has fostered a continued reliance on external agricultural products. Therefore, the importance of the agricultural sector as a perceived vital resource base has continued to diminish.

Much of the land degradation experienced in Malta is due to the rapid rate of urban sprawl over the island – a process that has relatively accelerated and proceeds despite the setting up of a Planning Authority in the early 90's; now augmented by an Environment Directorate to form MEPA (Malta Environment and Planning Authority).

Suburban growth has spread out from the hub of human settlement located around the two main harbours on the northeastern side of the island of Malta and has, gradually, enveloped the nearest towns.

Suburban growth has also occurred around, practically, every other form of settlement; including villages. Some of these have coalesced into shapeless suburbs along main transport links cutting off some vestiges of arable land. Meanwhile, many land owners bide their time and hope for the day when their fields are re-zoned as fit for urban or industrial development. That would enable them to gain a quick financial return from the sale of their land to real estate interests.

Alternative sources of income for agricultural land are not restricted to rezoning. Less radical alternatives include the lucrative leasing of fields into bird hunting and trapping sites. These have proved to be a sort of mixed blessing in terms of soil conservation and are further discussed below.

The Cost of Soil Erosion and Remedial Measures

Soil loss, through erosion, entails very real and specific economic costs, although it is often difficult to place precise monetary value on foregone opportunities. Such estimates are normally provided on global, regional, or large national scales (e.g. GLASOD). Unfortunately no detailed comparative exercise has yet been provided for the micro-scale presented by the Maltese Islands.

One way of assessing the cost of soil erosion is to quantify the financial burden of replacing the soil that has been eroded away from productive arable land. Maltese soils are generally very shallow and need to be replenished in order to maintain adequate fertility levels.

In other words, there is no possibility of soils being 'mined' in Malta since soil profiles are characteristically shallow and the underlying substrate is largely

soluble globigerina or coralline limestones. An even more important consideration is soil depth since moisture retention qualities are often dependant on this factor and this is crucial during the summer drought.

The main problem with monetary estimates is that soil is not recognised as a legal commodity in Maltese legislation; therefore it is technically illegal to sell soil in Malta. However a demand for soil exists on the island. Much of this demand originates from tourist development, new residences, roadside embellishment, and farmers.

Therefore, soil is still "sold" by earth excavation contractors by hiding the cost under transport tariffs. Soil suppliers are, mostly small to medium sized excavation contractors who are engaged for site preparation before building works can commence.

Any soil found on the construction site must be removed according to a strict permit system governing its transport. The Fertile Soil (Preservation) Act 1973 (amended in 1983) and L.N. 104 of 1973 Preservations of Fertile Soil Regulations prohibits the dumping of soil or its burial.

However, as in many other situations, legal provisions are subservient to economic mechanisms. In fact the continuous demand for soil and the hidden economic incentive ensures that no soil is lost during construction.

The Department of Agriculture is another major supplier of soil but its influence does not substantially distort the soil market. This is because the distribution of such soil from the Department is largely confined to farmers. Much of this soil is also poor in quality and, therefore, not much in demand.

An indication of relative costs is provided in Table 1, which are calculated on the prices negotiated for a residential buyer. Prices for manure and mushroom compost are also included to provide some information on the additional costs incurred in soil conditioning.

Relative costs depend upon the quantity of soil that is required as well as the relative quality of the soil. Clayey, raw carbonate soils tend to fetch lower prices since they are more difficult to work while the darker brown fertile loams command the highest prices.

The crumb structure of the latter allow optimal drainage and these are sometimes used as topsoil placed upon inferior quality soils. Terra Rossa soils often fetch very high prices amongst domestic buyers due to the widespread, and misplaced, belief that such soils are very fertile and are supposedly suited to the cultivation of citrus orchards.

Furthermore, the availability of soil for replenishment has decreased considerably over the last few years and this has triggered a corresponding increase in the market value of soil.

Preventive Measures

It is a well-known axiom that, under normal circumstances, it is far more

cost effective to prevent soil erosion rather than engage in remedial measures. Soil conservation measures may take several forms and may even involve non-agricultural land uses. Some measures may not even have been aimed at soil conservation but may result in inadvertent soil conservation benefits. An illustration of this is provided by a historical anecdote.

Pastoral farming was far more significant in the Maltese archipelago than at present. Sheep and goats occupied not only a social function, since they were the basic providers of milk and cheese, but they also exerted a significant ecological impact.

During those times, the bulk of the basic forage ration of these animals was obtained by grazing land that was unsuitable for arable cultivation. In most cases such land was found on steep slopes and at the base of inland cliffs and was dominated by scree slopes.

This is where Macchia vegetation dominated despite the relative instability of the underlying terrain. The grazing of sheep and goats was the only means of obtaining any yield from these uncultivated or rather un-cultivable landscapes.

Table 1. Estimates of cost of soil in Malta (modified from Role', 2001)

Soil type materials	Price per m ³ (In Euro)	Price (Euro) per truckload (15 m ³)
Clay, raw carbonate soil	n/a	n/a
Brown Loam	4 to 5.5	60 to 82.5
Terra Rossa	4 to 5	60 tp 75
Mix of soil and gravel (Hamrija Marbula)	3.5 to 4	52,5 to 60
Mashroom compost	2.0	30
Cattle/horse manure	5.75	86.25

Sant Antnin compost	7.00 per ton (subsidized rate for farmers)	n/a
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In order to control undulant fever and its association with sheep or goat milk infected by *Brucellosis melitensis*, a system was introduced in 1956 by which herdsmen were offered one Dutch Friesen heifer in calf for every 12 diseased goats. With the introduction of these dairy cattle, marginal grazed landscapes were abandoned in favour of areas, which afforded more efficient fodder production. Thus, the introduction of a system aimed at controlling Undulant fever resulted in a marked decrease in small ruminant herds and allowed the regeneration of Macchia woodland in areas which were traditionally prone to soil erosion.

Construction and maintenance of terrace retention structures

Much of the current effort in Malta, within soil conservation, focuses on the restoration of rubble walls. Terracing and the building of retaining rubble walls have traditionally contained soil erosion. It is impossible to provide a monetary estimate of the capital, which such ancient terraces constitute. The labour invested in such structures over so many years is impossible to quantify especially when one bears in mind that the availability of earth moving machinery is a relatively very recent commodity. It is equally difficult to calculate a global figure for the amount of capital lost through neglect of agricultural land since the relative productivity of some of these fields was rather marginal.

Soil conservation legislation (the Rubble Walls Act), introduced in 1998, is well-intentioned but is quite inadequate to ensure soil conservation. In fact the reasoning behind the Act was mostly aimed at the preservation of rural landscapes, and served to remove

unsightly boundary walls created out of 45 gallon drums and other assorted rubbish. Some field boundary walls even included rusted and derelict washing machines, fridges, and stoves!

As in the case of the Fertile Soils (Preservation) Act of 1973, legislation has its limitations. Market incentives seem to be far more effective in achieving desired targets. Estimates for the construction of rubble walls reach up to Lm40 (90 Euros) per square *qasba* (approximately 2.2 metres squared). Such prices apply to decorative rubble walls for domestic and tourist-related development. Farmers, of course, cannot pay such prices for the maintenance or re-building of their retaining rubble walls.

Full time farmers, therefore, have to find time to re-build the rubble walls within their farming schedule. Part-time farmers, on the other hand, often discover that it is quite impossible to carry out such maintenance and allow walls to fall into a serious state of disrepair. This problem is often compounded by tenant-landlord relationships where tenants may neglect rubble wall maintenance and may, therefore, become liable to eviction.

The cost for the rebuilding of retaining (load bearing) rubble walls varies according to the steepness of the slope they are meant to stabilise. This, of course, determines the height and thickness of the required rubble wall. Another important consideration, however, is the depth of excavation necessary to reach sound bedrock for the construction of a solid foundation. Some soils formed over clay lithologies would require several metres of excavation before the underlying globigerina layers are exposed. In such

cases, the construction of well-founded, retaining rubble walls is quite

impossible to achieve.

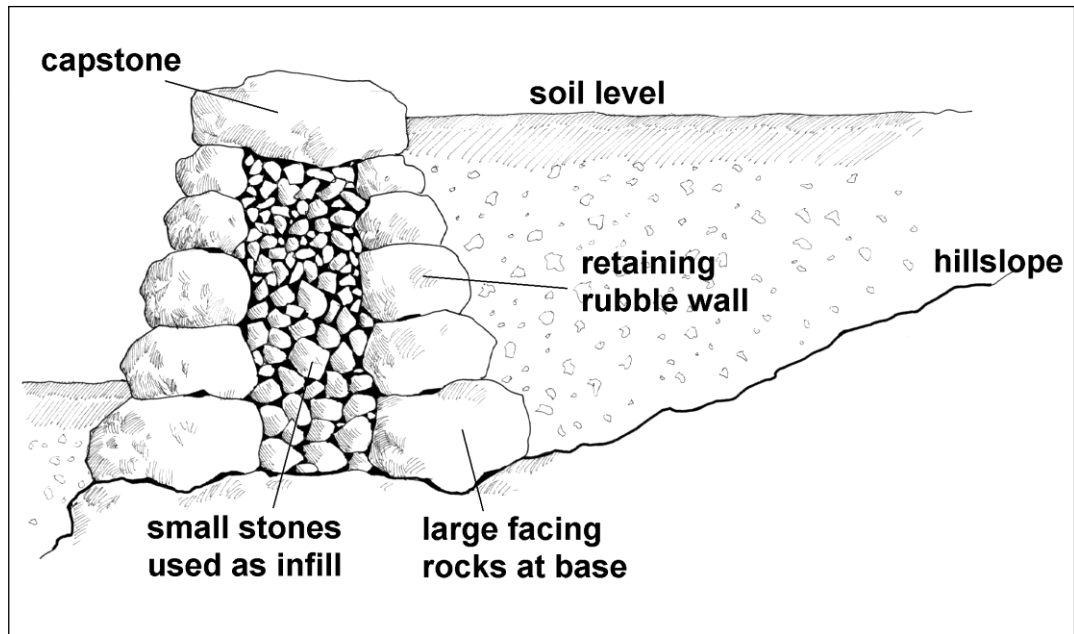


Figure 2 – Structure of Load-Bearing Dry Rubble Wall in Malta

The Role of the Tourist Industry

Soil conservation practices (the terraces and their retaining dry rubble walls) on small islands represent a national repository of sustainable wealth. Despite the fact that the terraced landscapes have become a vital part of the tourist product, tourism revenue does not go directly to their upkeep. It is only a few roadside rubble walls that have been maintained by the Ministry of Tourism's wall rebuilding unit.

We need to explore innovative and creative processes where tourist revenue directly subsidises the upkeep of rubble walls and terraces rather than getting lost within the State's general tax revenue. We have much to learn from the incentives created within the Cinque Terre National Park, in Italy, where the tourist engine has been channelled in a variety of ways to achieve the goal of soil conservation.

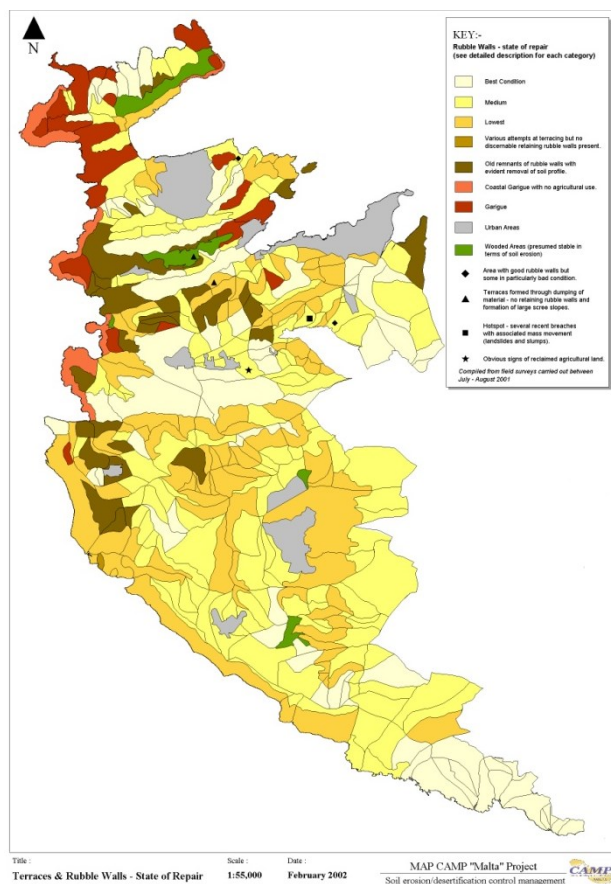
Agro tourism is practically non-existent in Malta and there is much scope for promotion within this sector. Tourist accommodation within farming communities is virtually absent and it is often perceived that there is little scope for development in this sector since hotel occupancy rates are well below full capacity. On the other hand, agro-tourism should serve as a vital injection of funds into the rural community. Tourist funds can be used for soil conservation purposes while residential schemes may yield a steady supply of cheap labour that can be trained in the art of rubble wall building.

Another way of involving the tourist sector is through the marketing of agricultural niche products to visiting tourists. Since Malta's accession into the European Union, the branding of typical Maltese products is stimulating local production where this is perceived to be produced in a special way. Organically grown foods should command premium prices if adequate certification is secured. Such foods have a ready market in the local hotel industry. Examples of likely candidates include traditional Maltese honey, goat and sheep cheese, rare local fruits like *bambinella* etc. DOC certification, also at a regional level will serve to provide a regional identity to different areas within the Maltese archipelago. Examples of these may include typical Mellieha area wine, Gozo cheese, and other similar products.

Government Subsidies

The department of agriculture offers financial aid in the form of a 4.5% subsidy on the interest on loans (from local banks) taken by farmers. This subsidy is granted to farmers following an application and after confirmation that the money will be utilised for the development of new and/ or improvement of an already existing agricultural enterprise. Permanent structures, including water reservoirs, and equipment are all eligible for financial assistance.

A further subsidy is also now being offered for



the rebuilding of rubble walls. These are aimed at the maintenance of terrace retaining rubble walls as well as repairs that have to be conducted after episodic autumn torrential rainfall events which result in rubble wall collapse. Recent studies for the northwest part of the island have revealed that most of the clay slopes surrounding the Maltese plateaus are prone to soil erosion. These findings are reproduced in figures 3 and 4.

The rubble wall subsidy currently stands at 20 Euros/m² for breached rubble walls. Of course, some conditions apply and these are listed below:

- Applicants need to be farmers who are registered with the Department of Agriculture
- Rubble walls must be load bearing walls i.e. walls that armour the steep slope of a terrace and not merely act as a demarcation of a field boundary. (min. 1m high)
- Applicants need to submit applications of a minimum of 25m² (preference to applications within the 25m² - 100m² range)
- Maximum payment of 10,000 Euros
- Minimum payment of 527.67 Euros

Such subsidies, unfortunately, underline a basic failure of the local agricultural market to ensure sustainable agricultural practices, which, in turn, ensure soil conservation. This is even more worrying when one considers that much of the Maltese farming output is in the form of relatively higher yield market gardening produce. The long-term application of any form of subsidy is also a cause for concern.

European Union farm subsidies have been considerably reduced over the last few budgets and the outlook is very uncertain.

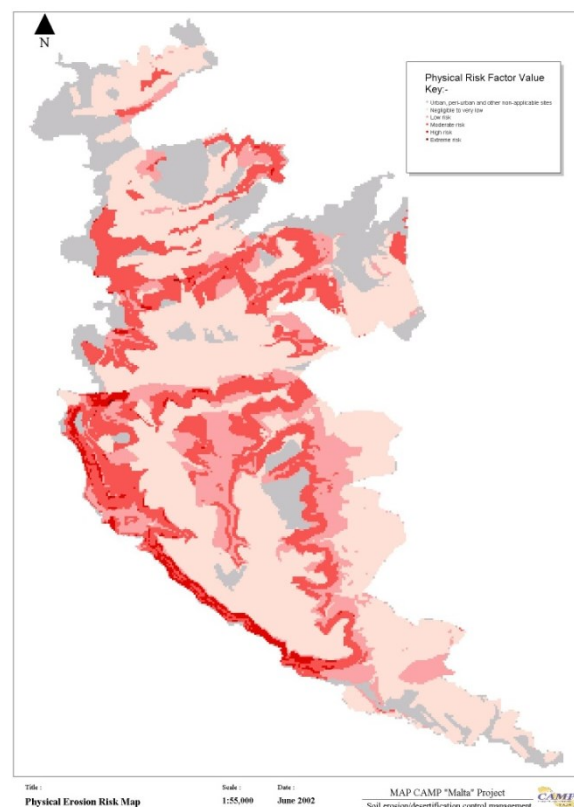
Non-Agricultural Land-Use

Soil erosion processes, however, are not restricted to the agricultural sector and need to be seen at a much wider scale. Several other economic sectors contribute to soil erosion while the effects of such processes are felt throughout the national economy.

One of the most obvious non-agricultural sectors, which are closely linked to soil erosion, is the transport sector in general and road construction in particular. Much blame has been allocated to road construction that was insensitive to soil erosion problems. The indiscriminate demolition of roadside rubble walls and their replacement with inadequate soil retention structures has resulted in several roadside landslides that often disrupt traffic.

Other related problems concern the channelling of surface water runoff onto contiguous fields. In some cases, some fields have experienced losses of up to 10cm of valuable topsoil following a single torrential downpour. The costs incurred through

Figure 3. State of repair of Rubble walls



such practices need to be adequately quantified and addressed.

Some examples of good practice already exist. Examples include the diversion of roadside culverts into water reservoirs where surface water runoff is allowed to seep into the underlying rock strata to form part of precious groundwater reserves.

Some non-agricultural land uses, which may also very often be surrounded by controversy, are excellent ways of ensuring long-term soil conservation. One of these is the construction of golf courses. With all the anti-golf arguments that one can think of, golf would surely get credit for its soil conservation potential once the project is established and running. The economic returns from the land base are dependant on human traffic throughput, which in turn is dependant on economic laws that govern this sport. Nonetheless proper land management and stewardship are a must for the survival of such projects.

Figure 4. Physical risk factor of soil erosion

Another controversial topic is the use of arable land for bird hunting and trapping. Bird trapping can be seen as a very lucrative alternative to arable cultivation. Estimates for yearly leases of trapping sites may reach up to Lm700 (1,600 Euros). This is about one hundred times the expected financial gain from traditional agricultural land use.

Unfortunately, these sites often produce severe negative impacts in terms of soil erosion. This is because the trapping site is cleared of all vegetation and, often, herbicides are used for this purpose. Bird hunting, on the other hand, may be seen as a subsidiary activity where hunting hides occupy a far more limited land area and this may permit arable rain-fed cultivation to be practised. In some cases, hunters have planted small tree clusters and this has, somewhat, reduced the risk of soil erosion. Much work still needs to be done, in this respect, to establish an effective dialogue with hunting lobbies to ensure that hunters plant local tree species instead of exotic fast growing species that may damage soil quality.

Conclusions

The discussion above highlights the need for a re-appraisal of the soil erosion phenomenon. Soil erosion is not merely an agricultural problem and possible solutions may be sought outside the agricultural sector. An illustration of this can be seen in the synergy that exists between soil erosion and water resources. Well-maintained terraces facilitate the conversion of surface water runoff into interflow and eventual groundwater recharge and such processes are becoming increasingly important in Malta where surface sealing is accelerating considerably.

Therefore, groundwater resources and their recharge are of vital interest to sustainability in the Maltese Islands and new mechanisms for cooperation between the two sectors must be explored. Similar approaches need to be made to other sectors with similar vested interests.

Citation: Zdruli, P. and Trisorio Liuzzi, G. (Eds). 2004. Determining an income-product generating approach for soil conservation management. Conference proceedings, Marrakech, Morocco 12-16 February 2004. MEDCOASTLAND publication 2. IAM Bari, Italy