Ending the Cinderella Status of Terraces and Lynchets in Europe

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Cultivation terraces – a worldwide phenomena...

From mountains in Peru...

Ifugao rice terraces...

Olives in Spain..

Vineyards in Italy..

‘lynchets’ in S England....

Now often uncared for, abandoned, or demolished...

Konzo terraces Kenya
Benefits of Terraces: Ecosystem Services,

- Food security – grain, wine, olives, rice, potato......
- Sustainable fertility – storage of nutrients
- Water and soil conservation – reduction of runoff & erosion, incl. landsliding
- Biodiversity – ‘weeds & ruderals’, rare communities, arboriculture..
- Scenic value – tourism (e.g. viticulture...)
- Historic value – tourism (e.g. Macchu Piccu, San Fruttuoso)
Benefits of Terraces: Soil erosion and Demography

In *The Conditions of Agricultural Growth*, Broserup directly implicated terracing as one of the step changes in land intensification (Broserup 1969 p. 80).
Terraced landscapes are a major landscape type in the **Globally Important Agricultural Heritage Sites (GIAHS) Program of UNESCO**

Of 20 most famous 8 have some archaeology & fewer have reliable dating

<table>
<thead>
<tr>
<th>Country</th>
<th>date</th>
<th>Type</th>
<th>Current Condition</th>
<th>Modern Function/service</th>
<th>Archaeology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Douro vineyards</td>
<td>Portugal</td>
<td>vineyard</td>
<td>well maintained</td>
<td>viticulture, tourism</td>
<td>No</td>
</tr>
<tr>
<td>Sierra de Tormantana</td>
<td>Spain</td>
<td>stone walled</td>
<td>part abandoned</td>
<td>orchards, vegetables, olives</td>
<td>Blason...</td>
</tr>
<tr>
<td>Cinque terre</td>
<td>Italy</td>
<td>Stone walled</td>
<td>part abandoned</td>
<td>viticulture, olives, tourism</td>
<td>No</td>
</tr>
<tr>
<td>Lavasa</td>
<td>Switzerland</td>
<td>stone walled</td>
<td>well maintained</td>
<td>viticulture, tourism</td>
<td>No</td>
</tr>
<tr>
<td>Washau vineyard</td>
<td>Austria</td>
<td>vineyard</td>
<td>well maintained</td>
<td>viticulture, tourism</td>
<td>No</td>
</tr>
<tr>
<td>Battle Hill terraces</td>
<td>Palestine</td>
<td>stone</td>
<td>poor</td>
<td>orchards</td>
<td>Some</td>
</tr>
<tr>
<td>Ifh terraces</td>
<td>Yemen</td>
<td>dryland</td>
<td>abandoned</td>
<td>degradation control, coffee</td>
<td>Wilkinson...</td>
</tr>
<tr>
<td>Ouadi-Ghadh</td>
<td>Lebanon</td>
<td>stone walled bench</td>
<td>degraded</td>
<td>grain, erosion control</td>
<td>Some</td>
</tr>
<tr>
<td>Bahal 'Ykah</td>
<td>Israel</td>
<td>1200-1000 BP</td>
<td>dryland</td>
<td>tourism, runoff retention</td>
<td>Herman...</td>
</tr>
<tr>
<td>Al Jabal Al Ahdr Al Aflaj</td>
<td>Oman</td>
<td>irrigated</td>
<td>poorly maintained</td>
<td>food, security, soil conservation</td>
<td>No</td>
</tr>
<tr>
<td>Konso</td>
<td>Ethiopia</td>
<td>1300 BP</td>
<td>stone walled irrigated</td>
<td>well maintained</td>
<td>erosion control, water supply</td>
</tr>
<tr>
<td>Saka</td>
<td>Nigeria</td>
<td>2000 BP</td>
<td>rice</td>
<td>soil water conservation</td>
<td>No</td>
</tr>
<tr>
<td>Cordilleras</td>
<td>Philippines</td>
<td>2000 BP</td>
<td>rice</td>
<td>part collapsed</td>
<td>rice, water, tourism</td>
</tr>
<tr>
<td>Bali Tegalag</td>
<td>Indonesia</td>
<td>1300 BP</td>
<td>rice</td>
<td>well maintained</td>
<td>rice, coffee, tourism</td>
</tr>
<tr>
<td>Sapa</td>
<td>Vietnam</td>
<td>2000 BP</td>
<td>rice</td>
<td>well maintained</td>
<td>runoff, soil, tourism</td>
</tr>
<tr>
<td>Ziyuej</td>
<td>China</td>
<td>2000 BP</td>
<td>rice</td>
<td>well maintained</td>
<td>rice, coffee, tourism</td>
</tr>
<tr>
<td>Fere</td>
<td>China</td>
<td>1300 BP</td>
<td>rice</td>
<td>well maintained</td>
<td>rice, biodiversity, water, soil</td>
</tr>
<tr>
<td>Gudeuljangnon</td>
<td>S Korea</td>
<td>400 BP</td>
<td>stone rice</td>
<td>well maintained</td>
<td>soil, water, biodiversity</td>
</tr>
<tr>
<td>Noto Peninsula</td>
<td>Japan</td>
<td>600-400 BP</td>
<td>stone walled rice</td>
<td>Part abandoned</td>
<td>water, landslide, ecosystem, scenic</td>
</tr>
<tr>
<td>Machu Picchu</td>
<td>Peru</td>
<td>700-600 BP</td>
<td>stone walled potato</td>
<td>abandoned</td>
<td>climate, water</td>
</tr>
</tbody>
</table>

An ongoing analysis of published projects shows that the majority of terrace systems are unexcavated, undated, and have not been subjected to geoarchaeological or paleoecological analysis

Brown et al., submitted
Terrace Archaeology and Culture in Europe: TerrACE

- Mapping and Organization
  - Studies either large scale and low resolution or dependent on «line plots» of terrace walls
  - Fusion of TLS and UAV structure-from-motion allows high resolution capture of vertical and horizontal surfaces

- Dating
  - Can be confused by method of construction and post depositional processes
  - Combination of pOSL, OSL and other analytical methods allow for stratigraphic interpretation to inform dates

- Ecology and Cultivation
  - Limited by the preservation of plant material and distances traveled by pollen
  - Phytoliths and DNA provide a more locally-constrained evidence of ecology and cultivation
Terrace Classification

- The most practical classification will use both the planform and the excavated profile
- Contour and braided terraces the most common
TerrACE

• 15+ sites in a NW-SE transect
• Climates from sub-artic to Xeric Mediterranean
• Variety of geological and climatic settings to demonstrate utility of OSL, Phytolith, and sedaDNA in varying environments
Ingram Valley, United Kingdom

- 5 terraces (7 after SfM analysis)
- Dating unsure, Bronze Age or Early Iron Age
- SOC levels higher in paleosol buried by terrace construction

Cucchiaro et al., 2020

SOC were buried in deep layers due to construction of terrace
Martelberg, Belgium

C/N ratios: SOC Stability

- 4 terraces, 3 excavated.
- Apparent lynchets w/cut, allowing for tall riser scarp
- SOC more stable (high C/N ratio) in terraced slope and valley bottom than on unterraced field.
- Phytoliths and other microremains indicative of grasses, frequent burning, and pasturing/manuring

Cucchiaro et al., in prep.
Villar-d'Arène, France

- LiDAR-derived DEM based on data captured in 2012
- Landscape cultivated at least since the Roman Period, if not the Bronze Age
- Terraces date at possibly to the foundation of the modern village in the 12th or 13th century.

Brown et al., submitted
Conclusions

• Terraces are an important component of past and present landscapes, serving as a record for the past of agriculture as well as a guard against further landscape change.

• Until recently, studies have relied on archaeological material or architectural phasing for dates, and scientifically dated studies have been infrequent.

• The full range of terraced landscapes must be studied by a combination of modern spatial analysis, scientific dating, and state-of-the-art paleoecological methods in order to fully characterize their construction and use histories, as well as to assess there impact on soils in the past and present.

• Early results from the United Kingdom, Belgium, and Italy show storage of SOC in paleosols buried by terrace construction, potential greater stability.

TerrACE (www.terrace.no) is supported by an ERC Advanced Grant, ID 787790

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