

**Terraced Landscapes:
Meeting the challenges to sustainability
A northern Mediterranean agricultural perspective**



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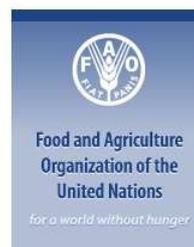


TABLE OF CONTENTS

I.	Introduction	3
II.	Present trends	4
	A. Over-arching framework.....	4
	B. Terraced landscapes in a northern Mediterranean traditional Subsistence system.....	5
	C. The breakdown of the traditional terraced subsistence farming system	8
	D. Selected areas of terraces maintained by successful commercial farming systems	12
	E. Possible strategies to ensure sustainability	15
III.	Conclusion	18
Figure 1	The inter-relationship of the four terraced models	4
Box 1	Highlights of some implications of different ‘Landscape’ definitions....	5
Box 2	Population pressure and terrace building	6
Box 3	Recent construction costs of dry stone terraces in France	13
Model 1	Terraced subsistence farming	8
Model 2A	Abandoned terraces	11
Model 2B	Terraced commercial farming	14
Model 3	Integrated rural terraced agriculture	17

Cover photos taken by Jacques du Guerny at Faucon, France, 2010

I. INTRODUCTION

Since the agricultural revolution of the Neolithic period, mankind has been searching for agricultural lands, creating them as necessary to respond to demand for food, agricultural products and housing. Archaeological evidence of dry-stone terraced landscapes in the Northern Mediterranean goes back to the Bronze Age¹, i.e. 3700 years ago. Terraces are also mentioned in Homer's *Odyssey*². It is to be noted that the back-breaking labour-intensive inputs for building and maintaining such terraced landscapes have continued to be provided over the centuries – a puzzling and remarkable sustainability. However, something happened in the 20th century. Increasingly, terraced landscapes have been abandoned and reverted to wilderness despite a growing awareness of their value³ as shown by research and projects such as Alpter funded by the European Commission⁴.

There is already a considerable literature on all aspects of terraced landscapes, from building techniques, water management issues, changes in plant and crop ecology, to socio-economic and cultural issues. One area that needs to receive more attention is the relationship between local farming systems and terraces from different angles. Specific issues include the following:

1. How farming systems led to the sustainability of terraced landscapes?
2. What are the reasons for the change of nature of the systems?
3. What are some of the reasons for the recent frequent un-sustainability of terraces?
and
4. What are some of the conditions required for a possible renewed sustainability for terraced landscapes?

The present paper is an attempt at improved understanding of these system dynamics.

This paper presents four simple models on the role of terraces in farming systems in the northern Mediterranean. The first model – *Terraced subsistence farming* corresponds to the end of the 19th century prevailing subsistence system. Model 2A- *Abandoned terraces* and 2B- *Urban-demand driven terraced commercial farming*, which is a success story of commercial farming, represent two cases of the evolution of terraced farming systems in the 20th century. Based on the lessons which can be drawn from these three models, a fourth

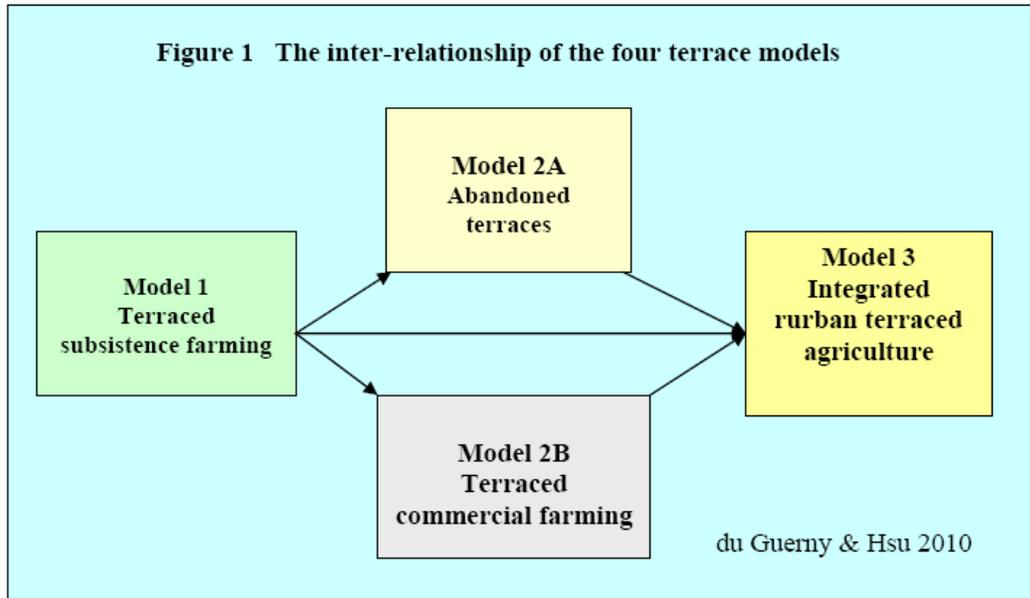
¹ Although terraces have gone through periods of expansion, consolidation and decline, the remarkable fact is that some of the oldest ones continue to have an impact on the landscape. See for example Roberto Maggi “*I monti sun eggi: The making of the Ligurian landscape in prehistory*” in *Ligurian Landscapes- studies in archaeology, geography and history*, 2004. On methods of dating antique terraces see: Athanasia Krahtopoulou and Charles Frederick, “The Stratigraphic Implications of Long-term Terrace Agriculture in Dynamic Landscapes: Polycyclic Terracing from Kythera Island, Greece”, *Geoarcheology: An International Journal*, Vol 23, No 4, 550-585, (2008).

² Homer, the *Odyssey* 24. 222-225. 8th century BC in: Simon Price and Lucia Nixon “Ancient Greek Agricultural Terraces: Evidence from Texts and Archaeological Surveys (American Journal of Archaeology 109:665-94, 2005) “*As he went down into the great orchard, he did not find Dolios, nor any of the servants or his sons; they had gone with the old man at their head to assemble haimasiai, which would protect the cultivated land.*” ‘Haimasiai’ is the Greek term for a ‘free standing wall’ which included ‘terraces’. One will note that this is presented as a collective task.

³ e.g. the inclusion of the Cinque Terre in Italy on UNESCO’s World Heritage List.

⁴ <http://www.alpter.net/>. Although, the project has now been concluded, the web site contains a wealth of information and publications. There are other web sites such as “Pierres sèches” <http://www.pierreseche.net/#portail> . On a more general level, one can consult FAO’s SARD-M project: <http://www.fao.org/sard/en/sardm/home/index.html>

one- Module 3: *Integrated rurban terraced agriculture*, is developed by the authors of this paper, which takes into account the transformation of the world economy, the explosion of urbanization, and socio-ecosystem dynamics and other factors. The aim of Model 3 – an *integrated rurban terraced agriculture*, is to stimulate developing and testing of context-specific terraced agriculture.



II. PRESENT TRENDS

A. *Overarching framework*

This section presents a simple model of a terraced subsistence farming system. It provides a benchmark to discuss changes which are occurring and possible future evolutions of the model. This model is embedded in the broad UNESCO definition of a cultural landscape. The co-evolution of man and nature has led to the creation of cultural landscapes which UNESCO defines as “combined works of nature and man”⁵. There exist other definitions, but this paper uses the UNESCO definition as specified by Almo Farina, who highlights the predominance of man in this inter-relationship: “a cultural landscape is a human-dominated landscape...”⁶ Farina thus inter-relates Cultural capital, Natural capital and Economic capital in a triangle, with Culture dominating the subsistence model. It is important to note, as referenced in *Box 1*, the term ‘landscape’ is not value-free. However, once one is aware of the cultural influence and takes into account its possible implications, one can circumvent this difficulty.

⁵ Article 1 of the 1972 World Heritage Convention.

⁶ Almo Farina « Principles and Methods in Landscape Ecology – Towards a Science of Landscape », Springer, page 270, 2007.

Box 1
Highlights of some implications of different
'Landscape' definitions

The word 'Landscape' was invented by 17th century Flemish painters and has inherited an aesthetic connotation. One wonders whether the Cinque Terre in Italy would be on the UNESCO list if the kilometres of terraces were not beautiful, particularly to the urban dwellers or to the tourists.

The French word for landscape 'paysage', closely associated with the socio-culturally loaded word 'peasant', corresponds more closely to the models in this paper.

G.S. Cumming . has an interesting definition: "the ability of a system to maintain its identity in the face of internal changes and external disturbances" (*from: An exploratory framework for the empirical measurement of resilience in Ecosystems 8:975-987, 2005*). The highlighting of internal and external changes is relevant for terraced landscapes.

The *Stockholm Resilience Centre* uses the term «socio-ecological systems» which contributes several important concepts for the study of terraced landscapes. In particular, a systems approach stressing "resilience" and "adaptability". *An effort to bring together cultural landscapes and social-ecological systems can be found in the recent workshop held in Berlin (15-16 June 2010) under the title: Social-Ecological Resilience of Cultural Landscapes.*

In the abstract of one of the papers, Thomas Kirchhoff *et al* concluded that the terms 'cultural landscape' and 'social-ecological systems', which corresponds to an effort at being more scientific, have in reality much in common and that neither are value free.

These are not just academic debates due to their consequence of placing emphasis on "conservation" instead of "development", thus favoring the urban culture, outside views and interests rather than the rural endogenous ones.

B. Terraced landscapes in a northern Mediterranean traditional subsistence system

Terraced landscapes represent a cultural landscape in hilly or mountainous regions. As has been noted, terraced landscapes have been built and lasted over centuries and even millennia. However, there is not necessarily continuity. One observes cycles of building and expansion followed by periods of stability and decline or abandonment before repeating the cycle. The last great period of expansion of terraced landscapes corresponds to the 18th and 19th centuries.

What is, for instance, the rationale for dry stone terrace building in the first place?

Many parts of the northern Mediterranean are characterised by steep mountains sloping right into the sea and a shortage of flat alluvial land for agriculture. Because the slopes cannot be cultivated as is, arable land needs to be created. The most adaptive response is some form of terracing. Mountains made of limestone, schist or metamorphic rocks provide on- the-spot materials:

Gathering them to build terraces also clears the future fields of stones.

As soon as there is population pressure, the search for land (an alternative would be out-migration) combines with the population pressure and becomes an important factor behind terrace building. This population pressure needs to be understood in a broad sense. It can be due to natural increase with a gradual spread of populations up valleys and slopes. However, it can also be due to pressures created by man-made constraints such as local defence considerations. For example, villages built on hilltops far from the valley plains; outside invasions obliging communities to take refuge in difficult terrain; conflicts in communities forcing out losing factions; clan divisions; or even by exploitative land tenure systems. The general role of population pressure can take on various influences depending on the local context: Refer to Box 2.

Box 2
Population pressure and terrace building

“Generally we conclude that the terraces in Antikythera and Kythera, Greece have been clearly related to demography in some way, but they are not so easy to link to specific episodes of population rise and fall. For example, on Antikythera in the 19th century, expansion into new terraced fields does not correlate well with documented, sudden bursts of new population. It seems to be a delayed response by householders to economic incentives from the top-down for agricultural diversification. In the case of England, there were some formal incentives offered by the 19th century British administration.”

“‘Delayed’, because, terraces were probably low yield in their early stages, e.g. their construction cut into the hillside were often mixed with bedrock in existing soils, which produced a temporarily worse soil for crops that only improved over time. ‘Delayed’ also because the initial exploitation strategy may often have been only a ‘bonus’ crop, not the main one for the families involved. It is not sure if this is relevant elsewhere.”

From the authors’ personal communication with Andrew Bevan, UCL Institute of Archaeology, UK. This conclusion is based on research by several different contributors involved with the Kythera Island Project (www.ucl.ac.uk/kip) and Antikythera Survey Project (www.ucl.ac.uk/asp).

When one sees hill and mountain slopes covered in dry stone terraces or their remains, one can but wonder how it was possible to mobilize the energy and labour to build them. In the case of a gradual expansion from a human settlement up the slopes, one can see how it was possible over time. According to various authors, once the building site is prepared and the stones available, it is possible to build a wall that is about two to 4.5 metre long by one metre high per person per day⁷.

Building was often done during the agricultural slack season (late autumn and winter), e.g. during a period of 2.5 months. For example, a team of ten men (villagers used to consider this a collective effort and ensured that experience was shared) with the help of some child-labour used mainly in clearing⁸, collecting stones, filling interstices between the large stones⁹, one could thus at a minimum spend two weeks in preparation and then build 20 meters a day. After 50 days (10 days are put aside for rest and other activities) one has 1000 metres of terraced wall! If this process is

repeated yearly, one can understand how imposing areas were terraced. This process is important because one will see that nowadays the situation is very different: Building and maintenance are no more an internal process of the farming system because they have now been transferred to costly outside labour.

A very important aspect was the maintenance of the terraces. It was a continuing affair of everybody: Plants were carefully pulled out of walls or cut before they could do damage; stones were replaced as soon as they moved; the edges of terraces were monitored to ensure that the appropriate plants were there, etc. Farmers and villagers were continuously visiting and working the terraces so the surveillance was done on a daily basis. This process ensured the resilience of terraces in case of strong rains or damage from landslides. Depending on the scale of the damage, the village networks of obligations meant that teams

⁷ E.g. Philippe de Beauchamp, *L’Architecture des Alpes Maritimes*, 1992 in Luca Bonardi, *Terraced Slopes in the Alpine Region- Construction techniques and formal models*.

⁸ Another way to ensure clearing of stones was to allow shepherds to tend their flocks on the land in exchange for collecting the stones and piling them in various places or making dry stone huts, called ‘borie’ in the South of France.

⁹ Jacques du Guerny speaks from personal experience as a child.

would be put together to quickly repair. When land was owned by landlords, teams provided labour as part of the dues to the landlord. As one will see it is difficult to ensure such surveillance and repair nowadays.

So far, the building of the terraces is stressed, but dry stone walls cannot exist or remain without their complement, which is water management. The terraces serve to slow the water run off, to irrigate the crops, and fill local reservoirs for irrigation during dry spells. However, there are also channels built following the relief to evacuate surplus water so as not to damage the terraces. The stone walls are the most visible part of the system and often conservation efforts run into difficulties because of an insufficient understanding of the role of water management as an integral part of the system maintenance. Within such a system, villagers knew who the best masons were and there was considerable prestige attached to possessing building and farming experiences. A word on the farming aspect of terraces: Terraces enabled increase in the diversity of crops because of the micro climates they could create. It is also critical to know how to best use the differences in soils and their depth. Note that soil is not equally distributed on the width of the terrace.

As one can see, the building, maintenance and cultivation of dry stone terraces requires considerable expertise, skills and experience. Although professional stone masons could be used, particularly by landlords who could pay, the entire process was endogenously driven by the communities.

These points are brought together in the Model 1 – terraced subsistence farming, which is explained below - refer to Model 1 diagram.

Model 1 is basically composed of three related parts:

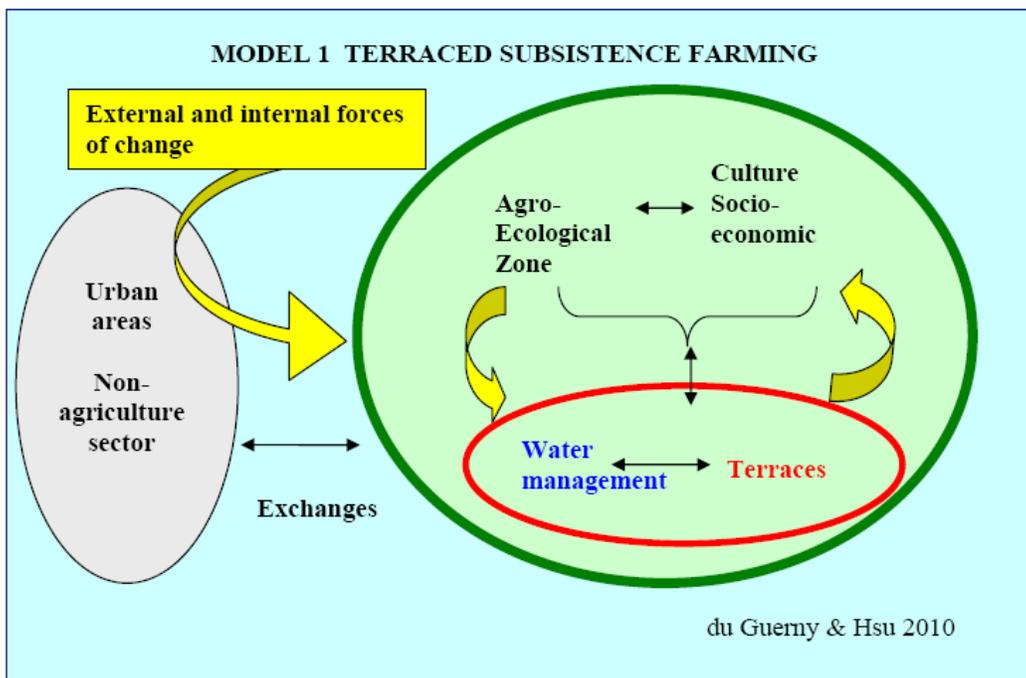
- In the 18th and 19th centuries in the northern Mediterranean, much of the hill or mountain agriculture corresponded to a subsistence farming system¹⁰. This first component, **subsistence farming** of a terraced farming system is represented in the green circle. Much of the physical capital is made of terraces and water which interrelate with the physical agro-ecological zone they are located in¹¹, and with the human and social capital found in the numbers, skills and socio-economic characteristics fashioned and driven by the local culture. This type of farming system, largely self sufficient, ensured subsistence, but required continuous hard labour in a frugal existence with little chance of escaping poverty. One should avoid romanticising it, especially in conservation efforts of terraces..... the proof can be found in the rural exodus which occurred when options other than farming the mountain slopes became available.
- The second component is the **urban area** with which peri-urban terraced farms had quite a bit of trade. However, the majority of more distant farms were in effect very

¹⁰ « A farming system is defined as a population of individual farm systems that have broadly similar resource bases, enterprise patterns, household livelihoods and constraints, and for which similar development strategies and interventions would be appropriate”. Dixon et al. From Farming Systems and Poverty – Improving farmers’ livelihoods in a changing world, FAO 2001.

¹¹ Agro-ecological zone: It corresponds roughly to a soil map on which a climate map is superimposed.

much cut off. They had only episodic contacts with urban areas to acquire essentials such as tools.

- The third component is the **external and internal forces** which provide shocks and disturbances to the farming system. During these centuries, they are mostly linked to physical events: such as extreme climatic events. However, man-made **external** forces were also important, for example, in the form of changes in taxation, access to industrial products, conscription, etc. The forces for change, coloured in yellow, **inside** the farming system are there to remind one that the system was not static, but evolved over time. This is important because in the models 2 A and 2B, these internal forces, together with the external forces, will have considerable impact in destabilizing the terraced subsistence farming system.



A terraced subsistence farming system does not mean a static system. As shown by its centuries of existence, such system has demonstrated considerable resilience and can evolve. Unfortunately, like all systems, it can only take stress and disturbances up to a certain point.

C. The breakdown of the traditional terraced subsistence farming system

As previously pointed out, there have been cycles through history of the expansion, decline and abandon of terraces. However, the terraced subsistence farming system remained functional. When circumstances changed, it re-emerged: Terraces were rebuilt, hamlets or villages resettled because the system was basically sustainable once some devastating disturbance had been overcome. A key to such resilience was probably due to the fact that the relationships between economic capital and natural capital were maintained by cultural

capital¹². An important implication of the role of cultural capital is that the strength of cultural capital is like a linchpin to the system: When it weakens, the system can disintegrate and technical solutions can become ineffective.

Something, however, happened in the 20th century in the Mediterranean. Consequently in many places, the terraced subsistence farming system did not seem to remain sustainable.

Two new models emerged from the original subsistence one:

- Model 2A - **Abandoned terraces**: A general decline of the terraced farming system resulted in terraces fallen into disrepair and being abandoned.
- Model 2B – **Terraced commercial farming**: The system changed from a terraced subsistence farming system into a successful Commercial Farming System.

This section will focus on Model 2A and the dynamics behind the decline.

Terraced landscapes, in early 20th century, reached their maximum expansion and one could thus expect some reduction in space. Yet the decline and abandon was on a scale more considerable than ever before. This was due to the fact the farming system, of which terraces were an intrinsic and essential part, entered into a period of decline, and even collapse, depending on the location. In turn, major driving factors¹³ behind the decline of the farming system, such as rural exodus, World War I (WWI) casualties, loss of young adults, and consequent loss of the labour required for building and maintenance. The role of WWI in the decimation of young male adults from rural areas is rarely mentioned. However, it resulted in breaking the “peasant” culture and prepared the ground for the dominance of economic values. More immediately, the population pressure behind building and maintaining terraces disappeared which weakened the social-ecological resilience of cultural landscapes.

The decline of terraces followed a general pattern: Abandonment of the more peripheral and distant terraces from farms and villages as well as those with slopes over 30°. Diminishing human stewardship led to landscapes becoming vulnerable to disturbances. One recalls here that terraced landscapes are especially vulnerable to the following factors:

- i) Agriculture is by definition the creation of an artificial environment. This artificial environment is unstable and requires continuing stewardship by farmers.
- ii) Terraced landscapes are a second level of artificiality adding to the previous one. Building on slopes is naturally unstable thus compounding the issue of stability and resilience.

This is why the loss of the necessary labour has such devastating impact on terraces, undermining the terraced subsistence farming system. For instance, on flat land, one can

¹² Almo Farina, The Cultural Landscape as a Model for the Integration of Ecology and Economics. BioScience, April 2000, Vol. 50 N° 4.

¹³ Maria Moorfeld, Landscapes in Eastern Germany at a turning point-population decline and the development of land consumption. Abstract of the workshop “Social-Ecological Resilience of Cultural landscapes, Berlin, 15-16 June 2010.

replace to some extent the work of a farmer son by a tractor if the son of the farmer is killed. Yet, putting stones back in place in a terraced-wall can only be done by human hand.....

It should also be noted that abandoning terraces does not result in the land returning to its initial state, but to a new re-naturalisation which significantly modified the landscape. In the Mediterranean, the landscape becomes covered by bushes and poor quality woods, e.g. “maquis” or “garrigue” which represent a loss in biodiversity and a considerable fire hazard¹⁴.

In the face of such processes, Mauro Varotto has identified three types of threats to terraced landscapes¹⁵:

- Lack of intervention which leads to the disappearance of terraces;
- Excess of intervention, for example, through agriculture production intensification or urbanization;
- Creation of compensatory wilderness. This danger comes from an urban perspective of the countryside being valued mostly as a recreational area and therefore indifferent to the loss of terraces.

In a ‘peasant’ culture, culture balanced natural and economic forms of capital. When subsistence farming culture is replaced by an ‘economic’ driven culture, it leads to a reassignment of the function of land. For example, terraced land near a town gets absorbed by urbanization. The value of one hectare of agricultural land is infinitely lower compared to what it could fetch on the market when sold for building¹⁶. Farmers generally cannot resist the lure of the windfall generated by the change in land function. This is especially true when it happens in conjunction with rural exodus where their sons have left the land and there is no successor to take over the farm. In addition, farmer’s pensions were low or non-existent. The sale of land provided their livelihood on retirement.

Another important and more recent factor was the European Common Agricultural Policy. The policy encouraged the gradual abandonment of traditional farming systems and the intensification of farming areas most suited for industrial farming¹⁷. Terraced landscapes cannot compete under this circumstance where the landscape is remodelled by economic forces. The large-scale commercial farming results in levelling of terraces to introduce mechanization. The introduction of monoculture simplified the complexity of the previous mosaic of plants and landscape. The mostly autarchic subsistence system becomes obsolete and declined as shown in Model 2A below, refer to Model 2A diagram.

¹⁴ S. Asins-Velis, *New Paradigms in Semi-Arid Mediterranean Terraced Landscape Studies*, in Workshop « I Terrazzamenti Risorse del Territorio », Genoa, 20-21 January 2006. Charles Watkins, *The management history and conservation of terraces in the Val di Vara, Liguria*. In *Ligurian Landscapes, studies in archaeology, geography and history*. University of London, 2004.

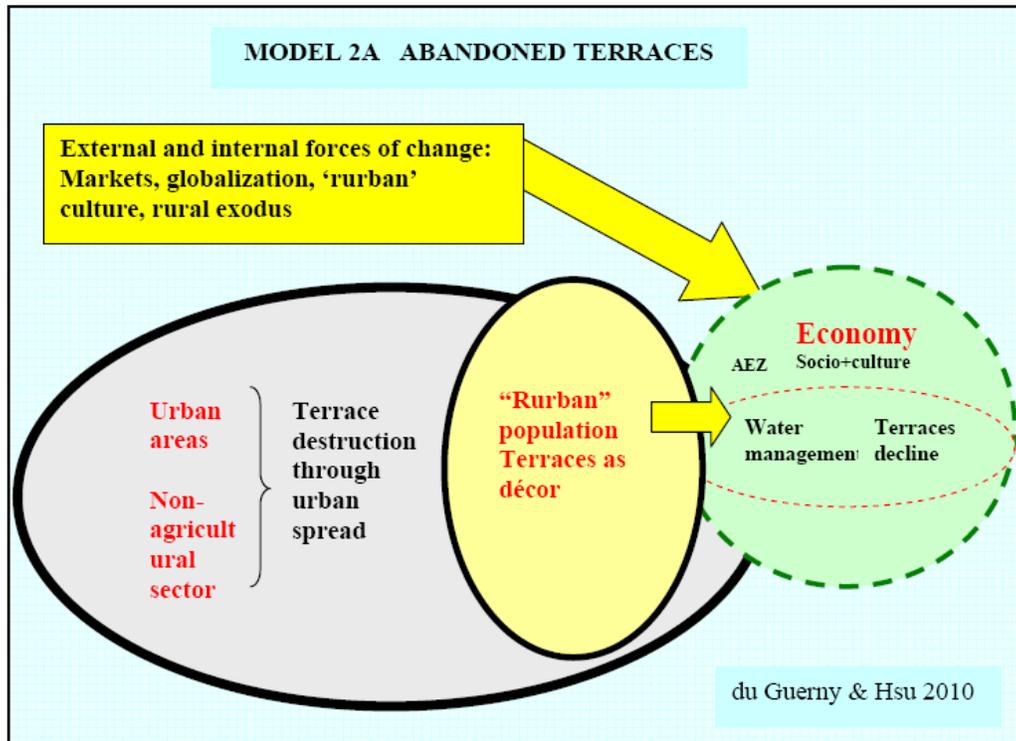
¹⁵ Mauro Varotto, *Conclusions. Towards the rediscovery of the “middle landscapes”*. In *Terraced Landscapes of the Alps – Atlas*, February 2008 (this is part of the Alpter project publications).

¹⁶ Asins-Velis, *op. cit.*

¹⁷ Mauro Agnoletti, *The European rural landscape among globalization, identity and sustainability*. Abstract of the workshop “Social-Ecological Resilience of Cultural Landscapes”, Berlin, 15-16 June 2010.

If one compares this Model 2A with the first Model of the terraces in traditional subsistence farming system, one will note, in particular, the following points:

- The quasi autarchic traditional subsistence farming system in the dotted green line has collapsed. The inter-relations have disappeared. The economy has become dominant at the expense of culture and nature, i.e. the agro-ecological zone (AEZ) base. Therefore the *raison d'être* of terraces has disappeared. The internal factors of resilience and adaptation have also largely disappeared.



- The urban sector plays a major role in determining the fate of the rural areas where the subsistence farming system had previously prevailed. The urban area in its spatial expansion directly absorbs and destroys terraced land to replace it with buildings and roads. The other way in which the urban culture takes over the rural areas is through creating a mixed "*rurban*" population, i.e. a population with an urban culture, mode of life and economic base, but physically transposed to the rural areas¹⁸. Existing terraces are kept, where convenient, for their aesthetic value. It should further be understood that the new rurban population does not compensate for rural exodus because, if it can provide labour for some gardening activities around its houses, it does not provide a labour force for farming activities. It does not, therefore, contribute to maintaining a population pressure to farmers for building and maintaining terraces.
- The external forces for change have grown in intensity and have also diversified; they are thus more difficult to resist.

¹⁸ According to Merriam Webster's Collegiate Dictionary the word was formed in 1918 of the contraction of 'rural' and 'urban' and means: 'an area which is chiefly residential, but where some farming is carried on'.

D. Selected areas of terraces maintained by successful commercial farming systems

The model 2A of farming decline followed by abandoning terraces is not found everywhere in the north Mediterranean region. Some areas have resisted decline and instead have seized opportunities, such as in the expansion of the market economy, increasing incomes in certain consumer groups, and in globalization. These areas have known success stories in which terraced landscapes play an important role.

The main characteristics of successful terraced landscapes from an agricultural perspective are the following:

- These areas combine a favourable natural resource potential for the **production niche** identified. Generally it is the monoculture of vines, but also olive trees or flowers, with scenic qualities in the eyes of the urban inhabitant. Famous examples are the Cinque Terre in Liguria, Italy; vineyards on the north bank of the lake of Geneva; or flowers near Nice.
- The beauty of the terraced landscapes naturally attracts tourists thus contributing to establishing an **agro-tourist industry**.
- One aspect rarely mentioned is that with tourists, an important segment of the wine **market** comes right to the doorstep of the farmer. Thus through tourism, it ensures the advertising of the farmers' products without having to pay for campaigns and avoiding transport costs of shipping the wine to urban markets. Furthermore, the tourism campaigns are financed by tourist authorities and enterprises.....

This type of successful commercial agriculture responds to markets and adapts to market changes. However, to be fully successful, it also makes the most of existing subsidies (e.g. from the European Commission), or favourable taxation regulations. Although emphasis has been placed in promoting high quality products, alone, they are not sufficient to ensure high financial returns.

To the agricultural expertise, the farm household needs to add entrepreneurship, understanding and knowledge of other fields, such as marketing, taxation and credit, even foreign languages. Gathering together the critical mass of knowledge and agricultural capacity is a complex undertaking. It includes clever divisions of labour and training within farm families, especially in order to minimize the costs of hiring outside expertise or labour.

Another important success factor is that the farmers do not stop at the production stage of raw materials, e.g. grapes. Additionally, the farmers now set up their own processing of products in order to control and collect the value added by the processing. For example, just selling grapes often does not enable farmers to earn sufficient income. So they set up their own winery and sell the finished product: the bottles of wine, the profits of which are several orders of magnitude more than the grapes! Such a process has resulted in the farm evolving into a complex enterprise. This complexity needs to be highlighted because it contains its own vulnerability. The vulnerabilities, for examples, are the continuing need to keep up with changes in markets; adaptation to and adoption of new technologies (with the

risk of indebtedness); and the continuing search for better quality in order to remain at the top of the competition. Managing all this with a household size of 2, 3 or 4 members is quite a feat!

Box 3
Recent construction costs of dry stone terraces in France

A group of civil engineering students compared the building costs between dry stone terraces, terrace walls made of stones in a mesh, and concrete walls. The dry stone walls were cheapest if their height was low. Concrete is the most expensive. Limestone walls were cheaper than schist or granite walls.

However, after heights of 1.3 meters, dry stone walls became more expensive due to the need to set-up scaffolding, which increased considerably the building time required.

In general nowadays only a third of the stones found on the spot can be used, which means transporting stones from a quarry: limestone was €36 m³ and an average truckload was 15 m³. Transported from a quarry 40km distant would result in a total cost of €500.

The labour cost for the preparation of the foundations came to €35/h. If the job was simple, then for 1metre length of wall it costs €9. If the terrain was difficult, it could take up to 2:30h and cost €88.5 per metre.

The labour cost for the actual building of a terraced wall came to €105 at €30/h for 1m length x 1m high. The minimum total cost was thus €140*.

Just to give an idea of what building on a large scale would cost. One can take Remo Terranova's estimate of the total stone terraces of the Cinque Terre: Put end to end, they represent a total length of 6,720 km of dry stone walls. At €40 a meter, one, very roughly, reaches a total cost of one billion euros!

**Source: Alava et al. Murs de soutènement comapraison environnementale et financière de différentes technologies. Ecole Centrale de Lyon, 2009.*

In this context, maintaining or expanding the terraces on which the vines are grown is crucial to the production process. Labour-saving technologies can facilitate the building and maintenance of terraces, the care of the vines, and harvesting of the grapes. For example, use of machinery adapted to narrow terraces, systems to move equipment and materials up and down hillside terraces (e.g. the stakes to hold the vines) as well as the harvested grapes. In this business model, the farmer often does not have the time and skill necessary to do more than routine maintenance of the terraces. Any serious rebuilding or building of terraces needs to be done by skilled stone masons at considerable expense, see Box 3.

Implementing this model can result in considerable financial success. The diagram below of Model 2B brings together the various points made previously. The farming system is purely driven by economic and financial considerations and is dominated by urban culture. Traditional culture hardly plays anymore a role in the farming system except as folklore, which is part of marketing the outputs.

Terraces and water management remain vital, but only in the selected areas for this commercial farming system. Elsewhere, terraces and water management continue to be abandoned:

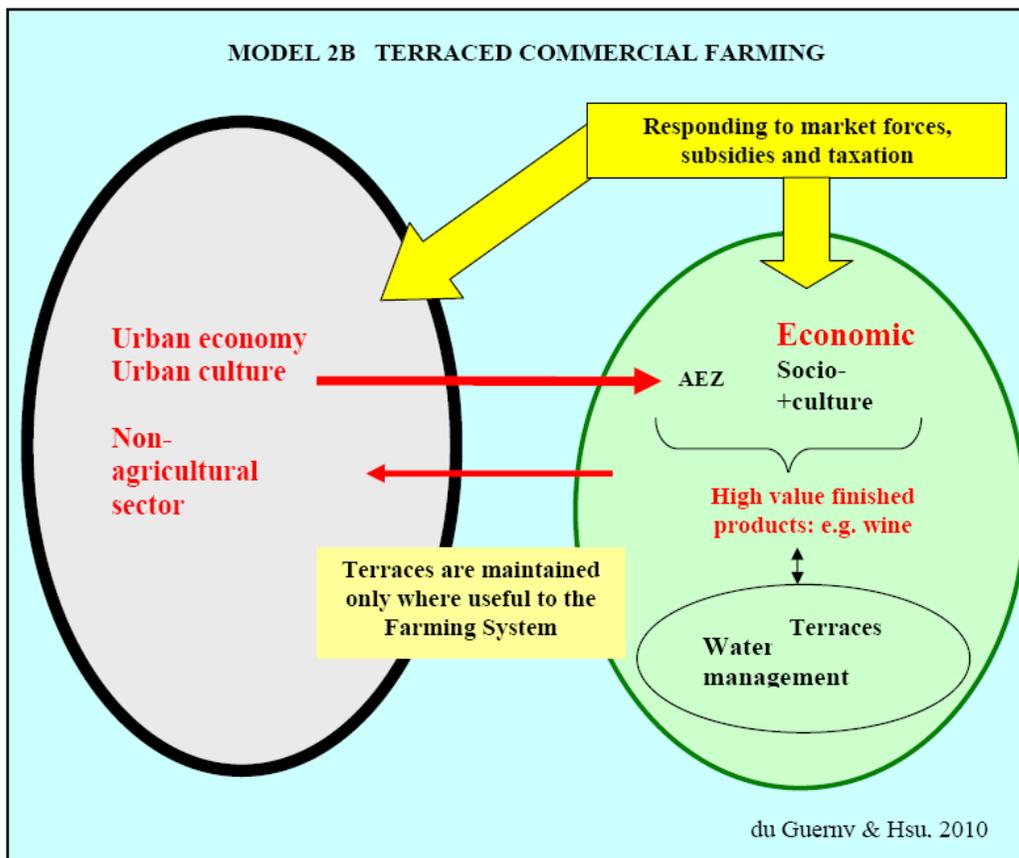
40 km inland from the Cinque Terre, the terraces of the Varese area are being abandoned¹⁹. Besides the fact that model 2B only works successfully in limited areas, it has been criticized for other shortcomings. These criticisms are illustrated below by Varotto and Farina²⁰. Varotto insists on the “diktat of productivity” and notes that “wherever the abandonment

¹⁹ Charles Watkins, op.cit.

²⁰ Varotto, op.cit. Farina, op.cit.

[of terraces] has been slowed down by the starting-up of new farms of commercial agriculture, often driven by quality products,... the terraced slopes have, in some cases, undergone heavy operations for adapting them to the requirements of mechanization". This means dry stone walls have been replaced by concrete ones; loss of biodiversity; ploughing up and down the slopes, instead of following the natural contour of the land, resulting in erosion. This is an important sustainability issue in view of short term profits and tourism generated.

No matter how profitable commercial farming is in the short term, this Model 2B might not hold true over the long term: When effects of environmental damage appear and if market tastes change in an unfavourable direction.



Farina is concerned with the long term sustainability after adopting a similar point of departure to that of Varotto. The new “economic landscape created to optimize crop quality and productivity is characterized by large monoculture fields in which most of the natural patterns..... have been simplified”. He notes that in these modern landscapes a few resources are heavily used or over-used at the expense of others thus destabilizing the underlying ecosystem. The underlying ecosystem which supports the new farming system has difficulties adapting to the changes. This is because the time-scale necessary for its adaptation is much longer than the time scale for economic change. This sets limits, often not well perceived, to the resilience of the new farming system. Farina finally points out that the system is not only driven by economic considerations, but also by technological systems that are ecologically vulnerable. Natural disturbances are responded to by technologies

which reduce the resilience of the farming system, opening the door to “natural disasters”. For example, monoculture and heavy machines result in greater vulnerability to pests which leads to increased use of pesticides..... until the pests become resistant, or the soil becomes less able to absorb rainfall with increased risk of landslides and flooding.

What needs to be stressed is that one tends to only see here the winning terraced areas and overlook the rest of those being abandoned. This is especially true if what remains is enough to attract tourists. Unfortunately, it is just a consideration of time frames: Immediate success which saves terraces as essential components of the landscape versus longer term vulnerability.

In sum, despite the financial success of model 2B as well as the integration of the old terraced landscape into a modern one remodelled by economic forces, its sustainability is open to question.

The sustainability is threatened from two different directions:

- i) Internally, by a business model the success of which is achieved at the expense of culture, society and the ecosystem. Terraces are maintained because they are technically functional, but they have lost other meanings in the society.
- ii) Externally, by market forces to which the farmer can adapt up to a point and even transform into opportunities, but which he does not control and which can change at a speed the farm cannot follow. In such a case, due to monoculture there is no possible fall back plan. Mono crop agriculture is vulnerable to boom and bust cycles.

E. Possible strategies to ensure sustainability

In view of the unfortunate or limited outcomes for the sustainability of terraced landscapes of Models 2A and 2B, it becomes necessary to search for alternative models if one wants to continue to have terraced landscapes. The European Commission is attempting to create an enabling environment in which terraces can at least be conserved through its Rural Development Policy, 2007-2013²¹. Farmland takes on new functions besides agricultural production, such as including public goods which comprise maintaining the landscape and biodiversity²². The policy also includes measures to encourage farmers to adopt soil conservation measures like terracing. Incentives can cover the extra costs incurred by farmers or their loss of income.

In practice, this holistic approach recommended is difficult to achieve. Coordination of activities conceived in isolation of one another, in particular, those concerning the hydro-geological ones, which have been perceived more as engineering problems and new socio-economic activities tend to remain separate. The main weakness of this type of strategy is that the local farming population can benefit from it as an assisted population because the farming population is not the driving force and does not internalize the activities. Sustainability is at stake once outside financial incentives end.

²¹ http://ec.europa.eu/agriculture/rurdev/index_en.htm

²² Asins-Velis, op.cit.

The European Commission also supported the already mentioned Alpter project. This has led to publications of the results especially in a Manual and in an Atlas²³. In his introduction to the Manual, Fontanari, after warning against falling into a “lost past that can never be recovered” formulates the fundamental question:

“How was the difficult, costly and time-consuming maintenance and exploitation of terraced areas to be reconciled with the needs and requirements of contemporary modes of human work and, above all, settlement?”

Any answer to this question means that the development of “terracing had to make a real contribution to the way people actually live nowadays”.

In the northern Mediterranean region where abandonment is often at an advanced stage, Fontanari stresses the need to “create a new landscape out of the ‘leftovers’ from the material culture that preceded our own”.

Here lies the greatest challenge: terracing must come from an *essential internal need of the farming communities*. Can this challenge be met?

Model 3 – integrated rural terraced agriculture, we now present, does not have the pretension to provide the solution. Recognizing without nostalgia the world as it is, the objective is to provide a framework with necessary components and their key inter-relations as a starting point for critical discussion, possible operationalization and testing in the context specific areas.

The basis of Model 3 is an “integrated farming system”. An integrated farming system is where ‘integration’ operates both internally and externally by closely relating to the nearest rural and urban areas as well as the more distant external forces.

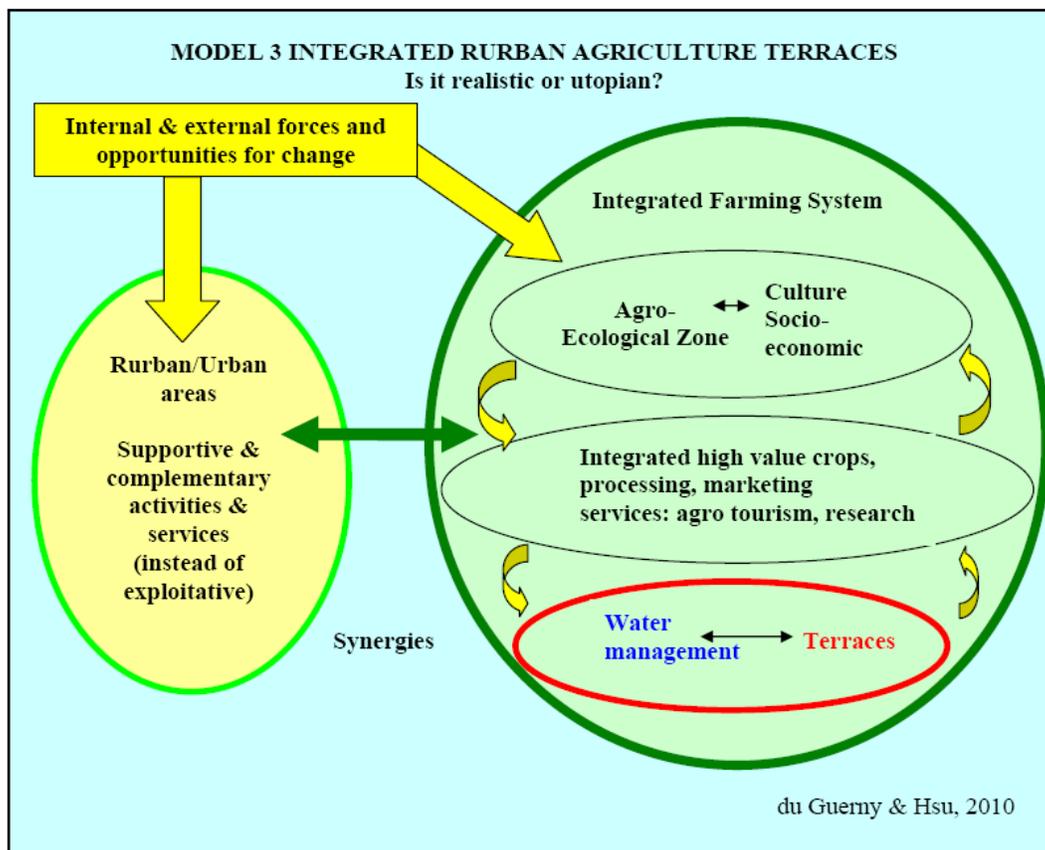
The pivotal point of model 3 becomes, like in Models 1 and 2B, the farming system, which must be based on terraces and water management. Model 3 is a modern, knowledge-based system that optimizes the use of the variations introduced by terraces and their stewardship. Such a system takes into account water, soil, temperature, etc. in order to produce a diversity of high value crops depending on the local conditions. In this way, the specific conditions provided by terraces are fully taken advantage of. Consequently, terraces are no more peripheral, but essential, to the livelihood. Knowledge becomes a key component of human capital: Adult farmers can learn through Farmer Field and Farmer Life Schools^{24, 25}. Farmers’ children can learn in such schools with specially designed curricula for the agro-ecological zone. In this manner farmers are naturally motivated to build and maintain terraces because they are the ‘corner stone’ of their system.

²³ Terraced landscapes of the Alps - Atlas; Terraced landscapes of the Alps - Manual

²⁴ The empirical knowledge of farmers and their capacity to learn if helped by some systematization and formalization should never be underestimated as demonstrated by Farmer Field Schools and Farmer Life Schools.

²⁵ Farmers’ Life School Manual, A joint publication by UNDP, FAO and World Education, January, 2004

The production function of crops needs to integrate, like in Model 2B, the steps in the food chain through processing and marketing in order that the farmers keep the value added along the chain. As each farm is generally not in a position to produce enough of a particular crop to justify the costs of the processing and marketing, cooperatives and diverse forms of association between farmers and also with nearby rural areas become necessary. This is different from Model 2B, which is a monocrop situation where a family can control the process and has less incentive to work together with other farmers. The need for association in Model 3 contributes to building social capital and can be reinforced by the local culture.



The internal working of the integrated farming system would remain dynamic and evolving in order to anticipate and adjust to outside demand changes. Such external changes, formerly perceived as threats, now are seen as new opportunities. This model 3 requires an accompanying research function with the rural areas. Research centres tailored to the farming system should be established to support development such as from genetics of indigenous varieties to engineering of locally appropriate labour-saving technologies. Nowadays, producing a finished product is no longer sufficient. Farmers today need also to capture a significant part of the benefits from marketing, which requires appropriate forms of partnerships or stake holding in local firms.

Naturally, to these agriculture-oriented activities that constitute the backbone of the system, one can add other kinds of activities, such as agro-tourism, mechanisms to sensitize urban children to different livelihoods, to quality products, or introduction to the farming culture.

The goal of this integrated farming system in Model 3 is to produce an income and a quality of life that provide an incentive for the youth to remain on the land, or, if they follow education to higher levels, to find supporting occupations in the nearby rural and urban areas in a new complementary instead of exploitative relationship with the dynamic farming system. In this manner the farming system can remain attractive to youth, but avoid a damaging brain drain as many of the educated youth can be employed and retained in areas useful for this integrated farming system.

In Model 3, the role of **public authorities** is to create an enabling environment in which the system can develop. Possibly, as a transition measure, public authorities could provide subsidies and tax incentives. Subsidies and tax incentives should only be of a temporary nature because, if successfully driven internally from the system, the system should not only stand on its own feet, but also become attractive.

Up to now the explanations of Model 3 focus on technicalities. Success also requires a less tangible ingredient holding the system together as well as helping it develop: **Culture**. The farming system becomes meaningful and attractive through culture once the material necessities are available. It is difficult to explain, but the system needs to be nurtured by culture. Culture is what ultimately can ensure the sustainability of the system.

In sum, is Model 3, an integrated rural agricultural terrace system realistic or utopian? If not realistic, other types of model need to be developed because Model 2B can only be a limited, short-term answer to terrace sustainability. It would be tragic if the only outcome were to be Model 2A, i.e. abandonment of terraced landscapes except for a few fossil ones. If Model 3 is judged to be worthwhile, then one should explore possibilities of developing it further to reach a testable stage.

III. CONCLUSION

Based on the evolution of terraced landscapes in the northern Mediterranean region over the recent centuries, the authors designed a series of simple models. These models focus on the place and role of terraced landscapes in different farming systems. The Model 1 presents a subsistence farming system based on terraces. The Model 2A presents and discusses the trend in abandoning terraces. The Model 2B discusses the role of terraces in a successful commercial farming system, but the extension of which remains limited. The Model 3 draws the lessons from the previous models and designs a farming system based on terraces which ensures their sustainability. At this stage, Model 3 remains a conceptual framework and if judged worthy of consideration for socio- agro-cultural and ecosystem sustainability, could be further developed for implementation.